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DEPARTMENT OF COMMERCE

BUREAU OF STANDARDS

George K. Burgess, Director

SAFETY RULES FOR RADIO INSTALLATIONS

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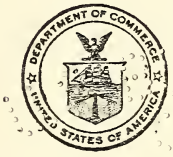
SAFETY RULES FOR RADIO INSTALLATIONS

COMPRISING PART 5 OF THE FOURTH EDITION NATIONAL ELECTRICAL SAFETY CODE

JULY 15, 1926



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PREFACE

Previous editions of the National Electrical Safety Code have been published in complete form. The fourth edition is being issued not only as a whole but also as separate publications dealing with the several subjects involved.

The fourth edition has been augmented by part 5 dealing with radio installations, and it is this part which is contained in this volume.

Transmitting stations of high power (as defined in the rules) are required to be installed in conformity with the rules of part 1 in so far as generating apparatus and installation of conductors are concerned. Part 1 contains the rules for the installation and maintenance of electrical supply stations and will be found in Handbook No. 6 as well as in the complete code. The construction of antennas is covered in part 5.

These rules have been formulated and approved by a sectional committee organized according to the rules of procedure of the American Engineering Standards Committee. Criticism of the rules and suggestions for their improvement are invited, and in future editions every effort will be made to perfect the rules, both in the development of detail and in the modification of any requirements which it is found can be improved.

GEORGE K. BURGESS,
Director.

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SAFETY RULES FOR RADIO INSTALLATIONS

COMPRISING PART 5 OF THE FOURTH EDITION, NATIONAL ELECTRICAL SAFETY CODE

DEFINITIONS

Alive or **live** means electrically connected to a source of potential difference, or electrically charged so as to have a potential different from that of the earth. The term "live" is sometimes used in place of the term "current carrying" where the intent is clear, to avoid repetitions of the longer term.

Antenna conflict means that an antenna or its guy wire is at a higher level than a supply or communication conductor and approximately parallel thereto, provided the breaking of the antenna or its support will be likely to result in contact between the antenna or guy wire and the supply or communication conductor.

Circuit means a conductor or system of conductors through which an electric current is intended to flow.

Communication lines means the conductors and their supporting or containing structures which are located outside of buildings and are used for public or private signal or communication service and which operate at not exceeding 400 volts to ground or 750 volts between any two points of the circuit and the transmitted power of which does not ex-

ceed 150 watts. When operating at less than 150 volts, no limit is placed on the capacity of the system.

Note: Telephone, telegraph, messenger-call, clock, fire or police alarm, and other systems conforming with the above are included.

Lines used for signaling purposes, but not included under the above definitions, are considered as supply lines of the same voltage and are to be so run.

Exception is made under certain conditions for communication lines used in the operation of supply lines.

Conductor means a metallic conducting material, usually in the form of a wire or cable, suitable for carrying an electric current. Does not include bus bars.

Current-carrying part means a part intended to be connected in an electric circuit to a source of voltage. Non-current-carrying parts are those not intended to be so connected.

Dead means free from any electrical connection to a source of potential difference and from electric charge; not having a potential different from that of the earth. The term is used only with reference to current-carrying parts which are sometimes alive.

Electrical supply equipment means equipment which produces, modifies, regulates, controls, or safeguards a supply of electrical energy. Similar equipment, however, is not included where used in connection with signaling systems under the following conditions:

(*a*) Where the voltage does not exceed 150.

(*b*) Where the voltage is between 150 and 400 and the power transmitted does not exceed 3 kilowatts.

Electrical supply lines means those conductors and their necessary supporting or containing structures which are located entirely outside of buildings and are used for transmitting a supply of electrical energy.

Electrical supply station means any building, room, or separate space within which electrical supply equipment is located and the interior of which is accessible, as a rule, only to properly qualified persons.

Note: This includes generating stations and substations and generator, storage-battery, and transformer rooms, but excludes manholes and isolated transformer vaults on private premises.

