

SUPPLEMENT
VOLUME NO. 2
FIFTH EDITION
WISCONSIN STATE ELECTRICAL CODE
Effective February 25, 1949

In this supplement are included the changes in Volume No. 2 of the Fifth Edition of the Wisconsin State Electrical Code. These amendments were adopted December 22, 1948 and became effective February 25, 1949.

It is suggested that immediately upon receipt of this supplement you change your copy of the code. This will eliminate the possibility of using obsolete orders.

Order 1001 **Page 13**

Delete this order. This order has been repealed. Actions taken under this order have been repealed or incorporated in permanent orders.

Order 13-2104 **Page 35**

Delete the note at the end of the order. The note was repealed to make Order 13-2104 mandatory.

Order 13-2109 **Page 38**

Add the following as a second note:

In buildings completed prior to December 1, 1946, receptacles may be connected to the existing receptacle or lighting circuits which are protected by 15 ampere tamper-resistant fuses (Type S).

Order 13-2307-E **Page 48**

Replace paragraph E of Order 13-2307 with the following:

E. A connection is permitted, for extending existing services, to make splices in fittings of the service run, and to extend existing wire size. This does not apply to buildings which have been moved in whole or in part off their foundations. In such cases the service, the ground, and distribution center shall be installed to conform to code requirements.

Order 13-2325 **Page 49**

Delete the last sentence of the order.

Order 13-3004—Underground Runs **Page 81**

Replace this order with the following:

Conductors run underground shall comply with the provisions of Orders 13-2311, 13-2312, and 13-2313 as far as mechanical protection is concerned.

Order 13-3005	Page 81
Delete this order.	
Order 13-3006	Page 83
Delete this order.	
Order 13-3007	Page 84
Delete this order.	
Order 13-3008	Page 84
Delete this order.	
Order 13-3020—Wiring in Ventilating Ducts	Page 86
Add the following new order.	

Electrical installations shall be so made that the possible spread of fire through fire-stopped partitions, hollow spaces, fire walls or fire partitions, vertical shafts, ventilating or air-conditioning ducts is reduced to a minimum. No wiring system of any type shall be installed in ducts for dust, loose stock or vapor removal. Where it is necessary to run a wiring system through air-conditioning ducts or plenum chambers, the wiring method shall be rigid conduit, flexible steel conduit with lead-covered conductors, or Type ACL armored cable, with fittings suitable for the location. 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.

Note. Consideration should be given to expansion and contraction of runs of conduit from temperature changes.

Section 13-310	Page 89
Add the following as a new section:	

SECTION 13-310—CONDUCTORS

Order 13-3101—General

The intent and purpose of the following rules is to provide that conductors shall have mechanical strength, insulation, and carrying capacity adequate for the particular conditions under which they are to be used.

The provisions of this section 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.

Order 13-3102—Conductor Insulation

Conductors shall be insulated except when uninsulated conductors are specifically permitted in this code. Conductor insulations as specified in the following table may be used for any of the wiring methods recognized in this chapter, except as otherwise provided for in the table or the notes following, or as otherwise specified in this code. They are suitable for 600 volts unless otherwise specified.

Trade Name	Type Letter	Max. Operating Temp.	Special Provisions
Rubber-Covered Fixture Wire	RF-64	60C 140F	Fixture wiring. Limited to 300 V.
Solid or Stranded	RF-32	60C 140F	Fixture wiring, and as permitted in Order 13-3103
Rubber-Covered Fixture Wire	FF-64	60C 140F	Fixture wiring. Limited to 300 V.
Flexible Stranding	FF-32	60C 140F	Fixture wiring.
Thermoplastic-Covered Fixture Wire—Solid or Stranded	TF	60C 140F	Fixture wiring, and as permitted in Order 13-3103
Thermoplastic-Covered Fixture Wire—Flexible Stranding	TFF	60C 140F	Fixture wiring.
Cotton-Covered, Heat-Resistant, Fixture Wire	CF	90C 194F	Fixture wiring. Limited to 300 V.
Asbestos-Covered, Heat Resistant, Fixture Wire	AF	125C 257F	Fixture wiring. Limited to 300 V.
Code Rubber	R	60C 140F	General use.
Heat-Resistant Rubber	RH	75C 167F	General use.
Moisture-Resistant Rubber	RW	60C 140F	General use and wet locations.
Latex Rubber	RU	60C 140F	General use.
Thermoplastic	T	60C 140F	General use No. 14 to 4/0 inclusive. Open work No. 14 to 2,000,000 C.M.
Moisture-Resistant Thermoplastic	TW	60C 140F	General use and wet locations No. 14 to 4/0 inc. Open work No. 14 to 2,000,000 C.M.
Thermoplastic and Asbestos	TA	90C 194F	Switchboard wiring only.
Varnished Cambric	V	85C 185F	Dry locations only. Smaller than No. 6 by special permission.
Asbestos and Varnished Cambric	AVA	110C 230F	Dry locations only.
Asbestos and Varnished Cambric	AVL	110C 230F	Wet locations.
Asbestos and Varnished Cambric	AVB	90C 194F	Dry locations only.
Asbestos	A	200C 392F	Dry locations only. Not for general use. In raceways, only for leads to or within apparatus. Limited to 300 V.
Asbestos	AA	200C 392F	Dry locations only. Open wiring. Not for general use. In raceways, only for leads to or within apparatus. Limited to 300 V.
Asbestos	AI	125C 257F	Dry locations only. Not for general use. In raceways, only for leads to or within apparatus. Limited to 300 V.

Trade Name	Type Letter	Max. Operating Temp.	Special Provisions
Asbestos	AIA	125C 257F	Dry locations only. Open wiring. Not for general use. In raceways, only for leads to or within apparatus.
Paper		85C 185F	For underground service conductors, or by special permission.
Slow-Burning	SB	90C 194F	Dry locations only. Open wiring; and in raceways where temperatures will exceed those permitted for rubber-covered or varnished cambric-covered conductors.
Slow-Burning Weatherproof	SBW	90C 194F	Dry locations only. Open wiring only.
Weatherproof	WP	80C 176F	Open wiring by special permission where other insulations are not suitable for existing conditions.

The rubber insulations include those made from natural and synthetic rubber, neoprene and other vulcanizable materials.

Thermoplastic insulation may stiffen at temperatures below minus 10C (14F) and care should be used in its installation at such temperatures.

For size of conductors recognized for the various insulating coverings, and for construction details, see Order 13-93001.

A. Temperature Limitations. No conductor shall be used under such conditions that its temperature, even when carrying current, will exceed the temperature specified in the table for the type of insulation involved.

B. Wet Locations. Insulated conductors used underground, in concrete slabs or other masonry in direct contact with earth, in wet locations, or where condensation or accumulation of moisture within the raceway is likely to occur, shall be moisture-resistant, rubber-covered (type RW); moisture-resistant, thermoplastic-covered (type TW); lead-covered; or of a type approved for the purpose.

Such conductors are not suitable for direct burial in the earth without approved mechanical protection.

C. Corrosive Conditions. Conductors exposed to oils, greases, vapors, gases, fumes, liquids or other substances having a deleterious effect upon the conductor or insulation shall be of a type approved for the purpose.

Order 13-3103—Minimum Size of Conductors

Conductors, whether solid or stranded, shall not be smaller than No. 14, except for printing press control circuits; as provided for flexible cords in Order 13-4006; for fixture wire in Order 13-4142; for fractional horsepower motors in Order 13-4312; for cranes and hoists in Order 13-6112; for elevator control and signal circuits in Order 13-6205; for machine tools in Order 13-6721; and for remote-control, low-energy power and signal circuits in Order 13-8006.

Order 13-3104—Stranded Conductors

Except when used as bus bars, conductors No. 6 and larger, installed in raceways, shall be stranded.

Order 13-3105—Conductors in Multiple

Conductors in sizes 1/0 to 500,000 c.m., inclusive, may be run in multiple provided they are of the same length and have the same circular-mil area and type of insulation. Not more than three No. 1/0, four No. 2/0 nor five Nos. 3/0 to 500,000 c.m. conductors, inclusive, may be run in multiple. Except as herein provided, conductors shall be run in multiple only by special permission or as permitted in Order 13-6205. Where conductors are run in multiple, they shall be arranged and terminate at both ends in such a manner as to insure equal division of the total current between all conductors that are involved.

Order 13-3106—Current-carrying Capacity

The maximum, continuous, current-carrying capacities of copper conductors are given in Tables 1 and 2 of Chapter 10. The current-carrying capacities of aluminum conductors shall be taken as 84 per cent of those given for the same sizes of copper conductors with the same kind of insulation.

Order 13-3485

Page 102

Delete this order.

Order 13-3648

Page 110

Change the number of this order to 13-3653 and add the following note:

It is recommended that where secondary systems are operated ungrounded, a combination ground detector and potentializer plug be used as an auxiliary fitting for busway systems to establish a definite potential difference between the bus bars and the grounded casing of the busways. This will serve to drain off any static or other charge from the entire busway system including its connected apparatus, supply and branch circuit conductors.

Orders 13-3648, 13-3649, 13-3650, 13-3651, 13-3652

Add the following new orders:

Order 13-3648—Rating of Overcurrent Protection—Feeders and Sub-feeders

If the allowable current rating of the busway does not correspond to a standard rating of the overcurrent device, the next higher rating may be used, but not exceeding 150 per cent of the allowable current rating of the busway.

Order 3649—Reduction in Size of Busway

Overcurrent protection may be omitted at points where busways are reduced in size, provided that the smaller busway does not extend more than 50 feet and has a current rating at least equal to one-third the rating or setting of the overcurrent device next back on the line, and provided further that such busway is free from contact with combustible material.

Order 13-3650—Branch Circuits

Where a busway is used as a feeder, devices or plug-in connections for tapping off branch circuits from the busway shall contain the

overcurrent devices required for the protection of the branch circuits, except as permitted in Order 13-2434. Where the overcurrent device is not readily accessible, it shall be enclosed or guarded until it is electrically disconnected from the busway.

Order 13-3651—Rating of Overcurrent Protection—Branch Circuits

A busway may be used as a branch circuit of any one of the types described in Section 13-210. When so used, the rating or setting of the overcurrent device protecting the busway shall determine the ampere rating of the branch circuit and the circuit shall in all respects conform with the requirements of Section 13-210 applying to branch circuits of that rating.

Order 13-3652—Length of Busways Used as Branch Circuits

Busways which are used as branch circuits and which are so designed that loads can be connected at any point shall be limited to such lengths as will provide that in normal use the circuits will not be overloaded. In general, the length of such run in feet should not exceed three times the ampere rating of the branch circuit.

Order 13-3705 Page 111

Delete the note following the second table in paragraph A of this order and replace it with the following:

The above tables apply where no fittings or devices, such as fixture studs, cable clamps, hickies, switches or receptacles are contained in the box. Where one or more fixture studs, cable clamps, or hickies are contained in the box, the number of conductors shall be one less than shown in the tables, with a further deduction of one for each flush device or combination of flush devices mounted on the same strap. A conductor running through the box is counted as one conductor, and each conductor terminating in the box is also counted as one conductor. If single flush boxes are ganged, and each section is occupied by a flush device or combination of flush devices on the same strap, the limitations will apply to each section individually.

Order 13-4003 Page 121

Delete the present Order 13-4003 and replace it with the following new Order 13-4003.

Order 13-4003—Use

Flexible cord may be used only for (1) pendants; (2) wiring of fixtures; (3) connection of portable lamps, tools, or appliances; (4) elevator cables; (5) wiring of cranes and hoists; (6) for the connection of stationary equipment to facilitate their interchange; or (7) to prevent the transmission of noise or vibration. Flexible cord shall not be used (a) as a substitute for the fixed wiring of a structure; (b) where run through holes in walls, ceilings, or floors; (c) where run through doorways, windows, or similar openings; (d) where attached to building surfaces; or (e) where concealed behind building walls, ceilings or floors.

Order 13-4005 Page 121

Change this order to permit the use of the following types of flexible cords:

S, SO, SJ, SJO, ST, SJT, or AFS

Order 13-4008 Pages 121-122

Change the last sentence of the order to read:

Cords shall be not smaller than required by Table 3, Chapter 10, for the rated current of the appliance.

Sections 13-410 and 13-420 Pages 123-130

Delete orders 13-4101, 13-4102, 13-4103, 13-4104, 13-4105, 13-4106, 13-4107, 13-4121, 13-4122, 13-4123, 13-4124, 13-4125, 13-4126, 13-4127, 13-4128, 13-4129, 13-4130, 13-4131, 13-4132, 13-4133, 13-4134, 13-4135, 13-4136, 13-4137, 13-4138, 13-4139, 13-4140, 13-4160, 13-4162, 13-4163, 13-4164, 13-4165, 13-4166, 13-4171, 13-4172, 13-4173, 13-4181, 13-4201, 13-4202, 13-4205, 13-4208, 13-4211, 13-4212, 13-4213, and 13-4214. Add the following new orders:

**SECTION 13-410—LIGHTING FIXTURES, LAMP-HOLDERS,
LAMPS, RECEPTACLES AND ROSETTES**

GENERAL

Order 13-4101—Scope

Lighting fixtures, lampholders, pendants, receptacles, and rosettes, incandescent filament lamps, arc lamps, electric discharge lamps, the wiring and equipment forming part of such lamps, fixtures and lighting installations shall conform to Orders 13-4102 to 13-4216 inclusive, except as otherwise provided in this code.

