

## 4.2 LUMINAIRE CORDS THROUGH RACEWAY IN DROP CEILINGS

### UL Staff

*UL staff will lead a discussion on designs of luminaire products that employ an integral power supply cord intended to be routed through raceway in drop ceilings.*

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Two designs of luminaires and their associated methods for connecting the electrical supply cords were described.

The first luminaire design is intended for use with drop ceilings and employs a length of flexible metal conduit (up to 24 in.) for routing of the supply cord from the luminaire to the junction box above the ceiling. Strain relief for the cord is provided at the ceiling level, and all components of the system are provided by the manufacturer.

The second luminaire design is also intended for use with a drop ceiling, but includes a short length of cord routed through a fitting that passes through the drop ceiling to a junction box that is intended to be mounted directly above the ceiling. Strain relief for the cord is provided at the ceiling level, and all components of the system are provided by the manufacturer.

Discussion of the applicable National Electrical Code requirements included Section 400.8 regarding uses not permitted for flexible cords, Section 410.30 on luminaires, and Section 300.1(B) regarding integral parts of equipment.

### Section 400.8

"Unless specifically permitted in 400.7, flexible cords and cables shall not be used for the following...

- (2) Where run through holes in walls, structural ceilings, suspended ceilings, or floors...
- (5) Where concealed by walls, floors, or ceilings or located above suspended or dropped ceilings
- (6) Where installed in raceways, except as otherwise permitted in this Code"

### Section 410.30

"(C) Electric-Discharge Luminaires (Fixtures).

A listed luminaire (fixture) or a listed assembly shall be permitted to be cord connected if the following conditions apply: ...

- (2) The flexible cord meets all of the following:
  - a. Is visible for the entire length outside the luminaire
  - b. Is not subject to strain or physical damage
  - c. Is terminated in a grounding-type attachment plug cap or busway plug or has a luminaire assembly with a strain relief and canopy"

### Section 300.1(B)

“(B) Integral Parts of Equipment. The provisions of this article are not intended to apply to the conductors that form an integral part of equipment, such as motors, controllers, motor control centers, or factory assembled control equipment or listed utilization equipment.”

The consensus of Council members indicated that UL should reconsider the Listing of these types of luminaire designs for the following reasons:

- NEC prohibits routing of a cord through a drop or suspended ceiling, and the fact that the components are assembled or packaged at the manufacturing facility does not supercede NEC Section 400.8.
- When the junction box is located directly above the ceiling tile, the box is inaccessible because its location inhibits movement of the ceiling tile.
- Power cord should not be permitted to be routed within the raceway per Section 400.8(6) because it is not specifically permitted elsewhere in the NEC.
- Section 300.22(C)(1) does not permit routing of cords in flexible metal conduit in other space used for environmental air.
- Components of these systems are not identified as factory-assembly and it is not practical for the AHJ to determine if the components are provided by the manufacturer or the installer.
- Components of these systems have been received in a separate parts bag and not assembled at the factory.
- Instructions provided with the components have allowed up to 6 ft of cord.

It was noted that NEC Section 410.30 is intended to be applicable to only high bay luminaires and that applying that requirement for these products would be a misapplication of the NEC.

UL's position on the issue has been that UL does not regard these product constructions as a safety hazard, and that the NEC requirements permit acceptance of designs that have been interpreted to comply with the intent of the requirements. However, UL will revisit this issue based on information provided by the Council.

**Action Item:** UL will further review these products with appropriate technical staff and NEC CMP representatives and advise the Council regarding UL actions.

**(B) Attachment Plugs.** Where used as permitted in 400.7(A)(3), (A)(6), and (A)(8), each flexible cord shall be equipped with an attachment plug and shall be energized from a receptacle outlet.

*Exception: As permitted in 368.8.*



**400.8 Uses Not Permitted.** Unless specifically permitted in 400.7, flexible cords and cables shall not be used for the following:

- (1) As a substitute for the fixed wiring of a structure
- (2) Where run through holes in walls, structural ceilings, suspended ceilings, dropped ceilings, or floors
- (3) Where run through doorways, windows, or similar openings
- (4) Where attached to building surfaces

*Exception: Flexible cord and cable shall be permitted to be attached to building surfaces in accordance with the provisions of 368.8.*

- (5) Where concealed by walls, floors, or ceilings or located above suspended or dropped ceilings
- (6) Where installed in raceways, except as otherwise permitted in this *Code*

**400.9 Splices.** Flexible cord shall be used only in continuous lengths without splice or tap where initially installed in applications permitted by 400.7(A). The repair of hard-service cord and junior hard-service cord (see Trade Name column in Table 400.4) 14 AWG and larger shall be permitted if conductors are spliced in accordance with 110.14(B) and the completed splice retains the insulation, outer sheath properties, and usage characteristics of the cord being spliced.