Grounded means connected to earth or to some extended conducting body which serves instead of the earth, whether the connection is intentional or accidental.

Grounded system means a system having a permanent and effective electrical connection to earth. This ground connection may be at one or more points.

Note: "Effective," as herein used, means a connection to earth of sufficiently low resistance and high current-carrying capacity to prevent any current in the ground wire from causing a harmful voltage to exist between the grounded conductors and neighboring exposed conducting surfaces which are in good contact with the earth, or with neighboring surfaces of the earth itself, under the most severe conditions which are liable to arise in practice.

Permanently grounded means having such an effective connection to the earth (by use of an underground system of metallic pipe mains or other suitable means) as described in the preceding paragraph.

Guarded means covered, shielded, fenced, inclosed, or otherwise protected, by means of suitable covers or casings, barrier rails or screens, mats or platforms, to remove the liability of dangerous contact or approach by persons or objects to a point of danger.

Insulated means separated from other conducting surfaces by a dielectric substance or air space permanently offering

a high resistance to the passage of current and to disruptive discharge through the substance or space.

Note: When any object is said to be insulated, it is understood to be insulated in suitable manner for the conditions to which it is subjected. Otherwise, it is, within the purpose of these rules, uninsulated. Insulating covering of conductors is one means for making the conductors insulated.

Insulating (where applied to the covering of a conductor, or to clothing, guards, rods, and other safety devices) means that a device, when interposed between a person and current-carrying parts, protects the person making use of it against electric shock from the current-carrying parts with which the device is intended to be used; the opposite of conducting.

Rural districts means all places not urban, usually in the country, but in some cases within city limits.

Service means the connecting conductors by which a supply of electrical energy is carried from a supply line to the building or premises served. For overhead circuits, it includes the conductors from the last line pole to the service switch or fuse. The portion of an overhead service between the pole and building is designated as "service drop."

Switch means a device for opening and closing or for changing the connection of a circuit. In these rules a switch will always be understood to be manually operated, unless otherwise stated.

Urban districts means thickly settled areas (whether in cities or suburbs) or where congested traffic often occurs. A highway, even though in the country, on which the traffic is often very heavy, is considered as urban.

Voltage or **volts** means the highest effective voltage between any two conductors of the circuit concerned, except that in grounded multiwire circuits, not exceeding 750 volts between outer conductors, it means the highest effective voltage between any wire of the circuit and the ground.

In ungrounded circuits not exceeding 750 volts, voltage to ground means the voltage of the circuit.

When one circuit is directly connected to another circuit of higher voltage (as in the case of an autotransformer), both are considered as of the higher voltage, unless the circuit of lower voltage is permanently grounded. Direct connection implies electrical connection as distinguished from connection merely through electromagnetic or electrostatic induction.

Wire gauges: The American Wire Gauge (A. W. G.), otherwise known as Brown & Sharpe (B. & S.), is the standard gauge for copper, aluminum, and other conductors, excepting steel, for which the Steel Wire Gauge (Stl. W. G.) is used throughout these rules.

SEC. 50. SCOPE

500. SCOPE.

The rules of part 5 apply to radio transmitting and receiving installations including antennas, counterpoise wires, lead-in conductors, grounding conductors, grounding connections, protective devices and batteries. The rules do not apply to antennas used for coupling carrier-current equipment to line conductors.

In case the installation is covered by more than one rule, the superior requirement shall apply.

SEC. 51. CLASSIFICATION OF RADIO STATIONS

510. CLASSIFICATION OF RADIO STATIONS.

For the purpose of these rules radio stations are classified as follows:

A. Receiving Stations.

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510—Continued.

B. Transmitting Stations.

1. LOW POWER.

Transmitting stations to which the power supplied is less than 100 watts and where the voltage of the power supplied is less than 400 volts.

2. MEDIUM POWER.

Transmitting stations not classified as low power or high power.

3. HIGH POWER.

Transmitting stations to which the power supplied is greater than 1,000 watts or where the voltage of the power supplied is greater than 2,000 volts.

