

1302 - Location and Enclosure of Fuses and Circuit Breakers.

a. Fuses shall be installed in readily and safely accessible locations. Circuit breakers shall be so installed that they may be manually operated from a readily and safely accessible place. Where possible, the top of a fuse and the center of the grip of a circuit breaker operating handle or lever, when in its highest position, shall not be more than 7 feet above the floor or working platform. Cutouts shall not be installed in clothes or water closets, bath rooms nor in any locations where access to same is liable to be obstructed.

(Fine print note.) It is the intent of the above rule to require cutouts to be so located that fuses may be readily and safely inspected or renewed without climbing over or removing obstructions or resorting to chair, box or portable ladder. By special permission the requirements may be waived or modified where cutouts are used with special apparatus as, for example, in the case of cutouts installed in sign flasher boxes.

b. Fuses or circuit breakers shall not be placed in locations where excessive moisture, acid fumes or corrosive vapors exist, when any other location is practicable, nor in the immediate vicinity of easily ignitable materials, nor where exposed to inflammable gases or flying particles of combustible material, except when absolutely necessary, and where so installed shall be suitably protected against the hazards of the location.

6. Fuses and circuit breakers shall be installed in approved metal outlet boxes or cabinets or other approved enclosures. In wet places or where exposed to the weather they shall be installed in approved weather-proof outlet boxes or cabinets. It is not required, however, that fuses on switchboards on which exposed knife switches are permitted nor that certain airbreak circuit breakers on switchboards, be installed in boxes or cabinets.

1303 - Fuses - General Requirements for.

a. Fuses shall be of approved enclosed type. They shall be marked so that the marking will be plainly visible with the name or trade mark of the maker, and the voltage and current for which the fuse is designed.

b. The rated capacity of fuses shall not exceed the allowable current-carrying capacity of conductors, as given in section 1209, unless specifically permitted by other sections of this code. Fixture wire or flexible cord of No. 18 B & S gage will be considered as properly protected from short circuits by 15 ampere fuses.

c. For the protection of conductors having safe carrying capacities exceeding the rated capacity of the largest approved enclosed type fuses, approved enclosed fuses arranged in multiple may be used provided as few fuses as possible are used and the fuses are of equal capacity and provided the outlet terminals are mounted on a single continuous pair of substantial bus bars. The total capacity of the fuses shall not exceed the safe carrying capacity of the conductors. This paragraph shall not apply to motor branch circuits.

d. Approved 125 volt plug fuses, or cartridge fuses in approved 125 volt plug casings, may be used in 250 volt 2-wire circuits which are directly derived from a 125-250 volt 3-wire system with grounded neutral provided the outlet bases have standard 250 volt spacing. They cannot be used in any 220-volt 3-phase circuit.

(Fine print note) The above rule shall not be construed to permit the use of any 125-volt switch in any 2-wire circuit operating at more than 125 volts; nor to permit less than the standard approved spacing between bare live parts of opposite polarity on outlet bases, panel boards, etc.

e. An individual switch (see section 1404) shall be installed directly ahead of every fusible outlet (including thermal outlets) with the following exceptions:

1. An individual switch shall not be required ahead of approved plug type fuses unless the lamps or other devices supplied through such cutout are controlled only from the point where such cutout is located.

2. An individual switch shall not be required ahead of either cartridge or plug type fuses in meter sets installed, maintained and under seal of the serving agency.

3. For individual range installations where the service fuses, range fuses, and lighting fuses are installed in one self-contained panel the service switch may serve to disconnect both the service fuses and the range fuses.

4. Switches shall not be required in connection with the individual cutouts in stage plugging boxes, ovens or other self-contained devices which have been approved as a unit; nor ahead of fuses used only for the protection of instrument circuits (usually installed on switchboards or motor control panels); nor ahead of large capacity cutouts operating at less than 100 volts.

5. Additional cutouts may be added to existing distributing panels (or cutout base assemblies) in a manner similar to the original installation, provided the space within the cabinet or cutout box will permit such additional cutouts to be safely and properly installed. No cutout shall be placed on the side wall of any cabinet or cutout box.

1304 - Circuit Breakers - Setting and Number of Trip Coils Required

a. Circuit breakers shall not be set more than 30 per cent above the allowable carrying capacity of the conductor unless a fuse of a rating which properly protects the conductor is also installed in the circuit.

b. An automatic circuit breaker, except as provided for generators in Section 1315 of this Code, when installed without other automatic overload protective devices, shall have one pole in each ungrounded conductor.

c. For all automatic circuit breakers, the number of overload trip coils shall not be less than as follows:

SYSTEMNUMBER AND LOCATION OF OVERLOAD
PROTECTIVE DEVICES.

3 wire 3 phase A.C. Ungrounded or
with one conductor grounded.

2 trip coils, one in each of
two ungrounded conductors.

3 wire 3 phase A.C. with grounded
neutral

3 trip coils, one in each conduct-
or or two trip coils and one fuse.

4 wire 3 phase A. C.

3 trip coils, one in each phase,
or 2 trip coils and one fuse.

4 wire 2 phase A. C. ungrounded

2 trip coils, one in each phase.

3 wire 2 phase A. C.

2 trip coils, one in each outside
conductor.

4 wire 2 phase A. C. with ground-
ed neutral.

4 trip coils, one in each un-
grounded conductor, or two trip
coils and two fuses.

5 wire 2 phase A. C.