Order 13-4102—Application to Other Sections

Equipment for use in hazardous locations shall conform to Section 13-500.

Order 13-4103—Live Parts

Fixtures, lampholders, lamps, rosettes and receptacles, shall have no live parts normally exposed to contact, except in the case of cleat-type lampholders, receptacles and rosettes which are located at least 8 feet above the floor. Lampholders, receptacles and switches which have exposed accessible terminals shall not be installed in metal fixture canopies or in open bases of portable table or floor lamps.

PROVISIONS FOR FIXTURE LOCATIONS

Order 13-4111—Fixtures in Damp, Wet or Corrosive Locations

Fixtures installed in damp or wet locations shall be of vaportight or other types approved for such locations and shall be so constructed or installed that water cannot enter or accumulate in wireways, lampholders or other electrical parts. Fixtures installed in corrosive locations shall be of a type approved for such locations.

Order 13-4112—Fixtures Near Combustible Material

Fixtures shall be so constructed, or installed, or equipped with shades or guards that combustible material will not be subjected to temperatures in excess of 90C (194F).

Order 13-4113—Fixtures Over Combustible Material

Lampholders installed over specially combustible material shall be of the unswitched type and unless individual switches are provided, shall be located at least 8 feet above the floor, or shall be otherwise so located or guarded that the lamps cannot be readily removed or damaged.

Order 13-4114—Fixtures in Show-windows

No externally wired fixture other than of the chain type shall be used in a show-window. For use of cords in show-windows, see Order 13-4005.

Order 13-4115—Fixtures in Clothes Closets

Fixtures in clothes closets shall be installed on the ceiling or on the wall above the door. Pendants shall not be installed in clothes closets.

**PROVISIONS AT FIXTURE OUTLET BOXES, CANOPIES
AND PANS**

Order 13-4121—Space for Conductors

Canopies and outlet boxes taken together shall provide adequate space so that fixture conductors and their connecting devices may be properly installed.

Order 13-4122—Temperature Limit of Conductors in Outlet Boxes

Fixtures shall be of such construction or so installed that the conductors in outlet boxes will not be subjected to temperatures greater than that for which the conductors are approved.

Order 13-4123—Outlet Boxes to be Covered

In a completed installation, each outlet box shall be provided with a cover unless covered by means of a fixture canopy, lampholder, receptacle, rosette, or similar device.

Order 13-4124—Covering of Combustible Material at Outlet Boxes

Any combustible wall or ceiling finish exposed between the edge of a fixture canopy or pan and an outlet box shall be covered with non-combustible material.

Order 13-4125—Connection of Fixtures

In general, fluorescent fixtures when supported independently of the outlet box shall be connected through metal raceways or armored conductors. This requirement may be waived when cord-equipped fixtures are suspended directly below the outlet box and the exposed cord is not subject to strain or mechanical injury.

FIXTURE SUPPORTS

Order 13-4131—Support—General

Fixtures, lampholders, rosettes, and receptacles shall be securely supported. A fixture which weighs more than 6 lbs. or exceeds 16 inches in any dimension shall not be supported by the screw shell of a lampholder.

Order 13-4132—Means of Support

Where there is an outlet box, a gas pipe, or a fitting which will provide adequate support, a fixture shall be attached thereto; otherwise a fixture shall be supported as required by Order 13-3709. A fixture which weighs more than 50 lbs. shall be supported independently of the outlet box.

WIRING OF FIXTURES

Order 13-4141—Fixture Wiring—General

Wiring on or within fixtures shall be neatly arranged and not exposed to mechanical injury. Excess wiring shall be avoided. Conductors shall be so arranged that they will not be subjected to temperatures above those for which they are approved.

Order 13-4142—Conductor Size

Fixture conductors shall not be smaller than No. 18.

Order 13-4143—Conductor Insulation

Fixtures shall be wired with conductors having insulation suitable for the current, voltage, and temperature to which the conductors will be subjected. Where fixtures are installed in damp, wet, or corrosive locations, conductors shall be of a type approved for such locations. For current carrying capacity of fixture wire, see Table 3, Chapter 10. For maximum operating temperature and voltage limitation of fixture wires, see paragraph D of Order 13-93001.

Order 13-4144—Conductors for Special Conditions

Fixtures provided with mogul base screw-shell lampholders and operating at not more than 300 volts between conductors shall be wired with Type AF fixture wire. Fixtures provided with other than mogul base screw-shell lampholders and operating at not more than 300 volts between conductors shall be wired with Type AF fixture wire or Type AFC, AFPO, or AFPD flexible cord; except that where temperatures do not exceed 90C (194F) Type CF fixture wire or Type CFC, CFPD, or CFPO flexible cord may be used, where temperatures do not exceed 60C (140F) Type T thermoplastic wire and Type TF and TFF fixture wire may be used, and where temperatures do not exceed 50C (122F) Type R rubber-covered wire, Type RF-64, RF-32, FF-64, and FF-32 fixture wire may be used, including use in fixtures of decorative type on which lamps of not over 60 watt rating are used in connection with imitation candles.

Order 13-4145—Conductors for Movable Parts

Stranded conductors shall be used on chain fixtures and other movable parts. Conductors shall be so arranged that the weight of the fixture or movable parts will not put a tension on the conductors.

Order 13-4146—Pendent Conductors for Incandescent Filament Lamps

Pendent lampholders with permanently attached leads, if used in other than festoon wiring, shall be hung from separate stranded rubber-covered conductors which are soldered directly to the circuit conductors but supported independently thereof. Such pendent conductors shall be not smaller than No. 14 for heavy-duty or medium-base screw-shell lampholders, nor, except for approved Christmas tree and decorative lighting outfits, smaller than No. 18 for intermediate-, or candelabra-base lampholders. If the pendent conductors are longer than 3 feet, they shall be twisted together.

Order 13-4147—Protection of Conductors

Conductors shall be secured in a manner that will not tend to cut or abrade the insulation. Conductors shall be protected from abrasion where they pass through metal. Exposed flexible cord or fixture wire shall not be used to supply permanently installed fixtures in show cases or wall cases.

Order 13-4148—Conductor Protection at Lampholders

Where a metal lampholder is attached to a flexible cord, the inlet shall be equipped with an insulating bushing which, if threaded, shall not be smaller than nominal $\frac{3}{8}$ inch pipe size. The edges of the bushing shall be rounded and all inside fins removed in order to provide a smooth bearing surface for the conductors.

Bushings having holes $\frac{3}{8}$ inch in diameter are suitable for use with plain pendent cord and holes $\frac{1}{2}$ inch in diameter with reinforced cord.

Order 13-4149—Connections, Splices and Taps

Fixtures shall be so installed that the connections between the fixture conductors and the circuit conductors may be inspected without requiring the disconnection of any part of the wiring, unless the fixture is connected by means of a plug and receptacle. Splices and taps shall not be located within fixture arms or stems. No unnecessary splices or taps shall be made within or on a fixture. For approved means of making connections, see Order 13-3009.

Order 13-4150—Fixture Raceways

Fixtures shall not be used as a raceway for circuit conductors unless the fixtures meet the requirements of approved raceways, except that the conductors of a single branch circuit may be carried through an installation of fixtures approved for end to end assembly to form a continuous raceway.

Individual fixtures of all types which are coupled, butted, telescoped, or connected together with metal raceways not over eighteen (18) inches in length, shall be considered as a single fixture.

Order 13-4151—Polarization of Fixtures

Fixtures shall be so wired that the screw-shells of lampholders will be connected to the same fixture or circuit conductor or terminal. For polarity identification of conductors to screw-shells of lampholders, see Order 13-2004.

LAMP HOLDERS

Order 13-4156—Lampholders, Screw-shell Type

Lampholders of the screw-shell type shall be installed for use as lampholders only.

Order 13-4157—Double-pole Switched Lampholders

Where used on unidentified 2-wire circuits tapped from the ungrounded conductors of multi-wire circuits, the switching device of lampholders of the switched type shall simultaneously disconnect both conductors of the circuit. See Order 13-2007.

Order 13-4158—Lampholders in Damp or Wet Locations

Lampholders installed in damp or wet locations shall be of the weatherproof type.

RECEPTACLES

Order 13-4161—Rating and Type

Receptacles installed for the attachment of portable cords shall be rated at not less than 15 amperes, 125 volts, or 10 amperes, 250 volts, and shall be of a type not suitable for use as lampholders.

Order 13-4162—Receptacles in Floors

Receptacles located in floors shall be enclosed in floor boxes especially approved for the purpose, except where such receptacles are located in elevated floors of show windows or other locations free from mechanical injury, moisture and dirt, the standard approved type of flush receptacle box may be used.

Order 13-4163—Receptacles in Damp or Wet Locations

Receptacles installed in damp or wet locations shall be of the weatherproof type.

ROSETTES

Order 13-4165—Approved Types

Fusible rosettes shall not be installed. Separable rosettes which make possible a change in polarity shall not be used. For construction specifications see Order 13-94108.

Order 13-4166—Rosettes in Damp or Wet Locations

Rosettes installed in such locations shall be of the weatherproof type.

CONSTRUCTION

Order 13-4171—Combustible Shades and Enclosures

Adequate air space shall be provided between lamps and shades or other enclosures of combustible material.

Order 13-4172—Portable Handlamps

Handlamps of the portable type supplied through flexible cords shall be of the molded composition or other type approved for the purpose. Brass-shell paper-lined lampholders shall not be used. Handlamps shall be equipped with a handle. Where subject to mechanical damage or where lamps may come in contact with combustible material, handlamps shall be equipped with a substantial guard attached to the lampholder or the handle.

For Garages see Order 13-5108.

Order 13-4173—Marking

All fixtures requiring ballasts or transformers shall be plainly marked with their electrical rating and the manufacturer's name, trade-mark or other suitable means of identification. The electrical rating shall include the voltage, frequency, and shall indicate the current rating of the unit including the ballast, transformer or auto-transformer.

SPECIAL PROVISIONS FOR FLUSH AND RECESSED FIXTURES

Order 13-4176—Approved Type

Fixtures which are installed in recessed cavities in walls or ceilings shall be of an approved type and shall conform to Orders 13-4177 to 13-4180 inclusive.

Order 13-4177—Temperature

Fixtures shall be so constructed or installed that adjacent combustible material will not be subjected to temperatures in excess of 90C (194F). Where a fixture is recessed in fire-resistant material in a building of fire-resistant construction, a temperature higher than 90C (194F), but not higher than 150C (302F) is acceptable if the fixture is plainly marked that it is approved for that service.

Order 13-4178—Clearance

Recessed portions of enclosures, other than at points of support, shall be spaced at least ½ inch from combustible material.

Order 13-4179—Wiring

Conductors having insulation suitable for the temperature encountered shall be used. Where conductor temperatures are in excess of 60C (140F), (a) Type SB (90°C) slow-burning wire may be run directly from fixture to fixture and from fixture to outlet; or (b) other types of conductors shall be brought through at least 4 feet of metal raceway from the fixture to an outlet box at least one foot from the fixture. Such conductors, unless approved for the purpose, shall not extend a distance of more than 6 feet from the fixture as measured along the raceway.

Order 13-4180—Construction

For the construction of flush and recessed fixtures, see Order 13-94102.

SPECIAL PROVISIONS FOR ELECTRIC DISCHARGE LIGHTING SYSTEMS OF 1,000 VOLTS OR LESS

Order 13-4181—General

Equipment for use with electric discharge lighting systems and designed for an open-circuit voltage of 1,000 volts or less shall be of a type approved for such service. In addition to complying with the general requirements for lighting fixtures, such equipment shall conform to Orders 13-4182 to 13-4187 inclusive. Transformers of the oil-filled type shall not be used. The terminals of an electric discharge lamp shall be considered as alive if any lamp terminal is connected to a potential of more than 300 volts.

Order 13-4182—Direct-current Equipment

Fixtures shall be installed on alternating-current circuits only, unless the fixtures are equipped with auxiliary equipment and resistors especially designed and approved for direct-current operation and the fixtures are so marked.

Order 13-4183—Voltages—Dwelling Occupancies

Equipment having an open-circuit voltage of more than 1,000 volts shall not be installed in dwelling occupancies. Equipment having an open-circuit voltage of more than 300 volts shall not be installed in dwelling occupancies unless such equipment is so designed that there shall be no exposed live parts when lamps are being inserted, in place, or being removed.

Order 13-4184—Fixture Mounting

Fixtures having exposed ballasts or transformers shall be so installed that such ballasts or transformers shall not be in contact with combustible material.

