

*National Electrical Code*®

1984 Edition

NFPA 70-1984

1984 Edition of the *National Electrical Code*

This 1984 edition of the *National Electrical Code* (NFPA 70-1984) was adopted by the National Fire Protection Association, Inc. on May 19, at its 1983 Annual Meeting, in Kansas City, MO, and was released by the Standards Council on July 14, 1983. It was approved by the American National Standards Institute on August 5, 1983. This 1984 edition supersedes all other previous editions, supplements, and printings dated 1897, 1899, 1901, 1903, 1904, 1905, 1907, 1909, 1911, 1913, 1915, 1918, 1920, 1923, 1925, 1926, 1928, 1930, 1931, 1933, 1935, 1937, 1940, 1942, 1943, 1947, 1949, 1951, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1962, 1965, 1968, 1971, 1975, 1978, and 1981.

Changes in this 1984 edition of the *National Electrical Code* (as compared with the 1981 edition) are indicated by vertical lines in the margin.

There is material in Article 517 which is identified as including text extracted from other NFPA documents. This identification is a result of action at the NFPA Annual Meeting and complaints filed with the NFPA Standards Council.

This Code is purely advisory as far as the NFPA and ANSI are concerned but is offered for use in law and for regulatory purposes in the interest of life and property protection. Anyone noticing any errors should notify the Secretary of the National Electrical Code Committee at the NFPA Executive Office.

**History and Development of the *National Electrical Code***

The National Fire Protection Association has acted as sponsor of the *National Electrical Code* since 1911. The original Code document was developed in 1897 as a result of the united efforts of various insurance, electrical, architectural, and allied interests.

In accordance with the provisions of the NFPA Regulations Governing Committee Projects, a National Electrical Code Technical Committee Report containing proposed amendments to the 1981 *National Electrical Code* was published by the NFPA in June, 1982. This report recorded the actions of the various Code-Making Panels and the Correlating Committee of the National Electrical Code Committee on each proposal that had been made to revise the 1981 Code. The report was circulated to all members of the National Electrical Code Committee, and was made available to other interested NFPA members and to the public for review and comment. Following the close of the public comment period, the Code-Making Panels met, acted on each comment and reported their action to the Correlating Committee. The NFPA published the *National Electrical Code Technical Committee Documentation* in April, 1983, which recorded the actions of the Code-Making Panels and the Correlating Committee on each public

Table 384-26. Minimum Spacings Between Bare Metal Parts

|                             | Opposite Polarity Where Mounted on the Same Surface |            | Opposite Polarity Where Held Free In Air |        | *Live Parts To Ground |
|-----------------------------|-----------------------------------------------------|------------|------------------------------------------|--------|-----------------------|
|                             | 1/4 inch                                            | 1 1/4 inch | 1/2 inch                                 | 1 inch |                       |
| Not over 125 volts, nominal | 1/4 inch                                            | 1 1/4 inch | 1/2 inch                                 | 1 inch | 1/2 inch              |
| Not over 250 volts, nominal | 1/4 inch                                            | 1 1/4 inch | 1/2 inch                                 | 1 inch | 1 inch                |
| Not over 600 volts, nominal | 2 inches                                            | 2 inches   | 1 inch                                   | 1 inch | 1 inch                |

For SI units: one inch = 25.4 millimeters.  
 \* For spacing between live parts and doors of cabinets, see Section 373-11(a) (1), (2), and (3).

**384-27. Grounding of Panelboards.** Panelboard cabinets shall be grounded in the manner specified in Article 250 or Section 384-3(c). An approved terminal bar for equipment grounding conductors shall be provided and secured inside of the cabinet for the attachment of all the feeder and branch-circuit equipment grounding conductors, where the panelboard is used with nonmetallic raceway or cable, or where separate grounding conductors are provided. The terminal bar shall be bonded to the cabinet or panelboard frame and shall not be connected to the neutral bar in other than service equipment.

*Exception No. 1: When an isolated ground conductor is provided as in Section 250-74, Exception No. 4, the insulated ground conductor which is run with the circuit conductors shall be permitted to pass through the panelboard without being connected to the panelboard grounding terminal bar.*

*Exception No. 2: The terminal bar for equipment grounding conductors shall be permitted to be connected to the neutral bar at separate buildings in accordance with the provisions of Section 250-24.*

## Chapter 4. Equipment for General Use

### ARTICLE 400 — FLEXIBLE CORDS AND CABLES

#### A. General

**400-1. Scope.** This article covers general requirements, applications, and construction specifications for flexible cords and flexible cables.

**400-2. Other Articles.** Flexible cords and flexible cables shall comply with this article and with the applicable provisions of other articles of this Code.

**400-3. Suitability.** Flexible cords and cables and their associated fittings shall be suitable for the conditions of use and location.

**400-4. Types.** Flexible cords and flexible cables shall conform to the description in Table 400-4. Types of flexible cords and flexible cables other than those listed in the table shall be the subject of special investigation.

#### Notes to Table 400-4

1. Except for Types SP-1, SP-2, SP-3, SPT-1, SPT-2, SPT-3, HPN, TP, TPT, SRD (3-conductor) and SRDT (3-conductor), individual conductors are twisted together.

