DEPARTMENT OF COMMERCE

BUREAU OF STANDARDS

George K. Burgess, Director

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

HANDBOOK OF THE BUREAU OF STANDARDS, No. 10

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COMPRISING PART 2 OF THE FOURTH EDITION NATIONAL ELECTRICAL SAFETY CODE

April 15, 1927

PRICE 60 CENTS

Sold only by the Superintendent of Documents, Government Printing Office
Washington, D. C.

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON
1927

PREFACE

Previous editions of the National Electrical Safety Code have been published in complete form. There has been some demand, however, for smaller handbooks containing a single part of the code, and in response to this demand fourth edition is being issued not only as a whole, but also as separate publications dealing with the several subjects covered.

This volume contains part 2 dealing with the construction and maintenance of overhead and underground electrical supply and communication lines.

The present edition of these rules is the result of a revision which has been carried out according to the procedure of the American Engineering Standards Committee. The revised rules have had the approval of a sectional committee organized according to those rules of procedure and containing representatives of the various classes of utilities concerned; representatives of the State utility commissions having jurisdiction; of the electrical workers; of the insurance interests, manufacturers, inspectors, and other classes of persons concerned.

A discussion of these rules will be found in the revised edition of Handbook No. 4. Criticism of the rules and suggestions for their improvement are invited, and in future editions every effort will be made to perfect the rules by modifying any of the requirements which it is found can be improved.

George K. Burgess,
Director.

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

COMPRISING PART 2 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.

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.

Cable vault. See definition of manhole.

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

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.

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

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

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.

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 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.)

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.

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:

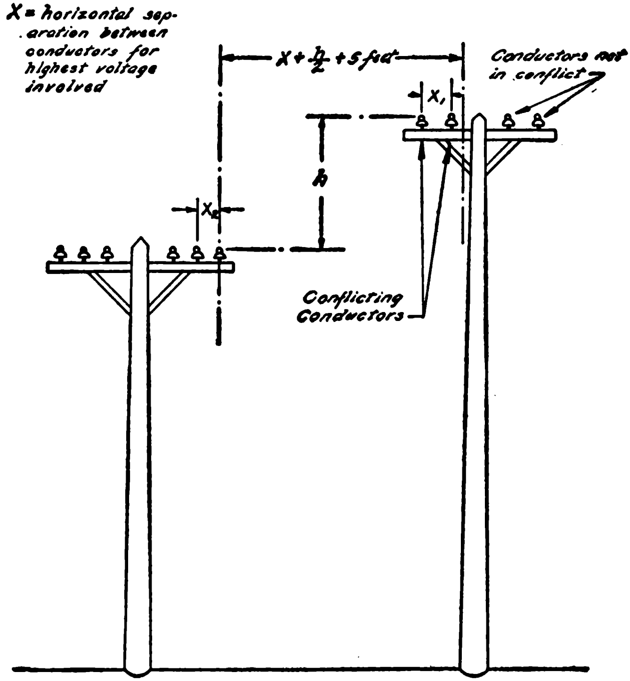
(*a*) Five feet.

(*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.

Conduit means (in overhead or interior work) a tube or duct especially constructed for the purpose of inclosing electrical conductors.

Current-carrying part means a 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



Conductor Conflict

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.

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

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.

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

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.

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 of less than 400 volts may be considered as supply lines, if so run and operated throughout.

Exposed (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.

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.

"**Effective**," as herein used, means a connection to earth of sufficiently low resistance and high current-carrying capacity to prevent any current in the grounding 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.

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

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.

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.

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.

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

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

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

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.

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

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.

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.

Manual means capable of being operated by personal intervention.

Minor communication lines means communication lines carrying not more than two circuits used mainly for local telephone or telegraph service, or for police or fire-alarm service.

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-gauge 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 one year.

(*e*) Tracks not operated as a public utility, such as industrial railways used in logging, mining, etc.

Open wires mean overhead wires not in conduits, and consisting of single or paired conductors as opposed to multiple-conductor cables.

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

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

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

Sag.