SEC. 52. ANTENNA AND COUNTERPOISE INSTALLATION

520. APPLICATION OF RULES.

These rules apply to the following:

A. Outdoor Antennas of all Classes of Receiving and Transmitting Stations. (There are no requirements for indoor antennas.)

B. Counterpoise Wires.

521. GENERAL REQUIREMENTS.

A. Counterpoise Wires.

Counterpoise wires shall conform to the requirements for antennas similarly located.

B. Antennas of Receiving and Low-Power Transmitting Stations.

Such antennas shall, in general, comply with the requirements for the construction of communication lines for public use in similar situations.

521—Continued.

C. Antennas of Medium and High-Power Transmitting Stations.

Such antennas shall, in general, comply with the requirements for the construction of supply lines in similar situations.

522. LOCATIONS TO BE AVOIDED.

The following situations should be avoided in erecting antennas and guy wires:

A. Attachments to supply or communication poles.

B. Crossings over railroad tracks or public highways.

C. Crossings over supply or communication conductors.

D. Crossings under supply or communication conductors.

E. Antenna conflicts with supply or communication conductors. (See definition of "Antenna Conflict.")

523. ORDINARY CONSTRUCTION OF ANTENNAS.

Antennas shall be constructed according to the requirements of rule 523 when they do not cross over railroad tracks, supply conductors, or communication conductors and do not conflict with supply or communication conductors.

A. Antenna Conductors.

1. MATERIAL

(a) RECEIVING ANTENNAS. No requirements.

(b) TRANSMITTING ANTENNAS. Antennas shall be of copper, bronze, copper-covered steel, or other metal which will not corrode excessively under the prevailing conditions.

2. SIZE.

Antenna conductor sizes shall be not less than given in Table 1.

523. A—Continued.

Table 1.—Antenna Conductor Sizes—Ordinary Construction

Material	Receiving antennas		Transmitting antennas			
			Low power		Medium and high power	
	Size A.W.G.	Diameter	Size A.W.G.	Diameter	Size A.W.G.	Diameter
Copper: Soft-drawn	14	*Inch* 0.064	14	*Inch* 0.064	7	*Inch* 0.144
Medium-drawn	14	.064	14	.064	8	.128
Hard-drawn	14	.064	14	.064	10	.102
Bronze or copper-covered steel	17	.045	14	.064	12	.081

3. STRENGTH.

(a) ANTENNAS OF RECEIVING AND LOW-POWER TRANSMITTING STATIONS. No requirements.

(b) ANTENNAS OF MEDIUM AND HIGH-POWER TRANSMITTING STATIONS. The strength of the antenna conductor shall be not less than that of No. 10 A. W. G. (diameter 0.102 inch) hard-drawn copper.

B. Antenna Insulators.

1. ANTENNAS OF RECEIVING AND LOW-POWER TRANSMITTING STATIONS.

No requirements.

523. B—Continued.

2. ANTENNAS OF MEDIUM AND HIGH-POWER TRANSMITTING STATIONS.

Insulators shall be of noncombustible material and shall have a creepage distance of not less than 10 inches.

C. Antenna Supports.

1. STRENGTH OF SUPPORTS.

Supports shall be of such initial size as to carry the vertical load and where necessary shall be guyed or braced so as to withstand the transverse and longitudinal loads to which they may be subjected.

2. ROOF SUPPORTS.

Antenna supports erected on roofs shall be of rigid construction, and, where necessary shall be arranged to distribute the load over the roof. Such supports shall be erected so that they are not dependent in any way on the antenna for stability.

3. CHIMNEYS

The attachment of antennas to chimneys should be avoided.

4. GROUNDING METAL SUPPORTS ON ROOFS.

Metal poles or masts extending more than 10 feet above the supporting building shall be permanently and effectively grounded.

5. TREES.

Where a tree is used as an antenna support, sufficient sag (or other means) shall be provided to keep the tension in the antenna safely below the breaking strength when the tree sways in the wind.

523—Continued.

