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PLAINTIFF'S EXHIBIT
E-21

National Electrical Code

1965 Edition

NATIONAL FIRE PROTECTION ASSOCIATION
INTERNATIONAL
60 BATTERYMARCH ST., BOSTON 10, MASS.

SC-ELEC-04000

hollow spaces, fire walls or fire partitions, vertical shafts, ventilating or air-handling ducts is reduced to a minimum.

300-22. Wiring in Ventilating and Exhaust Ducts.

(a) Where it is necessary to run a wiring system through air handling ducts or plenum chambers, the wiring method shall be rigid conduit, electrical metallic tubing, flexible steel conduit with lead-covered conductors, Type ACL metal-clad cable with fittings suitable for the location, Type MI mineral insulated-metal sheathed cable, or Type ALS aluminum sheathed cable. The terminals of circuits of such wiring systems shall be so located that it will not be necessary to install motors or control equipment in the ducts, except for temperature and humidity control. Raceways shall not interfere with the operation of automatic fire dampers in ducts.

Exception No. 1. The above provisions shall not apply to integral fan systems specifically approved for the purpose.

Exception No. 2. It is not the intent of this section to include habitable rooms or areas of a building, the prime purpose of which is not air handling. It may, however, include false ceiling space, hollow spaces in the wall, and the like if used for air handling purposes.

Exception No. 3. In ventilating systems used solely for data processing systems the wiring method shall be rigid conduit, electrical metallic tubing, flexible steel conduit with lead-covered conductors, Type ACL metal-clad cable with fittings approved for the purpose, Type MI mineral insulated-metal sheathed cable, Type ALS aluminum sheathed cable, or flexible cords or cables specifically approved as a part of the data processing system, when such cords or cables may be used in conformance with other sections of this code.

(b) No wiring system of any type shall be installed in ducts used for dust, loose stock, vapor removal or ventilation of commercial type cooking equipment.

300-23. Temporary Wiring.

(a) Suitable disconnecting switches or plug connectors shall be installed to permit the disconnection of all conductors of the temporary circuit by a single operation.

(b) No bare conductors nor earth returns shall be used for the wiring of any temporary circuit.

ARTICLE 310 — CONDUCTORS FOR GENERAL WIRING

310-1. General.

(a) The purpose of this Article is to assure that conductors have mechanical strength, insulation, and current carrying capacity adequate for the particular conditions under which they are to be used.

(b) Conductors shall be insulated, except when covered or bare conductors are specifically permitted in this Code.

(c) The provisions of this Article are not intended to apply to conductors which form an integral part of equipment such as motors, motor controllers, and the like, or which are provided for elsewhere in this Code.

310-2. Application and Construction.

(a) Conductor Application. Conductor insulations as specified in the following Table 310-2(a) may be installed for any of the wiring methods recognized in this Chapter, except as otherwise provided for in the Table or in Section 310-3, or as otherwise specified in this Code. They are suitable for 600 volts unless otherwise specified.

(b) Conductor Construction. Insulated conductors for use at 600 volts or less shall conform to the provisions of Table 310-2(b).

Table 310-2(a). Conductor Application

Trade Name	Type Letter	Max. Operating Temp.	Application Provisions
Rubber-Covered Fixture Wire Solid or 7-Strand	*RF-1	60°C 140°F	Fixture wiring, Limited to 300 V.
	*RF-2	60°C 140°F	Fixture wiring, and as permitted in Section 310-8.
Rubber-Covered Fixture Wire Flexible Stranding	*FF-1	60°C 140°F	Fixture wiring, Limited to 300 V.
	*FF-2	60°C 140°F	Fixture wiring, and as permitted in Section 310-8.
Heat-Resistant Rubber-Covered Fixture Wire Solid or 7-Strand	*RFH-1	75°C 167°F	Fixture wiring, Limited to 300 V.
	*RFH-2	75°C 167°F	Fixture wiring, and as permitted in Section 310-8.
Heat-Resistant Rubber-Covered Fixture Wire Flexible Stranding	*FFH-1	75°C 167°F	Fixture wiring, Limited to 300 V.
	*FFH-2	75°C 167°F	Fixture wiring, and as permitted in Section 310-8.
Thermoplastic-Covered Fixture Wire Solid or Stranded	*TF	60°C 140°F	Fixture wiring, and as permitted in Section 310-8, and for circuits as permitted in Article 725.
Thermoplastic-Covered Fixture Wire Flexible Stranding	*TFF	60°C 140°F	Fixture wiring, and as permitted in Section 310-8, and for circuits as permitted in Article 725.

*Fixture wires are not intended for installation as branch circuit conductors nor for the connection of portable or stationary appliances.