4 trip coils, one in each unground-
ed conductor, or two trip coils
and two fuses.

3 wire 1 phase A. C. or D. C.

2 trip coils, one in each outside
conductor.

2 wire A. C. or D. C. ungrounded
or with one conductor grounded.

1 trip coil, in ungrounded con-
ductor.

2 wire A. C. or D. C. with
grounded neutral.

2 trip coils, one in each con-
ductor.

4. Circuit breakers shall be plainly marked, so that the marking will be visible when installed, with the name of the maker and the current and voltage for which the device is designed.

1305 - Protection of Branch Circuits.

a. All ungrounded conductors of a branch circuit shall be protected by fuses or circuit breakers. When the grounded conductor is identified throughout the entire installation and properly connected, branch circuits shall be protected by fuses in the ungrounded conductors only. In locations where the conditions of grounding or the liability of the reversal of connections warrant, both conductors of 2-wire branch circuits shall be fused. (See section 1706).

b. Circuit breakers, if used for the protection of lighting and appliance branch circuits, shall be of a type specifically approved for this purpose.

c. Lighting and appliance branch circuits, except as noted in items (1), (2) and (3), below, shall be protected by fuses of no greater rated capacity than

15 amperes.....at 125 volts or less
10 amperes.....at 126 to 250 volts.

1. Special heating circuits, as noted in paragraph (a), section 1805 of this Code may be protected by fuses of not more than 25 amperes rated capacity.

2. Lighting circuits described in paragraph (b), section 1805 of this Code, may be protected by fuses of not more than 20 amperes rated capacity for 125 volt circuits or 10 amperes rated capacity for 250 volt circuits.

3. Special lighting circuits as noted in paragraph (c), section 1805 of this Code may be protected by fuses of not more than 40 amperes rated capacity for 125 volt circuits or 20 amperes rated capacity for 250 volt circuits.

1806 - Three-Wire Branch Circuits.

a. No 3-wire branch lighting circuit shall be installed in any dwelling installation of 6 circuits or less. 3-wire branch lighting circuits shall not be run except from 3-wire direct-current or single-phase alternating-current 125-250 volt systems having a properly identified and grounded neutral.

b. The neutrals of 3-wire branch circuits shall not be fused and they shall not be interconnected at any point except at the center of distribution. All outlet boxes or blocks, panel boards, etc., used with 3-wire branch circuits shall be expressly designed and approved for such use.

c. All loads supplied by 3-wire branch circuits shall be connected between the neutral and one of the outside conductors. Current-consuming devices or equipment operating at the voltage between outside wires shall not be supplied by a 3-wire branch circuit.

d. The maximum wattage and number of outlets, sockets, etc., on each side of a 3-wire branch circuit shall not exceed the permissible wattage or number of sockets allowed on 2-wire branch circuits. (See sections 1804 and 1805).

1807 - Panel Boards - Type Required.

a. Panel boards shall be so constructed and installed that access may be had to all switch buttons or handles and to plug fuses without exposing any circuit or feeder wiring or any bus bars, terminals, or other current-carrying parts when fuse plugs are in their receptacles.

b. Panel boards equipped with cartridge fuses shall, with the exception noted in paragraph (c) of Section 1803, have an individual safety type switch installed directly ahead (on the line side) of each cutout. This switch shall be installed in compliance with paragraph (a) of this section and shall be a part of an approved panel board assembly.

c. When cutout bases, with or without switches, are installed in cabinets or cutout boxes for use in lieu of panel boards, they shall comply with all applicable requirements for panel boards.

d. Feeder and branch circuit panel boards (or cutout bases and switches used in lieu of panel boards) shall be approved. When used with 3-wire circuits with grounded neutral or with 2-wire circuits with unfused grounded conductor, they shall be expressly designed and approved for such purposes. It shall not be permissible to splice the neutral to the main and carry it through solid without connection to a terminal provided for the purpose.

50.08
c. Suitable means shall be provided on panel boards of more than 4 circuits, on cutout bases used in lieu of panel boards, for identifying the cutouts with the circuits or equipment which they respectively control. This may be done by providing a card holder for each circuit or by numbering each cutout and providing a typed or printed directory on the door of the cabinet.

(Fine print note.) Cutouts installed in cabinets with sign flashers shall not be construed as panel boards when interpreting the requirements of this section.

1308 - Panel Boards - Spacing of live parts.

a. When there are exposed live metal parts on the back of board, a space of at least $\frac{1}{2}$ inch shall be provided between such live metal parts and the cabinet in which the board is mounted.

b. The following minimum distances shall be maintained between bare live metal parts of opposite polarity, bus bars, enclosed cutouts, etc.

<u>When mounted on the same surface.</u>	<u>When held free in air.</u>
Not over 125 volts --- $\frac{1}{2}$ inch	$\frac{1}{2}$ inch
Not over 250 volts --- $\frac{1}{2}$ "	$\frac{1}{2}$ "
Not over 600 " 2 "	1 "

At switches or enclosed fuses, parts of the same polarity may be placed as close together as convenience in handling will allow. The spacings given in the first column shall apply to the branch conductors where enclosed fuses are used. The spacings given in the second column shall apply to the distance between the raised main bars and between these bars and the branch bars over which they pass.

(Fine print note.) The above distances are the minimum allowable, and it is recommended that greater distances be adopted wherever the conditions will permit.