2. Cables constructed differently than specified herein and listed as component parts of a data processing system shall be permitted.

3. Types TP, TPT, TS, and TST shall be permitted in lengths not exceeding 8 feet (2.44 m) when attached directly, or by means of a special type of plug, to a portable appliance rated at 50 watts or less and of such nature that extreme flexibility of the cord is essential.

4. Rubber-filled or varnished cambric tapes shall be permitted as a substitute for the inner braids.

5. Types S, SO, ST, and STO shall be permitted for use on theater stages, in garages, and elsewhere where flexible cords are permitted by this Code.

6. Elevator traveling cables for operating control and signal circuits shall contain nonmetallic fillers as necessary to maintain concentricity. Cables exceeding 100 feet (30.5 m) between supports shall have steel supporting members. In locations subject to excessive moisture or corrosive vapors or gases, supporting members of other materials shall be permitted. Where steel supporting members are used, they shall run straight through the center of the cable assembly and shall not be cabled with the copper strands of any conductor.

In addition to conductors used for control and signaling circuits, Types E, EO, EN, ET, ETP, ETB and ETT elevator cables shall be permitted to incorporate in the construction one or more No. 20 AWG telephone conductor pairs and/or one or more coaxial cables. The No. 20 AWG conductor pairs may be covered with suitable shielding for telephone, audio or higher frequency communication circuits; the coaxial cables consist of a center conductor, insulation and shield for use in video or other radio

(Notes Continued on page 280)



See Notes 1 through 9.  
\* See Note 9.

| Trade Name             | Type | Size AWG | No. of Conductors | Insulation                                           | Insulation Thickness | AWG on Each Milie | Braid or Each Conductor | Outer Covering                    | Use                                                       |
|------------------------|------|----------|-------------------|------------------------------------------------------|----------------------|-------------------|-------------------------|-----------------------------------|-----------------------------------------------------------|
| Heater Cord            | HPD  | 18-12    | 2, 3, or 4        | Thermoset<br>or All<br>Asbestos<br>with<br>Thermoset | 18-16<br>14-12       | 15                | None                    | Cotton or Rayon                   | Portable<br>Heaters<br>Dry Locations<br>No: Hard Usage    |
| Parallel Heater Cord   | HPN  | 18-12    | 2 or 3            | Thermo-setting                                       | 18-16<br>14<br>12    | 45<br>80<br>95    | None                    | Thermosetting                     | Portable<br>Damp Locations<br>No: Hard Usage              |
| Jacketed Heater Cord   | HS   | 14-12    | 2, 3 or 4         | Thermoset<br>with<br>Asbestos                        | 14-12                | 30                | None                    | Cotton and Thermoset              | Portable<br>Damp Locations<br>Hard Usage                  |
| Jacketed Heater Cord   | HSJ  | 18-12    | 2, 3 or 4         | All Thermoset                                        | 18-16<br>14-12       | 30<br>45          | None                    | Cotton and Thermoset              | Portable<br>Heaters                                       |
| Jacketed Heater Cord   | HSJO | 18-12    |                   | Thermoset<br>with<br>Asbestos                        | 14-12                | 30                |                         |                                   | Portable<br>Damp Locations<br>Extra Hard Usage            |
| Jacketed Heater Cord   | HSO  | 14-12    | 2, 3 or 4         | All Thermoset                                        | 18-16<br>14-12       | 30<br>45          | None                    | Cotton and Oil-Resistant Compound | Portable<br>Damp Locations                                |
|                        | PD   | 18-10    |                   | Thermoset                                            | 14-10                | 45                |                         |                                   | Pendant<br>or Portable<br>Dry Locations<br>No: Hard Usage |
| Twisted Port-able Cord |      |          | 2 or more         | Thermoset<br>or plastic                              |                      |                   | Cotton                  | Cotton or Rayon                   |                                                           |

• See Notes 1 through 9.  
• See Note 9.

[illegible]

