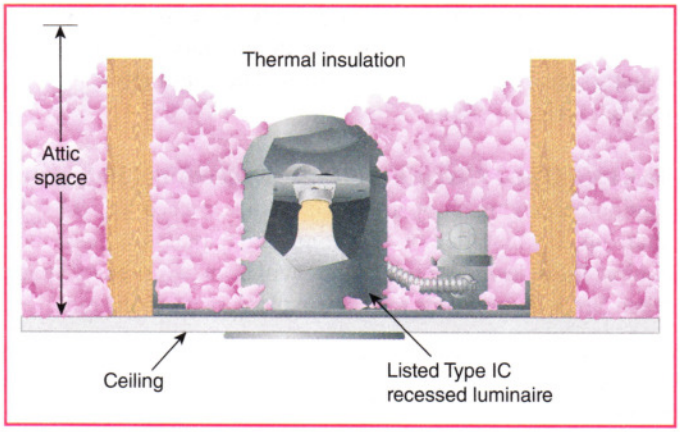

EXHIBIT 410.6 A listed Type IC recessed luminaire suitable for use in insulated ceilings and installed in direct contact with thermal insulation.

(3) The recessed luminaire shall be listed and shall be installed in accordance with a tested fire resistance–rated assembly. When a tested fire resistance–rated assembly allows the installation of a recessed fluorescent luminaire, a recessed LED luminaire of comparable construction shall be permitted.

410.117 Wiring.

(A) General. Conductors that have insulation suitable for the temperature encountered shall be used.

(B) Circuit Conductors. Branch-circuit conductors that have an insulation suitable for the temperature encountered shall be permitted to terminate in the luminaire.

(C) Tap Conductors. Tap conductors of a type suitable for the temperature encountered shall be permitted to run from the luminaire terminal connection to an outlet box placed at least 300 mm (1 ft) from the luminaire. Such tap conductors shall be in suitable raceway or Type AC or MC cable of at least 450 mm (18 in.) but not more than 1.8 m (6 ft) in length.

410.118 Access to Other Boxes. Luminaires recessed in ceilings, floors, or walls shall not be used to access outlet, pull, or junction boxes or conduit bodies, unless the box or conduit body is an integral part of the listed luminaire.

Part XI. Construction of Flush and Recessed Luminaires

410.120 Temperature. Luminaires shall be constructed such that adjacent combustible material is not subject to temperatures in excess of 90°C (194°F).

410.122 Lamp Wattage Marking. Incandescent lamp luminaires shall be marked to indicate the maximum allowable wattage of lamps. The markings shall be permanently installed, in letters at least 6 mm (¼ in.) high, and shall be located where visible during relamping.

410.124 Solder Prohibited. No solder shall be used in the construction of a luminaire recessed housing.

410.126 Lampholders. Lampholders of the screw shell type shall be of porcelain or other suitable insulating materials.

Part XII. Special Provisions for Electric-Discharge Lighting Systems of 1000 Volts or Less

410.130 General.

(A) Open-Circuit Voltage of 1000 Volts or Less. Equipment for use with electric-discharge lighting systems and designed for an open-circuit voltage of 1000 volts or less shall be of a type identified for such service.

(B) Considered as Energized. The terminals of an electric-discharge lamp shall be considered as energized where any lamp terminal is connected to a circuit of over 300 volts.

(C) Transformers of the Oil-Filled Type. Transformers of the oil-filled type shall not be used.

(D) Additional Requirements. In addition to complying with the general requirements for luminaires, such equipment shall comply with Part XII of this article.

(E) Thermal Protection — Fluorescent Luminaires.

(1) Integral Thermal Protection. The ballast of a fluorescent luminaire installed indoors shall have integral thermal protection. Replacement ballasts shall also have thermal protection integral with the ballast.

(2) Simple Reactance Ballasts. A simple reactance ballast in a fluorescent luminaire with straight tubular lamps shall not be required to be thermally protected.

(3) Exit Luminaires. A ballast in a fluorescent exit luminaire shall not have thermal protection.

(4) Egress Luminaires. A ballast in a fluorescent luminaire that is used for egress lighting and energized only during a failure of the normal supply shall not have thermal protection.