Trade Name	Type Letter	Max. Operating Temp.	Application Provisions
Cotton-Covered, Heat-Resistant, Fixture Wire	*CF	90°C 194°F	Fixture wiring. Limited to 300 V.
Asbestos-Covered Heat-Resistant, Fixture Wire	*AF	150°C 302°F	Fixture wiring. Limited to 300 V. and Indoor Dry Location.
Silicone Rubber Insulated Fixture Wire	*SF-1	200°C 392°F	Fixture wiring. Limited to 300 V.
Solid or 7 Strand	*SF-2	200°C 392°F	Fixture wiring and as permitted in Section 310-8.
Silicone Rubber Insulated Fixture Wire	*SFF-1	150°C 302°F	Fixture wiring. Limited to 300 V.
Flexible Stranding	*SFF-2	150°C 302°F	Fixture wiring and as permitted in Section 310-8.
Code Rubber	R	60°C 140°F	Dry locations.
Heat-Resistant Rubber	RH	75°C 167°F	Dry locations.
Heat Resistant Rubber	RHH	90°C 194°F	Dry locations.
Moisture-Resistant Rubber	RW	60°C 140°F	Dry and wet locations. For over 2000 volts, insulation shall be ozone-resistant.
Moisture and Heat Resistant Rubber	RH-RW	60°C 140°F	Dry and wet locations. For over 2000 volts, insulation shall be ozone-resistant.
		75°C 167°F	Dry locations. For over 2000 volts, insulation shall be ozone-resistant.
Moisture and Heat Resistant Rubber	RHW	75°C 167°F	Dry and wet locations. For over 2000 volts, insulation shall be ozone-resistant.
Latex Rubber	RU	60°C 140°F	Dry locations.

*Fixture wires are not intended for installation as branch circuit conductors nor for the connection of portable or stationary appliances.

Trade Name	Type Letter	Max. Operating Temp.	Application Provisions
Heat Resistant Latex Rubber	RUH	75°C	Dry locations.
Moisture Resistant Latex Rubber	RUW	60°C 140°F	Dry and wet locations.
Thermoplastic	T	60°C 140°F	Dry locations.
Moisture-Resistant Thermoplastic	TW	60°C 140°F	Dry and wet locations.
Heat-Resistant Thermoplastic	THHN	90°C 194°F	Dry locations.
Moisture and Heat-Resistant Thermoplastic	THW	75°C 167°F	Dry and wet locations.
Moisture and Heat-Resistant Thermoplastic	THWN	75°C 167°F	Dry and wet locations.
Thermoplastic and Asbestos	TA	90°C 194°F	Switchboard wiring only.
Thermoplastic and Fibrous Outer Braid	TBS	90°C 194°F	Switchboard wiring only.
Synthetic Heat-Resistant	SIS	90°C 194°F	Switchboard wiring only.
Mineral Insulation (Metal Sheathed)	MI	85°C 185°F	Dry and wet locations with Type O termination fittings. Max. operating temperature for special applications 250 C.
Silicone-Asbestos	SA	90°C	Dry locations max. operating temperature for special application 125 C.

Trade Name	Type Letter	Max. Operating Temp.	Application Provisions
Fluorinated Ethylene Propylene	FEP or FEPB	90°C 194°F 200°C 392°F	Dry locations. Dry locations special applications.
Varnished Cambric	V	85°C 185°F	Dry locations only. Smaller than No. 6 by special permission.
Asbestos and Varnished Cambric	AVA	110°C 230°F	Dry locations only.
Asbestos and Varnished Cambric	AVL	110°C 230°F	Dry and wet locations.
Asbestos and Varnished Cambric	AVB	90°C 194°F	Dry locations only.
Asbestos	A	200°C 392°F	Dry locations only. In raceways, only for leads to or within apparatus. Limited to 300 V.
Asbestos	AA	200°C 392°F	Dry locations only. Open wiring. In raceways, only for leads to or within apparatus. Limited to 300 V.
Asbestos	AI	125°C 257°F	Dry locations only. In raceways, only for leads to or within apparatus. Limited to 300 V.
Asbestos	AIA	125°C 257°F	Dry locations only. Open wiring. In raceways, only for leads to or within apparatus.
Paper		85°C 185°F	For underground service conductors, or by special permission.

Table 310-2(b). Conductor Insulations

Trade Name	Type Letter	Insulation	Thickness of Insulation	Outer Covering
Code	R	Code Rubber	14-12 2 64 Inch 10 3 64 Inch 8-2 4 64 Inch 1-4 0 5 64 Inch 213-500 6 64 Inch 501-1000 7 64 Inch 1001-2000 8 64 Inch	*Moisture-resistant, flame-retardant, non-metallic covering
Heat-Resistant	RH RHH	Heat-Resistant Rubber	**14-12 3 64 Inch 10 4 64 Inch 8-2 5 64 Inch 1-4 0 6 64 Inch 213-500 7 64 Inch 501-1000 8 64 Inch 1001-2000 9 64 Inch	*Moisture resistant, flame-retardant, non-metallic covering
Moisture-Resistant	RW	Moisture-Resistant Rubber	14-10 4 64 Inch 8-2 5 64 Inch 1-4 0 6 64 Inch 213-500 7 64 Inch 501-1000 8 64 Inch 1001-2000 9 64 Inch	*Moisture-resistant, flame-retardant, non-metallic covering
Moisture and Heat-Resistant	RH.RW	Moisture and Heat Resistant Rubber	14-10 3 64 Inch 8-2 4 64 Inch 1-4 0 5 64 Inch 213-500 6 64 Inch 501-1000 7 64 Inch 1001-2000 8 64 Inch	*Moisture-resistant, flame-retardant, non-metallic covering

*Outer covering is not required over rubber insulations which have been specifically approved for the purpose.