1309 - Distributing Centers other than Panel Boards.

a. The requirements of this section shall apply to low-potential distributing centers consisting of an assembly of cables, wires or busses in metal wire-ways to which fuses, switches or circuit breakers are connected for the control of feeders, motors and similar equipment, placed in or against a wall or partition and accessible only from the front. (See also Switchboards Article 25.)

b. All busses, cables, wires and connections shall be entirely enclosed in metal wire-ways, metal gutters, or conduit. Metal wire-ways shall be constructed and installed in compliance with section 1011.

c. The tap connections from cables or busses to the switches and cutouts of a distributing center need not be larger than the circuits which are controlled and protected by the switches and cutouts when the length of the tap does not exceed 3 feet.

d. Bus conductors in wire-ways shall be of such size that they will be properly protected by the fuses or circuit breaker to which they are connected; provided, however, that where the length of such conductors does not exceed 25 feet, they shall be considered as being properly protected from short circuits and grounds if the fuses to which they are connected are rated or the circuit breaker set not to exceed 400% of the safe carrying capacity of the conductor.

e. When the required size of bus conductor exceeds No. 4/0, bus bars equipped with suitable terminal lugs for branch feeder or branch circuit taps shall be provided. They shall be securely and rigidly supported so that there will be a minimum clearance of one inch between bare live metal parts of opposite polarity, and between such bare live metal parts and the metal of the wire-way or any uninsulated grounded surfaces.

f. Bare copper bus bars which are enclosed in cabinets or metal wire-ways shall not be required to carry continuously more than 1000 amperes per square inch of cross section.

g. The two or more conductors of alternating current and direct current circuits shall be installed in the same wire-way.

h. Conductors of different systems shall not be installed in the same wire-way unless dividing partitions are provided in the wire-way which will effectively separate the two systems. An exception to this rule shall be made in connection with the meter and service wires which are installed and maintained by the serving agency. (See section 1007, paragraph (c)).

i. Suitable means shall be provided at all distributing centers for identifying the switches and cutouts with the circuits or equipment which they respectively control.

1310 - Protection of Motor Circuits.

a. Each ungrounded conductor of a circuit supplying current to one motor or a group of motors shall be protected against overload in accordance with the general requirements contained in sections 1301 to 1304 inclusive of this code, except as such requirements are modified by this section.

b. Circuit breakers or fuses may be used for the protection of motor circuits. When the current or voltage exceeds the maximum current or voltage for which enclosed fuses are approved, circuit breakers shall be used.

c. Automatic overload protective devices may be omitted at the point where conductors carrying the current of only one motor are connected to feeders, provided their current-carrying capacity is at least $\frac{1}{3}$ that of the feeders, the length of the conductors between the feeders and the motor running overload protective devices is not greater than 25 feet and they are installed in conduit. If such running overload protective consists of thermal cutouts, the feeders to which the branch circuit is connected shall be protected by approved fuses, not by circuit breakers.

d. In a branch circuit supplying current to a single alternating current motor of the type requiring large starting current the rating of the fuse may be determined by taking for the carrying capacity of the conductor the value given in column C of the tables without regard to the kind of insulation on the wire. This shall not be construed as allowing the use of a rubber covered or varnished cambric covered conductor having a carrying capacity of less than 125% of the motor current rating according to tables A and B of section 1209 respectively in a circuit supplying current to a single motor.

(Fine print note) When auto transformer starters are used the required size of fuse to carry the starting current of motors of the above type will usually not exceed 250% of the motor name plate current rating for ratings not over 30 amperes and 200% for larger ratings. When auto transformer starters are not used the required size of the fuse will seldom need to exceed 300% of the motor name plate current rating for ratings not over 30 amperes and 250% for larger ratings.

The required size of fuses in a feeder supplying a group of motors of the type requiring large starting current will usually not exceed the sum of the name plate current ratings of the motors unless there is one motor in the group which has a rating of more than 40% of the total load on the feeder. Where the rating of one motor exceeds 40% of the total connected load, the required size of fuses may be somewhat larger than the sum of the name plate current ratings of the motors in order to carry the momentary heavy starting current of the large motor in addition to the normal full load currents of the remaining motors; in such cases it will be permissible to fuse the feeder conductors in excess of table (A) rating (but not in excess of table (C) rating) provided they have a safe continuous current-carrying capacity not less than the sum of the motor current ratings plus 25% of the full load current rating of the largest motor in the group. The actual size of fuses required in a feeder supplying a group of 3-phase motors where the capacity of one motor exceeds 40% of the total load will usually not exceed the values determined from the equations below, or the values indicated by the straight line graphs on page _____.

$$\begin{array}{ll} \text{Size of fuse for 220 volts 3-phase} & = 4.5 (L + .22R + 5.5) \\ \text{" " " " 440 " 3-phase} & = 2.25 (L + .22R + 11) \end{array}$$

Where L = H. P. rating of largest motor in group.

R = Sum of the H. P. ratings of the remaining motors.

c. The conductors in that portion of a motor circuit between a motor running protective device which is started or cut out during the starting period and its motor shall be considered as sufficiently protected during the starting period if there is a fuse or circuit-breaker back on the line which is rated or set at not more than 800% of the motor current rating.