Thermal protection that is integral with the ballast is required for fluorescent luminaires installed indoors. Thermally protected ballasts are also required as replacements for nonthermally protected ballasts in older fixtures. Thermally protected fluorescent lamp ballasts intended for use in accordance with 410.130(E) are marked "Class P." LED drivers are the LED lighting system's equivalent to ballasts. "LED driver" is a common industry term referring to the power supply for the LED.

Because different Class P ballasts have different heating characteristics, the heating characteristics should be considered

when selecting replacements for nonthermally protected ballasts. This type of ballast protection is set to open the circuit at a predetermined temperature to prevent abnormal ballast heat buildup caused by a fault in one or more of the ballast components or by some lampholder or wiring fault.

Illuminated exit signs are exempt from the thermal protection requirement because overheating during high ambient conditions could cause the thermal protection to operate. This action could impair evacuation during a fire. Egress lighting is also exempt from the thermal protection requirement for the same reason that illuminated exit signs are exempt. However, this exemption applies to egress lighting that is energized only during the emergency condition.

(F) High-Intensity Discharge Luminaires.

(1) Recessed. Recessed high-intensity luminaires designed to be installed in wall or ceiling cavities shall have thermal protection and be identified as thermally protected.

(2) Inherently Protected. Thermal protection shall not be required in a recessed high-intensity luminaire whose design, construction, and thermal performance characteristics are equivalent to a thermally protected luminaire and are identified as inherently protected.

(3) Installed in Poured Concrete. Thermal protection shall not be required in a recessed high-intensity discharge luminaire identified for use and installed in poured concrete.

(4) Recessed Remote Ballasts. A recessed remote ballast for a high-intensity discharge luminaire shall have thermal protection that is integral with the ballast and shall be identified as thermally protected.

Δ **(5) Metal Halide Lamp Containment.** Luminaires that use a metal halide lamp other than a thick-glass parabolic reflector lamp (PAR) shall be provided with a containment barrier that encloses the lamp, or shall be provided with a physical means that only allows the use of a lamp that is Type O.

Informational Note: See ANSI C78.389, *American National Standard for Electric Lamps — High Intensity Discharge, Methods of Measuring Characteristics.*

Metal halide lamps have been identified by insurers of large industrial facilities as the likely cause of ignition in fires. HID luminaires can create an ignition source when physical damage occurs to the arc tube in open luminaires. Lamp types that are suitable for use in open luminaires (those that do not require lamp enclosures) are classified by the lamp manufacturers as Type O or Type S. Type O lamps are provided with a shroud around the arc tube and are containment-tested in accordance with ANSI C78.387, *Electric Lamps — Metal-Halide Lamps — Methods of Measuring Characteristics*, and rated for use in open luminaires. The *NEC*® requires luminaires that use a metal halide lamp to have either a containment barrier that encloses the lamp or some means that allows only a Type O lamp to be installed.

410.134 Direct-Current Equipment. Luminaires installed on dc circuits shall be equipped with auxiliary equipment and resistors designed for dc operation. The luminaires shall be marked for dc operation.

410.135 Open-Circuit Voltage Exceeding 300 Volts. Equipment having an open-circuit voltage exceeding 300 volts shall not be installed in dwelling occupancies unless such equipment is designed so that there will be no exposed live parts when lamps are being inserted, are in place, or are being removed.

Luminaires intended for use in non-dwelling occupancies are so marked. Such luminaires often have maintenance features beyond the capabilities of most homeowners or operate at voltages in excess of those permitted by the *NEC* for dwelling occupancies.

See also

210.6(A) and **410.140(B)** for other references to voltage limitations within dwelling units

410.136 Luminaire Mounting.

(A) Exposed Components. Luminaires that have exposed ballasts, transformers, LED drivers, or power supplies shall be installed such that ballasts, transformers, LED drivers, or power supplies shall not be in contact with combustible material unless listed for such condition.

Δ **(B) Combustible Low-Density Cellulose Fiberboard.** Where a surface-mounted luminaire containing a ballast, transformer, LED driver, or power supply is to be installed on combustible low-density cellulose fiberboard, it shall be marked for this condition or shall be spaced not less than 38 mm (1½ in.) from the surface of the fiberboard. Where such luminaires are partially or wholly recessed, 410.110 through 410.126 shall apply.