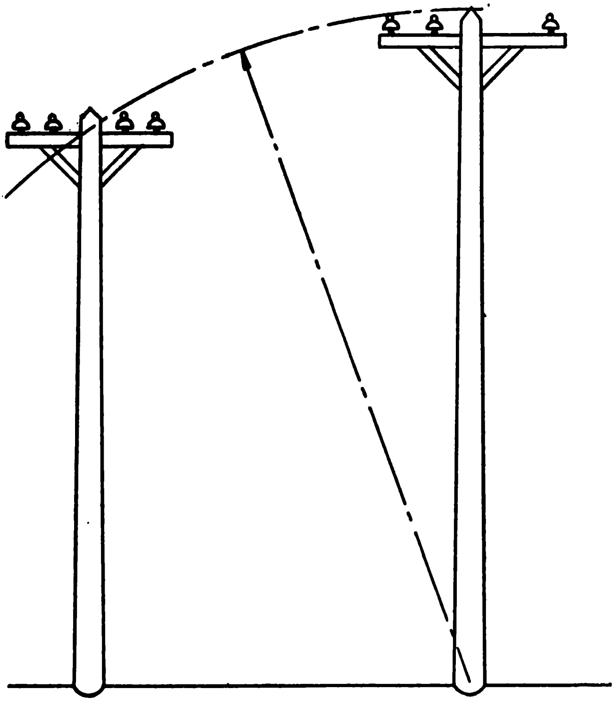
Apparent sag at any point means the departure of the wire at the particular point in the span from the straight line between the two points of support of the span, at 60° F., with no wind loading.

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. Where the two supports are at the same level this will be the normal sag.

Normal sag means the difference in elevation between the highest point of support of a span and the lowest point of the conductor in the span (or in the curve of the conductor in the span produced), at 60° F., with no wind loading.

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."

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.



Structure Conflict

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 per cent of the height of the taller pole line and not less than 20 feet.

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

Splicing chamber. See definition for manhole.

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.

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

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.

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SEC. 20. SCOPE, NATURE, AND APPLICATION OF RULES

200. Scope of Rules.

A. Extent of Application.

The following rules apply to electrical supply and electrical communication lines in overhead and underground construction whether operated in connection with public utilities, privately or municipally owned, with industrial establishments, or otherwise.

B. Not Complete Specifications.

These rules are not complete specifications but are intended to embody the requirements which are most important from the standpoint of safety to employees and the public.

C. Conformity with Good Practice.

Construction should be made according to accepted good practice for the given local conditions in all particulars not specified in the rules.

201. Application of the Rules and Exemptions.

A. Intent, Modification.

The rules shall apply to all installations except as modified or waived by the proper administrative authority. They are intended to be so modified or waived whenever they involve expense not justified by the protection secured or for any other reasons are impracticable; or whenever equivalent or safer construction can be more readily provided in other ways.

201. Application of the Rules and Exemptions—Con.

B. Realization of Intent.

The intent of the rules will be realized:

1. By applying the rules in full to all new installations, reconstructions, and extensions, except where for special reasons any rule is shown to be impracticable or where the advantage of uniformity with existing construction is greater than the advantage of construction in conformity with the rules.
2. By placing guards on existing installations or otherwise bringing them into compliance with the rules, except where the expense involved is not justifiable.

   Note.—The time allowed for bringing existing installations into compliance with the rules as specified in 2 will be determined by the proper administrative authority.

C. Waiver for Temporary Installations.

It will sometimes be necessary to modify or waive certain rules in cases of temporary installations or installations which are soon to be discarded or reconstructed.

D. Waiver in Emergencies.

In case of emergency or pending decision of the administrator, the person responsible for the installation may decide as to modification or waiver of any rule, subject to review by proper authority, but shall first notify all parties directly concerned in advance of construction.

202. MINIMUM REQUIREMENTS.

The rules state the minimum requirements for spacings, clearances, and strength of construction. More ample spacings and clearances or greater strength of construction may be provided if other requirements are not neglected in so doing.

Note.—Some of these minimum values are exceeded in much existing construction; service requirements frequently call for stronger supports and higher factors of safety than the minimum requirements of these rules.

SEC. 21. GENERAL REQUIREMENTS APPLYING TO OVERHEAD AND UNDERGROUND LINES

210. DESIGN AND CONSTRUCTION.

All electrical supply and communication lines and equipment shall be of suitable design and construction for the service and conditions under which they are to be operated.