| Table 400-4 (Continued)                         |    |        |                      |       |    |    |    |    |     |                                 |               |                           |                                                                                                       |                   |                      |                        |       |                        |       |                        |       |                    |       |    |    |    |     |      |               |                                                                                                       |                   |                      |
|-------------------------------------------------|----|--------|----------------------|-------|----|----|----|----|-----|---------------------------------|---------------|---------------------------|-------------------------------------------------------------------------------------------------------|-------------------|----------------------|------------------------|-------|------------------------|-------|------------------------|-------|--------------------|-------|----|----|----|-----|------|---------------|-------------------------------------------------------------------------------------------------------|-------------------|----------------------|
| All Elastomer<br>! (thermo-<br>plastic)<br>Cord |    |        |                      |       |    |    |    |    |     | All Plastic<br>Parallel<br>Cord |               |                           |                                                                                                       |                   |                      |                        |       |                        |       |                        |       |                    |       |    |    |    |     |      |               |                                                                                                       |                   |                      |
| SPE-1<br>Sec<br>Note 7                          | 18 | 2 or 3 | Thermo-<br>Elastomer | 18-16 | 45 | 60 | 80 | 95 | 110 | None                            | Thermoplastic | Pendant<br>or<br>Portable | Refriger-<br>ators,<br>Room Air<br>Cond-<br>itioners<br>and as<br>permitted<br>in Section<br>422-8(d) | Damp<br>Locations | Not<br>Hard<br>Usage | SPE-3<br>Sec<br>Note 7 | 18-12 | SPT-2<br>Sec<br>Note 7 | 18-16 | SPT-3<br>Sec<br>Note 7 | 18-10 | Thermo-<br>plastic | 18-16 | 60 | 80 | 95 | 110 | None | Thermoplastic | Refriger-<br>ators,<br>Room Air<br>Cond-<br>itioners<br>and as<br>permitted<br>in Section<br>422-8(d) | Damp<br>Locations | Not<br>Hard<br>Usage |
|                                                 |    |        |                      |       |    |    |    |    |     |                                 |               |                           |                                                                                                       |                   |                      |                        |       |                        |       |                        |       |                    |       |    |    |    |     |      |               |                                                                                                       |                   |                      |
|                                                 |    |        |                      |       |    |    |    |    |     |                                 |               |                           |                                                                                                       |                   |                      |                        |       |                        |       |                        |       |                    |       |    |    |    |     |      |               |                                                                                                       |                   |                      |
|                                                 |    |        |                      |       |    |    |    |    |     |                                 |               |                           |                                                                                                       |                   |                      |                        |       |                        |       |                        |       |                    |       |    |    |    |     |      |               |                                                                                                       |                   |                      |

Table 400-4 (Continued)

See Notes 1 through 9.

| Trade Name                    | Type Letter             | Size AWG        | No. of Conductors | Insulation              | Insulation Thickness |                         | Braid on Each Conductor | Outer Covering      | Use            |                  |
|-------------------------------|-------------------------|-----------------|-------------------|-------------------------|----------------------|-------------------------|-------------------------|---------------------|----------------|------------------|
| Hard Service Cord             | SO                      | 18-2            | 2 or more         | Thermoset               | 18-16 (Thermoset)    | 30                      | Oil-Resistant Thermoset | Pendant or Portable | Damp Locations | Extra Hard Usage |
|                               | Oil-Resistant Thermoset |                 |                   | 18-16 (Thermoset)       | 45                   | Oil-Resistant Thermoset |                         |                     |                |                  |
|                               | SOO                     | 18-12           | 2 or more         | Oil-Resistant Thermoset | 14-10 (Thermoset)    | 18                      | Oil-Resistant Thermoset | Pendant or Portable | Damp Locations | Not Hard Usage   |
|                               | Thermoset               | 8-2 (Thermoset) | 60                | Thermoset               |                      |                         |                         |                     |                |                  |
| All Thermoset Cord            | SPT-1                   | 18              | 2 or 3            | Thermoset               | 18-16                | 30                      | Thermoset               | Pendant or Portable | Damp Locations | Not Hard Usage   |
|                               | SPT-2                   | 18-16           |                   | 45                      | Thermoset            |                         |                         |                     |                |                  |
|                               | SPT-3                   | 18-12           | 2 or 3            | Thermoset               | 18-16                | 60                      | Thermoset               | Pendant or Portable | Damp Locations | Not Hard Usage   |
|                               | SPT-4                   | 18-12           |                   | 110                     | Thermoset            |                         |                         |                     |                |                  |
| Refrigerators, Cond. Room Air | 422-8(d)                | 422-8(d)        | 422-8(d)          | 422-8(d)                | 422-8(d)             | 422-8(d)                | 422-8(d)                | 422-8(d)            | 422-8(d)       | 422-8(d)         |

Table 400-4 (Continued)

See Notes 1 through 9.

Table 400-4 (Continued)