D. Attaching Antennas to Supports.

1. STRENGTH OF ATTACHMENT.

The means used for attaching the antenna to the support shall be such as to withstand a greater load than that which will break the conductor itself.

2. ATTACHMENT ON SMALL POLES.

If the pole is not strong enough to support a person, some arrangement shall be provided to draw up the antenna from the ground.

E. Minimum Clearance Above Ground.

1. SPANS 150 FEET OR LESS IN LENGTH.

Antenna conductors shall have clearances above ground as given in Table 2.

Table 2.—Minimum Antenna Clearances Above Ground

Location	Receiving and low-power antennas	Medium and high-power antennas
	Feet	*Feet*
Above streets and other traveled roadways	18	28
Along road in rural districts	15	28
Above roadways to residences garages	10	----------
Above spaces or ways accessible only to pedestrians	10	----------

523. **E**—Continued.

2. SPANS EXCEEDING 150 FEET IN LENGTH. For such spans the above clearances shall be increased by 0.1 foot for each 10 feet in excess of 150 feet.

F. Minimum Clearances below Supply and Communication Conductors.

Antennas shall have the following clearances from conductors under which they cross:

Table 3.—Minimum Antenna Clearances Below Other Conductors

Crossing under—	Receiving and low-power antennas	Medium and high-power antennas
	Feet	*Feet*
Communication conductors	2	10
Supply conductors, 0 to 750 volts	4	10
Supply conductors exceeding 750 volts	6	10

G. Clearances from Combustible Material.

Antennas of medium and high-power transmitting stations shall be placed so that an air gap of at least 10 inches exists between the antenna and the nearest combustible material.

524. SPECIAL CONSTRUCTION OF ANTENNAS.

Antennas shall be specially constructed according to the following requirements when they cross over railroad tracks, supply conductors, or communication conductors, or are in conflict with supply or communication conductors.

A. **Recommendation against Locating Antennas in Situations Where Special Construction is Required.**

It is strongly recommended that the installation of antennas in these special situations be avoided. If such locations are employed it must be recognized that special hazards are introduced and that great care is necessary in the construction and maintenance of antennas to avoid contact with supply or communication conductors or to avoid the reduction of clearance over railroad tracks.

B. **Construction of Antennas Crossing Over or Conflicting with Service Loops 0 to 150 Volts to Ground.**

Antennas constructed in these situations shall conform to the requirements for the ordinary construction of antennas (rule 523) and, in addition, with the requirements set forth below for splices (rule 524, C, 2) and for minimum clearances above communication and supply line conductors (rule 524, C, 4).

C. **Construction of Antennas Crossing Over or Conflicting with Communication Conductors or Supply Conductors 0 to 750 Volts.**

1. ANTENNA CONDUCTOR STRENGTH.

The strength of the antenna conductor shall be not less than that of hard-drawn copper of the following sizes:

524. C. 1—Continued.

Span length	Size of hard-drawn copper	
	Size A. W. G.	Diameter
		Inch
0 to 150 feet	8	0. 128
Exceeding 150 feet	6	. 162

2. SPLICES.

Splices in antenna spans shall be made with a suitable twisted-sleeve connector which will provide a strong unsoldered joint.

3. ANTENNA SUPPORTS.

(a) MATERIAL. The poles for supporting antennas shall be of steel, concrete, or wood. Wood poles shall be free from observable defects that would decrease their strength or durability.

(b) SIZE. Wood poles shall have a top diameter of not less than 6 inches.

(c) SETTING. Poles shall be set to such a depth and in such a manner that any applied load will break the pole before the butt is pulled loose from its setting.