211. INSTALLATION AND MAINTENANCE.

All electrical supply and communication lines and equipment shall be installed and maintained so as to reduce hazards to life as far as practicable.

212. ACCESSIBILITY.

All parts which must be examined or adjusted during operation shall be arranged so as to be readily accessible to authorized persons by the provision of adequate climbing spaces, working spaces, working facilities, and clearances between conductors.

213. Inspection and Tests of Lines and Equipment.

A. When in Service.

1. INITIAL COMPLIANCE WITH RULES.

   Lines and equipment shall comply with these safety rules upon being placed in service.

2. INSPECTION.

   Lines and equipment shall be systematically inspected from time to time by the person responsible for the installation.

3. TESTS.

   Lines and equipment shall be subjected, when necessary, to tests which will determine their fitness for service.

4. RECORD OF DEFECTS.

   Any defects revealed by inspection, if not promptly corrected, shall be recorded.

5. REMEDYING DEFECTS.

   Defective lines and equipment shall be put in good order or effectively disconnected.

B. When Out of Service.

1. LINES INFREQUENTLY USED.

   Supply lines and equipment infrequently used shall be inspected to see that they are in safe condition for service.

2. LINES TEMPORARILY OUT OF SERVICE.

   Lines temporarily out of service shall be maintained in such condition that a hazard will not be created.

213. INSPECTION AND TESTS OF LINES AND EQUIPMENT—Continued.

B. When Out of Service—Continued.

3. LINES PERMANENTLY ABANDONED.

Lines permanently abandoned shall be removed if they might create a hazard.

Note.—Overhead service drops to consumers are often disconnected without removal when the service is discontinued. This is considered good practice when it is undesirable to remove the service drop entirely.

214. ISOLATION AND GUARDING.

A. Current-carrying Parts.

To promote safety to the general public and to employees not authorized to approach conductors and other current-carrying parts of electrical supply lines, such parts shall be arranged so as to provide adequate clearance from the ground or other space generally accessible, or shall be provided with guards so as to isolate them effectively from accidental contact by such persons.

B. Noncurrent-carrying Parts.

Ungrounded metal-sheathed service cables, service conduits, metal fixtures, and similar noncurrent-carrying parts, if located in urban districts and where liable to become charged to more than 300 volts to ground, shall be isolated or guarded so as not to be exposed to accidental contact by unauthorized persons.

As an alternative to isolation or guarding, grounding of certain noncurrent-carrying parts is permitted by rule 215, **B**, and rule 280, **A**, 4.

215. GROUNDING OF CIRCUITS AND EQUIPMENT.

A. Methods.

The methods to be used for permanent grounding for lightning arresters of supply lines, for circuits, for equipment and for wire raceways are given in section 9. The methods to be used for grounding of lightning arresters of communication lines are specified in rule 393.

B. Parts to be Grounded.

In urban districts metal conduits, cable sheaths, and frames, cases, and hangers of equipment shall be permanently grounded.

Exception 1.—This rule does not apply when such parts are guarded from accidental contact by unauthorized persons.

Exception 2.—This rule does not apply where such parts are 8 feet or more above the ground.

Exception 3.—This rule does not apply to metal conduit and cable sheaths inclosing communication conductors, or supply conductors of not more than 300 volts to ground, provided such conduit and sheaths are not exposed to probable contact with circuits of more than 300 volts to ground.

Recommendation.—It is recommended that supply cables have the sheath bonded to any conduit extending above the ground surface.

Note.—Metal conduit above ground which contains extensions from metal-sheathed underground cable is considered to be sufficiently grounded by the cable sheath, provided such sheath is in good contact with the earth or is connected to a good ground. (For method of grounding see section 9.)

C. Use of Ground as Part of Circuit.

In urban districts supply circuits shall not be designed to use the ground normally as the sole conductor for any part of the circuit.

Recommendation.—It is recommended that such use be avoided in rural districts.

216. ARRANGEMENT OF SWITCHES.

A. Accessibility.

All switches shall be readily accessible to authorized persons.