1511 - Protection of Motors - General.

a. Motors of other than continuous rating or used on other than constant load duty and continuous rated motors of $\frac{1}{2}$ H. P. or less shall be considered as being sufficiently protected by the automatic overload devices used to protect the conductors of the motor circuit as provided in section 1510 of this Code.

b. Each continuous rated motor of over $\frac{1}{2}$ H. P. when used for constant load duty shall be protected by fuses, circuit breaker, or by thermal cutoffs or relays in accordance with sections 1512, 1513 and 1514 of this Code, respectively; provided, however, that no overload protection shall be required for motors driving condenser pumps or standard fire pumps, or in cases where other considerations are of more serious importance.

c. The motor running protective devices may be shunted or cut out during the period for starting the motor and the motor shall be considered sufficiently protected during this starting period by the next overload device back on the line if the rating of this fuse or the setting of this circuit-breaker is not over 500% of the name plate current rating of the motor.

1312 - Motor Protection - Using Fuses.

a. When fuses are used for the running protection of motors, a fuse shall be placed in each ungrounded conductor. The rating of these fuses shall not exceed 125% of the motor current rating unless this is not a value corresponding to a standard rating for fuses, when the next higher standard fuse rating may be taken.

b. Where it is evident from the nature of the load that fuses rated at 125% of the motor name plate current rating will not carry the peak current required by the motor, (as for example in the case of individual motor drives for cut-off saws, planers and similar machines) then suitable thermal cutouts, relays or time limit circuit breakers rated or set not to exceed 125% of the motor current rating shall be provided in lieu of fuses. (See section 2308 for requirements as to no-voltage release).

c. Two or more small motors ($\frac{1}{2}$ H. P. or less) grouped under the protection of a single set of fuses shall be considered as being sufficiently protected if the rating of the fuses does not exceed 15 amperes and if the total wattage of the circuit does not exceed 1200. (The use of motors on branch lighting circuits is restricted by Section 1803(c) of this Code).

1313 - Motor Protection - Using Circuit Breakers.

a. If a circuit breaker or overload relay is used to provide running protection for a motor it shall have a continuous current capacity of at least 110% of the name plate current rating of the motor. If the overload relay is of the time limit type its setting shall not exceed 125% of the name plate current rating of the motor and if of the instantaneous type its setting shall not exceed 160% of the name plate current rating of the motor. The instantaneous type of relay shall not be used in circuits or feeders supplying current to motors of the type requiring large starting current.

b. Circuit breakers shall not be used for the running protection of motors, except (a) on main switch boards or where otherwise subject to competent supervision, (b) where next back on the line there are fuses rated or circuit breakers set at not over 500% of the motor name plate current rating, or (c) for circuits having a maximum capacity greater than that for which approved enclosed fuses are rated.

c. Circuit breakers shall open all ungrounded conductors of the circuit simultaneously, except that for direct current and single phase motors on ungrounded circuits, 1 single pole circuit breaker may be used in each conductor or a single pole circuit breaker may be provided in one conductor and a fuse in the other.

One pole of the circuit-breaker may be placed in a permanently grounded conductor provided the circuit-breaker is so designed that the pole in the grounded conductor cannot be opened without simultaneously opening all of the conductors of the circuit.

d. The number of overload trip coils shall not be less than shown in the table of section 1304.

(Fine print note) Motor running overload protective devices used on 3-phase circuits with grounded neutral may have trip coils in two conductors of the circuit only where next back on the line are fuses rated or circuit-breakers set at not over 500% of the motor name plate current rating. Motor running overload protective devices used on 3-phase circuits having one conductor of the circuit grounded shall have trip coils connected in the ungrounded conductors of the circuit only.

e. A controller for a D. C. motor which has an overload release device operative during the starting as well as the running period may also serve as the automatic overload protective device.

f. The controller for an A. C. motor may also serve as the automatic overload protective device, if it is equipped with the required number of trip coils and if it is operative when in the running position to open all of the ungrounded conductors automatically under overload.

1514 - Motor Protection - Using Thermal Cutouts or Relays.

a. Thermal cutouts or relays used to provide running protection for a motor shall be rated or set at not more than 125% of the name plate current rating of the motor. If this is not a value corresponding to a standard rating for thermal cutouts then the next higher rated thermal cutout may be used.

b. Thermal cutouts or relays shall be installed in approved cabinets, cutout boxes or similar enclosures. A switch shall be provided directly ahead of each thermal cutout.

c. Thermal cutouts or relays shall not be used unless next back on the line there are fuses of a rating with which the thermal cutouts or relays can be safely used as indicated by the marking on the cutouts or relays.

(Fine print note) If the rating of the fuses with which thermal relays may be safely used is not specifically indicated, fuses rated not to exceed 500% of the normal current rating of the relay may be used, provided that fuses rated at 50 amperes or less will be considered as protecting relays having normal current ratings of less than 5 amperes.

d. Two or more motors without regard to size and each with thermal cutouts or relays for running protection may be grouped on a single motor circuit having fuses for the protection if its conductors provided the rating of the fuses does not exceed the rating with which the smallest thermal cutout or relay of the group can be safely used as indicated by the marking on the thermal cutout or relay.

