

2. When a single-phase or direct current service is installed to supply two (and not more than two) separately metered loads, two separate service switches and cutouts may be installed, one for each load, provided both meters and switches are all at one location and provided each switch is plainly identified by suitable sign or marking. Such switches shall not be located on opposite sides of a wall or partition.

3. Two separate service switches and cutouts may be installed, one for general lighting and one for exit lighting when and as required by section 1514(c) hereof.

4. Where switch and fuses are mounted in an approved cabinet having no wiring or live parts exposed and capable of being sealed or locked, the switch blade may be omitted in any grounded conductor if other approved means is provided within the cabinet for disconnecting such conductor. Terminals shall be provided on the switch base for the grounded conductor.

5. In 3-wire services with grounded neutral conductor, the service switch may be so designed as to permit either outside conductor to be opened independently of the other, but it shall be so designed that the neutral can not be opened without opening both outside conductors.

1507 - Service Cutouts - Arrangement of:

a. Approved fuses or circuit breaker shall, except as provided in section 1504 be installed in all ungrounded service conductors. Such cutout shall be located in compliance with section 1505 and shall be connected at and on the load side of the service switch and arranged to cut off current from all circuits, meters, and other devices supplied through the service, except the service switch.

b. No cutout shall be installed in any grounded service conductor unless such cutout is a circuit breaker so designed that the grounded conductor can not be opened without opening all other conductors; provided, however, that in replacing service cutouts in old 2-wire services where the existing grounded service conductor is not grounded at the building served, and in locations where the conditions of grounding or the liability of the reversal of connections warrant, a cutout shall be provided in each conductor of a 2-wire service. (See section 1501(b)).

c. The service cutout shall be enclosed in an approved box or cabinet, preferably in the service switch case, unless installed on a switchboard which is accessible only to authorized, qualified persons. If the cabinet containing the service fuses is locked or sealed so that the fuses are inaccessible to the occupant of the building, duplicate service fuses or branch fuses connected on the load side of the meter shall be provided at a point readily accessible to the occupant of the building.

1508 - Circuit Breaker Used as Service Switch and Cutout.

a. An automatic or non-automatic circuit breaker (air or oil break) may be used as a service switch, provided it opens all poles simultaneously when tripped by hand; is so constructed that the outside conductors can not be closed without first or simultaneously closing the neutral conductor, if any; and otherwise complies with all the requirements for service switches. When not subject to competent supervision the circuit breaker shall be of a type specially approved for service conditions.

b. An automatic over-load circuit breaker (air or oil break) may be used as a service cutout, provided it has a pole in each conductor except a neutral conductor; opens all poles simultaneously when tripped by hand; is so arranged that it will not automatically or manually open any grounded conductor without opening all other conductors; has over-load trip coils not less in number than that required by section 1504; and otherwise complies with all the requirements for service cutouts. The circuit breaker may have a pole in a neutral conductor if so constructed that the neutral conductor cannot be opened without opening the other conductors and so that both conductors can not be closed without first or simultaneously closing the neutral conductor.

c. One automatic overload circuit breaker may be used as combined service switch and service cutout, provided it complies with all the foregoing requirements, both as to service switches and service cutouts.

d. Air-break circuit breakers shall be inclosed in approved metal cabinets unless mounted on a switchboard that is accessible only to authorized qualified persons.

1509 - Disconnecting Means for Oil Circuit Breakers.

a. When an oil switch or oil circuit breaker is used as a service switch, suitable means shall be provided for isolating such switch or circuit breaker from the source of supply while it is being adjusted or repaired. If the voltage exceeds 300 volts, disconnectors or a disconnecting switch shall be provided. (See Section 1411). If the voltage does not exceed 300 volts, suitable bolted or screwed lugs or connectors, disconnecting pet-heads, or other equivalent disconnecting devices, may be used.

(Fine print note) If a suitable disconnecting switch is installed (in either primary or secondary circuit) on the service pole or on a pole not more than one span from the service pole, such switch may serve as the disconnecting means required by the above rule, provided no other service is supplied through such switch and provided the switch is so arranged that it may be operated from the ground or from a point near the ground and so that it may be locked in the open position. (See Section 2902(e)).

1510 - Service Conductors and Service Conduits.

a. Conductors of low-potential services shall be installed in a continuous length of rigid metal conduit from the point of entrance to the building into the service switch case, or into a metal gutter which is connected to the service switch case, except where the service switch is installed on a switchboard which has exposed bus bars on the back; in this case the service conduit may terminate at the back of the switchboard. Not more than one set of service conductors shall be installed in the same service conduit except in connection with services in the underground district which are installed and maintained by the serving agency. Conductors other than service conductors shall not be installed in service conduits.