Order 13-4185—Auxiliary Equipment Not Integral With Fixture

Auxiliary equipment, including reactors, capacitors, resistors, and similar equipment, where not installed as part of a lighting fixture assembly shall be enclosed in accessible, permanently-installed metal cabinets. Such separate equipment should be installed close to the lamps to keep the conductors between lamps and auxiliaries as short as possible. Where display cases are not permanently installed no portion of a secondary circuit may be included in more than a single case.

Order 13-4186—Auto-transformers

An auto-transformer which is used as part of a ballast for supplying lighting units and which raises the voltage to more than 300 volts shall be supplied only by a grounded system.

Order 13-4187—Switches

Snap switches shall conform to Order 13-3814.

SPECIAL PROVISIONS FOR ELECTRIC DISCHARGE LIGHTING SYSTEMS OF MORE THAN 1,000 VOLTS

Order 13-4191—General

Equipment for use with electric discharge lighting systems and designed for an open-circuit voltage of more than 1,000 volts shall be of a type approved for such service. In addition to complying with the general requirements for lighting fixtures, such equipment shall conform to Order 13-4191 to Order 13-4203 inclusive. The terminal of an electric discharge lamp shall be considered as alive when any terminal is connected to a potential of more than 300 volts.

For signs and outline lighting, see Section 13-600.

Order 13-4192—Control

Fixtures or lamp installations shall be controlled either singly or in groups by an externally-operable switch or circuit-breaker which will open all ungrounded primary conductors. The switch or circuit-breaker shall be located within sight of the fixtures or lamps, or it may be located elsewhere if it is provided with means for locking in the open position.

Order 13-4193—Switches

Snap switches shall conform to Order 13-3814.

Order 13-4194—Transformer Ratings

Transformers and ballasts shall have a secondary open-circuit voltage of not more than 15,000 volts with an allowance on test of 1,000 volts additional. The secondary current rating shall not be more than 240 milli-amperes. When the open circuit voltage is more than 7,500 volts, the secondary current rating shall not be more than 120 milli-amperes.

Order 13-4195—Transformer Type

Transformers shall be of an approved enclosed type. Transformers of other than the askarel filled or air-cooled type shall not be used.

Order 13-4196—Transformer Secondary Connections

The high-voltage windings of transformers shall not be connected in series or in parallel, except that for two transformers each having one end of its high-voltage winding grounded and connected to the enclosure, the high-voltage windings may be connected in series to form the equivalent of a mid-point grounded transformer. The grounded ends shall be connected by an insulated conductor not smaller than No. 14.

Order 13-4197—Location of Transformers

Transformers shall be accessible after installation. The transformers should be installed as near to the lamps as practicable to keep the secondary conductors as short as possible. Transformers shall be so located that adjacent combustible materials will not be subjected to temperatures in excess of 90C.

Order 13-4198—Wiring Method, Secondary Conductors

Approved gas-tube sign cable suitable for the voltage of the circuit shall be used. For installation of conductors see Order 13-6031.

Order 13-4199—Transformer Loading

The lamps connected to any transformer shall be of such length and characteristics as not to cause a condition of continuous over-voltage on the transformer.

Order 13-4200—Lamp Supports

Lamps shall be adequately supported as required in Order 13-6033.

Order 13-4201—Mechanical Injury

Lamps shall not be located where normally exposed to mechanical injury.

Order 13-4202—Lamp Terminals and Lampholders

Parts which must be removed for lamp replacement shall be hinged or fastened by an approved means. Lamps or lampholders or both shall be so designed that there shall be no exposed live parts when lamps are being inserted or are being removed, as provided in Order 13-6013.

Order 13-4203—Marking

Each fixture or each secondary circuit of tubing having an open-circuit voltage of more than 1,000 volts shall have a clearly legible marking in letters not less than ¼ inch high reading "Caution ----- volts." The voltage indicated shall be the rated open-circuit voltage.

ARC LAMPS

Order 13-4205—General

Arc lamps used in theatres shall conform to Order 13-5284, and arc lamps used in projection machines shall conform to Order 13-5431. Arc lamps used on constant-current systems shall conform to Order 13-7104.

GROUNDING

Order 13-4211—General

Fixtures and lighting equipment shall be grounded as provided in Orders 13-4212 to 13-4216 inclusive.

Order 13-4212—Metallic Wiring Systems

Metal fixtures installed on outlets wired with grounded metal race-way or grounded armored cable shall be grounded.

Order 13-4213—Non-metallic Wiring Systems

Metal fixtures installed on outlets wired with knob-and-tube work, or non-metallic sheathed cable, on circuits operating at 150 volts or less to ground, shall be grounded except as follows:

1. Fixtures mounted on metal or metal lath ceilings or walls may be insulated from their supports and from the metal lath by the use of insulating joints or fixture supports and canopy insulators. See Order 13-4215.

2. Fixtures not mounted on metal or metal-lath ceilings or walls need be neither insulated nor grounded. See Order 13-4215.

Fixtures made of insulating materials, and lampholders with shells of insulating material, are recommended for use with wiring systems that do not afford a ready means for grounding the exposed non-current-carrying parts of fixtures and lampholders.

Order 13-4214—Equipment of More Than 150 Volts to Ground

Metal fixtures, transformers and transformer enclosures on circuits operating at more than 150 volts to ground shall be grounded. Other exposed metal parts shall be grounded unless they are insulated from ground and other conducting surfaces and are inaccessible to unqualified persons, except that lamp tie wires, mounting screws, clips and decorative bands on glass lamps spaced not less than 1½ inches from lamp terminals need not be grounded.

Order 13-4215—Fixtures, Lampholders and Receptacle Plates Near Grounded Surfaces

Ungrounded metal lighting fixtures, lampholders and face plates shall not be installed within 8 feet vertically or 5 feet horizontally of laundry tubs, bath tubs, shower baths, plumbing fixtures, steam pipes or other grounded metal work or grounded surfaces. Metal pull chains used at these locations shall be provided with insulating links.

Order 13-4216—Methods of Grounding

Equipment shall be considered as grounded when mechanically connected in a permanent and effective manner to metal raceway, the armor of armored cable, the grounding conductor in non-metallic sheathed cable, a separate grounding conductor not smaller than No. 14, or to gas piping, provided that the raceway, armor, grounding conductor, or gas pipe is grounded in a manner specified in Section 13-250.

Order 13-4312	Page 136
Change the reference from "diagram 15" to "figure 20".	
Order 13-4314	Page 136
Change the reference from "diagram 15" to "figure 20".	
Order 13-4322	Page 137
Change the reference from "diagram 15" to "figure 20".	
Order 13-4342	Page 140
Change the reference from "diagram 15" to "figure 20".	
Order 13-4362	Page 141
Change the reference from "diagram 15" to "figure 20".	
Order 13-4381	Page 143
Change the reference from "diagram 15" to "figure 20".	
Order 13-4401	Page 145
Change the reference from "diagram 15" to "figure 20".	

Section 13-450

Pages 150-156

Delete orders 13-4501, 13-4502, 13-4503, 13-4504, 13-4505, 13-4506, 13-4507, 13-4508, 13-4509, 13-4521, 13-4522, 13-4523, 13-4524, 13-4525, 13-4526, 13-4527, 13-4528, 13-4531, 13-4532, 13-4541, 13-4546, 13-4551, and 13-4552. Add the following new orders:

SECTION 13-450—TRANSFORMERS AND TRANSFORMER VAULTS (Including Secondary Ties)

Order 13-4501—Application

This section applies to the installation of all transformers except: (1) current transformers; (2) dry-type transformers which constitute a component part of other apparatus and which conform to the requirements for such apparatus; (3) transformers for use with X-ray and high-frequency; (4) transformers used with Class 2 remote-control, low energy power and signal circuits which shall conform to Section 13-800 on control circuits; (5) transformers for sign and outline lighting which shall conform to Section 13-600; and (6) transformers for electric discharge lighting which shall conform to Section 13-410.

This section applies to the installation of transformers in hazardous locations except as modified by Section 13-500.

See also Section 13-710, Circuits and Equipment Operating at More than 600 Volts Between Conductors, and Service Installations Over 600 Volts as referred to in Section 13-230.

GENERAL PROVISIONS

Order 13-4511—Location

They shall be located and arranged to minimize possible life and fire hazards. The location of transformer vaults as affected by ventilating requirements is covered elsewhere in this section.

Order 13-4512—Overcurrent Protection

Overcurrent protection shall conform to the following. As used in this order, the word "transformer" means a transformer or a bank of transformers operating as a unit.

A. *Primary Side.* Each transformer shall be protected by an overcurrent device in the primary connection, rated or set at not more than 250 per cent of the rated primary current of the transformer, except that an individual overcurrent device is not required if the primary circuit overcurrent device provides the protection specified in this paragraph, and except as provided in paragraph B of this order.

B. *Primary and Secondary Side.* A transformer having an overcurrent device in the secondary connection, rated or set at not more than 250 per cent of the rated secondary current of the transformer, or a transformer equipped with a coordinated thermal overload protection by the manufacturer, is not required to have an individual overcurrent device in the primary connection provided the primary feeder overcurrent device is rated or set to open at a current value not more than six times the rated current of the transformer, for transformers

having not more than six per cent impedance, and not more than four times rated current of the transformer for transformers having more than six but not more than ten per cent impedance.

C. *Potential (Voltage Transformers.)* Potential transformers should have primary fuses. The fuse rating should not exceed 10 amperes for circuits of 600 volts or less, and 3 amperes for circuits of more than 600 volts. A resistor should be connected in series with high tension fuses if necessary to limit the possible short-circuit current to a value within the interrupting capacity of the fuse.

Order 13-4513—Secondary Ties

As used in this order the word "transformer" means a transformer or a bank of transformers operating as a unit. A secondary tie is a circuit operating at 600 volts or less between phases which connects two power sources or power supply points, such as the secondaries of two transformers. The tie may consist of one or more conductors per phase.

A. *Tie Circuits.* Tie circuits shall be provided at each end with overcurrent protection as required in Section 13-240 of this code, except under the conditions described in sub-paragraphs 1 and 2 of this order, in which cases, the overcurrent protection may be in accordance with sub-paragraph 3 of this order.

1. *Loads at Transformer Supply Points Only.* If all loads are connected at the transformer supply points at each end of the tie and overcurrent protection is not provided in accordance with Section 13-240, the rated current-carrying capacity of the tie shall be not less than 67 per cent of the rated secondary current of the largest transformer connected to the secondary tie system.

2. *Loads Connected Between Transformer Supply Points.* If load is connected to the tie at any point between transformer supply points and overcurrent protection is not provided in accordance with Section 13-240, the rated current-carrying capacity of the tie shall be not less than 100 per cent of the rated secondary current of the largest transformer connected to the secondary tie system except as otherwise provided in sub-paragraph 4.

3. *Tie Circuit Protection.* Under the conditions described in sub-paragraphs 1 and 2 of this order, both ends of each tie conductor shall be equipped with a protective device which will open at a predetermined temperature of the tie conductor under short circuit conditions. This protection shall consist of the following: (1) a fusible link cable connector, terminal or lug, commonly known as a limiter, each being of a size corresponding with that of the conductor and of approved construction and characteristics according to the operating voltage and the type of insulation on the tie conductors, or (2) automatic circuit-breakers actuated by devices having comparable current-time characteristics.

4. *Interconnection of Phase Conductors Between Transformer Supply Points.* If the tie consists of more than one conductor per

phase, the conductors of each phase shall be interconnected in order to establish a load supply point, and the protection specified in sub-paragraph 3 shall be provided in each tie conductor at this point, except as follows:

Loads may be connected to the individual conductors of a multiple-conductor tie without interconnecting the conductors of each phase and without the protection specified in sub-paragraph 3 at load connection points provided: the tie conductors of each phase have a combined capacity not less than 133 per cent of the rated secondary current of the largest transformer connected to the secondary tie system; the total load of such taps does not exceed the rated secondary current of the largest transformer; the loads are equally divided on each phase and on the individual conductors of each phase as far as practicable.

5. *Tie Circuit Control.* If the operating voltage exceeds 150 volts to ground, secondary ties provided with limiters shall have a switch at each end which when open will de-energize the associated tie conductors and limiters. The current rating of the switch shall be not less than the rated current of the conductors connected to the switch. It shall be capable of opening its rated current, and it shall be constructed so that it will not open under the magnetic forces resulting from short-circuit current.

B. *Overcurrent Protection for Secondary Connections.* When secondary ties are used an overcurrent device rated or set at not more than 250 per cent of the rated secondary current of the transformers shall be provided in the secondary connections of each transformer, and in addition an automatic circuit-breaker actuated by a reverse-current relay set to open the circuit at not more than the rated secondary current of the transformer shall be provided in the secondary connection of each transformer.

Order 13-4514—Parallel Operation

Transformers may be operated in parallel and protected as a unit if their electrical characteristics are such that they will divide the load in proportion to their rating.