1315 - Protection of Generators.

a. Direct current, constant potential generators, other than exciters for alternating current machines, shall be protected from excessive current by automatic cutouts of approved design; provided, however, that in central stations where the type of apparatus used and the nature of the system operated make protective devices inadvisable and unnecessary, their omission may be permitted by the inspection department. Single pole protection shall be accepted for 2-wire, direct current generators, if the protective device is actuated by the entire generator current and will completely open the generator circuit.

b. If a generator not electrically driven supplies a 2-wire grounded system, the protective device shall be so placed as to disconnect the generator from all wires of the circuit.

c. Two wire, direct current generators, used in conjunction with balancer sets to obtain neutrals for 3-wire systems, shall be equipped with protective devices which will disconnect the 3-wire systems in the case of excessive unbalancing of voltages.

d. Three-wire, direct current generators, whether compound or shunt wound, shall be equipped with protective devices, one in each armature lead and so connected as to be actuated by the entire current from the armature. Such protective device shall consist either of a double-pole, double-coil, overload circuit breaker, or of a 4-pole circuit breaker connected in the main and equalizer leads and tripped by two overload devices, one in each armature lead. Such protective devices shall be so interlocked that no one pole can be opened without simultaneously disconnecting both leads of the armature from the system.

e. Where a generator and a transformer are intended to operate as a unit for stepping up or stepping down the voltage, and are both located in the same building, a protective device between them shall not be required.

1516 - Protection of Heating Appliances.

NOTE:- For the general requirements relating to electrically heated devices see Article 22; for switch requirements see section 1409; for conductor sizes see sections 1202, 1203 and 1502.

a. Electrically heated appliances may be used on branch lighting or appliance circuits subject to the restrictions noted in paragraph (c), Section 1803, and paragraph (e), Section 1805 of this Code.

b. Electrically heated appliances, each of 10 amperes or 2500 watts or less, may be grouped on a special 250 volt branch circuit complying with section 1805(d) of this Code.

c. Except as modified by paragraphs (a) and (b) of this section, the rating of the fuses protecting a heating appliance shall not exceed 150% of the full load current rating of the appliance. When there is no approved fuse of the calculated size, the next higher standard fuse rating may be taken.

d. Sub-divided circuits of electrically heated appliances need not be separately fused, but individual heating elements of such electrically heated appliances shall be fused if they are rated at more than 30 amperes.

e. Electrically heated appliances having a full load current rating in excess of 25 amperes per conductor shall not be used with the 0-30 ampere output.

ARTICLE 14**SWITCHES**

NOTE - For the requirements relating to switches ahead of fuses see 1303(e); for panel boards see 1306; for services see Article 15; for exit lighting see 1514(d), 5522(d), and 5525(d); for elevators see 3203; for cranes and hoists see 3105; on switch boards see Article 25; in hazardous locations see Sections 3606, 3608, and 3610.

1401 - Installation of Switches; General.

a. Switches shall be so located that they may be operated from a readily and safely accessible place. They shall not be placed more than 7 feet above the floor, or working platform, without permission.

b. Knife switches, sign flashers, remote control switches and similar appliances shall be enclosed in approved metal cabinets. When located in wet places, or where exposed to the weather, they shall be mounted in approved weather proof switch boxes or cabinets. (For locations where open knife switches are permitted see Section 1404.)

c. Where flush switches are used, whether with conduit systems or not, they shall be enclosed in an approved metal box in addition to the porcelain enclosure of the switch.

1402 - Position and Connection of Knife Switches.

a. Single throw knife switches shall be so placed that gravity will not tend to close same. Double throw knife switches may be mounted so that the throw will be either vertical or horizontal, as preferred, but if the throw be vertical, a locking device shall be provided, so constructed as to insure the blades remaining in the open position when so set.

b. All knife switches, except double throw motor starting switches, as noted in Section 1408(b), shall be so wired that the blades will be dead when the switch is open.

1403 - Number of Poles Required for Switches.

- a. Service switches shall comply with the requirements of Section 1506. Other switches shall be so arranged that the opening of the switch will disconnect all the conductors of the supplied circuit except the grounded conductor of a direct current of single phase alternating current system which is suitably identified and grounded as prescribed elsewhere in this code.
- b. Single-pole switches shall not be placed in any neutral or grounded wire; provided, however, that single pole switches, when used in control circuits for automatic, auto-manual or remote control devices which operate on circuits having one wire grounded, and the contact devices of sign flashers shall be connected in the grounded conductor. Three way and four way switches shall be classed single-pole switches and shall be so wired that only one pole of the circuit will be carried to the switch.
- c. Where a circuit breaker serves as a switch, it shall conform to the requirements of this section as to the number of poles.

1404 - Safety Type Switches Required.

- a. Manually operated switches shall be of an approved safety type, except where other types are specifically permitted by this code and except as follows:

1. Switches are not required to be of the safety type when they are mounted on switch boards or motor control panels and accessible only to qualified authorized persons.
2. Service switches rated at more than 400 amperes are not required to be of the safety type where additional safety type switches are provided for the control of individual circuits and service switches which are installed, maintained and under the seal of the serving agency need not be of the safety type.
3. Switches are not required to be of safety type when operating at 100 volts and under, as, for example, in some electric furnace and electrolytic installations.
4. Disconnectors installed as permitted and required by Section 1407 paragraph (b) of this code need not be of the safety type.

ARTICLE 14SWITCHES

NOTE - For the requirements relating to switches ahead of fuses see 1303(e); for panel boards see 1306; for services see Article 15; for exit lighting see 1514(d), 3622(d), and 3623(d); for elevators see 3203; for cranes and hoists see 3105; on switch boards see Article 25; in hazardous locations see Sections 3606, 3608, and 3610.

1401 - Installation of Switches; General.