4. MINIMUM CLEARANCES ABOVE COMMUNICATION AND SUPPLY CONDUCTORS, 0 TO 750 VOLTS.

Antennas crossing over such conductors shall have the following clearances:

524. C. 4—Continued.

	Feet
Antennas of receiving and low-power transmitting stations	6
Antennas of medium and high-power transmitting stations	10

D. Antennas Crossing over Railroads or Crossing over or Conflicting with Supply Lines Exceeding 750 volts.

1. ANTENNAS OF RECEIVING AND LOW-POWER TRANSMITTING STATIONS.

Such antennas shall conform to the requirements for communication lines for public use in similar situations as far as grades of construction and clearances from all other wires and from ground are concerned. (See N. E. S. Code, part 2.)

2. ANTENNAS OF MEDIUM AND HIGH-POWER TRANSMITTING STATIONS.

Such antennas shall conform to the requirements for supply lines in similar situations as far as grades of construction and clearances from all other wires and from ground are concerned. (See N. E. S. Code, part 2.)

525. GUARDING OF ANTENNAS.

Antennas for transmitting stations shall be installed or protected so as to be inaccessible to unauthorized persons.

SEC. 53. LEAD-IN CONDUCTORS

530. APPLICATION OF RULES.

The requirements of this section apply to lead-in conductors of receiving stations and transmitting stations of low and medium power. Lead-in conductors of high-power transmitting stations shall meet such requirements of part 1 "Supply stations" as apply.

531. MATERIAL.

Lead-in conductors shall be of copper, bronze, copper-covered steel, or other metal which will not corrode excessively under the prevailing conditions.

532. SIZE.

A. Receiving Stations.

For receiving stations the size of lead-in conductor shall be not less than No. 14. A. W. G. (0.064 inch) if of copper, or less than No. 17 A. W. G. (0.045 inch) if of bronze or copper-covered steel.

B. Low and Medium Power Transmitting Stations.

For such transmitting stations the lead-in conductor shall be not less than No. 14 A. W. G. (0.064 inch).

533. INSTALLATION OF LEAD-IN CONDUCTOR.

A. From Antenna to First Building Attachment.

This section of the lead-in wire shall conform to the requirements for antennas similarly located.

B. From First Building Attachment to Building Entrance.

This section of the lead-in conductor shall be installed and maintained so that it can not swing closer to open supply conductors than the following distances:

533. B—Continued.

	Feet
Supply lines 0 to 750 volts	2
Supply lines exceeding 750 volts	10

Exception.—The 2-foot clearance may be reduced if the lead-in conductor is separated from supply conductors by a continuous and firmly fixed nonconductor which will maintain permanent separation. This nonconductor shall be in addition to any insulating covering on the wires.

C. From Building Entrance to Set.

1. RECEIVING STATIONS.

(a) Lead-in conductors shall be securely fastened in a workmanlike manner.

(b) Clearance between lead-in conductor and any supply conductor not in conduit shall not be less than 2 inches.

Exception.—This 2-inch clearance does not apply if a firmly fixed nonconductor such as porcelain tube affords a permanent separation. This nonconductor shall be in addition to any insulating covering on the wires.

2. LOW AND MEDIUM POWER TRANSMITTING STATIONS.

(a) Lead-in conductors shall be securely fastened to suitable insulators.

(b) Clearance between lead-in conductor and any supply wire shall be at least 5 inches.

(c) Lead-in conductors shall be installed and protected to prevent persons from readily coming into accidental contact with them.

SEC. 54. CONSTRUCTION AT BUILDING ENTRANCE

540. APPLICATION OF RULES.

The requirements of this section apply to construction at receiving stations and transmitting stations of low and medium power. Construction at building entrances at high-power transmitting stations shall meet such requirements of part 1 "Supply Stations" as apply.

541. ENTRANCE BUSHING.

Lead-in conductors shall enter the building through a rigid, noncombustible, nonabsorptive, insulating tube or bushing, or through a drilled window pane.

542. CREEPAGE AND AIR-GAP DISTANCE.

The entrance bushing or window pane mentioned in rule 541 above shall afford the following creepage and air-gap distance from extraneous bodies.:

Receiving stations	No requirement.
Low and medium power transmitting stations using damped waves	5 inches.
Low and medium power transmitting stations using undamped waves	3 inches.