| Trade Name           | Type Letter | Size, AWG  | No. of Conductors | Insulation                               | Nominal Insulation Thickness, mils | Braid on Each Conductor | Outer Covering                       | Use                                                   |
|----------------------|-------------|------------|-------------------|------------------------------------------|------------------------------------|-------------------------|--------------------------------------|-------------------------------------------------------|
| Range, Dryer, Cable  | SRD         | 10-4       | 3 or 4            | Thermoset                                | 10-4                               | None                    | Thermoset                            | Portable Damp Locations Ranges, Dryers                |
|                      | SRDE        | 10-4       | 3 or 4            | Thermoplastic elastomer                  |                                    | None                    | Thermoplastic elastomer              | Portable Damp Locations Ranges, Dryers                |
|                      | SRDT        | 10-4       | 3 or 4            | Thermoplastic                            |                                    | None                    | Thermoplastic                        | Portable Damp Locations Ranges, Dryers                |
|                      | ST          | 18-2       | 2 or more         | Thermoplastic or Thermoset               |                                    | None                    | Thermoplastic                        | Pendant Damp Locations Extra Usage                    |
| Hard Service Cord    | STO         | 18-2       | 2 or more         | Oil-Resistant Thermoset                  | 18-16 to 14-10                     | 45                      | Thermoplastic                        | Pendant or Portable                                   |
|                      | STOO        |            |                   | Oil-Resistant Thermoset                  | 8-2                                | 60                      | Oil-Resistant Thermoplastic          | Pendant or Portable                                   |
|                      | SV          | 18-17      | 2 or 3            | Thermoset                                | 18-17                              | 15                      | Thermoset                            | Pendant or Portable                                   |
|                      | SVS         | 18-17      | 2 or 3            | Thermoplastic elastomer or Thermoset     |                                    | None                    | Thermoplastic elastomer or Thermoset | Pendant or Portable                                   |
| Vacuum Cleaner Cord  | SV          | 18-17      | 2 or 3            | Thermoset                                | 18-17                              | 15                      | Thermoset                            | Pendant or Portable                                   |
|                      | SVTO        | See Note 7 |                   | Thermoset                                |                                    | None                    | Thermoplastic                        | Pendant or Portable                                   |
|                      | SVTO        | See Note 7 |                   | Thermoplastic                            |                                    | None                    | Thermoplastic                        | Pendant or Portable                                   |
|                      | SVTOO       | See Note 7 |                   | Oil-Resistant Thermoplastic or Thermoset |                                    | None                    | Oil-Resistant Thermoplastic          | Pendant or Portable                                   |
| Parallel Tinsel Cord | TP          | 27         | 2                 | Thermoset                                | 27                                 | 30                      | Thermoset                            | Attached to an Appliance Damp Locations No Hard Usage |
|                      | TPT         | 27         | 2                 | Thermoplastic                            | 27                                 | 30                      | Thermoplastic                        | Attached to an Appliance Damp Locations No Hard Usage |
|                      | TS          | 27         | 2                 | Thermoset                                | 27                                 | 15                      | Thermoset                            | Attached to an Appliance Damp Locations No Hard Usage |
|                      | TST         | 27         | 2                 | Thermoplastic                            | 27                                 | 15                      | Thermoplastic                        | Attached to an Appliance Damp Locations No Hard Usage |
| Jacketed Tinsel Cord | TS          | 27         | 2                 | Thermoset                                | 27                                 | 15                      | Thermoset                            | Attached to an Appliance Damp Locations No Hard Usage |
|                      | TST         | 27         | 2                 | Thermoplastic                            | 27                                 | 15                      | Thermoplastic                        | Attached to an Appliance Damp Locations No Hard Usage |
|                      | TS          | 27         | 2                 | Thermoset                                | 27                                 | 15                      | Thermoset                            | Attached to an Appliance Damp Locations No Hard Usage |
|                      | TST         | 27         | 2                 | Thermoplastic                            | 27                                 | 15                      | Thermoplastic                        | Attached to an Appliance Damp Locations No Hard Usage |

See Notes 1 through 9.

See Notes 1 through 9.

Table 400-4 (Continued)

Table 400-4 (Continued)

(Continued from page 271)

frequency communication circuits. The insulation of the conductors shall be rubber or thermoplastic of thickness not less than specified for the other conductors of the particular type of cable. Metallic shields shall have their own protective covering. Where used, these components shall be permitted to be incorporated in any layer of the cable assembly but shall not run straight through the center.

7. A third conductor in these cables is for grounding purposes only.

8. The individual conductors of all cords, except those of heat-resistant cords (Types AFC, AFPD, AFS, AFSJ, and CFPD), shall have a thermoset or thermoplastic insulation, except that the grounding conductor where used shall be in accordance with Section 400-23(b). Unvulcanized rubber compounds shall be permitted to be used for heater cords Types HPD, HSI, HSJO, HS, and HSO.

9. Where the voltage between any two conductors exceeds 300, but does not exceed 600, flexible cord of No. 10 and smaller shall have thermoset or thermoplastic insulation on the individual conductors at least 45 mils in thickness, unless Type S, SO, ST, or STO cord is used.

**400-5. Ampacity of Flexible Cords and Cables.** Table 400-5 gives the allowable ampacity for not more than three current-carrying copper conductors in a cord. If the number of current-carrying conductors in a cord exceeds three, the ampacity of each conductor shall be reduced as shown in the following table:

| Number of Conductors | Percent of Values in Table 400-5 |
|----------------------|----------------------------------|
| 4 through 6          | 80                               |
| 7 through 24         | 70                               |
| 25 through 42        | 60                               |
| 43 and above         | 50                               |

A conductor used for equipment grounding and a neutral conductor which carries only the unbalanced current from other conductors, as in the case of normally balanced circuits of three or more conductors, shall not be considered as current-carrying conductors.

Where a single conductor is used for both equipment grounding and to carry unbalanced current from other conductors, as provided for in Section 250-60 for electric ranges and electric clothes dryers, it shall not be considered as a current-carrying conductor.