(Fine print note) The term "continuous" as applied in the above rule to service conduit shall not be construed to prohibit the use of suitable approved threaded fittings as a substitute for clumsy and unsightly bends in service conduit runs. No splices or taps, however, shall be made in any service conductor between the service switch terminals and the point of connection with the supply wires of the serving agency or the point of connection with a bus service.

b. The required size of service conductors shall be determined in accordance with Section 1202 of this Code. No service conductor shall be smaller than No. 10.

c. When carried underground to a building service conductors shall be lead-sheathed and shall be installed in rigid metal conduit or in plugged or drifted iron or steel pipe of equivalent thickness; provided, however, that a grounded service conductor on direct current or single phase A. C. systems need not be lead-sheathed and may have any kind of insulation. If connected to overhead sources, the lead-sheathed conductors shall be carried up the pole at least 8 feet above the ground. No service riser shall be run to or installed on any pole until such pole has been specifically designated and approved for the purpose by the Serving Agency concerned.

(Fine print note) Where a long run or other conditions make it impracticable to follow the construction specified above, fibre conduit, steel-armored underground cable or other equivalent construction may be used.

d. No conduit containing lead-sheathed service conductors shall be smaller in size than one inch. In all cases, the conduit shall be of sufficient size to permit the conductors to be drawn in without injury to the lead sheath. (See Sections 1005(g) and 1007(1)).

c. The length of service conductors in the building shall be as short as is reasonably possible (See Section 1505) but in no case shall the length of service conductors in the building exceed 15 feet in the underground district or 25 feet in the overhead district. Conductors in conduit installed under the following conditions will not be considered as being in the building:

1. If it is buried in or under a concrete, brick, or tile floor which is laid on the ground and there is at least two inches of concrete, brick or tile between the conduit and the inside surface of the floor.

2. If it is buried in an exterior wall of concrete or brick and there is at least two inches of concrete or brick between the conduit and the interior surface of the wall.

3. When run in other walls or other locations if it is entirely surrounded and encased in suitable concrete of a minimum thickness of two inches, the conduit and concrete jacket being adequately supported.

f. When it is desired to protect an exposed run of service conduit by encasing it in concrete, the work must be done in a permanent and effective manner; for example, metal lath or other form of metal reinforcing may be strapped around the conduit with proper space between the conduit and the reinforcing and the concrete then applied as in fire proofing metal structural members in fireproof buildings.

g. Service conduit shall not be run on the exterior surface of a side or rear wall of a building if there is no clearance between such wall and the lot line.

h. Service conduit shall not be brought out through a roof except by permission. When permitted the service outlet shall be located not less than seven feet above roof. This will not be construed to prohibit the installation of a bus service on the roof of a building.

i. Where service conduit passes through wall or roof of building, it shall be so installed that water will not enter the building around the conduit.

j. Service conduits and service conductors shall be grounded as required and permitted by Article 17.

1511 - Entrance Fitting.

a. The outer end of an overhead service conduit, except where connected to a bus service, shall project not less than 8 inches nor more than 16 inches beyond the wall of the building.

and shall be fitted with an approved service conduit entrance fitting which shall be so installed that water will not enter the fitting or the conduit. In 3-wire services with grounded neutral, the neutral conductor shall enter the fitting between the other two conductors. The conductors shall be left projecting from the fitting not less than 18 inches and in any case a sufficient distance to provide for drip loops and for splicing to service drops.

b. The service entrance fitting shall be so located that the service conductors on the exterior walls of the building will be clear of fire escapes, awnings, swinging signs, shutters or similar attachments to the building and, where not in conduit, out of easy reach of unauthorized persons.

c. No service shall be installed which would require overhead service drops on or across any streets on which overhead lines are prohibited. Install no service fronting on any of these streets without first consulting the Serving Agency concerned as to the source of supply. (See Section 1513).

1512 - Special Requirements for Services from Underground Sources.

a. Low-potential services from underground sources shall, in addition to other applicable requirements of this Article, comply with the following special requirements:

b. The wiring in any building or group of buildings, including the service connections thereto, shall be so arranged that it will not serve as a shunt around any fuse or switch.

c. Each building shall be supplied with a separate service and main switch and cutout for each class of service to control entire building.

d. One set of mains for each class of service coming from the street manholes, and entering the basement where the fire wall separates two buildings, will be considered as a separate service for each building, provided each of the buildings is served direct from these underground mains through an approved individual main line switch and cutout.

e. If it is desired to serve, from one set of underground mains, all the buildings which are using one class of service and are located in the same city block, all classes of service shall be brought to one distribution center located in one building in the block in conduit. Each class of service shall pass through an approved main line switch and cutout. The several services shall be divided into proper capacities to serve each of the buildings and properly protected by cutouts at the distribution center. In addition to this, there shall be furnished the regular main line switch as provided for in this Code for each building.

f. Where it is required to run more than one circuit from the Serving Agencies' meter set to supply one consumer, each separate circuit shall be individually fused; that is, it will not be permissible to run more than one circuit or feeder into one meter set.

g. For building with neither excavated basement nor excavation under sidewalk, the Serving Agency shall install a bus service in compliance with Section 1513.