543. MECHANICAL PROTECTION OF BUSHINGS.

Entrance bushings of porcelain or other fragile material at transmitting stations shall be protected where exposed to mechanical injury.

SEC. 55. PROTECTIVE AND OPERATING GROUNDING CONDUCTORS

550. APPLICATION OF RULES.

The requirements of this section apply to grounding conductors of receiving stations and transmitting stations of low and medium power. Grounding conductors of high-power transmitting stations shall meet such requirements of part 1 "Supply Stations" as apply.

551. GENERAL.

The protective grounding conductor may be used also as the operating grounding conductor.

552. MATERIAL AND SIZE.

A. Receiving Stations.

1. MATERIAL.

No requirements.

2. SIZE.

(*a*) OPERATING GROUNDING CONDUCTOR. No requirements.

(*b*) PROTECTIVE GROUNDING CONDUCTOR. This conductor shall not be smaller than the lead-in conductor.

B. Transmitting Stations.

The operating and grounding conductors shall have strength and conductance per unit length not less than No. 14 A. W. G. (0.064 inch) hard-drawn copper.

553. INSTALLATION OF GROUNDING CONDUCTORS.

A. Method of Running.

1. Grounding conductors shall be run in as straight a line as possible from the set or the protective device to a good permanent ground.

2. Grounding conductors may be run either inside or outside of the building.

Recommendation.—It is recommended that the protective grounding wire for low and medium power transmitting stations be run outside of the building.

B. Mechanical Protection.

Grounding conductors shall be guarded where exposed to mechanical injury.

553—Continued.

C. Insulation.

Grounding conductors may be of insulated or bare wire and need not be run on insulating supports.

SEC. 56. GROUND CONNECTIONS

560. Application of Rules.

The requirements of this section apply to ground connections for all classes of transmitting stations, and to protective ground connections of receiving stations.

561. General.

Grounding shall be done in accordance with the following methods. (See section 9, N. E. S. Code, for complete rules for grounding.)

562. Gas Pipe Not to Be Used.

Gas pipe should not be used for grounding purposes.

563. Water-pipe Grounds.

The ground connections shall be made to a cold-water pipe where such pipe is available and is in service and connected to the street mains. An outlet pipe from a water tank fed by a street main or a well may be used, provided such outlet pipe is adequately bonded to the inlet pipe connected to the street water main or well.

564. Attachment to Pipes.

Grounding conductors shall be attached to pipes by means of suitable ground clamps. The entire surface of the pipe to be covered by the clamp shall be thoroughly cleaned.

565. Driven or Buried Grounds.

If cold-water pipes are not available, ground connections may be made to a galvanized iron pipe or to a rod driven into permanently damp earth or to a metal plate or other body of metal buried similarly.

566. ATTACHMENT TO GROUND ROD OR PLATE.

The grounding conductor shall be attached to the rod, buried plate, or other body of metal so as to give reliable connection both mechanically and electrically. This connection shall be made so that it will not fail through corrosion even when the joint is buried in the earth.

SEC. 57. PROTECTIVE DEVICES

570. APPLICATION OF RULES.

The requirements of this section apply to protective devices for receiving stations and transmitting stations of low and medium power. Protective devices for high-power transmitting stations shall meet such requirements of part 1 "Supply Stations" as apply.

571. LIGHTNING ARRESTER.

A. Where Required.

Each lead-in conductor of a receiving station shall be provided with a lightning arrester, whether or not an antenna grounding switch is used.

B. Operating Voltage.

The lightning arrester shall be such as to operate at a potential of 500 volts or less.

C. Location.

The arrester may be located outside the building as near as practicable to the point of entrance, or inside the building between the point of entrance and the receiving set and convenient to a ground. The arrester shall not be placed in the immediate vicinity of easily ignitable material or in a location exposed to dust, inflammable gases, or flyings of combustible materials.

572. ANTENNA GROUNDING SWITCH.

A. Where Required.

An antenna grounding switch shall be used at low and medium power transmitting stations. An antenna grounding switch is not required at receiving stations, but may be used in addition to the lightning arrester.