Table 400-5. Ampacity of Flexible Cords and Cables

(Based on Ambient Temperature of 30° C (86°F). See Section 400-13 and Table 400-4.)

| Size | Thermoset Types TP, TS | Thermoplastic Types TPT, TST | Thermoset Types C, PD, E, EO, EN, S, SO, SRD, SJ, SJO, SV, SVO, SP | Thermoplastic Types EY, EYT, ETLB, ETP, ST, STO, SRDT, SJT, SUTO, SVT, SVTO, SPT | Types AFS, AFSJ, HPD, HSI, HSJO, HS, HSO, HPN | Cotton Types CFPD*, Asbestos Types AFC*, AFPD* |
|------|------------------------|------------------------------|--------------------------------------------------------------------|----------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------|
| 27** | 0.5                    |                              | AT                                                                 | BT                                                                               |                                               |                                                |
| 20   |                        |                              | 5***                                                               | 7***                                                                             |                                               |                                                |
| 18   |                        |                              | 7                                                                  | 10                                                                               |                                               | 6                                              |
| 17   |                        |                              |                                                                    | 12                                                                               |                                               |                                                |
| 16   |                        |                              | 10                                                                 | 13                                                                               |                                               | 8                                              |
| 15   |                        |                              |                                                                    |                                                                                  | 17                                            |                                                |
| 14   |                        |                              | 15                                                                 | 18                                                                               | 20                                            | 17                                             |
| 12   |                        |                              | 20                                                                 | 25                                                                               | 30                                            | 23                                             |
| 10   |                        |                              | 25                                                                 | 30                                                                               | 35                                            | 28                                             |
| 8    |                        |                              | 35                                                                 | 40                                                                               |                                               |                                                |
| 6    |                        |                              | 45                                                                 | 55                                                                               |                                               |                                                |
| 4    |                        |                              | 60                                                                 | 70                                                                               |                                               |                                                |
| 2    |                        |                              | 80                                                                 | 95                                                                               |                                               |                                                |

\* These types are used almost exclusively in fixtures where they are exposed to high temperatures and ampere ratings are assigned accordingly.

\*\* Tinsel cord.

\*\*\* Elevator cables only.

† The ampacities under sub-heading A apply to 3-conductor cords and other multiconductor cords connected to utilization equipment so that only 3 conductors are current carrying. The ampacities under sub-heading B apply to 2-conductor cords and other multiconductor cords connected to utilization equipment so that only 2 conductors are current carrying.

NOTE: 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 that the limiting temperature of the conductors will be exceeded.

**400-6. Marking.** 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 Section 310-11(a).

Types SJ, SJO, SJT, SJO, S, SO, ST, and STO flexible cords shall be durably marked on the surface at intervals not exceeding 24 inches (610 mm) with the type designation, size, and number of conductors.

#### 400-7. Uses Permitted.

(a) Uses. Flexible cords and cables shall be used only for (1) pendants; (2) wiring of fixtures; (3) connection of portable lamps 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 designed to permit removal for maintenance.

nance and repair; (9) data processing cables as permitted by Section 645-2, (10) connection of moving parts; or (11) temporary wiring as permitted in Sections 305-2(b) and 305-2(c).

(b) **Attachment Plugs.** Where used as permitted in subsections (a)(3), (a)(6), and (a)(8) of this section, each flexible cord shall be equipped with an attachment plug and shall be energized from a receptacle outlet.

**400-8. Uses Not Permitted.** Unless specifically permitted in Section 400-7 flexible cords and cables shall not be used (1) as a substitute for the fixed wiring of a structure; (2) where run through holes in walls, ceilings, or floors; (3) where run through doorways, windows, or similar openings; (4) where attached to building surfaces; or (5) where concealed behind building walls, ceilings, or floors.

**400-9. Splices.** Flexible cord shall be used only in continuous lengths without splice or tap when initially installed in applications permitted by Section 400-7(a). The repair of hard service cord (see Column 1, Table 400-4) No. 14 and larger shall be permitted if conductors are spliced in accordance with Section 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 shall be so connected to devices and to fittings that tension will not be transmitted to joints or terminals.

(FPN): Some methods of preventing pull on a cord from being transmitted to joints or terminals are (1) knotting the cord, (2) winding with tape, and (3) 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 S, SO, SJ, SJO, ST, STO, SJT, SJO, or AFS.

*Exception No. 1: For the wiring of chain-supported 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.

**400-13. Overcurrent Protection.** Flexible cords not smaller than No. 18, 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 Section 240-4.

**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.

#### B. 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.

**400-22. Grounded-Conductor Identification.** One conductor of flexible cords which is intended to be used as a grounded circuit conductor shall have a continuous marker readily distinguishing it from the other conductor

or conductors. The identification shall consist of one of the methods indicated in (a) through (f) below.

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

(b) **Tracer in Braid.** A tracer in a braid of any color contrasting with that of the braid and no tracer in the braid of the other conductor or conductors. No tracer shall be used in the braid of any conductor of a flexible cord which contains a conductor having a braid finished to show white or natural gray.

*Exception: In the case of Types C and PD, and cords having the braids on the individual conductors finished to show white or natural gray. In such cords the identifying marker shall be permitted to consist of the solid white or natural gray finish on one conductor, provided there is a colored tracer in the braid of each other conductor.*

(c) **Colored Insulation.** A white or natural gray insulation on one conductor and insulation of a readily distinguishable color or colors on the other conductor or conductors for cords having no braids on the individual conductors.

For jacketed cords furnished with appliances, one conductor having its insulation colored light blue, with the other conductors having their insulation of a readily distinguishable color other than white or natural gray.

*Exception: Cords which have insulation on the individual conductors integral with the jacket.*

It shall be permissible to cover the insulation with an outer finish to provide the desired color.

(d) **Colored Separator.** A white or natural gray separator on one conductor and a separator of a readily distinguishable solid color on the other conductor or conductors of cords having insulation on the individual conductors integral with the jacket.