Order 13-4515—Guarding

Transformers shall be guarded as follows:

A. *Mechanical Protection.* Appropriate provisions shall be made to minimize the possibility of damage to transformers from external causes if the transformers are located where they are exposed to mechanical injury.

B. *Exposed Live Parts.* The transformer installation shall conform with the provisions for "Guarding of Live Parts" in Order 13-1112.

C. *Voltage Warning.* The operating voltage of exposed live parts of transformer installations shall be indicated by signs or visible markings on the equipment or structures.

Order 13-4516—Grounding

Exposed non-current carrying metal parts of transformer installations including fences shall be grounded under the conditions and in the manner prescribed for electrical equipment and other exposed metal parts in Section 13-250.

Order 13-4517—Name-plate

Each transformer shall be provided with a name-plate giving the name of the manufacturer; rated kilovolt-amperes, frequency, primary and secondary voltage; and the amount and kind of insulating liquid, if any, if the transformer rating exceeds 25 kva. If Class B insulation as defined in American Standard for Transformers C 57.1 is used in the construction of dry-type transformers of more than 100 kva, the name-plate shall so indicate.

SPECIFIC PROVISIONS APPLICABLE TO DIFFERENT TYPES OF TRANSFORMERS

Order 13-4521—Dry-type Transformers Installed Indoors

Transformers rated 100 kva or less shall have a separation of at least 12 inches from combustible material unless separated therefrom by a fire-resistant heat-insulating barrier, or unless of a rating not exceeding 600 volts and completely enclosed except for ventilating openings.

Transformers of more than 100 kva rating shall be installed in a transformer room of fire-resistant construction unless they are constructed with Class B insulation, as defined in American Standard for Transformers C 57.1, and are separated from combustible material not less than 6 feet horizontally and 12 feet vertically or are separated therefrom by a fire-resistant heat-insulating barrier.

Transformers rated more than 15,000 volts shall be installed in a vault.

Order 13-4522—Askarel-insulated Transformers Installed Indoors

Askarel-insulated transformers rated in excess of 25 kva shall be furnished with a pressure-relief vent. If installed in a poorly ventilated place they shall be furnished with a means for absorbing any gases generated by arcing inside the case, or the pressure relief vent shall be connected to a chimney or flue which will carry such gases outside the building. Askarel-insulated transformers rated more than 15,000 volts shall be installed in a vault.

Order 13-4523—Oil-insulated Transformers Installed Indoors

Oil-insulated transformers shall be installed in a vault constructed as specified in this section except as follows:

A. *Not Over 100 kva Total Capacity.* The provisions for transformer vaults specified in this section apply except that the vault may be constructed of reinforced concrete not less than 4 inches thick.

B. *Not Over 600 Volts.* A vault is not required provided suitable arrangements are made where necessary to prevent a transformer oil

fire igniting other materials, and the total transformer capacity in one location does not exceed 10 kva in a section of the building classified as combustible, or 75 kva where the surrounding structure is classified as fire-resistant construction.

C. *Furnace Transformers.* Electric furnace transformers of a total rating not exceeding 75 kva may be installed without a vault in a building or room of fire-resistant construction if arrangements necessary to prevent a transformer oil fire spreading to other combustible material are provided.

D. *Detached Buildings.* Transformers may be installed in a building which does not conform with the provisions specified in this code for transformer vaults provided neither the building nor its contents presents a fire hazard to any other building or property, and provided the building is used only in supplying electric service and is accessible only to qualified persons.

Order 13-4524—Oil-insulated Transformers Installed Outdoors

Combustible buildings, combustible parts of buildings, fire escapes, door and window openings of buildings, and other combustible material shall be safeguarded from fires originating in oil-insulated transformers installed on, attached to, or adjacent to a building or other property by providing effective space separation or an effective fire-resistant barrier, and by providing means of retaining or safely disposing of the oil from a ruptured transformer tank in cases where the transformer installation would present a fire hazard without such precautionary measures.

PROVISIONS FOR TRANSFORMER VAULTS

Order 13-4541—Location

Vaults shall be located where they can be ventilated to the outside air without using flues or ducts wherever such an arrangement is practicable.

Order 13-4542—Walls, Roof, and Floor

The walls and roof of vaults shall consist of reinforced concrete not less than 6 inches in thickness or of brick not less than 8 inches in thickness, or of load-bearing hollow tile not less than 12 inches in thickness, the inside surface of the wall being coated with cement plaster. The vault shall have a concrete floor at least 4 inches thick. The floor or walls of the building may be used for one or more parts of the vault if they are approved as being equivalent to the foregoing specifications.

Order 13-4543—Doorways

Any doorway leading from the vault into the building shall be protected as follows:

A. *Type of Door.* Each doorway shall be provided with a tight-fitting door of a type approved for openings in Class A situations as defined in the 1939 edition of the standard of the National Board of Fire Underwriters for Protection of Openings in Walls and Partitions

Against Fire. The authority enforcing this code may require such a door on each side of the wall if conditions warrant.

B. *Sills.* A door sill or curb of sufficient height to confine within the vault the oil from the largest transformer shall be provided and in no case shall the height be less than 4 inches.

C. *Locks.* Entrance doors shall be equipped with locks, and doors shall be kept locked, access being allowed only to qualified persons. Locks and latches shall be so arranged that the door may be readily and quickly opened from the inside.

Order 13-4544—Ventilation

The ventilation shall be adequate to prevent a transformer temperature in excess of the values prescribed in American Standard for Transformers C 57.1.

Order 13-4545—Ventilation Openings

Openings for ventilation shall be provided in accordance with the following:

A. *Location.* Ventilation openings shall be located as far away as possible from doors, windows, fire escapes, and combustible material.

B. *Arrangement.* Vaults ventilated by natural circulation of air may have roughly half of the total area of openings required for ventilation in one or more openings near the floor and the remainder in one or more openings in the roof or in the sidewalls near the roof; or all of the area required for ventilation may be provided in one or more openings in or near the roof.

C. *Size.* In the case of vaults ventilated to an outdoor area without using ducts or flues the combined net area of all ventilating openings after deducting the area occupied by screens, gratings, or louvers, shall be not less than 3 square inches per kva of transformer capacity in service except that the net area shall be not less than 1 square foot for any capacity under 50 kva.

D. *Covering.* Ventilation openings shall be covered with durable gratings, screens, or louvers, according to the treatment required in order to avoid unsafe conditions.

E. *Dampers.* If automatic dampers are used in the ventilation openings in vaults containing oil-insulated transformers, the actuating device should be made to function at a temperature resulting from fire and not at a temperature which might prevail as a result of an overheated transformer or bank of transformers. Care should be taken to avoid unintentional closing of automatic dampers.

F. *Ducts.* Ventilating ducts shall be constructed of fire-resistive material.

Order 13-4546—Drainage

If practicable, vaults containing more than 100 kva transformer capacity shall be provided with a drain which will carry off any accumulation of oil or water that may collect in the vault. The floor shall be pitched to the drain opening.

Order 13-4547—Water Pipes and Accessories

Any pipe or duct systems foreign to the electrical installation should not enter or pass through a transformer vault. If the presence of such foreign systems cannot be avoided, appurtenances thereto which require maintenance at regular intervals shall not be located inside the vault. Arrangements shall be made if necessary to avoid possible trouble from condensation, leaks, and breaks in such foreign systems. Piping or other facilities provided for fire protection or for water-cooled transformers are not deemed to be foreign to the electrical installation.

Order 13-4548—Storage in Vaults

Materials shall not be stored in transformer vaults.

Order 13-5107

Page 176

Add the following to Order 13-5107:

A take-up reel or equivalent approved device may be used.

Order 13-6112

Page 194

Delete this order and insert the following new order:

Order 13-6112—Conductor Sizes

Conductors shall be of the following sizes:

A. *Current-carrying Capacity.* The allowable current-carrying capacities of conductors shall be as follows:

Current-carrying Capacities of Conductors Having Rubber or Thermoplastic Insulation Which Supply Crane and Hoist Motors

Size AWG MCM	AMPERES	
	For Motors Having 30- and 60-Minute Short-Time Ratings	For Motors Having 5- and 15-Minute Short-Time Ratings
16	10	11
14	20	22
12	25	28
10	35	39
8	45	50
6	57	63
5	65	72
4	77	85
3	90	99
2	107	118
1	130	143
0	160	176
00	195	215
000	245	270
0000	300	330
250	350	385
300	410	450
350	460	510
400	515	570
450	565	620
500	620	680

The allowable current-carrying capacities of conductors having other than rubber or thermoplastic insulation, supplying motors of 5-, 15-, 30-, or 60 minute ratings, shall be as given in Tables 1 and 2, Chapter 10, increased by 10 per cent.

For the carrying capacity of conductors between controllers and resistors see Order 13-4313.

B. *Minimum No. 14.* Conductors shall not be smaller than No. 14 except:

1. On small cranes and hoists, No. 16 may be used provided the conductors are protected against mechanical injury.

2. On operating circuits, No. 16 may be used provided the conductors are protected against mechanical injury.

C. *Contact Conductors.* The size of contact wires shall be not less than the following:

Distance between end strain insulators	Size of wire
0-30 feet	No. 6
31-60 feet	No. 4
over 60 feet	No. 2

Order 13-6206

Page 200

Delete paragraph C of Order 13-6206 and substitute the following:

C. *Between Motors, Generators and Control Panels.* The conductors of circuits between motors, generators, and control panels may be grouped without any additional insulation of the separate conductors if the complete group is either taped or corded, and such covering properly painted with an insulating paint; provided that such conductors are not over 6 feet long, are supported at intervals not more than 3 feet and are not so located as to be subject to mechanical damage. If motor-generators are used with elevator motors and both are located adjacent to or underneath the control equipment and are provided with extra length terminal leads, such leads may be extended to connect directly to the elevator controller or motor-generator starter terminal studs without regard to the carrying capacity requirements of Sections 13-430 and 13-445; provided, that no such lead is longer than 6 feet.

Section 13-630

Page 203

Insert a new section made up of the following orders:

SECTION 13-630—ELECTRIC WELDERS

Order 13-6301—Scope

This section amplifies or modifies parts of Chapters 1 to 4 inclusive of this code in order to properly cover the operating conditions to which electric welder installations are subjected. Accordingly the appropriate provisions of Chapters 1 to 4 inclusive apply to the component parts of electric welder installations except as otherwise provided in this section. This section covers extensively used types of welders which require special treatment, as distinguished from weld-

ers which do not require special treatment and welders not in common use and not yet developed to the extent that rating and construction standards are possible.

TRANSFORMER ARC WELDERS

Order 13-6311—Capacity of Supply Conductors

The current-carrying capacity of conductors shall be as follows:

A. *Individual Welders.* The rated current-carrying capacity of the supply conductors shall be not less than the rated primary current of the welder.

B. *Group of Welders.* The rated current-carrying capacity of conductors which supply a group of welders may be less than the sum of the rated primary currents of the welders supplied. The conductor rating shall be determined in each case according to the welder loading based on the use to be made of each welder and the allowance permissible in the event that all the welders supplied by the conductors will not be in use at the same time. The load value used for each welder shall take into account both the magnitude and the duration of the load while the welder is in use.

Conductor ratings based on 100 per cent of the rated primary current of the two largest welders, 85 per cent for the third largest welder, 70 per cent for the fourth largest welder, and 60 per cent of the rated primary current for all the remaining welders, should provide an ample margin of safety under high production conditions with respect to the maximum permissible temperature of the conductors. Percentage values lower than those given are permissible in cases where the work is such that a high operating duty cycle for individual welders is impossible.

Order 13-6312—Overcurrent Protection

Overcurrent protection shall be as provided in paragraphs A and B. If the nearest standard rating of the overcurrent device used is under the value specified in this order or if the rating or setting specified results in unnecessary opening of the overcurrent device, the next higher rating or setting may be used.

A. *For Welders.* Each welder shall have overcurrent protection rated or set at not more than 200 per cent of the rated primary current of the welder, except that an overcurrent device is not required for a welder having supply conductors protected by an overcurrent device rated or set at not more than 200 per cent of the rated primary current of the welder.

B. *For Conductors.* Conductors which supply one or more welders shall be protected by an overcurrent device rated or set at not more than 200 per cent of the conductor rating.

Order 13-6313—Controller

A controller shall be provided in the supply connection of each welder which is not equipped with a controller mounted as an integral part of the welder. The controller shall be a motor-circuit switch or a circuit-breaker. The ampere rating shall be not less than the rated primary current of the welder. The horsepower rating of a switch used as a controller shall be not less than the numerical value ob-

tained by multiplying the rated primary current of the welder by 0.1, 0.2 or 0.25, respectively, for 220-, 440- and 550-volt welders. These factors apply to 2-pole switches.

Order 13-6314—Name Plate

A name-plate giving the following information shall be provided: name of manufacturer; frequency; primary voltage; rated primary current; maximum open-circuit secondary voltage; rated secondary current; basis of rating, i.e., the duty cycle, 30-minute rating or 60-minute rating.