**400.10 Pull at Joints and Terminals.** Flexible cords and cables shall be connected to devices and to fittings so that tension is not transmitted to joints or terminals.

*Exception: Listed portable single pole devices that are intended to accommodate such tension at their terminals shall be permitted to be used with single-conductor flexible cable.*

**FPN:** Some methods of preventing pull on a cord from being transmitted to joints or terminals are knotting the cord, winding with tape, and fittings designed for the purpose.

**400.11 In Show Windows and Show Cases.** Flexible cords used in show windows and show cases shall be Type

SJOOW, SJTW, SJTOW, SJTOOW, SOW, SOOW, STW, STOW, or STOOW.

*Exception No. 1: For the wiring of chain-supported luminaires (lighting fixtures).*

*Exception No. 2: As supply cords for portable lamps and other merchandise being displayed or exhibited.*

**400.12 Minimum Size.** The individual conductors of a flexible cord or cable shall not be smaller than the sizes in Table 400.4.

*Exception: The size of the insulated ground-check conductor of Type G-GC cables shall be not smaller than 10 AWG.*

**400.13 Overcurrent Protection.** Flexible cords not smaller than 18 AWG, and tinsel cords or cords having equivalent characteristics of smaller size approved for use with specific appliances, shall be considered as protected against overcurrent by the overcurrent devices described in 240.5.

**400.14 Protection from Damage.** Flexible cords and cables shall be protected by bushings or fittings where passing through holes in covers, outlet boxes, or similar enclosures.

## II. Construction Specifications

**400.20 Labels.** Flexible cords shall be examined and tested at the factory and labeled before shipment.

**400.21 Nominal Insulation Thickness.** The nominal thickness of insulation for conductors of flexible cords and cables shall not be less than specified in Table 400.4.

*Exception: The nominal insulation thickness for the ground-check conductors of Type G-GC cables shall not be less than 1.14 mm (45 mils) for 8 AWG and not less than 0.76 mm (30 mils) for 10 AWG.*

**400.22 Grounded-Conductor Identification.** One conductor of flexible cords that is intended to be used as a grounded circuit conductor shall have a continuous marker that readily distinguishes it from the other conductor or conductors. The identification shall consist of one of the methods indicated in 400.22(A) through (F).

**(A) Colored Braid.** A braid finished to show a white or gray color and the braid on the other conductor or conductors finished to show a readily distinguishable solid color or colors.

Table 400-5(B). Ampacity of Cable Types SC, SCE, SCT, PPE, G, G-GC, and W. [Based on Ambient Temperature of 30°C (86°F). See Table 400-4.]

Size (AWG or kcmil)	Temperature Rating of Cable								
	60°C (140°F)			75°C (167°F)			90°C (194°F)		
	D <sup>1</sup>	E <sup>2</sup>	F <sup>3</sup>	D <sup>1</sup>	E <sup>2</sup>	F <sup>3</sup>	D <sup>1</sup>	E <sup>2</sup>	F <sup>3</sup>
8	60	55	48	70	65	57	80	74	65
6	80	72	63	95	88	77	105	99	87
4	105	96	84	125	115	101	140	130	114
3	120	113	99	145	135	118	165	152	133
2	140	128	112	170	152	133	190	174	152
1	165	150	131	195	178	156	220	202	177
1/0	195	173	151	230	207	181	260	234	205
2/0	225	199	174	265	238	208	300	271	237
3/0	260	230	201	310	275	241	350	313	274
4/0	300	265	232	360	317	277	405	361	316
250	340	296	259	405	354	310	455	402	352
300	375	330	289	445	395	346	505	449	393
350	420	363	318	505	435	381	570	495	433
400	455	392	343	545	469	410	615	535	468
500	515	448	392	620	537	470	700	613	536

<sup>1</sup>The ampacities under subheading D shall be permitted for single-conductor Types SC, SCE, SCT, PPE, and W cable only where the individual conductors are not installed in raceways and are not in physical contact with each other except in lengths not to exceed 24 in. (610 mm) where passing through the wall of an enclosure.

<sup>2</sup>The ampacities under subheading E apply to two-conductor cables and other multiconductor cables connected to utilization equipment so that only two conductors are current carrying.

<sup>3</sup>The ampacities under subheading F apply to three-conductor cables and other multiconductor cables connected to utilization equipment so that only three conductors are current carrying.