(e) **Tinned Conductors.** One conductor having the individual strands tinned and the other conductor or conductors having the individual strands untinned for cords having insulation on the individual conductors integral with the jacket.

(f) **Surface Marking.** One or more stripes, ridges, or grooves so located on the exterior of the cord as to identify one conductor for cords having insulation on the individual conductors integral with the jacket.

**400-23. Grounding-Conductor Identification.** A conductor intended to be used as a grounding conductor shall have a continuous identifying marker readily distinguishing it from the other conductor or conductors. Conductors having a continuous green color or a continuous green color with one or more yellow stripes shall not be used for other than grounding purposes. The identifying marker shall consist of one of the methods in (a) or (b) below.

(a) **Colored Braid.** A braid finished to show a continuous green color or a continuous green color with one or more yellow stripes.

(b) **Colored Insulation or Covering.** For cords having no braids on the individual conductors, an insulation of a continuous green color or a continuous green color with one or more yellow stripes.

**400-24. Attachment Plugs.** Where a flexible cord is provided with a grounding conductor and equipped with an attachment plug, the attachment plug shall comply with Section 250-59(a) and (b).

#### C. Portable Cables Over 600 Volts, Nominal

**400-30. Scope.** This part applies to multiconductor portable cables used to connect mobile equipment and machinery.

#### 400-31. Construction.

(a) **Conductors.** The conductors shall be No. 8 AWG copper or larger and shall employ flexible stranding.

(b) **Shields.** Cables operated at over 2000 volts shall be shielded. Shielding shall be for the purpose of confining the voltage stresses to the insulation.

(c) **Grounding Conductor(s).** Grounding conductor(s) shall be provided. The total area shall be not less than that of the size of the conductor required in Section 250-95.

**400-32. Shielding.** All shields shall be grounded.

**400-33. Grounding.** Grounding conductors shall be connected in accordance with Part K of Article 250.

**400-34. Minimum Bending Radii.** The minimum bending radii for portable cables during installation and handling in service shall be adequate to prevent damage to the cable.

**400-35. Fittings.** Connectors used to connect lengths of cable in a run shall be of a type which lock firmly together. Provisions shall be made to prevent opening or closing these connectors while energized. Suitable means shall be used to eliminate tension at connectors and terminations.

**400-36. Splices and Terminations.** Portable cables shall not be operated with splices unless the splices are of the permanent molded, vulcanized types in accordance with Section 110-14(b). Terminations on high-voltage portable cables shall be accessible only to authorized and qualified personnel.

### ARTICLE 402 — FIXTURE WIRES

**402-1. Scope.** This article covers general requirements and construction specifications for fixture wires.

**402-2. Other Articles.** Fixture wires shall comply with this article and also with the applicable provisions of other articles of this Code.

(FPN): For application in lighting fixtures, see Article 410.

**402-3. Types.** Fixture wires shall be of a type listed in Table 402-3, and they shall comply with all requirements of that table. The fixture wires listed in Table 402-3 are all suitable for service at 600 volts, nominal, unless otherwise specified.

(FPN): Thermoplastic insulation may stiffen at temperatures colder than minus 10°C (plus 14°F), requiring care be exercised during installation at such temperatures. Thermoplastic insulation may also be deformed at normal temperatures where subjected to pressure, requiring care be exercised during installation and at points of support.

Table 402-3. Fixture Wire

| Trade Name                                                                                 | Type   | Insulation                      | AWG   | Thickness of Insulation | Mils | Outer Covering               | Max. Operating Temp. | Application Provisions                                                                                                           |
|--------------------------------------------------------------------------------------------|--------|---------------------------------|-------|-------------------------|------|------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Heat-Resistant Rubber-Covered Fixture Wire or Solid or 7-Strand                            | RFH-1  | Heat-Resistant Rubber           | 18    | 15                      | 30   | Nonmetallic Covering         | 75°C (167°F)         | Fixture wiring. Limited to 300 volts.                                                                                            |
|                                                                                            | RFH-2  | Heat-Resistant Rubber and Latex | 18-16 | 30                      | 18   | Nonmetallic Covering         | 75°C (167°F)         | Fixture wiring, and as permitted in Sections 725-16 and 760-16.                                                                  |
| Heat-Resistant Synthetic Linked Synthetic Polymer-Insulated Fixture Wire—Solid or Stranded | RFFH-2 | Cross-Linked Synthetic Polymer  | 18-16 | 30                      | 45   | None or Nonmetallic Covering | 90°C (194°F)         | Fixture wiring, and as permitted in Sections 725-16 and 760-16. Multiconductor cable as permitted in Sections 725-16 and 760-16. |
|                                                                                            | RFFH-3 | Linked Synthetic Polymer        | 18-16 | 45                      | 15   | Nonmetallic Covering         | 75°C (167°F)         | Fixture wiring. Limited to 300 volts.                                                                                            |
| Heat-Resistant Flexible Wire                                                               | FFH-2  | Heat-Resistant Rubber and Latex | 18-16 | 30                      | 18   | Nonmetallic Covering         | 75°C (167°F)         | Fixture wiring, and as permitted in Section 725-16.                                                                              |