MOTOR-GENERATOR ARC WELDERS

Order 13-6321—References

Motor-generator arc welder installations are covered by the appropriate orders of Chapters 1 to 4 inclusive applicable to conductors, motors, generators and associated equipment. Referring specifically to the motor supply connections, the following orders apply in addition to such other provisions as may be applicable. Conductor rating, Orders 13-4312 and 13-4316. Overcurrent protection: for motors, Order 13-4323; for conductors, Order 13-4342. Controllers, Order 13-4383. Disconnecting means, Order 13-4407.

RESISTANCE WELDERS

Order 13-6331—Capacity of Supply Conductors

The current-carrying capacity of the supply conductors necessary to limit the voltage drop to a value permissible for the satisfactory performance of the welder is usually greater than that required to prevent overheating as prescribed in paragraphs A and B.

A. *Individual Welders.* The rated current-carrying capacity for conductors for individual welders shall conform to the following:

1. *Varying Operation.* The rated current-carrying capacity of the supply conductors for a welder which may be operated at different times at different values of primary current or duty cycle shall be not less than 70 per cent of the rated primary current for seam and automatically fed welders, and 50 per cent of the rated primary current for manually-operated non-automatic welders.

2. *Specific Operation.* The rated current-carrying capacity of the supply conductors for a welder wired for a specific operation for which the actual primary current and duty cycle are known and remain unchanged shall be not less than the product of the actual primary current and the multiplier given below for the duty cycle at which the welder will be operated.

Duty Cycle (per cent) --	50	40	30	25	20	15	10	7.5	5.0 or less
Multiplier -----	.71	.63	.55	.50	.45	.39	.32	.27	.22

B. *Groups of Welders.* The rated current-carrying capacity of conductors which supply two or more welders shall be not less than the sum of the value obtained as explained in paragraph A of this order for the largest welder supplied, and 60 per cent of the values obtained as explained in paragraph A of this order for all the other welders supplied.

C. *Explanation of Terms.* (1) The rated primary current is the rated kva multiplied by 1,000 and divided by the rated primary voltage, using values given on the name-plate. (2) The actual primary current is the current drawn from the supply circuit during each welder operation at the particular heat tap and control setting used. (3) The duty cycle is the percentage of the time during which the welder is loaded. For instance, a spot welder supplied by a 60-cycle system (216,000 cycles per hour) making four hundred 15-cycle welds per hour would have a duty cycle of 2.8 per cent. (400 multiplied by 15, divided by 216,000, multiplied by 100). A seam welder operating 2 cycles "on" and 2 cycles "off" would have a duty cycle of 50 per cent.

Order 13-6332—Overcurrent Protection

Overcurrent protection shall be as provided in paragraphs A and B of this order. If the nearest standard rating of the overcurrent device used is under the value specified in this order, or if the rating or setting specified results in unnecessary opening of the overcurrent device, the next higher rating or setting may be used.

A. *For Welders.* Each welder shall have an overcurrent device rated or set at not more than 300 per cent of the rated primary current of the welder, except that an overcurrent device is not required for a welder having a supply circuit protected by an overcurrent device rated or set at not more than 300 per cent of the rated primary current of the welder.

B. *For Conductors.* Conductors which supply one or more welders shall be protected by an overcurrent device rated or set at not more than 300 per cent of the conductor rating.

Order 13-6333—Disconnecting Means

A switch or circuit-breaker shall be provided by which each welder and its control equipment can be isolated from the supply circuit. The current-carrying capacity of this disconnecting means shall be not less than the supply conductor rating determined as explained in this section. The supply circuit switch may be used as the welder disconnecting means if the circuit supplies only one welder.

Order 13-6334—Name-plate

A name-plate giving the following information shall be provided: name of manufacturer, frequency, primary voltage, rated kva at 50 per cent duty cycle, maximum and minimum open-circuit secondary voltage, short-circuit secondary current at maximum secondary voltage and specified throat and gap setting.

Order 13-6901

Delete Order 13-6901 and insert the following:

Order 13-6901—Wiring in Trailer

The wiring in a trailer used as a permanent residence which is to be connected to a regular outside distribution system should conform to the appropriate orders in this code.

Order 13-7001

Page 214

Add the following note:

The methods of supplying exit and emergency illumination in existing buildings will be determined in each individual case.

Order 13-8031

Pages 233-234

Add the following to the fourth sentence of paragraph B5:

—unless the driven rod or pipe is connected to the grounded conductor of a multi-grounded neutral power system.

Order 13-8101

Page 234

Insert the words “and television” between the word “radio” and the word “receiving” in the first line.

Table No. 1, Chapter 10

Page 256

Delete Table 1 and insert the following new Table 1:

TABLE 1

Allowable Current-Carrying Capacities of Conductors in Amperes
NOT MORE THAN THREE CONDUCTORS IN RACEWAY
OR CABLE

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

Size AWG MCM	Rubber		Paper		Asbestos Var-Cam Type AVA Type AVL	Impregnated Asbestos Type AI (14-8) Type AIA	Asbestos Type A (14-8) Type AA
	Type RW Type RU (14-6)	Rubber Type RH	Thermo- plastic Asbestos Type TA	Asbestos Type AVA Type AVL			
	Thermo- plastic Type T (14-4/0) Type TW (14-4/0)		Var-Cam Type V				
			Asbestos Var-Cam Type AVB				
14	15	15	25	30	30	30	
12	20	20	30	35	40	40	
10	30	30	40	45	50	55	
8	40	45	50	60	65	70	
6	55	65	70	80	85	95	
4	70	85	90	105	115	120	
3	80	100	105	120	130	145	
2	95	115	120	135	145	165	
1	110	130	140	160	170	190	
0	125	150	155	190	200	225	
00	145	175	185	215	230	250	
000	165	200	210	245	265	285	
0000	195	230	235	275	310	340	
250	215	255	270	315	335	-----	
300	240	285	300	345	380	-----	
350	260	310	325	390	420	-----	
400	280	335	360	420	450	-----	
500	320	380	405	470	500	-----	
600	355	420	455	525	545	-----	
700	385	460	490	560	600	-----	
750	400	475	500	580	620	-----	
800	410	490	515	600	640	-----	
900	435	520	555	-----	-----	-----	
1,000	455	545	585	680	730	-----	
1,250	495	590	645	-----	-----	-----	
1,500	520	625	700	785	-----	-----	
1,750	545	650	735	-----	-----	-----	
2,000	560	665	775	840	-----	-----	

CORRECTION FACTOR FOR ROOM TEMPERATURES OVER
30C. 86F.

C.	F.					
40	104	.82	.88	.90	.94	.95
45	113	.71	.82	.85	.90	.92
50	122	.58	.75	.80	.87	.89
55	131	.41	.67	.74	.83	.86
60	140	-----	.58	.67	.79	.83
70	158	-----	.35	.52	.71	.76
75	167	-----	-----	.43	.66	.72
80	176	-----	-----	.30	.61	.69
90	194	-----	-----	-----	.50	.61
100	212	-----	-----	-----	-----	.51
120	248	-----	-----	-----	-----	-----
140	284	-----	-----	-----	-----	-----

See notes following Table 2.

Table No. 2, Chapter 10

Page 257

Delete Table No. 2 and insert the following:

TABLE 2

Allowable Current-Carrying Capacities of Conductors in Amperes
SINGLE CONDUCTOR IN FREE AIR

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

Size AWG MCM	Rubber		Thermo- plastic Asbestos Type TA	Asbestos Var-Cam Type AVA Type AVL	Impreg- nated Asbestos Type AI (14-8) Type AIA	Asbestos Type A (14-8) Type AA	Slow- Burning Type SB		
	Type RW Type RU (14-6)	Rubber Type RH					Var-Cam Type V	Weather- proof Type WP Type SBW	
	Thermo- plastic Type T Type TW								Asbestos Var-Cam Type AVB
14	20	20	30	40	40	45	30		
12	25	25	40	50	50	55	40		
10	40	40	55	65	70	75	55		
8	55	65	70	85	90	100	70		
6	80	95	100	120	125	135	100		
4	105	125	135	160	170	180	130		
3	120	145	155	180	195	210	150		
2	140	170	180	210	225	240	175		
1	165	195	210	245	265	280	205		
0	195	230	245	285	305	325	235		
00	225	265	285	330	355	370	275		
000	260	310	330	385	410	430	320		
0000	300	360	385	445	475	510	370		
250	340	405	425	495	530	-----	410		
300	375	445	480	555	590	-----	460		
350	420	505	530	610	655	-----	510		
400	455	545	575	665	710	-----	555		
500	515	620	660	765	815	-----	630		
600	575	690	740	855	910	-----	710		
700	630	755	815	940	1005	-----	780		
750	655	785	845	980	1045	-----	810		
800	680	815	880	1020	1085	-----	845		
900	730	870	940	-----	-----	-----	905		
1000	780	935	1000	1165	1240	-----	965		
1250	890	1065	1130	-----	-----	-----	-----		
1500	980	1175	1260	1450	-----	-----	1215		
1750	1070	1280	1370	-----	-----	-----	-----		
2000	1155	1385	1470	1715	-----	-----	1405		

CORRECTION FACTOR FOR ROOM TEMPERATURES OVER
30 C. 86 F.

C.	F.						
40	104	.82	.88	.90	.94	.95	
45	113	.71	.82	.85	.90	.92	
50	122	.58	.75	.80	.87	.89	
55	131	.41	.67	.74	.83	.86	
60	140		.58	.67	.79	.83	.91
70	158		.35	.52	.71	.76	.87
75	167			.43	.66	.72	.86
80	176			.30	.61	.69	.84
90	194				.50	.61	.80
100	212					.51	.77
120	243						.69
140	284						.59

See notes following.

For explanation of Type Letters, and for recognized size of conductors for the various conductor insulations, see Orders 13-3102 and 13-93001. For installation requirements see Order 13-3102, and the various sections of this code.

1. *Aluminum Conductors.* For aluminum conductors, the allowable current-carrying capacities shall be taken as 84 per cent of those given in the table for the respective sizes of copper conductor with the same kind of insulation.

2. *Bare Conductors.* If bare conductors are used with insulated conductors, their allowable current-carrying capacity shall be limited to that permitted for the insulated conductor with which they are used.

3. *Application of Table.* For open wiring on insulators and for concealed knob-and-tube work, the allowable current-carrying capacities of Table 2 shall be used. For all other recognized wiring methods, the allowable current-carrying capacities of Table 1 shall be used, unless otherwise provided in this code.

4. *More Than Three Conductors in a Raceway.* Table 1 gives the allowable current-carrying capacity for not more than three conductors in a raceway or cable. If the number of conductors in a raceway or cable is from 4 to 6, the allowable current-carrying capacity of each conductor shall be reduced to 80 per cent of the values in Table 1. If the number of conductors in a raceway or cable is from 7 to 9, the allowable current-carrying capacity of each conductor shall be reduced to 70 per cent of the values in Table 1.

5. *Neutral Conductor.* 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 counted in determining current-carrying capacities as provided for in the preceding paragraph.

In a 3-wire circuit consisting of two phase wires and the neutral of a 4-wire, 3-phase system, a common conductor carries approximately the same current as the other conductors and is not therefore considered as a neutral conductor.

6. *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.

7. *Use of Conductors With Higher Operating Temperatures.* If the room temperature is within 10 degrees C of the maximum allowable

operating temperature of the insulation, it is desirable to use an insulation with a higher maximum allowable operating temperature; although insulation can be used in a room temperature approaching its maximum allowable operating temperature limit if the current is reduced in accordance with the table of correction factors for different room temperatures.

8. *Voltage Drop.* The allowable current-carrying capacities in Tables 1 and 2 are based on temperature alone and do not take voltage drop into consideration.

9. *Overcurrent Protection.* If the standard ratings and settings of overcurrent devices do not correspond with the ratings and settings allowed for conductors, the next higher standard rating and setting may be used, but not exceeding 150 per cent of the allowable carrying capacity of the conductor.

10. *Deterioration of Insulation.* It should be noted that even the best grades of rubber insulation will deteriorate in time, so eventually will need to be replaced.

Table 3, Chapter 10

Between page 258-259

Insert the following new table as Table 3.

TABLE 3
Allowable Current-Carrying Capacity of Flexible Cord and
Fixture Wire in Amperes

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

Size AWG	FLEXIBLE CORD						FIXTURE WIRE	
	Rubber and Cotton Types CT CTJ	Rubber Types PO, C, PD, P, PWP, K, E, EO	Rubber Types S, SO, SJ, SJO, SV, POSJ	Types AFS, AFSJ, HC, HPD, HSJ	Types AVPO AVPD	Cotton Types CFC* CFPD*	Rubber	Thermo- plastic Types TF TFP
27**	0.5							
18		5	7	10	17	6	5	6
17				12				
16		7	10	15	22	8	7	8
15				17				
14		15	15	20	28	17		17
12		20	20		36			
10		25	25		47			
8		35						
6		45						
4		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.

