U.S. DEPARTMENT OF COMMERCE
Luther H. Hodges, *Secretary*

NATIONAL BUREAU OF STANDARDS
A. V. Astin, *Director*

SAFETY RULES FOR THE INSTALLATION AND MAINTENANCE OF ELECTRIC SUPPLY AND COMMUNICATION LINES

Comprising Part 2, the Definitions and the Grounding Rules of the Sixth Edition of the National Electrical Safety Code

Approved by American Standards Association June 8, 1960 as American Standard C2.2–1960 (UDC 621.316.9)

National Bureau of Standards Handbook 81

Supersedes Handbook H32 and amends in part Pt. 2, Definitions and the Grounding Rules of Handbooks H30 and H43

Issued November 1, 1961

Reprinted May 1, 1966, with the addition of Supplement 1 included in the back of this handbook

For sale by the Superintendent of Documents, U.S. Government Printing Office Washington, D.C. 20402 - Price $2.50

ABSTRACT

This Handbook consists of definitions, grounding rules, and Part 2 of the sixth edition of the National Electrical Safety Code, dealing with the construction and maintenance of overhead and underground lines, previously published as National Bureau of Standards Handbook H32. The present edition of these rules is the result of a revision which has been carried out by the Sectional Committee in accordance with the procedure of the American Standards Association, and the text has been recognized as an American Standard. This revision serves to aline the rules with new developments and current practice in the industry. It represents the work of five technical subcommittees over a period of about eight years. Changes were made in approximately one hundred and fifty rules and definitions.

Reprinted July 1, 1963 with correction on page 92.

FOREWORD

This Handbook contains definitions, grounding rules, and Part 2 of the sixth edition of the National Electrical Safety Code, dealing with the construction and maintenance of overhead and underground lines, previously published as National Bureau of Standards Handbook H32.

The present edition of these rules is the result of a revision which has been carried out according to the procedure of the American Standards Association. The revised text has had the approval of the Sectional Committee, organized in conformity with this procedure, and has been recognized as an American Standard.

Criticism of the rules and suggestions for their improvement are invited, especially from those who have experience in their practical application. 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.

A. V. Astin, *Director.*

PREFACE

In preparation of the first few editions of the code, the Bureau held meetings in many parts of the country and welcomed suggestions from everyone concerned. It, however, reserved to itself the final decision on all contested points. The procedure followed in later revisions subsequent to the establishment of the American Standards Association differs essentially from the former practice in that final decisions as to all details are made by the sectional committees formally approved by the American Standards Association and operating under their rules of procedure. The Bureau, as sponsor for the work under this procedure, has given up its prerogative of determining details in return for the implied understanding that the many parties concerned will accept such a code as they can agree upon among themselves. All such codes of practice necessarily include compromises between conflicting aims. The Bureau has felt that decisions made by practically unanimous agreement among the interests affected would, in general, be wiser than those at which it might arrive after weighing the arguments of advocates for different views. It has, therefore, welcomed this procedure in spite of the fact that this involves the acceptance of some details of which it might not itself approve.

Rules in this code which are to be regarded as mandatory are characterized by the use of the word "shall." Where a rule is of an advisory nature it is indicated by the use of the word "should." Other practices which are considered desirable and not intended to be mandatory are stated as recommendations. It is realized that conditions may exist which necessitate departures from such recommendations.

A representative Committee on Interpretations has been set up to prepare replies to requests for interpretation of these rules. Requests for interpretation should state the rule in question as well as the conditions under which it is being

applied. Interpretations are intended to clarify the intent of specific rules and are not intended to supply consulting information on the application of the code. Requests for interpretation addressed to the National Bureau of Standards, if suitable for processing, will be sent to the Interpretations Committee. After due consideration by the Committee, which may involve many exchanges of correspondence, the inquirer will be notified of its decision.

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SEC. 1. DEFINITIONS OF SPECIAL TERMS

The following definitions are for use with the National Electrical Safety Code. For other use and for definitions not contained herein, see Definitions of Electrical Terms ASA–C42.

Alphabetical List of Defined Terms

1. **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.

2. **Appliance** means current-consuming equipment, fixed or portable; for example, heating, cooking, and small motor-operated equipment.

3. **Automatic** means self-acting, operating by its own mechanism when actuated by some impersonal influence—as, for example, a change in current strength; not manual, without personal intervention. Remote control that requires personal intervention is not automatic, but manual.

4. **Cable vault.** (See definition of "Manhole.")

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

6. **Circuit-breaker** means a device designed to open under abnormal conditions a current-carrying circuit without injury to itself. The term as used in this code applies only to the automatic type designed to trip on a predetermined overload of current.