| Trade Name                                                              | Type Letter | Insulation AWG           | Thickness of Insulation Mils | Outer Covering               | Max. Operating Temp. | Applications                                                    |
|-------------------------------------------------------------------------|-------------|--------------------------|------------------------------|------------------------------|----------------------|-----------------------------------------------------------------|
| Thermoplastic-Fix-Covered Fixture Wire—Solid or 7-Strand                | TF          | Thermoplastic 18-16      | 30                           | None                         | 60°C<br>140°F        | Fixture wiring, and as permitted in Sections 725-16 and 760-16. |
| Thermoplastic-Fix-Covered Flexible Stranding                            | TFF         | Thermoplastic 18-16      | 30                           | None                         | 60°C<br>140°F        | Fixture wiring, and as permitted in Section 725-16.             |
| Heat-Resistant Thermoplastic-Fix-Covered Fixture Wire—Solid or 7-Strand | TFN         | Thermoplastic 18-16      | 15                           | Nylon Jacketed or equivalent | 90°C<br>194°F        | Fixture wiring, and as permitted in Sections 725-16 and 760-16. |
| Heat-Resistant Thermoplastic-Fix-Covered Flexible Stranding             | TFFN        | Thermoplastic 18-16      | 15                           | Nylon Jacketed or equivalent | 90°C<br>194°F        | Fixture wiring, and as permitted in Section 725-16.             |
| Cotton-Covered, Heat-Resistant, Fix-Covered Fixture Wire                | CF          | Impregnated Cotton 18-14 | 30                           | None                         | 90°C<br>194°F        | Fixture wiring, and as permitted in Section 725-16.             |

Table 402-3 (Continued)

|                                                          |        |                                                            |                               |                      |                |                                                                 |
|----------------------------------------------------------|--------|------------------------------------------------------------|-------------------------------|----------------------|----------------|-----------------------------------------------------------------|
| Asbestos Covered Heat-Resistant Fix-Covered Fixture Wire | AF     | Impregnated Asbestos or Moisture-Resistant Insulation Mils | 18-14<br>20<br>25<br>45<br>20 | None                 | 150°C<br>302°F | Fixture wiring, limited to 300 volts and indoor dry locations.  |
| Silicone Insulated Fix-Covered Flexible Stranding        | SF-1   | Silicone Rubber                                            | 18                            | Nonmetallic Covering | 200°C<br>392°F | Fixture wiring, limited to 300 volts.                           |
| Silicone Insulated Fix-Covered Flexible Stranding        | SF-2   | Silicone Rubber                                            | 18-14                         | Nonmetallic Covering | 200°C<br>392°F | Fixture wiring, and as permitted in Sections 725-16 and 760-16. |
| Silicone Insulated Fix-Covered Flexible Stranding        | SF-F-1 | Silicone Rubber                                            | 18                            | Nonmetallic Covering | 150°C<br>302°F | Fixture wiring, limited to 300 volts.                           |
| Silicone Insulated Fix-Covered Flexible Stranding        | SF-F-2 | Silicone Rubber                                            | 18-14                         | Nonmetallic Covering | 150°C<br>302°F | Fixture wiring, and as permitted in Section 725-16.             |

|       |                                               |       |    |      |       |       |                                                                 |
|-------|-----------------------------------------------|-------|----|------|-------|-------|-----------------------------------------------------------------|
| ECTFE | 7-Strand                                      | 18-14 | 15 | None | 150°C | 302°F | Fixture wiring, and as permitted in Section 725-16.             |
| ECTFE | Flexible Stranding                            | 18-14 | 15 | None | 150°C | 302°F | Fixture wiring, and as permitted in Section 725-16.             |
| HF    | 7-Strand                                      | 18-14 | 15 | None | 150°C | 302°F | Fixture wiring, and as permitted in Section 725-16.             |
| HF    | Flexible Stranding                            | 18-14 | 15 | None | 150°C | 302°F | Fixture wiring, and as permitted in Section 725-16.             |
| XF    | Crosslinked Polyolefin Insulated Fixture Wire | 12-10 | 45 | None | 150°C | 302°F | Fixture wiring, Limited to 300 volts.                           |
| XFF   | Crosslinked Polyolefin Insulated Fixture Wire | 12-10 | 45 | None | 150°C | 302°F | Fixture wiring, Limited to 300 volts.                           |
| ZF    | Modified ETPPE Solid or 7-Strand              | 18-14 | 15 | None | 150°C | 302°F | Fixture wiring, and as permitted in Sections 725-16 and 760-16. |
| ZFF   | Flexible Stranding                            | 18-14 | 15 | None | 150°C | 302°F | Fixture wiring, and as permitted in Sections 725-16 and 760-16. |