More Than Three Conductors in a Cord

Table 3 gives the allowable current-carrying capacities 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 current-carrying capacity of each conductor shall be reduced to 80 per cent of the values in the table.

CORRECTION FACTOR FOR ROOM TEMPERATURES OVER
30 C. 86 F.

C.	F.						
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45	113	.71	.82	.85	.90	.92	
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100	212					.51	.77
120	243						.69
140	284						.59

See notes following.

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In a 3-wire circuit consisting of two phase wires and the neutral of a 4-wire, 3-phase system, a common conductor carries approximately the same current as the other conductors and is not therefore considered as a neutral conductor.

6. *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.

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operating temperature of the insulation, it is desirable to use an insulation with a higher maximum allowable operating temperature; although insulation can be used in a room temperature approaching its maximum allowable operating temperature limit if the current is reduced in accordance with the table of correction factors for different room temperatures.

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9. *Overcurrent Protection.* If the standard ratings and settings of overcurrent devices do not correspond with the ratings and settings allowed for conductors, the next higher standard rating and setting may be used, but not exceeding 150 per cent of the allowable carrying capacity of the conductor.

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27**	0.5							
18		5	7	10	17	6	5	6
17				12				
16		7	10	15	22	8	7	8
15				17				
14		15	15	20	28	17		17
12		20	20		36			
10		25	25		47			
8		35						
6		45						
4		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.

More Than Three Conductors in a Cord

Table 3 gives the allowable current-carrying capacities 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 current-carrying capacity of each conductor shall be reduced to 80 per cent of the values in the table.

Table 4, Chapter 10

Insert the following new table as Table 4.

Tables 4, 5, 9, and 11. Tables 4, 5, 9, and 11 apply only to complete conduit systems, and do not apply to short sections of conduit used for the protection of exposed wiring from mechanical injury.

TABLE 4

Number of Conductors in Conduit or Tubing
RUBBER COVERED, TYPES RF-32, R, RH, RW AND RU
THERMOPLASTIC, TYPES TF, T AND TW
ONE TO NINE CONDUCTORS

(For More Than Nine Conductors See Table 9
 (See Orders 13-3013, 13-3032, 13-3466, 13-3487))

Size AWG MC M	Number of Conductors in One Conduit or Tubing								
	1	2	3	4	5	6	7	8	9
18	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4
16	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4
14	1/2	1/2	1/2	3/4	3/4	1	1	1	1 1/4
12	1/2	1/2	1/2	3/4	3/4	1	1	1	1 1/4
10	1/2	3/4	3/4	1	1	1 1/4	1 1/4	1 1/4	1 1/2
8	1/2	3/4	3/4	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2
6	1/2	1	1	1 1/4	1 1/2	1 1/2	2	2	2
4	1/2	1 1/4	*1 1/4	1 1/2	1 1/2	2	2	2	2 1/2
3	3/4	1 1/4	1 1/4	1 1/2	2	2	2	2 1/2	2 1/2
2	3/4	1 1/4	1 1/4	2	2	2	2 1/2	2 1/2	2 1/2
1	3/4	1 1/2	1 1/2	2	2 1/2	2 1/2	3	3	3
0	1	1 1/2	2	2	2 1/2	2 1/2	3	3	3
00	1	2	2	2 1/2	2 1/2	3	3	3	3 1/2
000	1	2	2	2 1/2	3	3	3	3 1/2	3 1/2
0000	1 1/4	2	2 1/2	3	3	3	3 1/2	3 1/2	4
250	1 1/4	2 1/2	2 1/2	3	3	3 1/2	4	4	4 1/2
300	1 1/4	2 1/2	2 1/2	3	3	3 1/2	4	4	4 1/2
350	1 1/4	3	3	3 1/2	3 1/2	4	4 1/2	4 1/2	5
400	1 1/2	3	3	3 1/2	4	4	4 1/2	5	5
500	1 1/2	3	3	3 1/2	4	4 1/2	5	5	6
600	2	3 1/2	3 1/2	4	4 1/2	5	6	6	6
700	2	3 1/2	3 1/2	4 1/2	5	5	6	6	6
750	2	3 1/2	3 1/2	4 1/2	5	6	6	6	6
800	2	3 1/2	4	4 1/2	5	6	6	6	6
900	2	4	4	5	6	6	6	6	6
1000	2	4	4	5	6	6	6	6	6
1250	2 1/2	4 1/2	4 1/2	6	6	6	6	6	6
1500	3	5	5	6	6	6	6	6	6
1750	3	5	6	6	6	6	6	6	6
2000	3	6	6	6	6	6	6	6	6

See Note 4 to Tables 1 and 2.

* Where a service run of conduit or electrical metallic tubing does not exceed 50 feet in length and does not contain more than the equivalent of two quarter bends from end to end, two No. 4 insulated and one No. 4 bare conductors may be installed in 1-inch conduit or tubing.

Table 5, Chapter 10

Change the figure 1/2 in the sixth column, first line, opposite the figure "14" under the heading "size of conductors" to 3/4.

Tables 6 and 7

Delete tables 6 and 7.

Table 9, Chapter 10

Delete Table 9 and insert the following:

TABLE 9

Number of Conductors in Conduit or Tubing
MORE THAN NINE CONDUCTORS
RUBBER-COVERED TYPES RF-32, R, RH, RW, RU
THERMOPLASTIC TYPES TF, T, AND TW

(*When Specially Permitted by This Code
 (See Orders 13-3032, 13-3466, 13-3487))

Size AWG	Maximum Number of Conductors in Conduit or Tubing						
	3/4 Inch	1 Inch	1 1/4 Inch	1 1/2 Inch	2 Inch	2 1/2 Inch	3 Inch
18	12	20	35	49	80	115	176
16	10	17	30	41	68	97	150
14	-----	10	18	25	40	59	90
12	-----	-----	15	21	35	50	77
10	-----	-----	13	17	29	41	64
8	-----	-----	-----	10	17	25	38
6	-----	-----	-----	-----	-----	15	23

* More than nine conductors are permitted in a single conduit for conductors between a motor and its controller; stage pocket and border circuits, Order 13-5211; sign flashers, Order 13-6021-d; elevator control conductors, Order 13-6214; signal and control circuits, Orders 13-8006A1; 13-8012B2.

Table 10, Chapter 10

Delete Table 10.

Table 11, Chapter 10

Delete Table 11 and insert the following new Table No. 11:

TABLE 11

Combination of Conductors

(See Orders 13-3466, 13-3487)

For groups or combinations of conductors not included in the Tables 4 to 9, it is recommended that the conduit or tubing be of such size that the sum of the cross-sectional areas of the individual conductors will not be more than the percentage of the interior cross-sectional area of the conduit or tubing as shown in the following table:

Per Cent Area of Conduit or Tubing

	Number of Conductors				
	1	2	3	4	Over 4
Conductors (not lead covered)-----	53	31	43	40	40
Lead-covered conductors-----	55	30	40	38	35
For rewiring existing raceways for increased load where it is impracticable to increase the size of the raceway due to structural conditions-----	60	40	50	50	50

For carrying capacity of more than three conductors in a conduit or tubing, see Tables 1 and 2, Note 4.

See Note to Table 13 for size of conduit or tubing for combinations of conductors not included in Table 4.

See Tables 12 to 19 for dimensions of conductors, conduit and tubing.

Table No. 12

Insert the following new table.

Tables 12, 13, 16 and 17. Tables 12, 13, 16 and 17 give the nominal size of conductors and conduit or tubing recommended for use in computing size of conduit or tubing for various combinations of conductors. The dimensions represent average conditions only, and while variations will be found in dimensions of conductors and conduits of different manufacture, these variations will not affect the computation.

TABLE 12
Dimensions and Per Cent Area of Conduit or Tubing
Areas of Conduit or Tubing for the Combinations of Wires Permitted by Table 11

Trade Size	Internal Diameter Inches	AREA—SQUARE INCHES									
		Total 100%	Not Lead Covered				Lead Covered				
			1 Cond. 53%	2 Cond. 31%	3 Cond. 43%	4 Cond. and Over 40%	1 Cond. 55%	2 Cond. 30%	3 Cond. 40%	4 Cond. 38%	Over 4 Cond. 35%
1/2	.622	.30	.16	.09	.13	.12	.17	.09	.12	.11	.11
3/4	.824	.53	.28	.16	.23	.21	.29	.16	.21	.20	.19
1	1.049	.86	.46	.27	.37	.34	.47	.26	.34	.33	.30
1 1/4	1.380	1.50	.80	.47	.65	.60	.83	.45	.60	.57	.53
1 1/2	1.610	2.04	1.08	.63	.88	.82	1.12	.61	.82	.78	.71
2	2.067	3.36	1.78	1.04	1.44	1.34	1.85	1.01	1.34	1.28	1.18
2 1/2	2.469	4.79	2.54	1.48	2.06	1.92	2.63	1.44	1.92	1.82	1.68
3	3.068	7.38	3.91	2.29	3.17	2.95	4.06	2.21	2.95	2.80	2.58
3 1/2	3.548	9.90	5.25	3.07	4.26	3.96	5.44	2.97	3.96	3.76	3.47
4	4.026	12.72	6.74	3.94	5.47	5.09	7.00	3.82	5.09	4.83	4.45
4 1/2	4.506	15.95	8.45	4.94	6.86	6.38	8.77	4.78	6.38	6.06	5.57
5	5.047	20.00	10.60	6.20	8.60	8.00	11.00	6.00	8.00	7.60	7.00
6	6.065	28.89	15.31	8.96	12.42	11.56	15.89	8.67	11.56	10.98	10.11

Table 13, Chapter 10

Repeat Table 13 and adopt the following new Table 13.

TABLE 13
Dimensions of Rubber-Covered and Thermoplastic Covered Conductors

Size AWG MCM	Types RF-32, R, RH, RW		Types TF, T, TW, RU**	
	Approx. Diam. Inches	Approx. Area Sq. Ins.	Approx. Diam. Inches	Approx. Area Sq. Ins.
18	.146	.0167	.106	.0088
16	.158	.0196	.118	.0109
14	2/64 ins. .171	.0230	.131	.0135
14	3/64 ins. .204*	.0327*		
12	2/64 ins. .188	.0278	.148	.0172
12	3/64 ins. .221*	.0384*		
10	.242	.0460	.169	.0224
8	.311	.0760	.228	.0408
6	.397	.1238	.323	.0819
4	.452	.1605	.372	.1087
3	.481	.1817	.401	.1263
2	.513	.2067	.433	.1473
1	.588	.2715	.508	.2027
0	.629	.3107	.549	.2367
00	.675	.3578	.595	.2781
000	.727	.4151	.647	.3288
0000	.785	.4840	.705	.3904
250	.868	.5917	.788	.4877
300	.933	.6837	.843	.5581
350	.985	.7620	.895	.6291
400	1.032	.8365	.942	.6969
500	1.119	.9834	1.029	.8316
600	1.233	1.1940	1.143	1.0261
700	1.304	1.3355	1.214	1.1575
750	1.339	1.4082	1.249	1.2252
800	1.372	1.4784	1.282	1.2908
900	1.435	1.6173	1.345	1.4208
1000	1.494	1.7581	1.404	1.5482
1250	1.676	2.2062	1.577	1.9532
1500	1.801	2.5475	1.702	2.2748
1750	1.916	2.8895	1.817	2.5930
2000	2.021	3.2079	1.922	2.9013

No. 18 to No. 8, solid; No. 6 and larger stranded.
* The dimensions for Type RW conductors; also these dimensions to be used for new work in computing the size of conduit or tubing for combinations of conductors not shown in Table 4.
** Type RU conductors recognized in sizes No. 14 to No. 6.

Table 14, Chapter 10

Delete this table.

Table 15, Chapter 10

Delete this table.

Table 16, Chapter 10

Amend Table 16 by removing the conductor type "RPL" from the heading.

Table 18, Chapter 10

Delete Table 18 and adopt the following new Table 18 and table of multiplying factors.