1513 - Bus Service

Note. A bus service is usually installed and maintained by the serving company to whose system it is connected. It is required for buildings in the underground district which have neither excavated basement nor excavation under sidewalk and is recommended in the overhead district where current is distributed through separate services to two or more consumers, each consumer being supplied through an individual service switch and cutout located in that part of the building occupied by him.

a. Bus services shall be subject to and shall comply with all applicable requirements for other services, except as otherwise provided or required in this section.

b. All bus-service conductors in or on any building shall be installed in approved rigid metal conduit. All taps and connections shall be made in approved metal junction or cutout boxes. No bus-service conductors shall be run open on the exterior of any building and no bus-service conductor shall be open or exposed at any point on the building. For exception to this rule in the case of service wires on the exterior of buildings in the overhead district see Section 1602.

c. Whenever a bus service enters a building, a main service switch and cutout shall be provided. When a bus service is installed entirely on the exterior of a building, a main bus-service switch is not required on the building but the bus-service conductors shall be suitable protected by fuses.

d. An approved main service switch and cutout shall be installed in each individual service supplied from a bus-service in compliance with the rules for service switches and cutouts.

e. When a service is to be supplied from a serving agencies' bus-service installed on the exterior of the building, the service conduit shall be extended into the junction box of the serving agency and a sufficient length of service conductor shall be left in box to permit splices to be properly made, soldered, and taped by the serving agency. (See also Section 1006, paragraph (a) relative to conduit work in wet places).

(Fine print note) In old districts where the existing junction box is not of suitable type for conduit connection thereto, the service conduit shall terminate within 12 inches of the box and shall be fitted with an approved service conduit entrance fitting.

The size of bus-service conductors inside of buildings shall be determined in compliance with Section 1202. Due consideration may be given diversity of load and demand in determining the size of bus-service conductors which are installed entirely on the exterior of a building.

1514 - Exit Lighting Service.

a. An exit lighting service shall be installed in the classes of buildings noted in section 3622.

b. In theatres (including motion picture houses), where the supply can be obtained from two separate sources, two separate and distinct services shall be installed, one service being of sufficient capacity to supply current for the entire equipment of the theatre, the other service being of sufficient capacity to supply current for all emergency and exit lights.

(Fine print note) The term "separate source" as used in the above rule shall mean: (1) supply from a serving agency other than the one supplying current for the general lighting, or (2) supply from a direct current source with adequate storage battery reserve; provided, that the general lighting is supplied from an alternating current source; (3) gas lighting may be installed for exit lighting when the separate sources noted in items 1 and 2 are not available.

c. In buildings other than theatres and motion picture houses, where exit lighting is required, the supply shall be taken from a point on the street side of the main service switch. (For exception see section 3622(b)).

d. The main switch controlling emergency and exit lights shall be conspicuously marked to indicate that it controls such lights.

1515 - Location of Meters and Metering Equipment.

a. All the meters of the same building shall be installed at one general location or at as few different locations as is reasonably practicable.

b. Where two or more meters are grouped at one point, the party installing the wiring shall plainly and permanently mark or label each meter location in such a manner as will clearly identify the load to be supplied through such meter. If the permanent marking cannot be made at the time of roughing in, the meter loops shall be tagged so as to identify the load to be supplied.

c. Meters shall be located in safely accessible dry places, preferably about 6 feet above the floor, but not more than 8 feet above the floor or a readily and safely accessible platform. Meters shall, where conditions permit, be located where they will be accessible for reading and inspection without having to enter any locked enclosure, or otherwise inaccessible portion of the building; provided, however, that this will not apply to meters in stores, industrial plants, and other buildings that are regularly open during business hours nor to groups of meters installed in meter rooms in apartment houses and other buildings housing a number of separately metered customers.

(Fine print note) Meter locations will not be approved in any of the following places if other more suitable location is or can be made available: in attics, coal bins, bath rooms, toilet rooms, clothes closets, or elevator or ventilator shafts, or over doors, sinks, wash tubs, or lavatories, or in or over show windows.

1516 - Meter Switches and Cutouts.

a. An individual switch and cutout shall be installed in the circuit on the line side of each meter, and if instrument transformers are used in connection with the meter, the switch and cutout shall be connected on the line side of such transformers. The switch required by this rule shall completely disconnect the fuses and shall be located immediately adjacent to the meter. Exceptions to this rule are as follows:

1. When a service switch supplies only one meter and such meter is not placed at the service switch location, no additional switch or cutout will be required immediately ahead of the meter.
2. When two (and not more than two) meters are installed on the same service and for the same consumer an individual switch for each meter will not be required if both meters are located immediately adjacent to the service switch. If the additional meter is used to check the energy in one circuit only a separate cutout need not be provided for the main meter but the check meter shall be individually protected by a cutout.
3. An individual switch ahead of each meter will not be required in the case of meter installations under seal of the Serving Agency which are installed and maintained by such agency.
4. When making extensions to existing meter installations, additional meters may be installed in a manner similar to the original installation.

1517 - Meter Boards and Meter Protection.

a. Suitable provision shall be made for support and attachment of meters and metering devices. On concrete, brick, tile or similar walls, and on all plastered walls, a suitable meter board of minimum thickness of about 7/8 inch, or other suitable support, shall be provided.

b. Meters shall be suitably protected against moisture and mechanical injury. When installed where exposed to rain or to similar conditions, they shall be enclosed in cabinets of thoroughly substantial and effective weather-proof construction. If of wood, cabinets shall be made of well seasoned lumber not less than 1/2 inch in thickness. Makeshift boxes or other makeshift arrangements will not be approved for this purpose. Metal cabinets in wet places shall comply with section 1106 of this Code.

c. Instrument transformers used in connection with meters shall be installed in approved metal cabinets or boxes except when mounted on approved switchboards or in transformer rooms and similar enclosures which are accessible only to authorized qualified persons. They shall be installed in compliance with paragraph (b) Section 2701 except that slate or similar type bases will not be required where the transformer is installed in a box.