Table 402-3 (Continued)

| Table 402-3 (Continued)                                        |             |                                |       |                         |                |                      |                                                                 |
|----------------------------------------------------------------|-------------|--------------------------------|-------|-------------------------|----------------|----------------------|-----------------------------------------------------------------|
| Trade Name                                                     | Type Letter | Insulation                     | AWG   | Thickness of Insulation | Outer Covering | Max. Operating Temp. | Application Provisions                                          |
| Fluorinated Ethylene Propylene Fixture Wire Solid or 7-Strand  | PF          | Fluorinated Ethylene Propylene | 18-14 | 20                      | None           | 200°C                | Fixture wiring, and as permitted in Sections 725-16 and 760-16. |
|                                                                | PGF         | Fluorinated Ethylene Propylene | 18-14 | 14                      | Glass Braid    | 392°F                |                                                                 |
| Fluorinated Ethylene Propylene Fixture Wire Flexible Stranding | PFF         | Fluorinated Ethylene Propylene | 18-14 | 20                      | None           | 150°C                | Fixture wiring, and as permitted in Section 725-16.             |
|                                                                | PGFF        | Fluorinated Ethylene Propylene | 18-14 | 14                      | Glass Braid    | 302°F                |                                                                 |
| Tape Insulated Wire Solid or 7-Strand                          | KF-1        | Aromatic Polyimide Tape        | 18-10 | 5.5                     | None           | 200°C                | Fixture wiring, Limited to 300 volts.                           |
|                                                                | KF-2        | Aromatic Polyimide Tape        | 18-10 | 8.4                     | None           | 200°C                | Fixture wiring, and as permitted in Sections 725-16 and 760-16. |
| Tape Insulated Wire Flexible Stranding                         | KFF-1       | Aromatic Polyimide Tape        | 18-10 | 5.5                     | None           | 200°C                | Fixture wiring, Limited to 300 volts.                           |
|                                                                | KFF-2       | Aromatic Polyimide Tape        | 18-10 | 8.4                     | None           | 200°C                | Fixture wiring, and as permitted in Section 725-16.             |

Table 402-3 (Continued)

402-5. **Ampacity of Fixture Wires.** The ampacity of fixture wire shall not exceed the following:

Table 402-5

| Size (AWG) | Ampacity |
|------------|----------|
| 18         | 6        |
| 16         | 8        |
| 14         | 17       |
| 12         | 23       |
| 10         | 28       |

No conductor shall be used under such conditions that its operating temperature will exceed the temperature specified in Table 402-3 for the type of insulation involved.

402-6. **Minimum Size.** Fixture wires shall not be smaller than No. 18.

402-7. **Number of Conductors in Conduit.** The number of fixture wires permitted in a single conduit shall be as given in Table 2 of Chapter 9.

402-8. **Grounded-Conductor Identification.** One conductor of fixture wires which is intended to be used as a grounded conductor shall be identified by means of stripes or by the means described in Section 400-22(a) through (e).

402-9. **Marking.**

(a) **Required Information.** All fixture wires shall be marked to indicate the information required in Section 310-11(a).

(b) **Method of Marking.** Thermoplastic-insulated fixture wire shall be durably marked on the surface at intervals not exceeding 24 inches (610 mm). All other fixture wire shall be marked by means of a printed tag attached to the coil, reel, or carton.

402-10. **Uses Permitted.** Fixture wires shall be permitted: (1) for installation in lighting fixtures and in similar equipment where enclosed or protected and not subject to bending or twisting in use, or (2) for connecting lighting fixtures to the branch-circuit conductors supplying the fixtures.

402-11. **Uses Not Permitted.** Fixture wires shall not be used as branch-circuit conductors.

*Exception: As permitted by Section 725-16 for Class 1 circuits and Section 760-16 for fire protective signaling circuits.*

402-12. **Overcurrent Protection.** Overcurrent protection for fixture wires shall be as specified in Section 240-4.

## ARTICLE 410 — LIGHTING FIXTURES, LAMPHOLDERS, LAMPS, RECEPTACLES, AND ROSETTES

### A. General

410-1. **Scope.** This article covers lighting fixtures, lampholders, pendants, receptacles, and rosettes, incandescent filament lamps, arc lamps,

| Trade Name                                             | Type Letter | Insulation                                              | Thickness of Insulation | Outer Covering | Max. Operating Temp. | Application Provisions                                                                           |
|--------------------------------------------------------|-------------|---------------------------------------------------------|-------------------------|----------------|----------------------|--------------------------------------------------------------------------------------------------|
| Extruded Polyethylene or 7-Strand Nickel-Coated Copper | PTF         | Extruded Polyethylene                                   | 18-14                   | None           | 250°C 482°F          | Fixture wiring, and as permitted in Sections 725-16 and 760-16. (Nickel or nickel-coated copper) |
| Extruded Polyethylene or 7-Strand Nickel-Coated Copper | PTFF        | Extruded Polyethylene                                   | 18-14                   | None           | 150°C 302°F          | Fixture wiring, and as permitted in Section 725-16. (Silver or nickel-coated copper)             |
| Extruded Polyethylene or 7-Strand Nickel-Coated Copper | PAF         | Perfluoro-alkoxy Solid or 7-Strand Nickel-Coated Copper | 18-14                   | None           | 250°C 482°F          | Fixture wiring, and as permitted in Sections 725-16 and 760-16. (Nickel or nickel-coated copper) |
| Perfluoro-alkoxy Flexible Stranding                    | PAFF        | Perfluoro-alkoxy                                        | 18-14                   | None           | 150°C 302°F          | Fixture wiring, and as permitted in Section 725-16                                               |

Table 402-3 (Continued)