PN: Examples of these markings include, but are not limited to, "LS" for limited smoke and markings such as "sunlight resistant."

#### 400-7. Uses Permitted.

(a) **Uses.** Flexible cords and cables shall be used only for the following:

- (1) Pendants
- (2) Wiring of fixtures
- (3) Connection of portable lamps, portable and mobile signs, or appliances
- (4) Elevator cables
- (5) Wiring of cranes and hoists
- (6) Connection of stationary equipment to facilitate their frequent interchange
- (7) Prevention of the transmission of noise or vibration
- (8) Appliances where the fastening means and mechanical connections are specifically designed to permit ready removal for maintenance and repair, and the appliance is intended or identified for flexible cord connection
- (9) Data processing cables as permitted by Section 645-5
- (10) Connection of moving parts
- (11) Temporary wiring as permitted in Sections 305-4(b) and 305-4(c)

(b) **Attachment Plugs.** Where used as permitted in sub-sections (a)(3), (a)(6), and (a)(8), each flexible cord shall

be equipped with an attachment plug and shall be energized from a receptacle outlet.

*Exception: As permitted in Section 364-8.*

**400-8. Uses Not Permitted.** Unless specifically permitted in Section 400-7, flexible cords and cables shall not be used for the following:

- (1) As a substitute for the fixed wiring of a structure
- (2) Where run through holes in walls, structural ceilings, suspended ceilings, dropped ceilings, or floors
- (3) Where run through doorways, windows, or similar openings
- (4) Where attached to building surfaces

*Exception: Flexible cord and cable shall be permitted to be attached to building surfaces in accordance with the provisions of Section 364-8.*

- (5) Where concealed behind building walls, structural ceilings, suspended ceilings, dropped ceilings, or floors
- (6) Where installed in raceways, except as otherwise permitted in this Code

**400-9. Splices.** Flexible cord shall be used only in continuous lengths without splice or tap where initially installed in applications permitted by Section 400-7(a). The repair of hard-service cord and junior hard-service cord (see Trade Name column in Table 400-4) No. 14 and larger shall be

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**400.5 Ampacities for Flexible Cords and Cables.**

(A) **Ampacity Tables.** Table 400.5(A) provides the allowable ampacities, and Table 400.5(B) provides the ampacities for flexible cords and cables with not more than three current-carrying conductors. These tables shall be used in conjunction with applicable end-use product standards to ensure selection of the proper size and type. Where cords are used in ambient temperatures exceeding 30°C (86°F), the temperature correction factors from Table 310.16 that correspond to the temperature rating of the cord shall be applied to the ampacity from Table 400.5(B). Where the number of current-carrying conductors exceeds three, the allowable ampacity or the ampacity of each conductor shall be reduced from the 3-conductor rating as shown in Table 400.5.

**Table 400.5 Adjustment Factors for More Than Three Current-Carrying Conductors in a Flexible Cord or Cable**

Number of Conductors	Percent of Value in Tables 400.5(A) and 400.5(B)
4 - 6	80
7 - 9	70
10 - 20	50
21 - 30	45
31 - 40	40
41 and above	35

(B) **Ultimate Insulation Temperature.** In no case shall conductors be associated together in such a way with respect to the kind of circuit, the wiring method used, or the number of conductors such that the limiting temperature of the conductors is exceeded.

A neutral conductor that carries only the unbalanced current from other conductors of the same circuit shall not be required to meet the requirements of a current-carrying conductor.

In a 3-wire circuit consisting of two phase wires and the neutral of a 4-wire, 3-phase, wye-connected system, a common conductor carries approximately the same current as the line-to-neutral currents of the other conductors and shall be considered to be a current-carrying conductor.

On a 4-wire, 3-phase, wye circuit where the major portion of the load consists of nonlinear loads, there are harmonic currents present in the neutral conductor and the neutral shall be considered to be a current-carrying conductor.

An equipment grounding conductor shall not be considered a current-carrying conductor.

Where a single conductor is used for both equipment grounding and to carry unbalanced current from other conductors, as provided for in 250.140 for electric ranges and electric clothes dryers, it shall not be considered as a current-carrying conductor.

*Exception: For other loading conditions, adjustment factors shall be permitted to be calculated under 310.15(C).*

FPN: See Annex B, Table B.310.11, for adjustment factors for more than three current-carrying conductors in a race-way or cable with load diversity.