- a. Switches shall be so located that they may be operated from a readily and safely accessible place. They shall not be placed more than 7 feet above the floor, or working platform, without permission.
- b. Knife switches, sign flashers, remote control switches and similar appliances shall be enclosed in approved metal cabinets. When located in wet places, or where exposed to the weather, they shall be mounted in approved weather proof switch boxes or cabinets. (For locations where open knife switches are permitted see Section 1404.)
- c. Where flush switches are used, whether with conduit systems or not, they shall be enclosed in an approved metal box in addition to the porcelain enclosure of the switch.

1402 - Position and Connection of Knife Switches.

- a. Single throw knife switches shall be so placed that gravity will not tend to close same. Double throw knife switches may be mounted so that the throw will be either vertical or horizontal, as preferred, but if the throw be vertical, a locking device shall be provided, so constructed as to insure the blades remaining in the open position when so set.
- b. All knife switches, except double throw motor starting switches, as noted in Section 1408(b), shall be so wired that the blades will be dead when the switch is open.

1403 - Number of Poles Required for Switches.

- a. Service switches shall comply with the requirements of Section 1506. Other switches shall be so arranged that the opening of the switch will disconnect all the conductors of the supplied circuit except the grounded conductor of a direct current of single phase alternating current system which is suitably identified and grounded as prescribed elsewhere in this code.
- b. Single-pole switches shall not be placed in any neutral or grounded wire; provided, however, that single pole switches, when used in control circuits for automatic, auto-manual or remote control devices which operate on circuits having one wire grounded, and the contact devices of sign flashers shall be connected in the grounded conductor. Three way and four way switches shall be classed single-pole switches and shall be so wired that only one pole of the circuit will be carried to the switch.
- c. Where a circuit breaker serves as a switch, it shall conform to the requirements of this section as to the number of poles.

1404 - Safety Type Switches Required.

- a. Manually operated switches shall be of an approved safety type, except where other types are specifically permitted by this code and except as follows:
1. Switches are not required to be of the safety type when they are mounted on switch boards or motor control panels and accessible only to qualified authorized persons.
 2. Service switches rated at more than 400 amperes are not required to be of the safety type where additional safety type switches are provided for the control of individual circuits and service switches which are installed, maintained and under the seal of the serving agency need not be of the safety type.
 3. Switches are not required to be of safety type when operating at 100 volts and under, as, for example, in some electric furnace and electrolytic installations.
 4. Disconnectors installed as permitted and required by Section 1407 paragraph (b) of this code need not be of the safety type.

1405 - Requirements for Safety Type Switches.

a. Safety type switches shall be so designed and constructed that no current-carrying parts thereof are normally exposed when the switch is in the open or closed position and so that the operator can not come in contact with the current-carrying parts during ordinary operation. So-called externally operated, dead-front, snap, tumbler, and similar types of switches which meet the above requirements and which are approved as complete devices, including the enclosure and operating mechanism, shall be classed as safety type switches.

b. All fused externally operated switches, except individual motor starting switches shall be so arranged that authorized persons may open the switch case without opening the switch.

1406 - Rating, Identification and Marking of Switches.

a. Except where otherwise expressly stated or permitted, switches shall be capable of safely interrupting the loaded circuit under the normal current and voltage conditions involved. They shall be plainly marked, where the marking can be seen when installed, with the name of the maker and the current and the voltage for which they are designed.

b. Switches shall be so marked or constructed as to indicate whether they are open or closed. Switches shall be so marked or labeled as to indicate the circuits or equipment controlled by them, unless so located in relation to the controlled equipment that such indication is sufficiently evident.

1407 - Motor and Motor Control Disconnecting Switches.

a. Each motor with its starting device shall be controlled by a switch so arranged that the opening of the switch will disconnect all ungrounded conductors. It may also disconnect the grounded conductor, if any. The switch shall have a continuous duty rating at least equal to the current-carrying capacity of the conductors between the motor and its running overload protective device.

b. Where it will not be necessary for the switch to be operated under load disconnectors installed in compliance with Section 1411 of this code may be used: (a) with high potential motors; or (b) with low-potential motors if the disconnectors are so interlocked with the motor starter or controller that they can not be opened or closed except when the starter is in the off position.

c. The switch called for in paragraph (a) above may be omitted where the motor starting switch consists of an approved self-contained manually operated single-throw air break switch which disconnects all ungrounded conductors of the circuit.

(Fine print note) The above rule will not permit the omission of the switch ahead of compensator or ahead of any automatic oil circuit breaker which is used for the running overload protection of the motor and therefore a part of the motor control equipment. (See paragraph (f) of this section.)

d. When two or more motors operate together as a single unit and are controlled by the same control equipment, a separate switch is not required for each motor. A separate switch is not required for each of the two or more motors on the same crane.

e. A circuit breaker (automatic or non-automatic) which opens all ungrounded conductors simultaneously when tripped by hand, may serve as the switch required by this section with the exceptions noted under paragraph (c) of this section.

f. If the motor is supplied by a separate branch circuit which is individually controlled by a switch, then such branch circuit switch may serve as the switch required by paragraph (a) of this section, provided: (a) it is so arranged that it can be locked in the open position; and (b) the motor starting device disconnects all ungrounded conductors. In other cases and for all elevator installations the switch shall be located closely adjacent to and within quick access from the control equipment which it disconnects.