1518 - Wiring at Meter Locations.

a. When meter loops are installed without protective trims, suitable outlet fittings (see paragraph (b) of this Section) shall be provided and so located and arranged that the length of exposed leads required for meter connection will be as short as practicable. When brought out at the side of cabinet, they shall be installed in conduit with outlet fitting located at the bottom edge and center of the space on the meter board provided for the meter. Meter outlet fittings may be installed at the top of cabinets but shall not be installed at the bottom of cabinets where it is practicable to use the top or side connection.

b. Meter outlet fittings shall in all cases be horizontally placed and shall provide separate bushed holes in one line (not staggered) for meter wires.

c. Unless permission is obtained from the Serving Agency, the line wires shall be brought out at the left of the meter outlet fitting, the load wires to the right and the potential tap (if required) between the load wires. The length of wires beyond the outlet shall be ample to reach and connect to meter and in general shall not be less than indicated in the table shown in Section 1519.

d. Potential taps, soldered to the neutral or middle leg of the circuit, shall be provided in all 3-wire installations except single phase meter loops located in residences, flats and apartments.

e. In 3-wire services having one wire grounded and identified, the ungrounded wire (dark insulation) shall be brought out through outside holes of meter outlet fitting.

1519 - Space for Meters and Meter Transformers.

a. In arranging meter locations, sufficient space shall be provided to permit the meters and the transformers and other devices used in connection therewith to be readily and safely installed, inspected and tested.

b. For meter installations of the types and capacities shown in the following table, and in the absence of specific information from the Serving Agency, clear space shall be provided approximately as follows for each self-contained meter. For installations not included in the table the contractor shall consult with the Serving Agency and obtain specific information as to spacing required.

Space for Self-Contained Meters.

Amps	Meter Switch Volts		Space width	Inches height	Depth	Length of Meter Leads
30	240 or less, 1 phase		12	12	8	10
60	240 " " " "		14	14	8	10
100	240 " " " "		16	14	8	10
30	480 or less, polyphase		16	18	9	18
60	480 " " " "		18	18	9	18
100	480 " " " "		20	18	9	18
30	550 or less, direct current		14	16	9	18
60	550 " " " "		16	17	9	18
100	550 " " " "		18	20	9	18
200	550 " " " "		20	20	9	18

c. Potential taps shall be provided in all 3-wire meter loops except single phase meter loops installed in residences, flats and apartments. No meter loop shall have less than 4 wires.

d. In 2-wire services having one wire grounded and identified the ungrounded leg (2 black wires) shall be brought out through the outside holes of the meter outlet fitting.

ARTICLE 26OUTSIDE WORK - LOW POTENTIAL SYSTEMS1601 - General.

a. The requirements of this Article shall apply (a) to all low potential wiring, except outline lighting and signs, on the exterior of buildings or other structures (b) to low potential line or yard wires connecting, or carried adjacent to, buildings or other structures (c) to decorative lighting systems outside of buildings and to yard lighting systems.

(Fine print note) Systems over 600 volts are covered in Article 29. The requirements of signal systems are given in Article 30.

1602 - Wiring on Exterior of Buildings.

a. All wiring on the exterior of buildings or other structures shall be installed in rigid metal conduit; provided, that open wiring installed as prescribed by this section, may be used for yard wires and line wires only on the exterior of buildings fronting on streets in which overhead lines are permitted. No lamps or other current consuming devices shall be attached to open wiring on the exterior of buildings, except as permitted by section 1605 of this Article.

b. Wires or cables which are liable to contact with awnings, swinging signs, shutters or other movable objects shall be inclosed in approved conduit made weatherproof.

c. Wires or cables exposed to the weather shall be supported on petteicant insulators placed at intervals not exceeding 15 feet, this interval being decreased if the wires are subject to disturbance; and the insulators shall be so designed or located as to hold individual wires at least 1 foot apart and at least 2 inches from the surface wired over; provided, however, that brackets, racks, supports or insulators especially approved for the location may be used if they separate individual wires at least 6 inches and are placed at intervals not exceeding 9 feet.

d. Multiple-conductor cables shall be kept at least 6 inches from adjacent workwork and at least 12 inches from overhanging projections of combustible material, unless approved fittings which afford equivalent protection are used.

e. Wires not exposed to the weather may be supported on glass or porcelain knobs placed at intervals not exceeding 4½ feet and retaining the wires at least 1 inch from the surface wired over.

f. Outside conductors shall have an approved insulating covering, as prescribed by section 901(c) of this Code.

g. Conductors not enclosed in conduit shall, where they enter buildings, have drip loops outside and the holes through which they pass shall be bushed with non-combustible, non-absorptive insulating tubes slanting upward toward the inside. (For installations not requiring conduit see sections 1001(f) and 1002(a)).

h. Conduit work on the exterior of buildings shall be water-proof, and shall comply with all applicable requirements of sections 1005 to 1007, inclusive, of this Code.

i. Line or yard wires on the exterior of buildings shall not be brought closer than 4 inches to the conductors of other light, power or signal circuits not encased in conduit.