**For 14-12 sizes RHH shall be 3 64 inch thickness insulation.

Table 310-2(b)—Continued

Trade Name	Type Letter	Insulation	Thickness of Insulation	Outer Covering
Moisture and Heat-Resistant	RHW	Moisture and Heat Resistant Rubber	14–10 — 32 Mils 8–2 — 45 Mils 1–4/0 — 60 Mils 213–500 — 75 Mils 501–1000 — 90 Mils 1001–2000 — 105 Mils	*Moisture-resistant, flame retardant, non-metallic covering
Heat-Resistant Latex Rubber	RUH	90% Unmilled, Grainless Rubber	14–10 — 18 Mils 8–2 — 25 Mils	Moisture-resistant, flame-retardant, non-metallic covering
Moisture-Resistant Latex Rubber	RUW	90% Unmilled, Grainless Rubber	14–10 — 18 Mils 8–2 — 25 Mils	Moisture-resistant, flame-retardant, non-metallic covering
Thermoplastic	T	Flame-Retardant, Thermoplastic Compound	14–10 — 30 Mils 8 — 45 Mils 6–2 — 60 Mils 1–4/0 — 75 Mils 213–500 — 90 Mils 501–1000 — 105 Mils 1001–2000 — 120 Mils	None

* Outer covering is not required over rubber insulations which have been specifically approved for the purpose.

Moisture-Resistant Thermoplastic	TW	Flame-Retardant, Moisture-Resistant Thermoplastic	14–10 — 30 Mils 8 — 45 Mils 6–2 — 60 Mils 1–4/0 — 75 Mils 213–500 — 90 Mils 501–1000 — 105 Mils 1001–2000 — 120 Mils	None
Heat-Resistant Thermoplastic	THHN	Flame-Retardant Heat-Resistant Thermoplastic	14–12 — 15 Mils 10 — 20 Mils 8–6 — 30 Mils 4–2 — 40 Mils 1–4/0 — 50 Mils 250–500 MCM — 60 Mils	Nylon Jacket
Moisture and Heat-Resistant Thermoplastic	THW	Flame-Retardant, Moisture and Heat-Resistant Thermoplastic	14–10 — 30 Mils 8–2 — 45 Mils 1–4/0 — 60 Mils 213–500 — 75 Mils 501–1000 — 90 Mils 1001–2000 — 105 Mils	None
Moisture and Heat-Resistant Thermoplastic	THWN	Flame-Retardant, Moisture and Heat-Resistant Thermoplastic	14–12 — 15 Mils 10 — 20 Mils 8–6 — 30 Mils 4–2 — 40 Mils 1–4/0 — 50 Mils 250–500 MCM — 60 Mils	Nylon Jacket
Thermoplastic and Asbestos	TA	Thermoplastic and Asbestos	14–8 — Thrpl. 20 Mils, Asb. 20 Mils 6–2 — Thrpl. 30 Mils, Asb. 25 Mils 1–4/0 — Thrpl. 40 Mils, Asb. 30 Mils	Flame-retardant, non-metallic covering

Table 310-2(b)—Continued

Trade Name	Type Letter	Insulation	Thickness of Insulation	Outer Covering
Thermoplastic and Fibrous Braid	TBS	Thermoplastic	14–10 ... 2/64 Inch 8 ... 3/64 Inch 6–2 ... 4/64 Inch 1–4/0 ... 5/64 Inch	Flame-retardant, non-metallic covering
Synthetic Heat-Resistant	SIS	Heat-Resistant Rubber	14–10 ... 2/64 Inch 8 ... 3/64 Inch 6–2 ... 4/64 Inch 1–4/0 ... 5/64 Inch	None
Mineral-Insulated Metal-Sheathed	MI	Magnesium Oxide	16–4 ... 50 Mils 3–250 MCM ... 55 Mils	Copper
Silicone-Asbestos	SA	Silicone Rubber	14–10 ... 3/64 Inch 8–2 ... 4/64 Inch 1–4/0 ... 5/64 Inch 213–500 ... 6/64 Inch 501–1000 ... 7/64 Inch 1001–2000 ... 8/64 Inch	Asbestos or glass
Fluorinated Ethylene Propylene	FEP	Fluorinated Ethylene Propylene	14–10 ... 20 Mils 8–2 ... 30 Mils	None
	FEPB	Fluorinated Ethylene Propylene	14–8 ... 14 Mils	Glass braid
			6–2 ... 14 Mils	Asbestos braid