TABLE 18
Properties of Copper Conductors

Size AWG	Area Cir. Mils	Concentric Lay Stranded Conductors		Bare Conductors		D. C. Resistance Ohms/M Ft. at 25 C. 77 F.	
		No. Wires	Diam. Each Wire Inches	Diam. Inches	*Area Sq. Inches	Bare Cond.	Tin'd. Cond.
18	1624	Solid	.0403	.0403	.0013	6.510	6.77
16	2583	Solid	.0508	.0508	.0020	4.094	4.25
14	4107	Solid	.0641	.0641	.0032	2.575	2.68
12	6530	Solid	.0808	.0808	.0051	1.619	1.69
10	10380	Solid	.1019	.1019	.0081	1.018	1.06
8	16510	Solid	.1285	.1285	.0130	.641	.660
6	26250	7	.0612	.184	.027	.410	.426
4	41740	7	.0772	.232	.042	.259	.269
3	52640	7	.0867	.260	.053	.205	.213
2	66370	7	.0974	.292	.067	.162	.169
1	83690	19	.0664	.332	.087	.129	.134
0	105500	19	.0745	.373	.109	.102	.106
00	133100	19	.0837	.418	.137	.0811	.0844
000	167800	19	.0940	.470	.173	.0642	.0668
0000	211600	19	.1055	.528	.219	.0509	.0524
	250000	37	.0822	.575	.260	.0431	.0444
	300000	37	.0900	.630	.312	.0360	.0371
	350000	37	.0973	.681	.364	.0308	.0318
	400000	37	.1040	.728	.416	.0270	.0278
	500000	37	.1162	.814	.520	.0216	.0225
	600000	61	.0992	.893	.626	.0180	.0185
	700000	61	.1071	.964	.730	.0154	.0159
	750000	61	.1109	.998	.782	.0144	.0148
	800000	61	.1145	1.031	.835	.0135	.0139
	900000	61	.1215	1.093	.938	.0120	.0124
	1000000	61	.1280	1.152	1.042	.0108	.0111
	1250000	91	.1172	1.289	1.305	.00864	.00890
	1500000	91	.1284	1.412	1.566	.00719	.00740
	1750000	127	.1174	1.526	1.829	.00617	.00636
	2000000	127	.1255	1.631	2.089	.00539	.00555

* Area given is that of a circle having a diameter equal to the over-all diameter of a stranded conductor.

The values given in the table are those given in Circular 31 of the National Bureau of Standards except that those shown in the last column are those given in Specification B33 of the American Society for Testing Materials.

The resistance values given in the last two columns are applicable only to direct current. When conductors larger than No. 4/0 are used with alternating current the following multiplying factors should be used to compensate for skin effect.

Multiplying Factors for Converting D.C. Resistance to A.C. Resistance

Size CM	Multiplying Factor	
	25 Cycles	60 Cycles
250000		1.005
300000		1.006
350000		1.009
400000		1.011
500000		1.018
600000	1.005	1.025
700000	1.006	1.034
750000	1.007	1.039
800000	1.008	1.044
900000	1.010	1.055
1000000	1.012	1.067
1250000	1.019	1.102
1500000	1.027	1.142
1750000	1.037	1.185
2000000	1.048	1.233

Table 20, Chapter 10

Delete Table 20 and insert the following new Table 20:

TABLE 20
Conductor Sizes and Overcurrent Protection for Motors, See Tables 26 and 27, Chapter 10

These values are in accordance with Orders 13-4312, 13-4322, 13-4324 and 13-4342, except as follows: The current values in Column 1 are to be taken from Tables 21 to 24, including footnotes, but the values shown for running protection in Columns 5 and 6 must be modified if nameplate full load current values are different. Conductor sizes shown in Columns 2 and 3 may be smaller for certain motors as provided in Order 13-4312. The current values shown in Columns 5 and 6 must be reduced by 8 per cent for all motors other than open type motors marked to have a temperature rise not over 40 degrees C as required by Order 13-4322. For certain exceptions to the values in Columns 7, 8, 9, and 10, see Order 13-4342. See Order 13-4343 for values to be used for several motors on one branch circuit.

Full Load Current Rating of motor amperes	Minimum size conductor in raceways. For conductors in air or for other insulations. See Tables 1 and 2 AWG and MCM		Running Protection of Motors		Maximum Allowable Rating or Setting of Branch Circuit Protective Devices				Without Code Letters DC and wound-rotor motors.
	Type R Type T	Type RH	Maximum rating of non-adjustable protective devices	Maximum setting of adjustable protective device	With Code Letters		With Code Letters		
					Single-phase and squirrel cage and synchronous. Full voltage, resistor or reactor starting, Code Letters F to R inc.	Single-phase and squirrel cage and synchronous. Full voltage, resistor or reactor starting, Code Letters F to R inc.	Single-phase and squirrel cage and synchronous. Full voltage, resistor or reactor starting, Code Letters B to E inc.	Squirrel cage and synchronous auto-transformer starting, Code Letters B to E inc.	
Col. No. 1	2	3	Amperes	Amperes	7	8	9	10	With Code Letters All motors. Code Letter A.
1**	14	14	2*	1.25*	15	15	15	15	15
2**	14	14	3*	2.50*	15	15	15	15	15
3**	14	14	4*	3.75*	15	15	15	15	15
4**	14	14	6*	5.0 *	15	15	15	15	15
5**	14	14	8*	6.25*	15	15	15	15	15
6**	14	14	8*	7.50*	20	15	15	15	15
7	14	14	10*	8.75*	25	20	20	20	15
8	14	14	10*	10.0 *	25	20	20	20	15

9	14	14	12*	11.25*	30	25	20	15
10	14	14	15*	12.50*	30	25	20	15
11	14	14	15*	13.75*	35	30	25	20
12	14	14	15	15.00	40	30	25	20
13	12	12	20	16.25	40	35	30	20
14	12	12	20	17.50	45	35	30	25
15	12	12	20	18.75	45	40	30	25
16	12	12	20	20.00	50	40	35	25
17	10	10	25	21.25	60	45	35	30
18	10	10	25	22.50	60	45	40	30
19	10	10	25	23.75	60	50	40	30
20	10	10	25	25.0	60	50	40	30
22	10	10	30	27.50	70	60	45	35
24	10	10	30	30.00	80	60	50	40
26	8	8	35	32.50	80	70	60	45
28	8	8	35	35.00	90	70	60	45
30	8	8	40	37.50	90	70	60	45
32	8	8	40	40.00	100	80	70	50
34	6	6	45	42.50	110	90	80	60
36	6	6	45	45.00	110	90	80	60
38	6	6	50	47.50	125	100	80	60
40	6	6	50	50.00	125	100	90	70
42	6	6	50	52.50	125	110	90	70
44	6	6	60	55.0	125	110	90	70
46	4	4	60	57.50	150	125	100	70
48	4	4	60	60.0	150	125	100	80
50	4	4	60	62.50	150	125	110	80
52	4	4	70	65.0	175	150	110	80
54	4	4	70	67.50	175	150	110	90
56	4	4	70	70.00	175	150	120	90
58	3	3	70	72.50	175	150	120	90
60	3	3	80	75.00	200	175	125	100
62	3	3	80	77.50	200	175	125	100
64	3	3	80	80.00	200	175	150	100
66	2	2	80	82.50	200	175	150	100
68	2	2	90	85.00	225	175	150	110
70	2	2	90	87.50	225	175	150	110

Full Load Current Rating of motor amperes	Maximum Allowable Rating or Setting of Branch Circuit Protective Devices							
	Minimum size conductor in raceways for conductors in air or for other insulations See Tables 1 and 2 AWG and MCM		For Running Protection of Motors		Maximum Allowable Rating or Setting of Branch Circuit Protective Devices			
	Type R Type T	Type RH	Maximum rating of non-adjustable protective devices Amperes	Maximum setting of adjustable protective device Amperes	With Code Letters Single-phase and squirrel cage and synchronous. Full voltage, resistor and reactor starting, Code Letters F to R inc.	With Code Letters Single-phase and squirrel cage and synchronous. Full voltage, resistor and reactor starting, Code Letters B to E inc. Auto-transformer starts, Code Letters F, O, R, inc. Without Code Letters Squirrel cage and synchronous, auto-transformer starting, squirrel cage, squirrel cage, ** Both not more than 30 amperes.		
Col. No. 1	2	3	5	6	7	8	9	10
72	2	3	90	90.00	225	200	150	110
74	2	3	90	92.50	225	200	150	125
76	2	3	100	95.00	250	200	175	125
78	1	3	100	97.50	250	200	175	125
80	1	3	100	100.00	250	200	175	125
82	1	2	110	102.50	250	225	175	125
84	1	2	110	105.00	250	225	175	130
86	1	2	110	107.50	300	225	175	150
88	1	2	110	110.00	300	225	200	150
90	0	2	110	112.50	300	225	200	150
92	0	2	125	115.00	300	250	200	150
94	0	1	125	117.50	300	250	200	150
96	0	1	125	120.00	300	250	200	150
98	0	1	125	122.50	300	250	200	150
100	0	1	125	125.00	300	250	200	150
105	0	1	150	131.5	350	300	225	175
110	0	0	150	137.5	350	300	225	175
115	0	0	150	144.0	400	300	250	175
120	0	0	150	150.0	400	300	250	200
125	0	0	175	156.5	400	350	250	200

130	000	00	175	162.5	400	350	300	200
135	0000	00	175	169.0	450	350	300	225
140	0000	00	175	175.0	450	350	300	225
145	0000	000	200	181.5	450	400	300	225
150	0000	000	200	187.5	450	400	300	225
155	0000	000	200	194.0	500	400	350	250
160	250	000	200	200.0	500	400	350	250
165	250	0000	225	206.0	500	450	350	300
170	250	0000	225	213.0	500	450	350	300
175	300	0000	225	219.0	600	450	350	300
180	300	0000	225	225.0	600	450	300	300
185	300	0000	250	231.0	600	500	400	300
190	300	250	250	238.0	600	500	400	300
195	350	250	250	244.0	600	500	400	300
200	350	250	250	250.0	600	500	400	300
210	400	300	250	263.0	600	600	400	350
220	400	300	300	275.0	600	600	450	350
230	500	300	300	288.0	600	600	500	350
240	500	350	300	300.0	600	600	500	400
250	500	350	300	313.0	600	600	500	400
260	600	400	350	325.0	600	600	600	400
270	600	400	350	338.0	600	600	600	450
280	600	500	350	350.0	600	600	600	450
290	700	500	350	363.0	600	600	600	450
300	700	500	400	375.0	600	600	600	450
320	750	600	400	400.0	600	600	600	500
340	900	600	450	425.0	600	600	600	600
360	1000	700	450	450.0	600	600	600	600
380	1250	750	500	475.0	600	600	600	600
400	1500	900	500	500.0	600	600	600	600
420	1750	1000	600	525.0	600	600	600	600
440	2000	1250	600	550.0	600	600	600	600
460	460	1250	600	575.0	600	600	600	600
480	480	1500	600	600.0	600	600	600	600
500	500	1500	600	625.0	600	600	600	600

* For running protection of motors of 1 horsepower or less, see Order 13-4322
 ** For the grouping of small motors under the protection of a single set of fuses, see Order 13-4343
 *** High-reactance squirrel-cage motors are those designed to limit the starting current by means of deep-slot secondaries or double-wound secondaries and are generally started on full voltage.

Table 28, Chapter 10

Delete the present Table 28 and insert the following new table.

TABLE 28

NUMBER OF OVERCURRENT UNITS, SUCH AS TRIP COILS OR RELAYS, FOR PROTECTION OF CIRCUITS

(See Order 13-2405 for the overcurrent protection of conductors in general, Order 13-2371 for Services and Order 13-4327 for Motors.)

SYSTEMS	*Number and Location of Overcurrent Units
2-Wire, Single-phase A.C. or D.C. Ungrounded.	Two (one in each conductor. Fig. 1).
2-Wire, Single-phase A.C. or D.C., One Wire Grounded.	One (in ungrounded conductor. Fig. 2).
2-Wire, Single-phase A.C. or D.C., Mid-point Grounded.	Two (one in each conductor. Fig. 3).
2-Wire, Single-phase A.C. Derived from 3-Phase, with Ungrounded Neutral.	Two (one in each conductor. Fig. 4).
2-Wire, Single-phase Derived from 3-Phase, Grounded Neutral System by Using outside Wires of 3-Phase Circuit.	Two (one in each conductor. Fig. 5).
3-Wire, Single-phase A.C. or D.C. Ungrounded Neutral.	Three (one in each conductor. Fig. 6).
3-Wire, Single-phase A.C. or D.C. Grounded Neutral.	Two (one in each conductor except neutral conductor. Fig. 7).
3-Wire, 2-Phase, A.C., Common Wire Ungrounded.	Three (one in each conductor. Fig. 8).
3-Wire, 2-Phase, A.C., Common Wire Grounded.	Two (one in each conductor except common conductor. Fig. 9).
4-Wire, 2-Phase, Ungrounded, Phases Separate.	Four (one in each conductor. Fig. 10).
4-Wire, 2-Phase, Grounded Neutral, or 5-Wire, 2-Phase, Grounded Neutral.	Four (one in each conductor except neutral conductor. Figs. 11 and 12).
3-Wire, 3-Phase, Ungrounded.	Three (one in each conductor. Fig. **13).
3-Wire, 3-Phase, 1 Wire Grounded.	Two (one in each ungrounded conductor. Fig. 14).
3-Wire, 3-Phase, Grounded Neutral.	Three (one in each conductor. Fig. **15).
3-Wire, 3-Phase, Mid-point of one phase grounded.	Three (one in each conductor. Fig. **17).
4-Wire, 3-Phase, Grounded Neutral.	Three (one in each ungrounded conductor. Fig. **18).
4-Wire, 3-Phase, Ungrounded Neutral.	Four (one in each conductor. Fig. 19).