7. **Climbing space** means the vertical space reserved along the side of a pole or structure to permit ready access for linemen to equipment and conductors located on the pole structure.

8. **Common use** means simultaneous use by two or more utilities of the same kind.

9. **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.

10. **Grounding conductor** means a conductor which is used to connect the equipment or the wiring system with a grounding electrode or electrodes.

11. **Lateral conductor** means, in pole wiring work, a wire or cable extending in a general horizontal direction approximately at right angles to the general direction of the line conductors.

12. **Line conductor** means one of the wires or cables carrying electric current, supported by poles, towers, or other structures, but not including vertical or lateral connecting wires.

13. **Vertical conductor** means, in pole wiring work, a wire or cable extending in an approximately vertical direction.

Conflict:

14. **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.

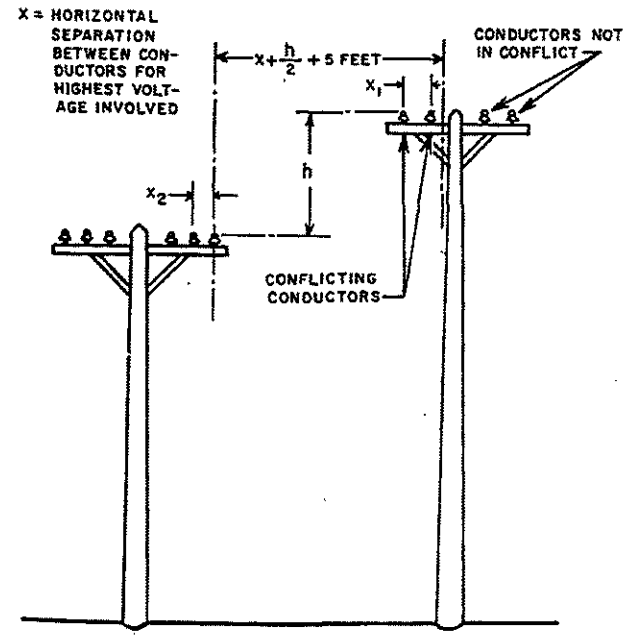

FIGURE 1. *Conductor conflict.*

15. **Conductor conflict** means that a conductor is so situated with respect to a conductor of another line at a lower level that the horizontal distance between them is less than the sum of the following values:

(a) Five feet.
(b) One-half the difference of level between the conductors concerned.
(c) The value required in tables 6, 7, or 8 for horizontal separation between conductors on the

same support for the highest voltage carried by either conductor concerned. (See illustration.)

16. **Structure conflict** (as applied to a pole line) means that the line is so situated with respect to a second line that the overturning (at the ground line) of the first line will result in contact between its poles or conductors and the conductors of the second line, assuming that no conductors are broken in either line. (See illustration.)

Exceptions: Lines are not considered as conflicting under the following conditions:

(1) Where one line crosses another.

(2) Where two lines are on opposite sides of a highway, street, or alley and are separated by a distance not less than 60 percent of the height of the taller pole line and not less than 20 feet.

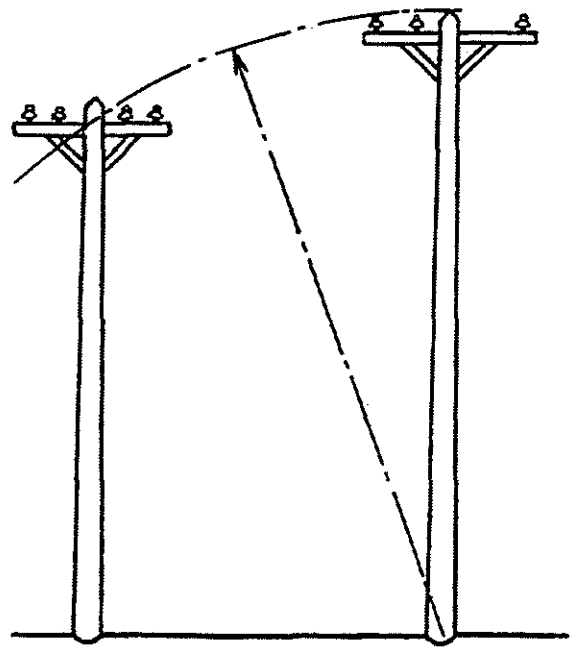

FIGURE 2. *Structure conflict.*

17. **Current-carrying part** means a conducting part intended to be connected in an electric circuit to a source of voltage. Noncurrent-carrying parts are those not intended to be so connected.

18. **Dead** means free from any electric 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.