1602 - Wires connecting, or carried adjacent to Buildings or Other Structures.

a. Line or yard wires shall be so placed that moisture is not liable to cause a leakage or ground on the circuit. They shall not be in contact with anything but their supports. They shall not be less than one foot apart except when in conduit or multiple-conductor cable or on approved racks or brackets.

b. Open wires shall be at least eight feet above the nearest point of buildings over which they pass, and if attached to roofs, shall be supported on substantial roof structures. Wherever feasible, wires crossing over buildings shall be supported on structures which are independent of the buildings. (For lines over 600 volts, see section 2901).

c. Open wires shall be at least 3 feet horizontally from buildings (or their attachments) unless 3 feet higher than the roof. When this clearance cannot be maintained, and the hazard is such as to require it, suitable guards shall be provided between the wires and any window or door which can be opened, balcony, fire escape or other similar attachment to the building.

d. Where buildings exceed 3 stories, or 50 feet in height, overhead wires shall be arranged where practicable so that a clear space (or zone) at least 6 feet will be left adjacent to the buildings to facilitate the raising of ladders when necessary for fire fighting. (For lines over 600 volts see section 2901).

e. Conductors used for service connections between pole and building service shall not be smaller than No. 8 if of soft copper, nor smaller than No. 10 if of medium or hard-drawn copper.

f. Overhead wires above alleys, driveways and other spaces open to vehicular traffic shall have a minimum vertical clearance of 17 feet.

1604 - Supporting Structures for Overhead Wires.

a. Electric light and power wires shall not be placed on the same cross-arm with telegraph, telephone or other signal wires which enter any building. An exception shall be made for wires used only for operating purposes by an operating utility and entering buildings used for such purposes. When placed on the same pole with such wires the distance between the two inside pins of each cross-arm shall be not less than 24 inches for circuits operating at a potential to ground not exceeding 300 volts, and shall be not less than 30 inches for higher potentials.

b. The grounding of metallic sheaths of cables shall conform to the requirements of article 17 of this Code.

c. Wood poles shall be free from defects that would materially reduce their strength and durability, and shall have no less nominal top diameter than 6 inches, - other overhead structures shall be strongly and durably constructed, and shall have strength at least equivalent to that of the minimum pole permitted.

d. The depth of pole setting shall not be less than that shown in the following table:

Total length of Pole, Ft.	Depth in Ground, Ft.
30	5
35	5
40	5
45	6
50	6½
55	7
60	7

(Find print note) The depths indicated in the above table are applicable for good firm soil. Where the soil is not firm, special methods of pole setting shall be resorted to. Where poles are set subject to heavy strain or at corners and curves, a greater depth should be used. In rock the minimum depth shall be 5 feet.

1605 - Temporary Decorative and Festoon Lighting.

a. Permits shall be secured prior to the installation of any decorative or festoon lighting system. (See section 204).

- b. The voltage between any two conductors of a festoon lighting circuit shall not exceed 300 volts, nor shall the voltage to ground from any conductor of the circuit exceed 150.
- c. The wiring for festoon lighting shall be so arranged that not more than 25 amperes will be placed on a branch circuit fuse. The three-wire system may be used, in which case the total load on each side of the three-wire circuit shall not exceed 25 amperes. The supply for decorative lighting shall be taken only from points on the wiring system where the correct fusing can be provided for.
- d. Sockets shall be of approved weatherproof type and, when they are attached by means of flexible leads, shall have the connections to the circuit wires staggered. All joints shall be substantially soldered and covered with both rubber and friction tape and then painted with an insulating paint.
- e. The conductors of festoon streamers shall not be smaller than No. 14, and shall have an approved rubber insulating covering.
- f. When the span of any string of lights exceeds 40 feet, the string shall be supported by means of a messenger wire, which shall be substantially festooned at each end and shall have ample strength to support the weight attached to it, and in no case shall the size be smaller than No. 10.
- g. Festoon lighting strings or messengers shall not be supported by or secured to any fire escape or drain pipe. They shall be insulated from their supports by approved strain insulators.
- h. All wires on the exterior of buildings less than eight feet above the sidewalk or ground shall be enclosed in conduit.
- i. In cases where permission to install string or festoon lighting over roadway areas has been granted by the Council, the method of supporting and protecting conductors shall be submitted to and approved by the Electrical Division before commencement of the work.

(Fine print note) The requirements for decorative lighting systems inside of buildings are given in section 1913.

1806 - Yard Lighting.

- a. No lamps shall be attached to overhead wires between posts or other supporting structures except as noted in paragraph (b) below and except as permitted by section 1805 of this Article for temporary decorative lighting. Sockets and receptacles used for yard lighting shall be firmly secured by attachment to rigid

conduit which conduit shall be secured to the post or other supporting structure and shall be provided with a suitable terminal fitting (having separate bushed hole for each conductor) at the point of attachment to yard wires. (See section 1602(a)).

b. Where it would be impracticable to comply with the requirements of paragraph (a) of this section, special permission may be given to suspend lamps from suitable messenger wires between posts or other supporting structures. In such cases plans shall be submitted to and approved by the Electrical Division prior to the commencement of the work.

c. Existing yard lighting installations, not in compliance with the requirements of this section, shall be removed or changed to comply with those requirements not later than January 1, 1923.

ARTICLE 17PROTECTIVE GROUNDING OF CIRCUITS AND EQUIPMENT.1701 - General.

a. When grounding is required as a protective measure, as specified in this Code, it shall be done in a permanent and effective manner, and in accordance with the method specified herein, and the connections shall be so arranged that under normal conditions of service there will be no objectionable flow of current over the grounding conductor. Where an objectionable flow of current over a grounding conductor occurs due to the use of multiple grounds, one or more of such grounds shall be abandoned or their locations shall be changed.

b. No automatic cutoff shall be placed in a grounding conductor, or its connections, except in a grounding conductor from equipment where its operation will result in the automatic disconnection from all sources of energy of the circuit loads connected to the equipment so grounded.

c. Where a system grounding conductor is employed, it shall be effectually grounded at intervals which will satisfy the requirements as to current-carrying capacity and resistance prescribed in this article.

d. The combined resistance of the grounding conductor and the connection with the ground shall not exceed three ohms for water pipe connections, nor 25 ohms for buried or driven grounds. Where it is impracticable to obtain, with one artificial ground, resistance as low as 25 ohms, this requirement shall be waived, and two artificial grounds, at least six feet apart and with combined area of not less than four square feet, shall be provided.

1702 - Grounding Low Potential Circuits.

a. Two-wire direct current systems shall be grounded as provided herein, if fed from overhead circuits and the voltage of the system does not exceed 300 volts.

(Fine print note) It is recommended that 2-wire direct current systems be grounded if a neutral point can be established and if the maximum difference of potential between the neutral point and any other point on the circuit does not exceed 300 volts.

It is recommended that 2-wire direct current systems be not grounded if the potential to ground of either conductor exceeds 300 volts.

b. Three-wire direct current systems shall be grounded as provided in this article, not at the neutral, at one or more supply stations but not at individual services.

c. Alternating current systems shall be grounded as provided in this article, if the maximum difference of potential between the grounded point and any other point on the circuit does not exceed 150 volts. Electric furnace circuits need not be grounded.

(Fine print note) It is recommended that such systems also be grounded as provided herein, if the difference of potential exceeds 150 volts but does not exceed 300 volts.

d. If exposed to potentials 750 volts and above through transformer windings or otherwise, secondary circuits of current and potential transformers of less than 750 volts shall be isolated or grounded unless placed in grounded conduit or other suitable duct, or identified and guarded as required for conductors of the highest voltage to which they are exposed. (See section 1703 (g)).

e. On single phase alternating current systems the ground shall be made at each service on the line side of the service switch before the service is connected to the line. (See section 1703). On multiphase alternating current systems the ground shall be made as described for single phase systems if the grounded conductor of the multiphase supply system is brought to the premises for rendering service. This rule shall not apply to services fed from underground sources where neutral is common to both A.C. and D.C. systems.

f. For alternating current systems, the point to be grounded shall be selected as follows:

Single phase, 2-wire: on either conductor, and at that point of the system which brings about the lowest voltage from ground of unguarded current-carrying parts of connected devices and also permits of most convenient grounding. This shall not be construed to require grounding of either conductor of a two-wire 220 volt service fed from a 110/220 volt system, or from a 220 volt, 3-phase system.

Single Phase, 3-wire: on neutral conductor.

Two phase	(At that point of the system
or three	which brings about the lowest
phase,	voltage from ground of un-
Three,	guarded current-carrying parts
Four or	of connected devices and also
Five wire	permits of most convenient
systems.	grounding.

g. Where only one phase of a 2-phase or 3-phase secondary system is employed for lighting, that phase shall be grounded, and at the neutral conductor if one is used.

h. No direct-current service conductor shall be grounded in or on any building.

i. Where transformers supply a common set of mains, such fuses as are installed shall be so placed as not to leave any portion of the secondary without ground protection after they have been blown.

j. The grounded conductor of an interior wiring system shall have but one grounding connection within the building.

1705 - Grounding Service Conductor.

a. The circuit grounding conductor shall be connected to the service conductor ahead (on the line side) of the service switch, and within the service switch cabinet. The connection of the grounding conductor to service conductor shall be made in an approved manner. The two conductors shall not be held under one binding screw or clamping nut unless soldered into lugs or fitted with equivalent approved terminals.

(Fine print note) The term "circuit grounding conductor" refers to the copper wire or cable that is installed and used for the purpose of connecting a service conductor to ground.

b. The circuit grounding conductor shall be installed in conduit from the point of connection to the service conductor to the point of connection to the water pipe. (See section 1706.) A bare copper conductor may be used if installed in conduit or other metal piping (not less than 2 inch trade size) and bonded to such piping at both ends; provided, however, that no other conductors shall be installed in such conduit or piping.

c. The conduit or piping containing the circuit grounding conductor shall terminate in a fitting adjacent to water pipe. This fitting shall be so designed as to effectively protect the ground connection from mechanical injury and shall have attached to it proper ground clamps for gripping the water pipe and a lug in which the grounding conductor shall be soldered.

(Fine print note) It is the intent of the above rule to require suitable protective fittings over ground connections so as to reduce to a minimum the possibility of loss of ground connection.

d. So far as practicable the circuit grounding conductor shall be installed and connected before the job is reported ready for rough inspection.

1704 - Grounding Conduit and Frames of Equipment.

- a. For conduit, armored cable, metal raceways, or metal wireways, the grounding conductor shall be attached as near as practicable to the point where the conductors in the conduit or wireway concerned receive their supply. The point of attachment shall, if practicable, be in sight and readily accessible.
- b. Where the service conduit is grounded, its grounding conductor shall run from it directly to ground or directly to the circuit grounding conductor (see paragraph (e) below); provided, however, that conduit or other metal piping (not less in size than indicated by the table in section 1705(e)), may, if bonded to the service conduit, serve as the grounding conductor if run direct from service switch cabinet to ground connection with no fittings (other than fittings having threaded or equivalent connections) cut in line.
- c. Where a secondary system is grounded at the service in accordance with section 1703 of this Article, the service conduit, interior conduit, armored cable, metal raceway and the non current-carrying metal parts of equipment, etc., may be connected to the circuit grounding conductor. When so used, the size of the circuit grounding conductor shall in no case be less than the minimum required size of the largest grounding conductor connected thereto. (See section 1705(e)).
- d. Grounding conductors for conduit, cable armor, frames of equipment, etc., shall be installed in compliance with the requirements of this Code for circuit wires similarly located except that conduit or other metal piping of the size indicated in section 1705(e) of this Article may serve as the grounding conductor.
- e. Where instruments, meters, or relays operate with windings or working parts, at a potential of 750 volts or above to ground, the cases and other exposed bare metal parts of these devices insulated from the current carrying parts shall be grounded. Where instruments, meters or relays are operated from current or potential instrument transformers used on circuits of 750 volts or above to ground, the cases and other exposed bare metal parts which are insulated from the current carrying parts shall be grounded. (See section 1705(f)).
- f. Sections of conduit, armored cable, metal raceways or other equipment, shall be bonded together and the whole grounded or each section shall be separately grounded. Equipment in the immediate vicinity of gas pipes shall be bonded thereto. This requirement shall not apply to service runs or to isolated lengths of conduit, armored cable or metal raceway not exceeding 25 feet, provided the runs are insulated from ground and adjacent grounded metal and are guarded when within reach from grounded surfaces.

1703 - Grounding Conductor - Size and Material Required.

- a. The grounding conductor shall be of copper (except where metal piping is permitted) and where practicable shall be without joint or splice.
- b. The path to ground provided for a circuit shall, in general, have ampere capacity sufficient to insure the continuity and continued effectiveness of the path under conditions of excess current caused by accidental grounding of any normally ungrounded conductor of the circuit.
- c. The grounding conductor for a direct current system shall have a current capacity not less than that of the largest feeder of the same system leaving the station. In no case shall the grounding conductor be smaller than No. 6. (See section 1702(h)).
- d. The grounding conductor for an alternating current system shall have an ampere capacity not less than one-fifth that of the conductor to which it is attached. The grounding conductor shall not be smaller than No. 6 except that a No. 10 grounding conductor may be used for grounding a service conductor that is not larger than No. 10. The grounding conductor need not be larger than No. 0.
- e. The size of a conductor (wire or pipe) grounding conduit, armored cable, metal raceways and equipment shall be not less than that given in the following table:
- | Capacity of nearest outlet protecting conductors in conduit armored cable metal raceway or equipment. | Size of Copper wire Grounding Conductor | Size of Grounding Pipe. |
|---|---|-------------------------|
| 0 to 100 amperes | No. 10 | $\frac{1}{2}$ inch |
| 101 to 200 " | No. 8 | $\frac{3}{4}$ " |
| 201 to 500 " | No. 4 | 1 " |
| Over 500 " | No. 2 | 1 1/2 " |
- No. 10 copper may be used as a conductor grounding portable equipment, the conductors to which are protected by fuses not greater than 15 amperes. For portable equipment using more than 15 amperes, the above table shall be followed.
- f. The size of a conductor grounding the non current-carrying metal parts of instruments, meters or relays shall be not less than No. 18. (See section 1704(c)).
- g. The grounding conductor for the secondary circuits of current and potential transformers shall be not smaller than the conductor of the secondary circuit. (See section 1702(d)).

b. For lightning arresters, the grounding conductor shall have a current-carrying capacity sufficient to insure the continuity and continued effectiveness of the ground connection under conditions of excess current, caused by, or following, discharge of the arrester. No individual lightning arrester grounding conductor shall have a smaller carrying capacity than No. 6 copper wire.