* 1. An overcurrent unit may consist of a series overcurrent tripping device or the combination of a current transformer and a secondary overcurrent tripping device. Either two or three secondary overcurrent tripping devices may be used with three current transformers on a 3-phase system similar to those shown in Figures 15 and 18.

** 2. When three current transformers are used instead of three series overcurrent tripping devices shown in Figures 13, 15, 17 and 18, the secondary tripping devices may consist of three secondary overcurrent tripping devices or two secondary overcurrent tripping devices with a residual current tripping device of a lower range. See Figure 16.

3. Where standard devices are not available with three or four overcurrent units as required in the table, it is permissible to substitute two overcurrent units and one fuse where three overcurrent units are called for, two overcurrent units and two fuses where four overcurrent units are called for. The fuse or fuses are to be placed in the conductors not containing an overcurrent unit. This practice, however, of substituting fuses for overcurrent units is to be discouraged for obvious reasons.

Table 29, Chapter 10

Delete Table 29 and insert the following new Table 29.

TABLE 29

Demand Loads for Household Electric Ranges and Other Cooking Appliances Over 1 1/4 KW Rating

Column A to be Used in All Cases Except as Otherwise Permitted in Note 3 Below

Number of Ranges	Maximum Demand (See Notes)	Demand Factors (See Note 3)	
	Column A (Not Over 12 kw Rating)	Column B (Less than 3 1/2 kw Rating)	Column C (3 1/2 kw to 8 3/4 kw Rating)
1.....	8 kw	80%	80%
2.....	11 kw	75%	65%
3.....	14 kw	70%	55%
4.....	17 kw	66%	50%
5.....	20 kw	62%	45%
6.....	21 kw	59%	43%
7.....	22 kw	56%	40%
8.....	23 kw	53%	38%
9.....	24 kw	51%	35%
10.....	25 kw	49%	34%
11.....	26 kw	47%	32%
12.....	27 kw	45%	32%
13.....	28 kw	43%	32%
14.....	29 kw	41%	32%
15.....	30 kw	40%	32%
16.....	31 kw	39%	28%
17.....	32 kw	38%	28%
18.....	33 kw	37%	28%
19.....	34 kw	36%	28%
20.....	35 kw	35%	28%
21.....	36 kw	34%	26%
22.....	37 kw	33%	26%
23.....	38 kw	32%	26%
24.....	39 kw	31%	26%
25.....	40 kw	30%	26%
26-30.....	15 kw plus 1 kw	30%	24%
31-40.....	for each range	30%	22%
41-50.....	25 kw plus 1/4	30%	20%
51-60.....	kw for each	30%	18%
61 and over.....	range	30%	16%

Note 1. Over 12 kw to 21 kw Ranges. For ranges individually rated more than 12 kw but not more than 21 kw, five per cent shall be added to the above maximum demand (Column A) for each additional kw of rating or major fraction thereof by which the individual range rating exceeds 12 kw.

Note 2. Over 21 kw Ranges. Ranges individually rated more than 21 kw are not considered as household electric ranges and the demand should be determined on the basis of rating and use. Generally, the demand for commercial ranges should be based on the maximum nameplate rating.

Note 3. Over 1 1/4 kw to 8 3/4 kw. In lieu of the method provided in Column A, the load for ranges individually rated more than 1 1/4 kw but not more than 8 3/4 kw may be considered as the sum of the nameplate ratings of all the ranges, multiplied by the demand factors specified in Columns B or C for the given number of ranges.

Note 4. Branch Circuit Load. Branch circuit load for one range may be computed in accordance with the above table.

Table 30

Following page 277

Insert the following new Table 30.

TABLE 30
Capacitor Ratings for Use With Open-Type Three-Phase Sixty Cycle Induction Motors

Motor Rating HP	3600 RPM*		1800 RPM*		1200 RPM*		900 RPM*		720 RPM*		600 RPM*	
	Max. Capacitor Rating Kva	Reduction In Line Current %	Max. Capacitor Rating Kva	Reduction In Line Current %	Max. Capacitor Rating Kva	Reduction In Line Current %	Max. Capacitor Rating Kva	Reduction In Line Current %	Max. Capacitor Rating Kva	Reduction In Line Current %	Max. Capacitor Rating Kva	Reduction In Line Current %
10	2.5	9	4.	11	4.	12	5.	17	5.	23	7.5	28
15	2.5	9	5.	11	5.	11	7.5	15	7.5	21	10.	26
20	5.	9	5.	10	5.	11	7.5	15	10.	20	10.	24
25	5.	9	7.5	10	7.5	10	10.	14	10.	19	15.	22
30	7.5	9	10.	9	10.	10	12.5	13	12.5	18	15.	21
40	10.	9	10.	9	10.	9	15.	12	15.	16	17.5	19
50	12.5	9	12.5	8	12.5	9	17.5	11	20.	15	22.5	16
60	15.	9	15.	8	15.	8	20.	11	27.5	14	25.	15
75	17.5	9	17.5	8	17.5	8	25.	10	30.	13	30.	15
100	22.5	9	22.5	8	22.5	8	30.	9	40.	12	37.5	14
125	25.	9	27.5	8	27.5	8	35.	9	47.5	11	47.5	13
150	32.5	9	35.	8	35.	8	45.	9	60.	11	55.	13
200	42.5	9	42.5	8	42.5	8		9		10	67.5	12

* Synchronous speed.

If capacitors of a lower rating than the values given in the table are used, the percentage reduction in line current given in the table shall be reduced a corresponding amount.

Figures 1 to 14 inclusive

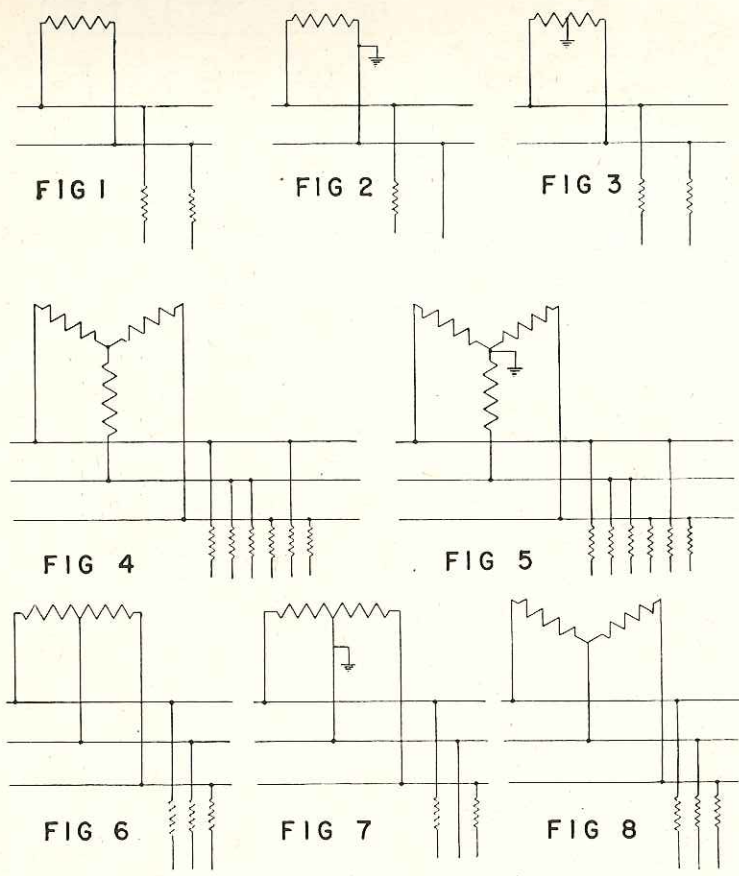
Page 284

Delete the present figures 1 to 14 inclusive and insert the following new figures 1 to 19 inclusive.

DIAGRAMS

Diagrams 1 to 19 showing Number of Overcurrent Units such as Trip Coils or Relays for the Protection of Circuits as required by Table 28.

** See Note 2 Table 28.



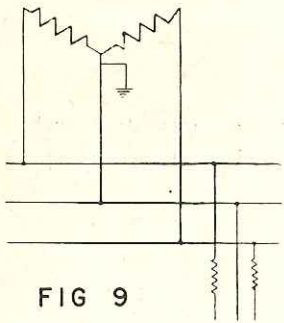


FIG 9

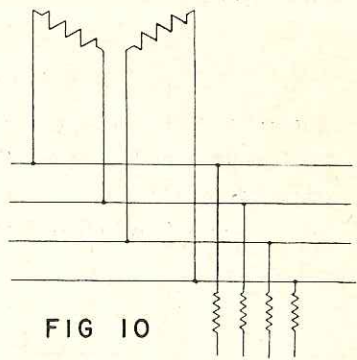


FIG 10

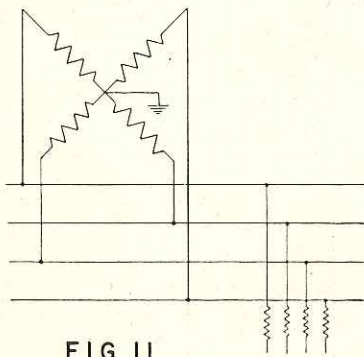


FIG 11

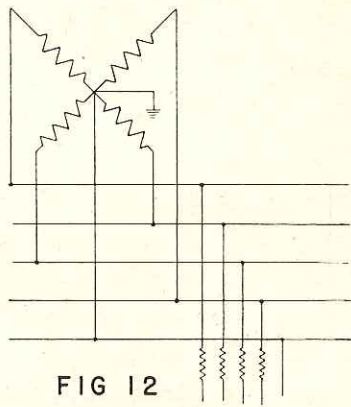


FIG 12

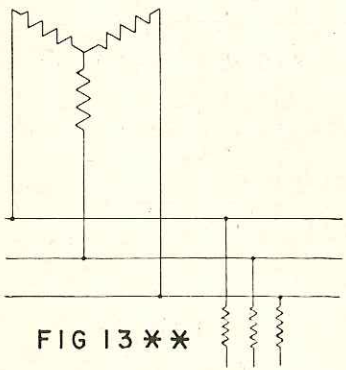


FIG 13**

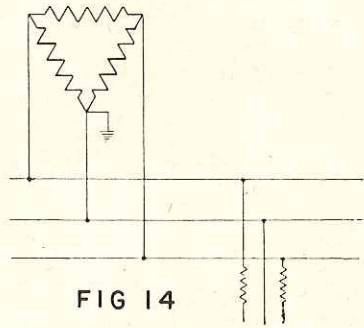


FIG 14

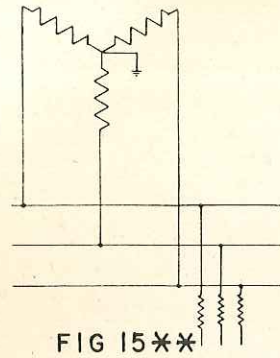


FIG 15**

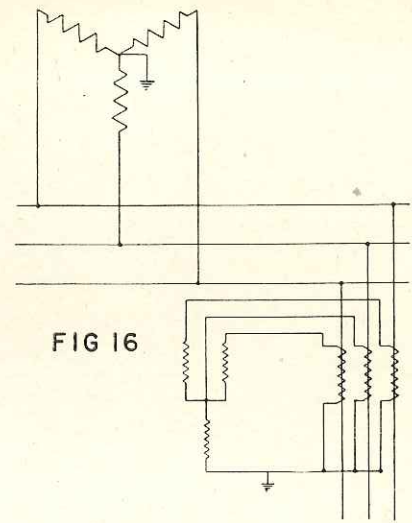


FIG 16

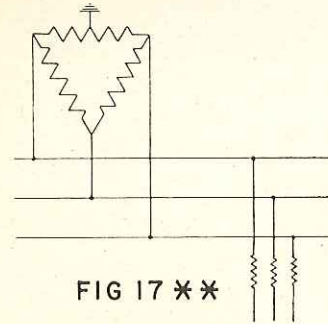


FIG 17**

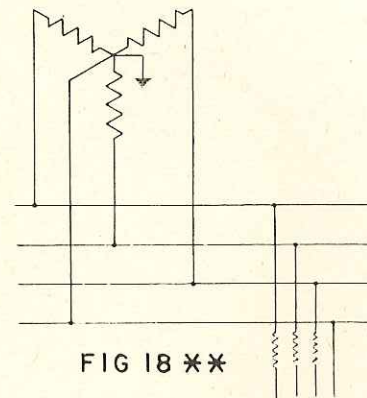


FIG 18**

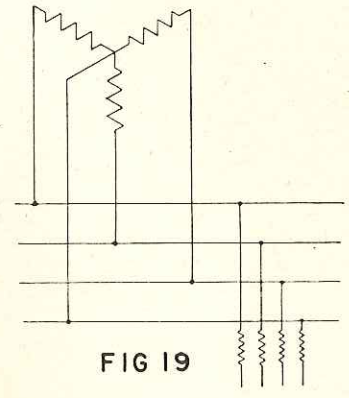


FIG 19

Figure 15

Change the number of the figure to "figure 20".