19. **Device** means a unit of an electric wiring system which is intended to carry but not consume electric energy.

20. **Disconnector** means a switch which is intended to open a circuit only after the load has been thrown off by some other means.

Note: Manual switches designed for opening loaded circuits are usually installed in circuit with disconnectors, to provide a safe means for opening the circuit under load.

21. **Duct** means (in underground work) a single tubular runway for underground cables.

22. **Electrical supply station** means any building, room, or separate space within which electric-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. (See definition of "transformer vault".)

23. **Equipment** means a general term including fittings, devices, appliances, fixtures, apparatus, and the like, used as a part of, or in connection with, an electric installation.

24. **Electric-supply equipment** means equipment which produces, modifies, regulates, controls, or safeguards a supply of electric 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.

25. **Utilization equipment** means equipment, devices, and connected wiring which utilize electric energy for mechanical, chemical, heating, lighting, testing, or similar purposes and are not a part of supply equipment, supply lines, or communication lines.

26. **Explosion-proof** means capable of withstanding without injury and without transmitting flame to the outside any explosion of gas which may occur within.

Exposed:

27. **Applied to circuits or lines** means in such a position that in case of failure of supports or insulation contact with another circuit or line may result.

28. **Applied to equipment** means that an object or device can be inadvertently touched or approached nearer than a safe distance by any person. It is applied to objects not suitably guarded or isolated.

29. **Externally operable** means capable of being operated without exposing the operator to contact with live parts.

Note: This term is applied to equipment, such as a switch, that is inclosed in a case or cabinet.

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

31. **Effectively grounded** means permanently connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to prevent the building up of voltages which may result in undue hazard to connected equipment or to persons.

32. **Grounded system** means a system of conductors in which at least one conductor or point (usually the middle wire, or neutral point of transformer or generator windings) is intentionally grounded, either solidly or through a current-limiting device.

33. **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.

Note: Wires which are insulated, but not otherwise protected, are not considered as guarded.

34. **Handhole** means an opening in an underground system into which workmen reach, but do not enter.

35. **Inclosed** means surrounded by a case which will prevent accidental contact of a person with live parts. A solid inclosure means one which will neither admit accumulations of flyings or dust, nor transmit sparks or flying particles to the accumulations outside.

36. **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.

37. **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.

38. **Isolated** means that an object is not readily accessible to persons unless special means for access are used.

39. **Isolation by elevation** means elevated sufficiently so that persons may safely walk underneath.

40. **Joint use** means simultaneous use by two or more kinds of utilities.

41. **Lateral working space** means the space reserved for working between conductor levels outside the climbing space, and to its right and left.

42. **Lightning arrester** means a device which has the property of reducing the voltage of a surge applied to its terminals, is capable of interrupting follow current if present, and restores itself to its original operating conditions.

Lines:

43. **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 exceed 150 watts. When operating at less than 150 volts no limit is placed on the capacity of the system.

Note: Telephone, telegraph, railroad-signal, messenger-call, clock, fire, police-alarm, community television antenna and other systems conforming with the above are included.

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

Exception is made under certain conditions for communication circuits used in the operation of supply lines. (See rule 288, A).

44. **Electric-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 electric energy.

Does not include open wiring on buildings, in yards or similar locations where spans are less than 20 feet, and all the precautions required for stations or utilization equipment, as the case may be, are observed.

Railway signal lines of more than 400 volts to ground are always supply lines within the meaning of these rules, and those of less than 400 volts may be considered as supply lines, if so run and operated throughout.

45. **Low-voltage protection** means the effect of a device operative on the reduction or failure of voltage to cause and maintain the interruption of power supply to the equipment protected.

46. **Low-voltage release** means the effect of a device operative on the reduction or failure of voltage to cause the interruption of power supply to the equipment, but not preventing the reestablishment of the power supply on return of voltage.

47. **Manhole** (more accurately termed splicing chamber or cable vault) means an opening in an underground system which workmen or others may enter for the purpose of installing cables, transformers, junction boxes, and other devices, and for making connections and tests.

48. **Manual** means capable of being operated by personal intervention.

49. **Minor tracks** means railway tracks included in the following list:

(a) Spurs less than 2,000 feet long and not exceeding two tracks in the same span.

(b) Branches on which no regular service is maintained or which are not operated during the winter season.

(c) Narrow-gage tracks or other tracks on which standard rolling stock can not, for physical reasons, be operated.

(d) Tracks used only temporarily for a period not exceeding 1 year.

(e) Tracks not operated as a common carrier, such as industrial railways used in logging, mining, etc.