Varnished Cambric	V	Varnished Cambric	14–8 ... 3/64 Inch 6–2 ... 4/64 Inch 1–4/0 ... 5/64 Inch 213–500 ... 6/64 Inch 501–1000 ... 7/64 Inch 1001–2000 ... 8/64 Inch	Non-metallic covering or lead sheath
Asbestos and Varnished Cambric	AVA and AVL	Impregnated Asbestos and Varnished Cambric	Dimen. in Mils: AVA 1st Asb. / AVA 2nd Asb. / AVL 2nd Asb. 14–8 solid only — / 30 / 20 / 25 14–8 ... 10 / 30 / 15 / 25 6–2 ... 15 / 30 / 20 / 25 1–4/0 ... 20 / 30 / 30 / 30 213–500 ... 25 / 40 / 40 / 40 501–1000 ... 30 / 40 / 40 / 40 1001–2000 ... 30 / 50 / 50 / 50	AVA-asbestos braid or glass AVL-lead sheath
			VC / Asb. 18–8 ... 30 / 20 6–2 ... 40 / 30 1–4/0 ... 40 / 40	Flame-retardant, cotton braid switchboard wiring
Asbestos and Varnished Cambric	AVB	Impregnated Asbestos and Varnished Cambric	Asb. / VC / 2nd Asb. 14–8 ... 10 / 30 / 15 6–2 ... 15 / 30 / 20 1–4/0 ... 20 / 30 / 30 213–500 ... 25 / 40 / 40 501–1000 ... 30 / 40 / 40 1001–2000 ... 30 / 50 / 50	Flame-retardant, cotton braid

Table 310-2(b)—Continued

Trade Name	Type Letter	Insulation	Thickness of Insulation	Outer Covering
Asbestos	A	Asbestos	14 12-8	30 Mils 40 Mils	Without asbestos braid
Asbestos	AA	Asbestos	14 12-8 6-2 1-4 0	30 Mils 30 Mils 40 Mils 60 Mils	With asbestos braid or glass
Asbestos	AI	Impregnated Asbestos	14 12-8	30 Mils 40 Mils	Without asbestos braid
Asbestos	AIA	Impregnated Asbestos	14 12-8 6-2 1-4 0 213-500 501-1000	Sol. Str. 30 Mils 30 Mils 30 Mils 40 Mils 40 Mils 60 Mils 60 Mils 75 Mils 90 Mils 105 Mils	With asbestos braid or glass

Paper		Paper	Lead sheath

The non-metallic covering over individual rubber-covered conductors of aluminum sheathed cable and of lead-sheathed or multiple-conductor cable is not required to be flame retardant. For armored cable, see Section 334-2. For non-metallic-sheathed cable, see Section 336-2. For Type UF cable, see Section 339-1. For aluminum sheathed cable, see Section 331-6.

(c) Marking. Insulated wires, cables and cords of all kinds except paper-insulated wire shall have a continuous distinctive marking so that their maker may be readily identified. All wires, cables and cords shall also be plainly tagged or marked as follows:

(1) The maximum working voltage for which the wire was tested or approved. This may be omitted for asbestos-covered switchboard wires.

(2) The words "National Electrical Code Standard," or "NEC Std."

(3) Name of the manufacturing company and, if desired, trade name of the wire.

(4) Month and year when manufactured.

(5) The proper type letter for the particular style of wire or cable as given in the following sections.

(d) Surface Marking. A durable marking on the surface shall be provided at intervals not exceeding 24 inches showing the name of the manufacturer or a significant abbreviation thereof, type letter or letters as specified in Article 310, Table 310-2(b) and Articles 330, 338, and 339, the size Awg. or circular mils and the maximum voltage on the following types of wire and cable rated 600 volts or less:

(1) Single conductor only, rubber insulated and thermoplastic insulated for General Wiring.

(2) Non-Metallic Sheathed Cable.

(3) Service-Entrance Cable.

(4) Underground Feeder and Branch-Circuit Cable.

All other types of wire and cable, flexible cords, fixture wires, switchboard wires, and any of the above types with a metallic covering are not required to have a marking on the surface.

(e) Classification. In addition to the type letters specified in Table 310-2(b), the following letters shall apply:

(1) A type letter or letters used alone indicates a single insulated conductor.

(2) The letter "D" used as a suffix indicates a twin wire with two insulated conductors laid parallel under an outer nonmetallic covering.

(3) The letter "M" used as a suffix indicates an assembly of two or more insulated conductors twisted together under an outer nonmetallic covering.

(4) The letter "L" used as a suffix indicates an outer covering of lead.

(5) Voltage. Type letters, when used alone, indicate conductors for use at not more than 600 volts. Conductors for use at higher voltages shall be indicated by adding numerical suffixes to the type letters as follows:

Table 310-2(i) (3)

Thickness of Varnished-Cambric Insulation for Multiple-Conductor Cable, in 64ths of an Inch

Conductor Size AWG or MCM	For Voltages Not Exceeding									
	1000		2000		3000		4000		5000	
	C	B	C	B	C	B	C	B	C	B
14	4	0	..	..	..	..	..	..	..	..
12	4	0	5	0	..	..	..	..	..	..
10	4	0	5	0	5	2	..	..	..	..
8-2	4	0	5	0	5	2	6	3	6	4
1-4/0	5	0	6	0	6	2	6	3	6	4
213-500	6	0	6	0	6	2	6	3	7	4
501-1000	6	2	6	2	6	3	6	4	7	4
1001-2000	7	2	7	2	7	3	7	4	7	5

The thickness given in columns headed "C" are for the insulation on the individual conductors. Those given in the columns headed "B" are for the thickness of the overall belt of insulation.