Informational Note: See ASTM E84-20, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or ANSI/UL 723-2018, *Standard for Test for Surface Burning Characteristics of Building Materials*. Combustible low-density cellulose fiberboard includes sheets, panels, and tiles that have a density of 320 kg/m^3 (20 lb/ft^3) or less and that are formed of bonded plant fiber material but does not include solid or laminated wood or fiberboard that has a density in excess of 320 kg/m^3 (20 lb/ft^3) or is a material that has been integrally treated with fire-retarding chemicals to the degree that the flame spread index in any plane of the material will not exceed 25, determined in accordance with tests for surface burning characteristics of building materials.

410.137 Equipment Not Integral with Luminaire.

(A) Metal Cabinets. Auxiliary equipment, including reactors, capacitors, resistors, and similar equipment, where not installed as part of a luminaire assembly, shall be enclosed in accessible, permanently installed metal cabinets.

(B) Separate Mounting. Separately mounted ballasts, transformers, LED drivers, or power supplies that are listed for direct

connection to a wiring system shall not be required to be additionally enclosed.

(C) Wired Luminaire Sections. Wired luminaire sections are paired, with a ballast(s) or LED driver(s) supplying a light source or light sources in both. For interconnection between paired units, it shall be permissible to use metric designator 12 (trade size ⅜) flexible metal conduit in lengths not exceeding 7.5 m (25 ft), installed in accordance with Part II of Article 348. Luminaire wire operating at line voltage, supplying only the ballast(s) or LED driver(s) of one of the paired luminaires, shall be permitted in the same raceway as the light source supply wires of the paired luminaires where the voltage rating of the light source supply wires is greater than the line voltage.

Wired luminaire sections are shipped in pairs and marked for use in pairs. Each individual unit includes lamps in odd-numbered quantities (one or three is most common), with the odd-numbered lamp in each luminaire supplied by a two-lamp ballast located in one luminaire of the pair. Two-lamp ballasts are more energy efficient than single- or three-lamp ballasts.

410.138 Autotransformers. An autotransformer that is used to raise the voltage to more than 300 volts, as part of a ballast for supplying lighting units, shall be supplied only by a grounded system.

410.139 Switches. Snap switches shall comply with 404.14.

Part XIII. Special Provisions for Electric-Discharge Lighting Systems of More Than 1000 Volts

410.140 General.

(A) Listing. Electric-discharge lighting systems with an open-circuit voltage exceeding 1000 volts shall be listed and installed in conformance with that listing.

(B) Dwelling Occupancies. Equipment that has an open-circuit voltage exceeding 1000 volts shall not be installed in or on dwelling occupancies.

(C) Live Parts. The terminal of an electric-discharge lamp shall be considered as a live part.

Δ **(D) Additional Requirements.** In addition to complying with the general requirements for luminaires, such equipment shall comply with Part XIII of this article.

410.141 Control.

(A) Disconnection. Luminaires or lamp installation shall be controlled either singly or in groups by an externally operable switch or circuit breaker that opens all ungrounded primary conductors.

(B) Within Sight or Locked Type. The switch or circuit breaker shall be located within sight from the luminaires or lamps, or it shall be permitted to be located elsewhere if it is lockable open in accordance with 110.25.

410.142 Lamp Terminals and Lampholders. Parts that must be removed for lamp replacement shall be hinged or held captive. Lamps or lampholders shall be designed so that there are no exposed live parts when lamps are being inserted or removed.

410.143 Transformers.

(A) Type. Transformers shall be enclosed, identified for the use, and listed.

(B) Voltage. The secondary circuit voltage shall not exceed 15,000 volts, nominal, under any load condition. The voltage to ground of any output terminals of the secondary circuit shall not exceed 7500 volts under any load conditions.

(C) Rating. Transformers shall have a secondary short-circuit current rating of not more than 150 mA if the open-circuit voltage is over 7500 volts, and not more than 300 mA if the open-circuit voltage rating is 7500 volts or less.

(D) Secondary Connections. Secondary circuit outputs shall not be connected in parallel or in series.

410.144 Transformer Locations.

(A) Accessible. Transformers shall be accessible after installation.

(B) Secondary Conductors. Transformers shall be installed as near to the lamps as practicable to keep the secondary conductors as short as possible.

(C) Adjacent to Combustible Materials. Transformers shall be located so that adjacent combustible materials are not subjected to temperatures in excess of 90°C (194°F).