B. Indicating Open or Closed Position.

All switches shall indicate clearly whether they are open or closed.

C. Uniform Position.

The handles or control mechanism for all switches throughout any system shall have so far as practicable the same position when open and a uniformly different position when closed, in order to minimize operating errors. Where it is advisable to depart from this practice, the switches should be marked so as to minimize the liability to mistakes in operation.

SEC. 22–28. RULES FOR OVERHEAD LINES

SEC. 22. RELATIONS BETWEEN VARIOUS CLASSES OF LINES

220. RELATIVE LEVELS.

A. Standardization of Levels.

The levels at which different classes of conductors are to be located should be standardized where practicable for any given community by agreement of the utilities concerned.

Note.—This practice facilitates the extension of lines and promotes the safety of the public and workers by permitting the relative levels and required clearances to be readily obtained on jointly or commonly used poles as well as at crossings and conflicts.

220. RELATIVE LEVELS—Continued.

B. Relative Levels—Supply and Communication Conductors.

1. PREFERRED LEVELS.

Where supply and communication conductors cross each other or are in conflict, or are located on the same poles or towers, the supply conductors shall preferably be carried at the higher level.

Exception.—This does not apply to trolley feeders which may be located for convenience approximately at the level of the trolley contact conductor.

Note.—Supply lines generally use larger conductors than communication lines so there is less liability of contact between the two if the supply conductors are located in the upper position. This relative location also avoids the necessity of workmen on communication conductors passing through supply conductors and working above them, and avoids the necessity of increasing the grade of construction required for communication conductors.

2. MINOR EXTENSIONS.

In localities where the practice of placing conductors of communication circuits for public use above supply conductors has been generally established, minor extensions may be made in either system, keeping the conductors in the same relative position. These extensions should not continue beyond a location at which it becomes practicable to change to the arrangement standardized by these rules.

220. RELATIVE LEVELS—Continued.

B. Relative Levels—Supply and Communication Conductors—Continued.

3. SPECIAL CONSTRUCTION FOR SUPPLY CIRCUITS, THE VOLTAGE OF WHICH DOES NOT EXCEED 550 VOLTS, AND CARRYING POWER NOT IN EXCESS OF 1,600 WATTS.

Where all circuits are owned or operated by one party, or where cooperative consideration determines that the circumstances warrant and the necessary coordinating methods are employed, supply wires carrying a voltage not exceeding 440 volts, where practicable, or in exceptional cases 550 volts between conductors, with transmitted power not in excess of 1,600 watts, when involved in the joint use of poles with communication circuits, may be installed in accordance with Note *h* (3) of Table 1 in rule 232, A, and Note *a* of Table 11 in rule 238, A, 1, under the following conditions:

(*a*) That such supply circuits are of wire having a good grade of commercial double-braid weatherproof covering not smaller than No. 8 A. W. G. medium harddrawn copper or its equivalent in strength, and the construction otherwise conforms with the requirements for supply circuits of the same class.

(*b*) That the supply circuits be placed on the end and adjacent pins of the bottom cross arm, and that a climbing space of at least 30 inches be maintained up the pole. Special precautions shall be taken to render such circuits conspicuous, such as painting a stripe on the cross arm or using a different form of insulator from the others on the pole line.

220. RELATIVE LEVELS—Continued.

B. Relative Levels—Supply and Communication Conductors—Continued.

(*c*) That there shall be a vertical clearance of at least 2 feet between the cross arm carrying these supply circuits and the next cross arm above. The other pins on the cross arm carrying the supply circuit may be occupied by communication conductors used in the operation or control of railway or supply apparatus, but not for telegraph or telephone service.

(*d*) That such supply circuits shall be equipped with fuses and arresters installed in the supply end of the circuit. The fuses shall have a capacity not in excess of twice the maximum operating current value of the circuit they protect, but need not be less than 7 amperes. The arresters shall be designed so as to break down at a voltage of approximately twice the voltage between the wires of the circuit, but which need not be less than 500 volts. Where the supply circuits are alternating current, fuses shall be installed in the secondary side of the supply transformer and shall be such as to open the circuit successfully when the voltage is as great as that of the primary voltage of the transformer.

220. RELATIVE LEVELS—Continued.

C. Relative Levels—Supply Lines of Different Voltage Classifications (as Classified in Table 11).

1. AT CROSSINGS OR CONFLICTS.

Where supply conductors of different voltage classifications cross each other or are in conflict, the higher-voltage lines shall preferably be carried at the higher level.

2. ON POLES USED ONLY BY SUPPLY CONDUCTORS.

Where supply conductors of different voltage classifications are on the same poles, relative levels should be as follows:

(*a*) Where all circuits are owned by one utility, the conductors of higher voltages should generally be placed above those of lower voltage.

Note.—These relative levels will often avoid the necessity of increasing the grade of construction for cross arms, pins, and conductor fastenings of the lower-voltage conductors.

(*b*) Where different circuits are owned by separate utilities, the circuits of each utility may be grouped together and one group of circuits may be placed above the other group provided that the circuits in each group are located so that those of higher voltage are at the higher levels and that either of the following conditions is met:

(1) A vertical spacing of not less than 4 feet (or 6 feet where required by Table 11, rule 238, A, 1) is maintained between the nearest line conductors of the respective utilities (this space to be identified if necessary as a division space).

(2) Conductors of a lower voltage classification are at a higher level than those of a higher classification only where on the opposite side of the pole.

221. AVOIDANCE OF CONFLICT.

Two parallel pole lines, either of which carries supply conductors, shall where practicable be so separated from each other that neither conflicts with the other. If this is impracticable, then the conflicting line or lines shall be built of the grade of construction required by section 24 for a conflicting line or the two lines shall be combined in a single pole line.

222. JOINT USE OF POLES BY SUPPLY AND COMMUNICATION CIRCUITS.

A. Advantages.

Joint use of poles under suitable conditions and with certain types of circuits offers many advantages and promotes safety.

B. Cooperative Study.

Joint use involves contractual relations between utilities, consideration of service requirements, and economies as well as safety. It, therefore, requires cooperative study by the utilities concerned.

C. Conditions Under Which Joint Use is Desirable.

In the case of local or distribution circuits along the same highway or similar right of way, where, under the provisions of section 24 applying to joint use, grade C construction or less would be required, joint use is generally preferable to separate pole lines (except sometimes in rural districts) unless the number of conductors is very large or the character of the circuits makes joint use undesirable.

Where circuits other than those mentioned above are involved, the choice between joint use of poles and separate pole lines shall be determined through cooperative consideration, by the utilities concerned, of all the factors involved, including the character

222. JOINT USE OF POLES BY SUPPLY AND COMMUNICATION CIRCUITS—Continued.

C. **Conditions Under Which Joint Use is Desirable**—Continued.

of circuits, the total number and weight of conductors, tree conditions, number and location of branches and service drops, availability of right of way, etc. Where such joint use is mutually agreed upon, it shall be subject to the appropriate grade of construction as specified in section 24. Where such joint use is not employed, separate lines as specified in rule 223 shall be used.

In any event, joint use is preferable to separate lines where it would be impracticable to avoid an overbuilt conflict with separate lines.

223. SEPARATE POLE LINES.

Where two separate pole lines are to be used, one of which carries supply conductors and the other communication conductors, they shall be separated, if practicable, so that neither conflicts with the other, but if within conflicting distance, they shall be separated as far as practicable.

SEC. 23. CLEARANCES

230. GENERAL.

A. **Application.**

This section covers all clearances involving poles and wires. Clearances of lamps from pole surfaces, from spaces accessible to the general public, and height above ground are covered in rule 286, E.

B. **Constant-Current Circuits.**

The clearances for constant-current circuits shall be determined on the basis of their nominal full-load voltage.

230. GENERAL—Continued.

C. Metal-Sheathed Supply Cables.

As far as clearances are concerned, permanently grounded continuous metal-sheathed supply cables of all voltages are classified the same as open supply wires of 0 to 750 volts.

D. Maintenance of Clearances.

When initial wire sags have increased, due to permanent elongation of wires or movement of supporting structures, so that the clearances or separations have materially decreased, slack should be taken up.

Note.—As soft copper stretches more than medium or hard, the taking up of slack will be necessary chiefly in lines where soft wire is used.