Table 310-2(i) (4)

Thickness of Asbestos and Varnished-Cambric Insulation for Single-Conductor Cable, Types AVA, AVB and AVL, in Mils

Conductor AWG or MCM	1st Wall Asbestos	Varnished Cambric					Asbestos 2nd Wall
	For Voltages Not Exceeding						
	1000-5000	1000	2000	3000	4000	5000	1000-5000
14-2	15	45	60	80	100	120	25
1-4/0	20	45	60	80	100	120	30
213-500	25	45	60	80	100	120	40
501-1000	30	45	60	80	100	120	40
1001-2000	30	55	75	95	115	140	50

390-2. Wiring Methods. Only wiring methods recognized in this Code shall be used.

390-3. Code Provisions to Apply. The provisions of this Code shall apply for the type of wiring method used and the type of construction employed.

Chapter 4. Equipment for General Use

ARTICLE 400 — FLEXIBLE CORDS

A. General and Types

400-1. General. Flexible cords shall be suitable for the conditions of use and location.

400-2. Types. Cords of the several types shall conform to the descriptions of Table 400-11. Types of flexible cords other than those listed in Table 400-11 and other uses for types listed in the Table, shall be the subject of special investigations and shall not be used before being approved.

B. Use and Installation

400-3. Use. Flexible cord may 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, or (7) prevention of the transmission of noise or vibration; or (8) facilitating the removal or disconnection of fixed appliances for maintenance or repair.

400-4. Prohibited Uses. Flexible cord 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.

400-5. Splices. Flexible cord shall be used only in continuous length without splice or tap.

400-6. Cords in Show-Windows and Show-Cases. Flexible cord used in show-windows and show cases shall be of types S, SO, ST, STO, ST SJT, or AFS, except for the wiring of chain supported fixtures, and for supplying current to portable lamps and other merchandise for exhibition purposes.

400-7. Minimum Size. Flexible cords shall not be smaller than No. 18 except that tinsel cords, or cords having equivalent characteristics, of smaller size may be approved for use with specific appliances.

400-8. Insulation Over 300 Volts. Where the voltage between any two conductors exceeds 300, but does not exceed 600, flexible cords No. 10 and smaller shall have rubber or thermoplastic insulation on all individual conductors at least 3/64 inch in thickness, unless Type S, SO or ST cord is used.

400-9. Overcurrent Protection and Ampacities of Flexible Cords.

(a) 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 240-5. Cords shall be not smaller than required in Table 400-9 (b) for the rated current of the connected equipment.

Table 400-9(b). Ampacity of Flexible Cord

Table 400-9(b) gives the allowable ampacity for not more than three current carrying conductors in a cord. If the number of current carrying conductors in a cord is from four to six, the allowable ampacity of each conductor shall be reduced to 80 per cent of the values in the Table. The ampacities for the sizes and types of three conductor cords connected to utilization equipment, where the third conductor is used for equipment grounding only and does not carry any load current, are given in Notes 1 and 2 following the Table.

(Based on Room Temperature of 30°C (86° F.). See Section 400-9 and Table 400-11.)

Size AWG	Rubber Types TP, TS Thermoplastic Types TPT, TSP	Rubber Types PO, C, PD, P, K, E, EO Thermoplastic Type ET	Rubber Types S, SO, SRD, SJ, SJO, SV, SVO, SP Thermoplastic Types ST, STO, SRDT, SJT, SJTO, SVT, SVTO, SPT	Types AFS, AFSJ, HC, HPD, HSJ, HSJO, HS, HSO, HPN	Types AVPO, AVPD	Cotton Types CFC*, CFPO*, CFPD* Asbestos Types AFC*, AFPO*, AFPD*
27**	0.5	..	..	..	..	..
18	...	5	7	10	17	6
17	...	..	..	12	..	..
16	...	7	10	15	22	8
15	...	..	..	17	..	..
14	...	15	15	20	28	17
12	...	20	20	30	36	23
10	...	25	25	35	47	28
8	...	35	35	..	..	..
6	...	45	45	..	..	..
4	...	60	60	..	..	..
2	...	80	..	..	..	..

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

Note 1. For Nos. 18, 16 and 14 AWG sizes of Types S, SO and ST Cords, the allowable ampacities are 10, 13 and 18 amperes respectively.

Note 2. For Nos. 18 and 16 AWG sizes of SJ, SJO and SJT Cords, the allowable ampacities are 10 and 13 amperes respectively.

Note 3. *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 employed, or the number of conductors, that the limiting temperature of the conductors will be exceeded.

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 terminal screws. This shall be accomplished by a knot in the cord, winding with tape, by a special fitting designed for that purpose, or by other approved means which will prevent a pull on the cord from being directly transmitted to joints or terminal screws.

Notes to Table 400-11

1. Except for Types AFPO, CFPO, PO-1, PO-2, PO, SP-1, SP-2, SPT-1, SPT-2, TP, TPT, and AVPO, individual conductors are twisted together.

2. Type PO-1 is for use only with portable lamps, portable radio receiving appliances, portable clocks and similar appliances which are not liable to be moved frequently and where appearance is a consideration.