50. **Open wire** means a conductor or pair of conductors separately supported above the surface of the ground.

51. **Panelboard** means a single panel, or a group of panel units designed for assembly in the form of a single panel, including busses and with or without switches and/or automatic overcurrent-protective devices for the control of light, heat, or power circuits of small individual as well as aggregate capacity; designed to be placed in a cabinet or cut-out box placed in or against a wall or partition, and accessible only from the front. (See definition of "Switchboard.")

52. **Qualified** means familiar with the construction and operation of the apparatus and the hazards involved.

53. **Raceway** means any channel for loosely holding wires or cables in interior work, which is designed expressly and used solely for this purpose. Raceways may be of metal, wood, or insulating material, and the term includes wood and metal moldings consisting of a backing and capping, and also metal ducts into which wires are to be pulled.

54. **Reconstruction** means replacement of any portion of an existing installation by new equipment or construction. Does not include ordinary maintenance replacements.

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

Sag:

56. **Apparent sag at any point** means the departure of the wire at the particular point in the span from the straight line between the two points of support of the span, at 60° F, with no wind loading.

57. **Apparent sag of a span** means the maximum departure of the wire in a given span from the straight line between the two points of support of the span, at 60° F, with no wind loading.

58. **Final unloaded sag** means the sag of a conductor after it has been subjected for an appreciable period to the loading prescribed for the loading district in which it is situated, or equivalent loading, and the loading removed.

59. **Initial unloaded sag** means the sag of a conductor prior to the application of any external load.

60. **Maximum total sag** means the total sag at the midpoint of the straight line joining the two points of support of the conductor.

61. **Total sag** means the distance measured vertically from any point of a conductor to the straight line joining its two points of support, under conditions of ice loading equivalent to the total resultant loading for the district in which it is located.

62. **Unloaded sag of a conductor at any point in a span** means the distance measured vertically from the particular point in the conductor to a straight line between its two points of support, without any external load.

63. **Service** means the conductors and equipment for delivering electric energy from the secondary distribution or street main, or other distribution feeder, or from the transformer, to the wiring system of the 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."

64. **Span length** means the horizontal distance between two adjacent supporting points of a conductor.

65. **Splicing chamber.** (See definition of "Manhole.")

66. **Substantial** means so constructed and arranged as to be of adequate strength and durability for the service to be performed under the prevailing conditions.

67. **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.

68. **Switchboard** when referred to in connection with supply of electricity means a large single panel, frame, or assembly of panels, on which are mounted (on the face, or back, or both) switches, fuses, busses, and usually instruments.

69. **Tags** means "men at work" tags of distinctive appearance, indicating that the equipment or lines so marked are being worked on.

Tension:

70. **Final unloaded conductor tension** means the longitudinal tension in a conductor after the conductor has been stretched by the application for an appreciable period, and subsequent release, of the loadings of ice and wind, and temperature decrease, assumed for the loading district in which the conductor is strung (or equivalent loading).

71. **Initial conductor tension** means the longitudinal tension in a conductor prior to the application of any external load.

72. **Transformer vault** means an isolated inclosure either above or below ground with fire-resistant walls, ceiling, and floor, in which transformers and related equipment are installed, and which is not continuously attended during operation.

73. **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:

74. **Voltage of an effectively grounded circuit** means the highest effective voltage between any conductor and ground unless otherwise indicated.

75. **Voltage of a circuit not effectively grounded** means the highest effective voltage between any two conductors unless otherwise indicated.

If 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 effectively grounded, in which case its voltage is not determined by the circuit of higher voltage. Direct connection implies electric connection as distinguished from connection merely through electromagnetic or electrostatic induction.

Voltage to ground of:

76. **A grounded circuit** means the highest effective voltage between any conductor of the circuit and that point or conductor of the circuit which is grounded.

77. **An ungrounded circuit** means the highest effective voltage between any two conductors of the circuit concerned.

Voltage to ground of a conductor of:

78. **A grounded circuit** means the highest effective voltage between such conductor and that point or conductor of the circuit which is grounded.

79. **An ungrounded circuit** means the highest effective voltage between such conductor and any other conductor of the circuit concerned.

80. **Wire gages:** The American Wire Gage (AWG), otherwise known as Brown & Sharpe (B&S), is the standard gage for copper, aluminum, and other conductors, excepting steel, for which the Steel Wire Gage (Stl. WG) is used throughout these rules.

SEC. 9. RULES COVERING METHODS OF PROTECTIVE GROUNDING OF CIRCUITS, EQUIPMENT, AND LIGHTNING ARRESTERS FOR STATIONS, LINES, AND UTILIZATION EQUIPMENT

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