1408 - Motor Starting Switches.

a. Self-contained manually operated switches, starters and controllers and the manually operated parts of other starters and controllers (such as the starting button for remote control) shall, if reasonably possible, be located within sight of the motor, or within sight of the machinery driven by the motor, preferably within sight of the driven machinery.

b. Motor starting switches shall be of an approved safety type. They shall be so constructed and installed that fuses, if fuses are used, will be dead when the switch is in the open position; and, except in the case of double throw motor starting switches designed for starting and running positions, shall be so constructed and installed that the blades of the switch will be dead when the switch is in the open position.

c. Where a double-throw switch is used to shunt the motor running overload protective device during the starting period, it shall be of such type that it will be held in the "off" and "running" position, but cannot be left in the "starting" position.

d. Snap switches used for the control of A. C. motors larger than one horse power shall be of a type approved for this purpose. Snap switches used for the control of A. C. motors one horse power and less shall be rated not less than 200% of the normal full load current of the motor.

(Fine Print Note) See Article 23 for requirements relating to motor starting and control devices.

1409 - Heater Switches.

a. Each complete electrically heated appliance whether containing one or more heating elements shall, except as provided in paragraph (b) of this section, be controlled by an indicating switch arranged to disconnect all ungrounded conductors. This switch shall, unless means of control is provided on heater, be located immediately adjacent to the appliance.

(Fine print note) With an approved water heater of a type having the heating element enclosed within the water tank or within an external casing through which the water circulates, the switch controlling such heater need not be located immediately adjacent to the heater, but it shall be located where it will be readily and quickly accessible in case of emergency.

b. Switches controlling the individual units of electric ranges, etc., shall not be considered as taking the place of the switch required by paragraph (a) of this section, but an approved attachment plug and receptacle may serve in lieu of the switch when used with portable or semi-portable appliances; provided, however, that for range installations in single family dwellings, the service switch may serve as the range disconnecting switch. (See section 1303 paragraph (e)).

1410 - Lighting Switches.

a. Switches shall be provided for the control of fixtures having keyless sockets. When fixtures having keyless sockets are so located or used that lamps will not be backed out of sockets, a single switch controlling the branch circuit may be used.

b. When light outlets are provided in basements or cellars as required by paragraph (c), section 1302 of this Code, at least one such outlet shall be controlled by a switch located at the point of entrance to such basement or cellar. In order to facilitate future extensions both circuit conductors shall be carried to basement independent of switch control.

(Fine print note) All switches used on lighting circuits must be of an approved safety type. (See sections 1307, 1404 and 1405). Exit lighting must be controlled as prescribed in sections 3622(d), 3623 (d) and 1514 (d).

1411 - Disconnectors.

Note. A disconnecting switch or disconnector is a switch which is designed and intended to open a circuit only after the load has been interrupted by some other means. For installations where disconnectors are required or permitted see sections 1509, 1407 and 2902.

a. All disconnectors shall be provided with suitable means for safe normal operation. With high-potential disconnectors, this will usually consist of an insulated hook stick, remote control mechanism, or an insulated external operating lever.

b. Elsewhere than in central stations, sub-stations, and generator, transformer, switching and meter rooms, accessible only to qualified, authorized persons, disconnectors shall be protected by suitable enclosures or casings. Such enclosures shall be constructed of metal unless permission is obtained in advance to use other materials. The door of the enclosure shall be kept closed except when opened for operation or inspection. If installed so that the bottom of the enclosure is less than 7 feet above the floor, the door or cover shall be kept locked. If installed at a greater height than 7 feet, a latch or other suitable means may be used for keeping the door or cover closed. When the disconnectors are operable from the exterior of the enclosure, and also when provided with remote control mechanism, the operating handle or lever shall be provided with means for locking, and shall be kept locked when in open position and when in closed position so as to prevent opening or closing the disconnectors under load.

c. When disconnectors are installed in central stations, sub-stations, and generator, transformer, switching, and meter rooms, to which only qualified persons are permitted access, they shall be provided with enclosures, guards, or screens that will prevent accidental contact, or they shall be elevated above the floor not less than 8½ feet.

d. All disconnectors shall be provided with permanent and conspicuous warning signs which shall read substantially as follows: "WARNING - DISCONNECTORS - DO NOT OPEN UNDER LOAD." When a group of disconnectors is installed in one room or compartment, a single conspicuous sign may be sufficient.

ARTICLE 15**SERVICES, SERVICE SWITCHES AND CUTOUTS, AND METERING EQUIPMENT**

NOTE: - The special requirements for services over 600 volts are given in Article 29.

1501 - Number of Buildings Supplied by one Service Limited.

a. No service shall supply more than one building except as provided by section 1512 for service in the underground district and except as follows:

1. Any number of buildings located in the same factory yard and under the same occupancy may be supplied through one service. Service switch and cutout may, however, be required in the individual buildings. See Section 1504.
2. Adjacent buildings on the same lot and under the same occupancy may be supplied through one service.
3. Services in different buildings may be supplied through a bus service.

1502 - Number of Services Supplying One Building Limited.

a. The number of services supplying the same consumer shall be kept at the minimum that is reasonably possible. As a general rule, not more than one lighting service, one power service, and one heating service shall be installed for any one consumer from the same supply system. If two or more of the said three classes of loads are supplied from the same secondaries or mains of the serving agency, it is preferable that only one service be installed. When an existing service becomes inadequate on account of an increase in the load supplied thereby, such service shall be increased to one of the required capacity. (For services from underground sources see section 1512).