B. Type of Switch.

1. RECEIVING STATIONS.

The switch should be of the single-pole double-throw type.

2. LOW AND MEDIUM POWER TRANSMITTING STATIONS.

The switch shall be of the double-throw type and shall meet the following requirements:

Minimum break distance..... 4 inches.
Minimum cross-section of switch blade
..... ⅛ inch x ½ inch.
Switch base: Nonabsorptive insulating material.

C. Location.

The switch may be located either outside or inside the building. The switch should be placed in the most direct line between the lead-in conductor and the point where the grounding connection is made.

D. Clearance for Live Switch Parts.

The switch shall be mounted so that its current-carrying parts will clear the building wall or conductors not connected to the switch by the following distances:

Switches for receiving stations: No clearance required.

572. D—Continued.

Switches for low and medium power transmitting stations:

Damped-wave sets	5 inches.
Undamped-wave sets	3 inches.

E. Method of Connection.

1. RECEIVING STATIONS.

The switch shall be wired so that the antenna lead-in conductor can be disconnected from the set and connected to the grounding conductor. When in the grounding position the switch shall short-circuit the lightning arrester.

2. LOW AND MEDIUM POWER TRANSMITTING STATIONS.

No requirements.

F. Operation of Switch.

1. RECEIVING STATIONS.

No requirements.

2. LOW AND MEDIUM POWER TRANSMITTING STATIONS.

Antenna and counterpoise lead-in conductors of low and medium power transmitting stations shall be connected to the grounding conductor whenever the station is not in use.

573. PROTECTION AGAINST KICK-BACK.

A. Where Required.

Protection should be provided at low and medium power transmitting stations where necessary to protect the supply system against high-potential surges and "kick-backs."

573

B. Apparatus—Continued.

Any of the following methods may be used:

1. Two condensers usually of 0.1 to 0.5 microfarad capacity, and capable of withstanding five times the normal voltage to which they are subjected placed in series with one another across the supply line with mid-point between condensers grounded. Across (in parallel with) each of these condensers shall be connected a shunting fixed spark gap capable of not more than 1/32 inch separation.
2. Two vacuum-tube-type protectors in series with one another across the line with the mid-point grounded (if the line voltage does not exceed 110 volts).
3. Electrolytic lightning arresters, such as the aluminum-cell type.

C. Location.

Apparatus for protection against "kick-back" should be installed across the supply conductors as near as possible to each radio transformer, rotary spark gap, motor, and generator (in motor-generator sets), or other auxiliary apparatus.

SEC. 58. CONNECTION TO POWER SUPPLY LINES

580. Connection to Power Supply Lines.

Devices used in connection with power supply lines and methods of wiring shall be in accordance with the rules covering permanent or portable fixtures, devices, and appliances (see N. E. S. Code, sec. 37).

SEC. 59. BATTERIES

590. APPLICATION OF RULES.

The requirements of this section apply to batteries for receiving stations and transmitting stations of low and medium power. Battery installations for high-power transmitting stations shall meet such requirements of part 1 "Supply Stations" as apply.

591. CARE IN HANDLING.

Care shall be used in handling batteries in order to avoid contacts with terminals having a high enough difference of potential to cause shock.

592. STORAGE BATTERY.

A. Wiring.

The wiring of storage batteries used with radio receiving equipment shall be subject to the rules covering the wiring of permanent or portable fixtures, devices, and appliances (see N. E. S. Code, sec. 37).

B. Ventilation.

Storage batteries shall be located where there is adequate ventilation.

C. Precautions.

1. Open flames shall be kept away from storage batteries.
2. Storage batteries should be placed on trays or mats of lead, rubber, or other material which will not be affected by the electrolyte.

D. Large Battery Installations.

Installation of nonportable storage batteries of more than 50 kilowatt-hour capacity at the 8-hour rate of discharge, if used for radio, shall comply with section 13 and rule 353 of the N. E. S. Code.