1706 - Grounding to Water Pipe.

Note: As a general rule in locations (other than the underground district) where service ground connection cannot be made to a water piping system at the building served, both conductors of E-wire branch circuits must be fused. (See section 1204(a)).

a. Ground connection shall be made on a water piping system if one is available. As a general rule, water pipe shall be considered available if it is in or on the building and within 20 feet of the equipment or circuit which is to be grounded. The connection shall be made to cold-water piping, if available, not to steam or hot-water piping.

b. For circuit grounds the point of connection to the piping system shall be located on the street side of water meter when such meter is installed in the building or the water meter (in building) shall be shunted by means of two approved clamps and a conductor of the same size as the grounding conductor. (See section 1703).

c. Ground connections for equipment, conduit, armored cable, metal raceway and the like may be made to the water piping at a point near the equipment to be grounded.

1707 - Ground Connections - To Be Permanent, Effective and Accessible.

a. Where a non-conductive, protective coating, such as enamel, is provided for equipment, couplings and fittings, such coating shall be completely removed from threads and other surfaces in order to insure a good contact between ground clamp and equipment. Pipes or rods used to provide a ground shall be cleaned of rust, scale, paint, etc., at the point of attachment of the ground clamp. The connection and contact with the ground shall be permanent and effective, and shall always be made on a water piping system if one is available. (See section 1706).

b. The ground conductor shall be attached to the pipe or rod (a) by means of an approved bolted clamp to which the conductor is soldered or otherwise connected in an approved manner, or (b) by means of a brass plug screwed into the pipe and provided with a lug to receive the conductor, or (c) by other approved means.

c. The connection to water pipe for service circuit ground shall be protected as required by section 1703(c) of this article.

d. Where practicable the point of ground connection shall be in sight and readily accessible. In no case shall any ground connection be concealed before inspection.

1706 - Certain Grounds Prohibited.

a. Gas piping systems within buildings shall be used as a ground only when water piping is not available, and then only for grounding equipment; provided, however, that gas piping may serve as the sole ground for small fixtures located at a considerable distance from water piping. Where gas piping is so utilized, it shall be bonded to the water piping system at their point of entrance. Gas piping need not be insulated from otherwise well grounded, straight electric fixtures.

b. Protective ground connections shall not be made to grounded conductors or rails of electric railway circuits when other effective means of grounding are available, except ground connections for lightning arresters, conduit or other equipment, on such electric railway circuits.

(Fine print note) In all cases where ground connection cannot be made to a water piping system, the advisability and method of providing artificial ground connection shall be determined by the Inspector.

1707 - Supply Station, and Lightning Arrester Grounds.

a. At supply stations, grounding conductors for circuits, equipment and lightning arresters shall be permanently and effectively connected to all available active, continuous, metallic underground piping systems between which no appreciable difference of potential normally exists; otherwise, to one system only. Elsewhere than at supply stations, the grounding conductor shall be connected to at least one such piping system, if available. Gas piping shall be avoided wherever practicable, except as provided in Section 1708 of this Article. Where underground metallic piping systems are not available, other grounds, which will provide the desired permanence and conductance, may be permitted.

b. Lightning arrester ground connections shall not be made to the same artificial ground (driven pipes or buried plates) as circuits or equipment, but shall be well spaced and when practicable kept at least twenty feet from other artificial ground. The ground connection shall be made at such a point that the grounding conductor will be as short and straight as practicable. Protection for lightning-arrester ground conductors shall be of non-magnetic material, unless the ground conductor is electrically connected to both ends of the protective device.

(Fine print note) Lightning arrester grounds for radio signalling systems are covered in Article 35.

ARTICLE 18WATTAGE REQUIREMENTS

NOTE:- The wattage requirements set forth in this Article are the minimum requirements. If the connected load exceeds the wattage specified herein, wiring must be installed accordingly.

1801 - Wattage Requirements in Commercial and Industrial Establishments.

a. A sufficient number of lighting circuits shall be installed in commercial and industrial establishments to permit the use of not less than 1½ watts per square foot of floor area. Exceptions to this rule are as follows:

1. For sales or display rooms in one story buildings and for guest rooms of hotels, lodging houses, detention buildings, etc., the capacity shall be based on a minimum of one watt per square foot of floor area.

2. For storage rooms and similar spaces, and in toilets, closets, dressing rooms, passage ways, halls, etc., the capacity shall be based on a minimum of ½ watt per square foot of floor area.

3. For general lighting of working spaces in factories, work shops, etc., the capacity shall be based on a minimum of one watt per square foot of floor area.

4. No outlet shall be wired for less than 50 watts, irrespective of the floor area of any room.

(Fine print note) It is not the intent of the above rules to require that circuit wiring be actually installed where only a portion of the floor area is to be lighted, but it is the intent to require that a sufficient number of circuit outlets and necessary feeder capacity be provided at distributing center to permit the use of the total wattage required in the event the entire area is wired for light.

b. The area of mezzanine floors shall be included and the wattage specified in paragraph (a) above computed for same according to the purpose for which such mezzanine floor area is used.