410.145 Exposure to Damage. Lamps shall not be located where normally exposed to physical damage.

410.146 Marking. Each luminaire or each secondary circuit of tubing having an open-circuit voltage of over 1000 volts shall have a clearly legible marking in letters not less than 6 mm (¼ in.) high reading "Caution ____ volts." The voltage indicated shall be the rated open-circuit voltage. The caution sign(s) or label(s) shall comply with 110.21(B).

Part XIV. Lighting Track

410.150 Installation.

(A) Lighting Track. Lighting track shall be permanently installed and permanently connected to a branch circuit. Only lighting track fittings shall be installed on lighting track. Lighting track fittings shall not be equipped with general-purpose receptacles.

A lighting track fitting differs from a *fitting* as defined in Article 100, in that it usually performs both an electrical and a mechanical function. Such assemblies are not intended to be used for locating convenience receptacles or as an alternative for required receptacle outlets such as those required in 210.62 for show windows. Lighting track can be removed and relocated and, therefore, is not a substitute for required receptacles.

(B) Connected Load. The connected load on lighting track shall not exceed the rating of the track. Lighting track shall be supplied by a branch circuit having a rating not more than that of the track. The load calculation in 220.46(B) shall not be required to limit the length of track on a single branch circuit, and it shall not be required to limit the number of luminaires on a single track.

Section 220.46(B) is intended to be used for load calculations of feeders and services. It does not limit the length of track or number of installed luminaires.

See also

220.46(B), Calculation Example for a load calculation method for track lighting

(C) Locations Not Permitted. Lighting track shall not be installed in the following locations:

(1) Where likely to be subjected to physical damage
(2) In wet or damp locations
(3) Where subject to corrosive vapors
(4) In storage battery rooms
(5) In hazardous (classified) locations
(6) Where concealed
(7) Where extended through walls or partitions
(8) Less than 1.5 m (5 ft) above the finished floor except where protected from physical damage or track operating at less than 30 volts rms open-circuit voltage
(9) Where prohibited by 410.10(D)

(D) Support. Fittings identified for use on lighting track shall be designed specifically for the track on which they are to be installed. They shall be securely fastened to the track, shall maintain polarization and connections to the equipment grounding conductor, and shall be designed to be suspended directly from the track.

410.153 Heavy-Duty Lighting Track. Heavy-duty lighting track is lighting track identified for use exceeding 20 amperes. Each fitting attached to a heavy-duty lighting track shall have individual overcurrent protection.

410.154 Fastening. Lighting track shall be securely mounted so that each fastening is suitable for supporting the maximum weight of luminaires that can be installed. Unless identified for supports at greater intervals, a single section 1.2 m (4 ft) or shorter in length shall have two supports, and, where installed in a continuous row, each individual section of not more than 1.2 m (4 ft) in length shall have one additional support.

410.155 Construction Requirements.

(A) Construction. The housing for the lighting track system shall be of substantial construction to maintain rigidity. The conductors shall be installed within the track housing, permitting insertion of a luminaire, and designed to prevent tampering and accidental contact with live parts. Components of lighting track systems of different voltages shall not be interchangeable. The track conductors shall be a minimum 12 AWG or equal and shall be copper. The track system ends shall be insulated and capped.

(B) Equipment Grounding Conductor. Lighting track shall be connected to the equipment grounding conductor in accordance with Part V of this article, and the track sections shall be securely coupled to maintain continuity of the circuitry, polarization, and grounding throughout.

Part XV. Decorative Lighting and Similar Accessories

410.160 Listing of Decorative Lighting. Decorative lighting and similar accessories used for holiday lighting and similar purposes, in accordance with 590.3(B), shall be listed.

Part XVI. Special Provisions for Horticultural Lighting Equipment

410.170 General. Luminaires complying with Parts, I. II, III, IV, V, VI, VII, IX, X, XI, and XII of this article shall be permitted to be used for horticultural lighting. Part XVI shall additionally apply to lighting equipment specifically identified for horticultural use.

Informational Note: Lighting equipment identified for horticultural use is designed to provide a spectral characteristic needed for the growth of plants and can also provide supplemental general illumination within the growing environment.

With the increasing numbers of indoor plant-growing facilities being established, requirements are necessary for the safe use of horticultural lighting. Horticultural lighting equipment provides a wavelength(s) of light that promotes plant growth. The *NEC* has requirements for agricultural buildings in Article 547. Because horticultural lighting equipment needs to be adjustable to accommodate seasonal plant diversity and growth, flexible connection to branch circuits and between luminaires is usually necessary. In many installations, horticultural lighting equipment is installed closely together.