**400.6 Markings.**

(A) **Standard Markings.** Flexible cords and cables shall be marked by means of a printed tag attached to the coil reel or carton. The tag shall contain the information required in 310.11(A). Types S, SC, SCE, SCT, SE, SEO, SEOO, SJ, SJE, SJEO, SJEOO, SJO, SJT, SJTO, SJTOO, SO, SOO, ST, STO, STOO, SEW, SEOW, SEOOW, SJEW, SJEOW, SJEOOW, SJOW, SJTW, SJTOW, SJTOOW, SOW, SOOW, STW, STOW, and STOOW flexible cords and G, G-GC, PPE, and W flexible cables shall be durably marked on the surface at intervals not exceeding 610 mm (24 in.) with the type designation, size, and number of conductors.

(B) **Optional Markings.** Flexible cords and cable types listed in Table 400.4 shall be permitted to be surface marked to indicate special characteristics of the cable materials. These markings include, but are not limited to, markings for limited smoke, sunlight resistance, and so forth.

**400.7 Uses Permitted.**

(A) **Uses.** Flexible cords and cables shall be used only for the following:

- (1) Pendants
- (2) Wiring of luminaires (fixtures)
- (3) Connection of portable lamps, portable and mobile signs, or appliances
- (4) Elevator cables
- (5) Wiring of cranes and hoists
- (6) Connection of utilization equipment to facilitate frequent interchange
- (7) Prevention of the transmission of noise or vibration
- (8) Appliances where the fastening means and mechanical connections are specifically designed to permit ready removal for maintenance and repair, and the appliance is intended or identified for flexible cord connection
- (9) Connection of moving parts
- (10) Where specifically permitted elsewhere in this Code

(B) **Attachment Plugs.** Where used as permitted in 400.7(A)(3), (A)(6), and (A)(8), each flexible cord shall be equipped with an attachment plug and shall be energized from a receptacle outlet.

*Exception: As permitted in 368.56.*

**400.8 Uses Not Permitted.** Unless specifically permitted in 400.7, flexible cords and cables shall not be used for the following:

- (1) As a substitute for the fixed wiring of a structure

Table 400.5(A) Allowable Ampacity for Flexible Cords and Cables [Based on Ambient Temperature of 30°C (86°F). See 400.13 and Table 400.4.]

Size (AWG)	Thermoplastic Types TPT, TST	Thermoset Types C, E, EO, PD, S, SJ, SJO, SJOW, SJOO, SJOOW, SO, SOW, SOO, SOOW, SP-1, SP-2, SP-3, SRD, SV, SVO, SVOO		Types HPD, HPN, HSJ, HSJO, HSJOO
		A <sup>+</sup>	B <sup>+</sup>	
27*	0.5	—	—	—
20	—	5**	***	—
18	—	7	10	10
17	—	—	12	13
16	—	10	13	15
15	—	—	—	17
14	—	15	18	20
12	—	20	25	30
10	—	25	30	35
8	—	35	40	—
6	—	45	55	—
4	—	60	70	—
2	—	80	95	—

\*Tinsel cord.

\*\*Elevator cables only.

\*\*\*7 amperes for elevator cables only; 2 amperes for other types.

+The allowable currents under Column A apply to 3-conductor cords and other multiconductor cords connected to utilization equipment so that only 3 conductors are current-carrying. The allowable currents under Column B apply to 2-conductor cords and other multiconductor cords connected to utilization equipment so that only 2 conductors are current carrying.

(2) Where run through holes in walls, structural ceilings, suspended ceilings, dropped ceilings, or floors

(3) Where run through doorways, windows, or similar openings

(4) Where attached to building surfaces

*Exception to (4): Flexible cord and cable shall be permitted to be attached to building surfaces in accordance with the provisions of 368.56(B)*

(5) Where concealed by walls, floors, or ceilings or located above suspended or dropped ceilings

(6) Where installed in raceways, except as otherwise permitted in this Code

(7) Where subject to physical damage

**400.9 Splices.** Flexible cord shall be used only in continuous lengths without splice or tap where initially installed in appli-

cations permitted by 400.7(A). The repair of hard-service cord and junior hard-service cord (see Trade Name column in Table 400.4) 14 AWG and larger shall be permitted if conductors are spliced in accordance with 110.14(B) and the completed splice retains the insulation, outer sheath properties, and usage characteristics of the cord being spliced.

**400.10 Pull at Joints and Terminals.** Flexible cords and cables shall be connected to devices and to fittings so that tension is not transmitted to joints or terminals.

*Exception: Listed portable single-pole devices that are intended to accommodate such tension at their terminals shall be permitted to be used with single-conductor flexible cable.*

FPN: Some methods of preventing pull on a cord from being transmitted to joints or terminals are knotting the cord, winding with tape, and fittings designed for the purpose.