(Fine print note) When two or more services are run to or into any building, whether from the same supply system or from separate systems, it is recommended that they terminate at the same general location in the building; and, in the case of overhead services, terminate at the same general location on the exterior of the building. Where this would be impracticable it is recommended that the individual consumers, each occupying an entirely separated portion of the building, be supplied through a bus service in accordance with Section 1513 hereof.

It is the intent of this section to prevent an indiscriminate and unnecessary multiplicity of services, which complicates the electrical installation and constitutes an avoidable hazard in several respects. The rule will not be construed to prohibit the installation of emergency, exit, or standby services, or to prohibit the use of both alternating and direct current from the system of one or more serving agencies; or to prohibit separate services for certain special classes of apparatus which can not be satisfactorily supplied through the same service with other loads.

1503 - Character of Service.

a. All ordinary lighting installations shall be wired and arranged for 2 wire service if the required size of the 2 wire service conductors (determined in accordance with section 1202) will not exceed No. 6. Larger installations shall be wired for 3 wire service.

b. Heating or cooking loads of more than 2500 watts capacity shall be supplied through a 3 wire service at 110-220 volts or through a 2 wire service at not less than 220 volts. (See Sec. 2201.)

(Fine print note) It is recommended that the contractor or consumer consult the serving agency as to the availability of service before making any installation not in conformity with the above practice and before installing service for any direct-current motor; any single phase motor larger than 2 H. P.; any 3 phase motor smaller than 5 H. P.; any 220 volt, 3 phase motor larger than 50 H. P.; any 440 volt, 3 phase motor of 80 H. P. or less; or any high potential motor. (See section 1511(c)).

1504 - Service Switch and Cut-out Required.

a. An approved main service switch and an approved main service cutout (fuses or circuit breaker) shall be installed in every low potential service as hereinafter prescribed. Exceptions to this rule are as follows:

1. Neither service switch nor cutout will be required where factory yard wires enter a building from a distribution center in a near-by building under the same occupancy and management, provided the overhead cutout next back is small enough to properly protect the conductors inside the building in question and provided such yard wires are not exposed to contact or loading from overhead wires of a higher voltage or of another system.

2. When a low potential feeder enters a building from transformers installed in a transformer vault or enclosure located within such building, the service switch and cutout may be omitted in such low potential feeder, provided the following requirements are complied with:

(a) The feeder shall be supplied from an independent transformer or bank of transformers operating as a unit.

(b) Such transformers or bank of transformers shall be independently controlled and protected on the primary side by an automatic over load oil circuit breaker which is of suitable interrupting capacity and which is so arranged and has the over load trip so set that it will properly protect the conductors of such feeder against over load independently of any other feeder.

(c) Such circuit breaker shall be equipped with suitable reliable means by which the breaker may be tripped manually from a readily and safely accessible point outside the transformer vault or enclosure. Such manual tripping means shall be plainly marked to show its purpose.

3. Where the transformers are installed in a vault or enclosure located on the consumers' premises outside of and immediately adjacent to the building in question, the secondary service switch and cutout may, in exceptional cases and subject to compliance with the above requirements, be omitted only by special permission obtained by writing in advance. The secondary service switch and cutout shall not be omitted when the transformers are installed on a pole.

b. Service equipment on systems over 600 volts shall be installed in compliance with Article 29 of this Code.

1505- Location of Service Switch and Cutout.

a. The service switch and cutout shall be located in a readily and safely accessible place and as near as possible to the point where the service conductors first enter the building, either within the building or outside the building wall in a location protected from the weather (see Section 1106). Access and passage to the service switch and cutout shall be kept clear and unobstructed.

b. Service switches or cutouts shall not be installed on ceilings nor in attics, clothes or water closets, bath rooms, or coal bins, nor placed in or over show windows, nor over sinks, laundry tubs or lavatories. Service switches and cutouts shall not be located in the extra-hazardous locations described in section 3607, nor on the second or higher floors of buildings except by special permission.

(Fine print note) To comply with the above rules the service switch and cutout must be placed within 7 feet of the floor, ground, or permanent platform from which they are reached, so that they may be reached quickly, without climbing over or removing obstructions or resorting to box, chair, or portable ladder and so that, in operating the switch or replacing fuses, a person will not have to place himself in a hazardous position, as, for example, by reaching over or under belts or moving machinery.

1506 - Service Switch - Type and Installation.

a. The service switch shall be of approved safety type, capable of safely interrupting its rated current at rated voltage, unless otherwise allowed by special permission. Such permission shall not be granted unless the switch controls a principally non-inductive load and is not liable to be operated under full load conditions. The switch shall be operable without opening the metal enclosure; shall be so designed or marked as to indicate plainly whether it is in the open or closed position, and shall be so arranged that it may be locked or sealed in the open position. Exceptions to this rule may be allowed under the conditions noted in Section 1404 of this Code.

b. Panel board switches especially designed for the purpose, if rated at not less than 50 amperes, 250 volts or 60 amperes, 125 volts and which otherwise comply with the requirements of this section may be used as service switches.

c. The service switch shall, with the following exceptions, be so arranged and installed that the opening of the switch will, with one operation, open all conductors of the service and disconnect therefrom all fuses, meters, and other equipment, (including blades of service switch) supplied through the service:

1. When a 4 wire service is installed to supply a 3-wire 3-phase power load and a single-phase lighting load, two separate service switches and cutouts may be installed, one for the power load and one for the lighting load, provided they are in adjacent locations and provided each switch is plainly identified by suitable permanent sign or marking.