410.172 Listing. Lighting equipment identified for horticultural use shall be listed.

410.174 Installation and Use. Lighting equipment identified for horticultural use shall be installed and used in accordance with the manufacturer's installation instructions and installation markings on the equipment as required by that listing.

410.176 Locations Not Permitted.

(A) General Lighting. Lighting equipment identified for horticultural use shall not be installed as lighting for general illumination unless such use is indicated in the manufacturer's instructions.

(B) Installed Location. Lighting equipment identified for horticultural use shall not be installed where it is likely to be subject to physical damage or where concealed.

410.178 Flexible Cord. Flexible cord shall only be permitted when provided as part of listed lighting equipment identified for horticultural use for any of the following uses:

(1) Connecting a horticultural lighting luminaire directly to a branch circuit outlet
(2) Interconnecting horticultural lighting luminaires
(3) Connecting a horticultural lighting luminaire to a remote power source

Informational Note: Remote power sources include LED drivers, fluorescent ballasts, or HID ballasts.

410.180 Fittings and Connectors. Fittings and connectors attached to flexible cords shall be provided as part of a listed horticultural lighting equipment device or system and installed in accordance with the instructions provided as part of that listing.

410.182 Equipment Grounding Conductor. Lighting equipment identified for horticultural use shall be connected to the equipment grounding conductor in accordance with Part V of this article.

410.184 Ground-Fault Circuit-Interrupter (GFCI) Protection and Special Purpose Ground-Fault Circuit-Interrupter (SPGFCI) Protection. Lighting equipment identified for horticultural use and employing flexible cord(s) with one or more separable connector(s) or attachment plug(s) shall be supplied by lighting outlets protected by a listed GFCI.

Exception: Circuits exceeding 150 volts to ground shall be protected by a listed SPGFCI.

Informational Note: See UL 943C, *Outline of Investigation for Special Purpose Ground-Fault Circuit-Interrupters*, for information on special purpose ground-fault circuit interrupters.

Δ **410.186 Support.** Fittings identified for support of horticultural lighting equipment shall be used in accordance with the installation instructions provided and shall be securely fastened.

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N Part XVII. Special Provisions for Germicidal Irradiation Luminaires

N 410.190 General.

N 410.191 Listing. Luminaires intended to emit germicidal irradiation shall be listed and identified as germicidal equipment.

N 410.193 Installation. Luminaires shall be installed in accordance with the manufacturer's instructions and equipment markings.

N 410.195 Locations Not Permitted.

N (A) General Lighting. Luminaires shall not be installed as lighting for general illumination unless such use is indicated in the manufacturer's instructions.

N (B) Installed Location. Luminaires shall not be installed where likely to be subject to physical damage.

N (C) Dwellings. Luminaires shall not be installed in a dwelling unless listed and identified for use in dwellings.

N (D) Mounting Height. Luminaires installed in a building space that will be occupied during luminaire operation shall not be mounted below the minimum height specified by its listing and installation instructions.

N 410.197 Germicidal Irradiation Systems.

N (A) Listing. A germicidal irradiation system intended to provide a safeguard against UV exposure by ensuring that a building space will not be occupied during luminaire operation shall be listed and identified as a germicidal system.

N (B) System Components. All system components shall be provided by the system manufacturer or clearly specified in the installation instructions as a component that the installer is required to source separately.

N (C) Installation. A germicidal irradiation system shall be installed in accordance with the manufacturer's installation instructions and installation markings.

N (D) Dwellings. A germicidal irradiation system shall not be installed in a dwelling unless listed and identified for use in dwellings.

ARTICLE 411 Low-Voltage Lighting

Δ **411.1 Scope.** This article covers low voltage lighting systems and their associated components.

Δ **411.2 Reconditioned Equipment.** Listed low-voltage lighting systems or a lighting system assembled from listed parts shall not be reconditioned.

Δ **(A) Listed System.** The luminaires, power supply, and luminaire fittings (including the exposed bare conductors) of a low-voltage lighting system shall be listed for use as part of the same identified lighting system.

(B) Assembly of Listed Parts. A lighting system assembled from the following listed parts shall be permitted: