

RULES OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

*Adopted at Montreal, Sept. 10, 1891, and
Amended at Buffalo, Feb. 23, 1892.*

CLASS A.—CENTRAL STATIONS.—FOR LIGHT OR
POWER.

*These Rules also Apply to Dynamo-Rooms in
Isolated Plants, Connected With or De-
tached from Buildings Used for Other
Purposes. Also to all Varieties of Appa-
ratus, of both High and Low Potential.*

GENERATORS OR MOTORS—Must be:

1. Located in a dry place.
2. Insulated on floors or base frames, which must be kept filled to prevent absorption of moisture, and also kept clean and dry.
3. Not exposed to flying or combustible materials.
4. Each covered with a waterproof cover when not operating.

In no case must a generator be placed in a room where any hazardous process is carried on, such as the working room of a cotton, jute, flax, woolen or flour mill.

CARE AND ATTENDANCE.—A competent man must be kept on duty in the room where generators are operating.

Oily waste must be kept in metal cans and removed daily.

CONDUCTORS.—From generators, switchboards, rheostats, or other instruments, and thence to outside lines, conductors must be:

1. In plain sight.
2. Wholly on non-combustible insulators, such as glass or porcelain.
3. Separated from contact with floors, partitions or walls through which they may pass by non-combustible insulating tubes.
4. Kept rigidly so far apart that they cannot come in contact.
5. Covered with non-inflammable insulating material sufficient to prevent accidental contact.
6. Ample in carrying capacity to prevent heating. (See Capacity of Wires Table.)
7. Connected by splices or joints equal in carrying capacity to the conductors themselves, soldered, if necessary to make them efficient and permanent.
8. When under floors or in distributing towers, placed in spaces ample for inspection and ventilation, and provided with special insulating covering.

SWITCHBOARDS—Must be:

1. So placed as to make it impossible to communicate fire to surrounding combustible material; accessible from all sides when the

connections are on the back; or may be placed against a brick or stone wall when the connections are entirely on the face.

2. Kept free from moisture.

3. Made of non-combustible material, or of hard wood, filled to prevent absorption of moisture.

4. Equipped with bars and wires in accordance with Rules 1, 2, 4, 5, 6, and 7, for placing interior conductors.

RESISTANCE BOXES AND EQUALIZERS—Must be:

1. Equipped with metal or non-combustible frames.

2. Treated as sources of heat.

3. Placed on the switch, or a distance of a foot from combustible material, or separated therefrom by asbestos or cement.

LIGHTNING ARRESTERS—Must be:

1. Attached to each side of every overhead circuit connected with the station.

2. In plain sight.

3. On the switchboard, or in an equally accessible place, away from combustible material.

4. Connected with at least two earths by separate wires of large size.

5. So constructed as not to maintain an arc after the discharge has passed.

TESTING.—All series and alternating circuits must be tested every two hours while in operation to discover any leakage to earth, abnormal in view of the potential and method of operation.

All multiple arc low potential systems (300 volts or less) must be provided with an indicating or detecting device, readily attachable, to afford easy means of testing where the station operates perpetually.

Data obtained from all tests must be preserved for examination by insurance inspectors.

CLASS B.—ARC (SERIES) SYSTEM.

OVERHEAD CONDUCTORS.—All outside overhead conductors (including services) must be:

1. Covered with some insulating material not easily abraded.

2. Firmly secured to properly insulated and substantially built supports, all the wires having an insulation equal to that of the conductors they confine.

3. So placed that moisture cannot form a cross connection between them, not less than a foot apart and not in contact with any substance other than proper insulating supports.

4. At least seven feet above the highest point of flat roofs and at least one foot above the ridge of pitched roofs over which they pass or to which they are attached.

5. Protected, whenever necessary, in view of possible accidents to conductors or supports, from possibility of contact with other conducting wires or substances to which current may leak, by dead insulated guard irons or wires. Special precautions of this kind

must be taken where sharp angles occur, or where any wires might possibly come in contact with electric light or power wires.

6. Provided with petticoat insulators of glass or porcelain. Porcelain knobs and rubber hooks are prohibited.

7. So spliced or joined as to be both mechanically and electrically secure without solder. They must then be soldered to insure preservation, and covered with an insulation equal to that on the conductors.

The following formula for soldering fluid is approved:

Saturated solution of zinc	5 parts.
Alcohol	4 parts.
Glycerine	1 part.

Conductors should not be run over or attached to buildings other than those in which light or power is being, or is to be, used, but on separate poles or structures always easily inspected.

SERVICE BLOCKS must be covered over their entire surface with at least two coats of waterproof paint, and so maintained.

Telegraph, telephone, and similar wires must not be placed on the same arm with electric or power wires, and *should not* be placed on the same structure or pole.

Interior Conductors.

ALL INTERIOR CONDUCTORS—Must be:

1. Where they enter buildings from outside terminal insulators to and through the walls

covered with waterproof insulation, and must have drip loops outside, preferably slanting upward toward the inside, and bushed with waterproof and non-combustible insulating tube.

2. Arranged to enter and leave the building through a double contact switch, which will effectually close the main circuit and disconnect the interior wires when it is turned "off." The switch must be so constructed that it shall be automatic in its action, not stopping between points when started, and prevent an arc between the points under all circumstances; it must indicate on inspection whether the current be "on" or "off," and be mounted on a non-combustible base in a position where it can be kept free from moisture, and easy of access to police or firemen.

3. Always in plain sight, never covered, except in special cases, where an armored tube may be necessary.

4. Covered in all cases with a waterproof non-combustible material that will adhere to the wire, not fray by friction, and bear a temperature of 150 degrees F. without softening.

5. In dry places, kept rigidly apart at least ten inches, except when covered (in addition to insulation)—by a waterproof, non-conducting and non-inflammable tubing, which must be strong enough to protect the insulating covering from injury. Conductors thus placed may be run not less than three inches apart, and be fastened with staples, under which are placed mechanically rigid insulating strips or

saddles of greater width than the metal of the staple, by which possibility of injury to the tube may be prevented.

6. In damp places, attached to glass or porcelain insulators, and separated ten inches or more.

7. When passing through walls, floors, timbers, or partitions, treated as in central stations under like conditions.

Lamps and Other Devices.

ARC LAMPS—Must be in every case:

1. Carefully isolated from inflammable material.

2. Provided at all times with a glass globe surrounding the arc, securely fastened upon a closed base. No broken or cracked globes may be used.

3. Provided with a hand switch, also an automatic switch, that will shunt the current around the carbons should they fail to feed properly.

4. Provided with reliable stops to prevent carbons from falling out in case the clamps become loose.

5. Carefully insulated from the circuit in all their exposed parts.

6. Where inflammable material is near or under the lamps, provided with a wire netting around the globe and a spark arrester above, to prevent escape of sparks, melted copper or carbon.

Incandescent lamps in series circuits, having a maximum potential of 350 volts or over, must be governed by the same rules as for arc lights, and each series lamp provided with a hand switch and automatic cut-out switch; when lights are in multiple series, such switches and cut-outs must not control less than a single group of lights. Electro-magnetic devices for switches are not approved.

Under no circumstances will incandescent lamps on series circuits be allowed to be attached to gas fixtures.

CLASS C.—INCANDESCENT (LOW PRESSURE) SYSTEMS.—300 VOLTS OR LESS.

Overhead Conductors.

OUTSIDE OVERHEAD CONDUCTORS—Must be:

1. Erected in accordance with general rules for arc (series) circuit conductors.
2. Separated not less than six inches, where they enter buildings as service conductors, and be provided with a double pole fusible cut-out, as near as possible to the point of entrance to the building, and outside the walls when practicable.

Underground Conductors.

UNDERGROUND CONDUCTORS—Must be:

1. Provided with suitable protecting devices at the ends of tube or conduit services in-

side the walls of buildings, as a guard against moisture and injury.

2. Terminated at a properly placed double-pole house cut-out.

3. Of specially insulated conductors after leaving the tube or conduit, and separated by at least 10 inches, until the double-pole cut-out is reached.

Inside Wiring.

Wires should be so placed that in the event of the failure or deterioration of their insulating covering the conductors will still remain insulated.

At the entrance of every building there shall be a double-pole switch placed in the service conductors, whereby the current may be entirely cut off.

CONDUCTORS—Must not be:

1. Of sizes smaller than No. 16 B. & S., No. 18 B. W. G., or No. 3 E. S. G.
2. Lead or paraffine covered.
3. Covered with soft rubber tube.
4. Laid in molding of any kind in damp places.
5. Laid in moldings with open grooves against the wall or ceiling.
6. Laid in molding where less than half an inch of solid insulation is between parallel wires, and between wires and walls or ceilings.
7. Inside conductors must not be laid in plaster, cement, or similar finish without an exterior metallic protection.

CLEATWORK is not desirable, and cleats must *not* be used unless—

1. In a very dry place.
2. In a place perfectly open for inspection at any time.
3. They are porcelain, or well seasoned wood, filled, to prevent absorption of moisture.
4. They are so arranged that wires of opposite polarity, with a difference of potential of 150 volts or less, will be kept at least two and one-half inches apart, and that where a higher voltage is used, this distance be increased proportionately.
5. There is a backing provided, of wood at least half an inch thick, well seasoned and filled, to prevent absorption of moisture.

METAL STAPLES must never be used to fasten conductors unless—

1. Provided with an insulating sleeve or saddle rigidly attached to the metal of the staple, and having such strength and surface as to prevent mechanical injury to the insulation of the conductor.
2. Under conditions in which cleatwork would be acceptable, or where driven into a molding specially adapted for open work.

Special Wiring.

Wherever conductors cross gas, water, or other metallic pipes, or any other conductors or conducting material (except arc light wires), they should be separated therefrom by some continuous non-conductor at least one

inch. In crossing arc light wires the low-tension conductors must be placed at a distance of at least six inches. In wet places an air space must be left between conductors and pipes in crossing, and the former must be run in such a way that they cannot come in contact with the pipe accidentally. Wires should be run over all pipes upon which condensed moisture is likely to gather, or which by leakage might cause trouble on a circuit.

In rooms where inflammable gases exist the incandescent lamp and socket must be inclosed in a vapor-tight globe. This is not understood to include rooms where illuminating gases are used in the ordinary manner.

In breweries, stables, dye-houses, paper and pulp mills, or other buildings specially liable to moisture, all conductors, except where used for pendants, must be:

1. Separated at least six inches.
2. Provided with a durable moisture-proof covering.
3. Supported by porcelain or glass insulators.

Moisture-proof and non-inflammable tubing may be accepted in lieu of such construction.

No switches or fusible cut-outs will be allowed in such places.

INTERIOR CONDUITS—Must not be:

1. Combustible.
2. Of such material or construction that will be injured by plaster or cement, or other

surrounding material, or that the insulation of the conductor will be ultimately injured or destroyed by the elements.

3. So constructed or placed that difficulty will be experienced in removing or replacing the conductors.

4. Subject to mechanical injury by saws, chisels, or nails.

5. Supplied with a twin conductor in a single tube where a current of more than 10 ampères is expected.

6. Depended upon for insulation. The conductors must be covered with moisture-proof material.

The object of a tube or conduit is to facilitate the insertion or extraction of the conductors, to protect them from mechanical injury, and as far as possible, from moisture.

Twin tube conductors must not be separated from each other by rubber or similar material, but by cotton or other readily carbonizable substance.

Conductors passing through walls or ceilings must be encased in a suitable tubing, which must extend at least one inch beyond the finished surface until the mortar or other similar material be entirely dry, when the projection may be reduced to half an inch.

DOUBLE POLE SAFETY CUT-OUTS—Must be:

1. Placed where the overhead or underground conductors enter a building and join the inside wires.

2. Placed at every point where a change is made in the size of wires (unless the cut-out in the larger wire will protect the smaller.) This includes all flexible conductors. All such junctions must be in plain sight.

3. Constructed with bases of non-combustible and moisture-proof material.

4. So constructed and placed that an arc cannot be maintained between the terminals by the fusing of the metal.

5. So placed that on any combination fixture, no group of lamps requiring a current of six ampères or more shall be ultimately dependent upon one cut-out.

6. Wherever used for more than six ampères (or where the plug or equivalent device is not used) equipped with fusible strips or wires provided with contact surfaces or tips of harder metal soldered or otherwise having perfect electrical connection with the fusible part of the strip.

SAFETY FUSES must be so proportioned to the conductors they are intended to protect that they will melt before the maximum safe carrying capacity of the wire is exceeded.

All fuses, where possible, must be stamped or otherwise marked with the number of ampères equal to the safe carrying capacity of the wire they protect.

All cut-out blocks, when installed, must be similarly marked.

The safe carrying capacity of a wire changes under different circumstances, being about 40

per cent. less when the wire is closed in a tube or piece of molding than when bare and exposed to the air, when the heat is rapidly radiated. It must be clearly understood that the size of the fuse depends upon the size of the smallest conductor it protects, and not upon the amount of current to be used on the circuit. Below is a table showing the safe carrying capacity of conductors of different sizes in Birmingham, Brown & Sharpe and Edison gauges, which must be followed in the placing of interior conductors.

Brown & Sharpe.		Birmingham.		Edison Standard.	
Gauge No.	Ampères.	Gauge No.	Ampères.	Gauge No.	Ampères.
0000	175	0000	175	200	175
000	145	000	150	180	160
00	120	00	130	140	135
0	100	0	110	110	110
1	95	1	95	90	95
2	70	2	85	80	85
3	60	3	75	65	75
4	50	4	65	55	65
5	45	5	60	50	60
6	35	6	50	40	50
7	30	7	45	30	40
8	24	8	35	25	35
10	20	10	30	20	30
12	15	12	20	12	20
14	10	14	15	8	15
16	5	16	10	5	10
		18	5	3	5

SWITCHES—Must:

1. Be mounted on moisture-proof and incombustible bases, such as slate or porcelain.
2. Be double pole when the circuits which they control are connected to fixtures attached to gas pipes, and when six ampères or more are to pass through them.
3. Have a firm and secure contact, must make and break readily, and not stick when

motion has once been imparted by the handle.

4. Have carrying capacity sufficient to prevent heating above the surrounding atmosphere.

5. Be placed in dry accessible places, and be grouped as far as possible, being mounted, when practicable, upon slate or equally indestructible back boards.

MOTORS.—In wiring for motive power, the same precautions must be taken as with the current of the same volume and potential for lighting. The motor and resistance box must be protected by a double-pole cut-out and controlled by a double-pole switch.

ARC LIGHTS ON LOW POTENTIAL CIRCUITS—
—Must be:

1. Supplied by branch conductors not smaller than No. 12 B. & S. gauge.

2. Connected with main conductors only through double-pole cut-outs.

3. Only furnished with such resistances or regulators as are inclosed in non-combustible material, such resistances being treated as sources of heat.

4. Supplied with globes protected as in the case of arc lights on high potential circuits.

Fixture Work.

1. In all cases where conductors are concealed within or attached to fixtures, the latter must be insulated from the gas pipe system of the building.

2. When wired outside, the conductors must be so secured as not to be cut or abraded by the pressure of the fastenings, or motion of the fixtures.

3. All conductors for fixture work must have a waterproof insulation that is durable and not easily abraded, and must not in any case be smaller than No. 16 B. & S., No. 18 B. W. G., or No. 3 E. S. G.

4. All burrs or fins must be removed before the conductors are drawn into a fixture.

5. The tendency to condensation within the pipes must be guarded against by sealing the upper end of the fixture.

6. No combination fixture in which the conductors are concealed in a space less than one-fourth inch between the inside pipe and the outside casing will be approved.

7. Each fixture must be tested for possible "contacts" between conductors and fixture, and for "short circuits," before the fixture is connected to its supply conductors.

8. The ceiling blocks of fixtures should be made of insulating material.

Electric Gas-Lighting.

Where electric gas-lighting is to be used on the same fixture with the electric light:

1. No part of the gas piping or fixture shall be in electrical connection with the gas-lighting circuit.

2. The wires used with the fixture must have a non-inflammable insulation, or where

concealed between the pipe and shell of the fixture the insulation must be such as is required for fixture wiring for the electric light.

3. The whole installation must test free from "grounds."

4. The two installations must test perfectly free of connection with each other.

Pendants and Sockets.

No portion of the lamp socket exposed to contact with outside objects must be allowed to come into electrical contact with either of the conductors.

CORD PENDANTS—Must be:

1. Made of conductors, each of which is composed of several strands insulated from the other conductor by a mechanical separator of carbonizable material, and both surrounded in damp places with a moisture-proof and a non-inflammable layer.

2. Protected by insulating bushings where the cord enters the socket.

3. So suspended that the entire weight of the socket and lamp will be borne by knots, above the points where the cord comes through the ceiling block or rosette, in order that the strain may be taken from the joints and binding screws. All sockets used for wire or cord pendants should have openings at least equal to one-quarter inch gas pipe size.

4. Allowed to sustain nothing heavier than a four-light cluster, and in such a case sufficient

provision should be made by an extra heavy cord or wire, as a mechanical reinforcement.

5. Equipped with keyless sockets as far as practicable, controlled by wall switches. In no case may a lamp giving more than fifty (50) candle-power be placed in a key socket on a flexible pendant.

CLASS D.—ALTERNATING SYSTEMS.

Converters or Transformers.

CONVERTERS—Must not:

1. Be placed inside of any building except the central station unless as hereinafter provided.

2. Be placed in any but metallic or non-combustible cases.

3. Be attached to the outside walls of buildings, unless separated therefrom by substantial insulating supports.

4. Be placed in any other than a dry and convenient location (which can be secured from opening into the interior of the building such as a vault) when an underground service is used.

5. Be placed without safety fuses at the junction between main and service conductors and safety fuses in the secondary circuits where they will not be affected by the heat of the converter.

Primary Conductors.

In those cases where it may not be possible to exclude the transformers and primary wires entirely from the building, the following precautions must be strictly observed:

1. The transformer must be located at a point as near as possible to that at which the primary wires enter the building.

2. Between these points the conductors must be heavily insulated with a coating of moisture-proof material, and, in addition, must be so covered and protected that mechanical injury to them or contact with them shall be practically impossible.

3. The primary conductors, if within a building, must be furnished with a double pole switch, and also with an automatic double pole cut-out where the wires enter the building, or where they leave the main line, on the pole or in the conduit. These switches should, if possible, be inclosed in secure and fireproof boxes outside the building.

4. The primary conductors, when inside a building, must be kept apart at least 10 inches, and at the same distance from all other conducting bodies.

Secondary Conductors.

The conductors from the secondary coil of the transformer to the lamps or other translating devices must be installed according to the rules for "inside wiring" for "low potential systems."

CLASS E.—ELECTRIC RAILWAYS.

Power Stations.

All rules pertaining to arc light wires and stations shall apply (so far as practicable) to street railway stations and their conductors.

Railway Systems with Ground Return.

Electric railway systems in which the motor cars are driven by a current from a single wire, with ground or floor return circuit, are prohibited *except* as hereinafter provided:

1. When there is no liability of other conductors coming in contact with the trolley wire.

2. When the location of the generator is such that the ground circuit will not create a fire hazard to the property.

3. When an approved automatic circuit breaker or other device that will immediately cut off the current in case the trolley wires become grounded is introduced in each circuit as it leaves the power station. This device must be mounted on a fireproof base, and be in full view of the attendant.

Trolley Wires.

TROLLEY WIRES—Must be:

1. No smaller than No. 0 B. & S. copper, or No. 4 B. & S. silicon bronze, and must readily stand the strain put upon them when in use.

2. Well insulated from their supports, and in case of the side or double pole construction, the supports shall also be insulated from the poles immediately outside the trolley wire.

3. Capable of being disconnected at the power house, or of being divided into sections, so that in case of fire on the railway route the current may be shut off from the particular section and not interfere with the work of the firemen in extinguishing the flames. This rule also applies to feeders.

4. Safely protected against contact with all other conductors.

Car Wiring.

All wires in cars must be run out of reach of the passengers, and shall be insulated with a waterproof insulation.

Lighting and Railway Power Wires.

Lighting and power wires must not be permitted in the same circuit with trolley wires with a ground return, except in street railway cars, car houses, and power stations. The same dynamo may be used for both purposes, provided the connection from the dynamo for each circuit shall be a double-pole switch so arranged that only one of the circuits can be in use at the same time.

CLASS F.—BATTERIES.

When current for light and power is taken from primary or secondary batteries, the

same general regulations must be observed as apply to such wires fed from dynamo generators developing the same difference of potential.

CLASS G.—MISCELLANEOUS.

1. The wiring in any building must test free from "grounds" before the current is turned on. This test may be made with a magneto bell that will ring through a resistance of 20,000 ohms, where currents of less than 250 volts are used.

2. No ground wires for lighting arresters may be attached to gas pipes within the building.

3. All conductors connecting with telephone, district messenger, burglar alarm, watch clock, electric time, and other similar instruments must, if in any portion of their length they are liable to become crossed with circuits carrying currents for light or power, be provided near the point of entrance to the building with some protective device which will operate to shunt the instruments in case of a dangerous rise of potential, and will open the circuit and arrest an abnormal current flow. Any conductor normally forming an innocuous circuit may become a source of fire hazard if crossed with another conductor through which it may become charged with a relatively high pressure.