3. Types TP, TPT, TS, and TST are suitable for use in lengths not exceeding eight feet 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. Type K is suitable for use on theatre stages.

5. Rubber-filled or varnished cambric tapes may be substituted for the inner braids.

6. Types S, SO, and ST are suitable for use on theatre stages, in garages and elsewhere, where flexible cords are permitted by this Code.

7. Traveling cables for operating, control and signal circuits may have one or more *metallic* fillers or may have a supporting filler of stranded steel wires having its own protective braid or cover. Cables exceeding 100 feet in length shall have steel supporting fillers, except in locations subject to excessive moisture or corrosive vapors or gases. Where steel supporting fillers 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.

Type E and EO Cables may incorporate in the construction #20 Gauge Conductors formed as a pair, and covered with suitable metallic braided shielding for telephone circuits. The insulation of the conductors may be *rubber or thermoplastic* of thickness specified for Type E and EO Cables. The shield shall have its own protective covering. This component may be incorporated in any layer of the *cable assembly*, and shall not run straight through the center.

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

9. The individual conductors of all cords except those of heat-resisting cords (Types AFC, AFPO, AFPD, AFS, AFSJ, AVPO, AVPD, CFC, CFPO and CFPD) shall have a rubber or thermoplastic insulation, except that the grounding conductor where used shall be in accordance with Paragraph 400-11(b). A rubber compound shall be vulcanized except for heater cords. (Types HC, HPD and HSJ and for bell fillers in Types P-1, P-2, and P.

Table 400-11. Flexible Cord.

(See Section 400-2)

Trade Name	Type Letter	Size AWG	No. of Conductors	Insulation	Braid on Each Conductor	Outer Covering	Use		
Parallel Tinsel Cord	TP See Note 3	27	2	Rubber	None	Rubber	Attached to an Appliance	Damp Places	Not Hard Usage
	TPT See Note 3	27	2	Thermo-plastic	None	Thermo-plastic	Attached to an Appliance	Damp Places	Not Hard Usage
Jacketed Tinsel Cord	TS See Note 3	27	2 or 3	Rubber	None	Rubber	Attached to an Appliance	Damp Places	Not Hard Usage
	TST See Note 3	27	2 or 3	Thermo-plastic	None	Thermo-plastic	Attached to an Appliance	Damp Places	Not Hard Usage
Asbestos-Covered Heat-Resistant Cord	AFC	18–10	2 or 3	Impregnated Asbestos	Cotton or Rayon	None	Pendant	Dry Places	Not Hard Usage
	AFPO		2		None	Cotton, Rayon or Saturated Asbestos			
	AFPD		2 or 3						
Cotton-Covered Heat-Resistant Cord	CFC	18–10	2 or 3	Impregnated Cotton	Cotton or Rayon	None	Pendant	Dry Places	Not Hard Usage
	CFPO		2		None	Cotton or Rayon			
	CFPD		2 or 3						

See Notes

Parallel Cord	PO 1	18	2	Rubber	Cotton	Cotton or Rayon	See Note 2 Pendant or Portable	Dry Places	Not Hard Usage
	PO 2	18–16							
	PO	18–10							
All Rubber Parallel Cord	SP-1	18	2	Rubber	None	Rubber	Pendant or Portable	Damp Places	Not Hard Usage
	SP-2 See Note 8	18–16							
	SP-3 See Note 8	18–12		Rubber	None	Rubber	Refrigerators or Room Air Conditioners	Damp Places	Not Hard Usage
All Plastic Parallel Cord	SPT-1	18	2	Thermo-plastic	None	Thermoplastic	Pendant or Portable	Damp Places	Not Hard Usage
	SPT-2 See Note 8	18–16							
All Plastic Parallel Cord	SPT-3 See Note 8	18–10	2	Thermo-plastic	None	Thermoplastic	Refrigerators or Room Air Conditioners	Damp Places	Not Hard Usage
Junior Cord	C	18–10	2 or more	Rubber	Cotton	None	Pendant or Port.	Dry Places	Not Hard Usage
Twisted Portable Cord	PD	18–10	2 or more	Rubber	Cotton	Cotton or Rayon	Pendant or Port.	Dry Places	Not Hard Usage

See Notes

Trade Name	Type Letter	Size AWG	No. of Conductors	Insulation	Braid on Each Conductor	Outer Covering	Use		
Reinforced Cord	P-1	18	2 or more	Rubber	Cotton	Cotton over Rubber Filler	Pendant or Portable	Dry Places	Not Hard Usage
	P-2	18-16							
	P	18-10							Hard Usage
Braided Heavy Duty Cord	K See Note 4	18-10	2 or more	Rubber	Cotton	Two Cotton, Moisture-Resistant Finish See Note 5	Pendant or Portable	Damp Places	Hard Usage
Vacuum Cleaner Cord	SV, SVO	18	2	Rubber	None	Rubber	Pendant or Portable	Damp Places	Not Hard Usage
	SVT, SVTO See Note 8			Thermopl'		Thermoplastic			
Junior Hard Service Cord	SJ	18-16	2, 3, or 4	Rubber	None	Rubber	Pendant or Portable	Damp Places	Hard Usage
	SJO					Oil Resistant Compound			
	SJT SJTO			Thermopl' or Rubber		Thermoplastic			
Hard Service Cord	S See Note 6	18-2	2 or more	Rubber	None	Rubber	Pendant or Portable	Damp Places	Extra Hard Usage
	SO					Oil Resist. Compound			
	ST			Thermopl' or Rubber		Thermoplastic			
	STO					Oil Resistant Thermoplastic			
Rubber-Asbestos Heat-Resistant Cord	AFSJ	18-16	2 or 3	Impregnated Asbestos	None	Rubber	Portable	Damp Places	Portable Heaters
	AFS	18-16-14							
Heater Cord	HC	18-12	2, 3 or 4	Rubber & Asbestos	Cotton	None	Portable	Dry Places	Portable Heaters
	HPD	18-12	2, 3 or 4	Rubber with Asbestos or All Neoprene	None	Cotton or Rayon			
Rubber Insulating Heater Cord	HSJ	18-16	2, 3 or 4	Rubber with Asbestos or All Neoprene	None	Cotton and Rubber	Portable	Damp Places	Portable Heaters
Junior Heater Cord	HSJO	18-16	2, 3 or 4	Rubber with Asbestos or All Neoprene	None	Cotton and Oil Resistant Compound	Portable	Damp Places	Portable Heaters
	HS	14-12				Cotton and Rubber or Neoprene			
	HSO	14-12				Cotton and Oil Resistant Compound			

See Notes

Type Name	Type Letter	Size AWG	No. of Conductors	Insulation	Braid on Each Conductor	Outer Covering	Use		
Flexible Heater Cord	HPN	18–16	2	Thermo-setting	None	Thermosetting	Portable	Damp Places	Portable Heaters
Heat & Moisture-Resistant Cord	AVPO	18–10	2	Asbestos & Var. Cam.	None	Asbestos, Flame-Ret. Moisture Resistant	Pendant or Portable	Damp Places	Not Hard Usage
	AVPD		2 or 3						
Range, Dryer Cable	SRD	10–4	3 or 4	Rubber	None	Rubber or Neoprene	Portable	Damp Places	Ranges, Dryers
	SRDT	10–4	3 or 4	Thermo-plastic	None	Thermoplastic	Portable	Damp Places	Ranges, Dryers
Elevator Cable	ECF See Note 7	18–14	2 or more	Thermo-plastic	Nylon	Three cotton, Outer Flame-Retardant & Moisture-Resistant. See Note 5	Elevator Lighting and Control	Hazardous Locations	Non-Hazardous Locations
	ECO See Note 7	18–14		Rubber	Cotton	Three Cotton, Outer one Flame-Retardant & Moisture-Resist. See Note 5 (One Cotton and a Neoprene Jacket See Note 5			

See Notes

C. Construction Specifications

400-12. **Labels.** Flexible cords shall be examined and tested at the factory and shall be labeled before shipment.

400-13. **Grounded Conductor Identification.** One conductor of flexible cords shall have a continuous marker readily distinguishing it from the other conductor or conductors. The identification shall consist of one of the following:

(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, except in the case of Types C, PD and PO cords having the braids on the individual conductors finished to show white or natural gray. In such C, PD and PO cords the identifying marker may 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 (except cords which have insulation on the individual conductors integral with the jacket). The insulation may be covered 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 no 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.** A stripe, ridge or groove 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.

400-14. **Grounding Conductor Identification.** A conductor intended to be used as a grounding conductor shall have a continuous identifying marker readily distinguishable if from the other conductor or conductors. Conductors having a green covering shall not be used for other than grounding purposes. The identifying marker shall consist of one of the following:

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

(b) **Colored Insulation or Covering.** For cords having no braids on the individual conductors a continuous green color in addition to a continuous green color with a yellow stripe covering on one conductor.

400-15. Insulation Thickness. The nominal thickness of rubber or thermoplastic conductor insulation in Types TS, TST, PO-1, P-1, SV, and SVT shall be not less than 1/64 inch. The nominal thickness of rubber insulation in Types HC, HPD, HSJ, and HS shall be not less than 1/64 inch for the Nos. 18-16 AWG sizes, and not less than 2/64 inch for the Nos. 14-12 AWG sizes. For heater cord other than Types HS and HPS, the all Neoprene insulation shall be 2/64 inch for No. 18 and No. 16 AWG sizes and 3/64 inch for No. 14 and No. 12 AWG sizes. The nominal thickness of the thermoplastic insulation in Type ET elevator cable shall be not less than 20 mils for the No. 18 and No. 16 AWG size and not less than 1/32 inch for the No. 14 AWG size. The nominal thickness of the rubber insulation in Types E and EO elevator cables shall be not less than 20 mils for the No. 18 and 16 AWG sizes and not less than 2/64 inch for the No. 14 AWG size for ratings not exceeding 300 volts. The nominal thickness of latex-rubber insulation, when employed, in Types SJ, SJO, S and SO shall be not less than 15 mils for the Nos. 18-16 AWG sizes and not less than 18 mils for the No. 14 AWG and larger sizes. The nominal thickness of conductor insulation in Types PO, P, SP-2, SPT-2, HPN, SRD, and SRDT shall be not less than 3/64 inch. The nominal thickness of thermoplastic insulation in Type SPT-3 shall be not less than 4/64 inch for sizes 18-16 and 5/64 inch for No. 14, 6/64 inch for No. 12 and 7/64 inch for No. 10 AWG. For other types, the minimum nominal thickness of rubber or thermoplastic conductor insulation shall be as follows: size AWG 27, and 18 to 16—2/64 inch; 14 to 10—3/64 inch; 8 to 2—4/64 inch.

400-16. Attached to Receptacle Plugs. Where a flexible cord is provided with a grounding conductor and equipped with an attachment plug, the plug shall comply with Paragraphs 250-59(a and b).

ARTICLE 402 — FIXTURE WIRES

402-1. Use. Fixture wires are designed for installation in lighting fixtures and in similar equipment where enclosed or protected and not subject to bending or twisting in use. Also, they are used for connecting lighting fixtures to the conductors of the circuit that supplies the fixtures.

For application in lighting fixtures, see Article 410.

Fixture wires are not intended for the connection of portable or stationary appliances, nor for installation as branch circuit conductors, except as permitted in Article 725.

402-2. Minimum Size. Fixture wires shall not be smaller than No. 18.

402-3. Insulation.

(a) The rubber insulations include those made from natural and synthetic rubber, neoprene and other vulcanized materials.

Thermoplastic insulation may stiffen at temperatures below minus 10°C. (14°F.) and care should be used in its installation at such temperatures. It may be deformed when subject to pressure; care should be taken in its installation, as for example, at bushings, or points of support. See Section 373-6(b).

(b) No conductor shall be used under such conditions that its temperature, even when carrying current, will exceed the temperature specified in Table 310-2(a) for the type of insulation involved.

Table 402-4. Allowable Ampacity of Fixture Wire

(Based on Room Temperature of 30°C., 86°F.)

Size AWG	Fixture Wire	
	Rubber Types RF-1, RF-2, FF-1, FF-2, RFH-1, RFH-2, FFH-1, FFH-2	Thermoplastic Types TF, TFF Cotton Type CF* Asbestos Type AF* Silicone Rubber Types SF-1*, SF-2*, SFF-1*, SFF-2*
18	5	6
16	7	8
14	..	17

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

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 employed, or the number of conductors, that the limiting temperature of the conductors will be exceeded.

402-5. Overcurrent Protection.

See Section 240-5, Exception No. 3.

Table 402-6. Fixture Wire

Trade Name	Type Letter	Insulation	Thickness of Insulation	Outer Covering
Rubber-Covered Fixture Wire Solid or 7-Strand	RF-1	Code Rubber	18.....1/64 Inch	Non-metallic covering
	RF-2	Code Rubber	18–16.....2/64 Inch	Non-metallic covering
		Latex Rubber	18–16.....18 Mils	
Rubber-Covered Fixture Wire Flexible Stranding	FF-1	Code Rubber	18.....1/64 Inch	Non-metallic covering
	FF-2	Code Rubber	18–16.....2/64 Inch	Non-metallic covering
		Latex Rubber	18–16.....18 Mils	
Heat Resistant Rubber-Covered Fixture Wire Solid or 7-Strand	RFH-1	Heat-Resistant Rubber	18.....1/64 Inch	Non-metallic covering
	RFH-2	Heat-Resistant Rubber	18–16.....2/64 Inch	Non-metallic covering
		Heat-Resistant Latex Rubber	18–16.....18 Mils	
Heat Resistant Rubber-Covered Fixture Wire Flexible Stranding	FFH-1	Heat-Resistant Rubber	18.....1/64 Inch	Non-metallic covering
	FFH-2	Heat-Resistant Rubber	18–16.....2/64 Inch	Non-metallic covering
		Heat-Resistant Latex Rubber	18–16.....18 Mils	
Thermoplastic-Covered Fixture Wire—Solid or Stranded	TF	Thermoplastic	18–16.....2/64 Inch	None

Continued on next page

Table 402-6 (Continued)

Trade Name	Type Letter	Insulation	Thickness of Insulation	Outer Covering
Thermoplastic-Covered Fixture Wire—Flexible Stranding	TFF	Thermoplastic	18–16.....2/64 Inch	None
Cotton-Covered, Heat-Resistant, Fixture Wire	CF	Impregnated Cotton	18–14.....2/64 Inch	None
Asbestos-Covered, Heat-Resistant, Fixture Wire	AF	Impregnated Asbestos	18–14.....2/64 Inch	None
Silicone Insulated Fixture Wire Solid or 7-Strand	SF-1	Silicone Rubber	18.....1/64 Inch	Non Metallic Covering
	SF-2	Silicone Rubber	18-14.....1/32 Inch	Non Metallic Covering
Silicone Insulated Fixture Wire Flexible Stranding	SFF-1	Silicone Rubber	18.....1.64 Inch	Non Metallic Covering
	SFF-2	Silicone Rubber	18-14.....1.32 Inch	Non Metallic Covering