231. HORIZONTAL CLEARANCES OF SUPPORTING STRUCTURES FROM OTHER OBJECTS.

Poles, towers, and other supporting structures and their guys and braces shall have the following horizontal clearances from other objects. The clearance shall be measured between the nearest parts of the objects concerned.

A. From Fire Hydrants.

Not less than 3 feet.

Recommendation.—Where conditions permit, a clearance of not less than 4 feet is recommended.

B. From Street Corners.

Where hydrants are located at street corners, poles and towers should not be set so far from the corners as to make necessary the use of flying taps inaccessible from the poles.

C. From Curbs.

Not less than 6 inches measured to the street side of the curb.

231. HORIZONTAL CLEARANCES OF SUPPORTING STRUCTURES FROM OTHER OBJECTS—Continued.

D. From Railroad Tracks.

Where railroad tracks are paralleled or crossed by overhead lines, the poles shall, if practicable, be located not less than 12 feet from the nearest track rail.

Exception 1.—At sidings a clearance of not less than 7 feet may be allowed, provided sufficient space for a driveway be left where cars are loaded or unloaded.

Exception 2.—Supports for overhead trolley contact conductors may be located as near their own track rail as conditions require. If very close, however, permanent screens on cars will be necessary to protect passengers.

Exception 3.—Where necessary to provide safe operating conditions which require an uninterrupted view of signals, signs, etc., along tracks, the parties concerned shall cooperate in locating poles to provide the necessary clearance where practicable.

232. VERTICAL CLEARANCE OF WIRES ABOVE GROUND OR RAILS.

The vertical clearance of all wires above ground in generally accessible places or above rails shall be not less than the following:

A. Basic Clearances.

The clearances in Table 1 apply under the following conditions.

Temperature of 60° F., no wind.

Span lengths 0 to 150 feet.

Voltage 0 to 50,000 volts.

Fixed conductor supports.

For other conditions see rule 232, B.

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232. Vertical Clearance of Wires Above Ground or Rails—Continued.

A. Basic Clearances—Continued.

Table 1.—Minimum Vertical Clearance of Wires Above Ground or Rails

[All voltages are between wires unless otherwise stated. Supply wires include trolley feeders]

Nature of ground or rails underneath wires	Guys; messengers; communication, span, and lightning protection wires; permanently grounded continuous-metal-sheath cables. All voltages	Open supply line wires, arc wires and service drops			Trolley contact conductors and associated span or messenger wires [a]	
		0 to 750 volts	750 to 15,000 volts	15,000 to 50,000 volts	0 to 750 volts to ground	Exceeding 750 volts to ground
WHERE WIRES CROSS OVER						
Track rails of railroads handling freight cars on top of which men are permitted [b]	*Feet* [c] 27	*Feet* [c] 27	*Feet* [c] 28	*Feet* 30	*Feet* [d] 22	*Feet* [d] 22
Track rails of railroads not included above. [b]	18	18	20	22	[e] 18	[e] 20
Streets, alleys or roads in urban or rural districts	[f] 18	18	20	22	[e] 18	[e] 20
Driveways to residence garages	10	10	20	22	[e] 18	[e] 20
Spaces or ways accessible to pedestrians only	[g] 15	[h] 15	15	17	[i] 16	[i] 18
WHERE WIRES RUN ALONG						
Streets or alleys in urban districts	[f,h] 18	[f] 18	20	22	[e] 18	[e] 20
Roads in rural districts	[j,k,l] 15	[j] 15	18	20	[e] 18	[e] 20

See footnotes on page 27

232. Vertical Clearance of Wires Above Ground or Rails—Continued.

A. Basic Clearances—Continued.

Footnotes for Table 1

a Where subways, tunnels, or bridges require it, less clearances above ground than required by Table 1 may be used locally. The trolley contact conductor should be graded very gradually from the regular construction down to the reduced elevation.

b For wire crossings over railways handling only cars considerably lower than ordinary freight cars, the clearance may be reduced by an amount equal to the difference in height between the highest car handled and the highest ordinary freight car, but the clearance shall not be reduced below that required for street crossings.

c This clearance may be reduced to 25 feet where paralleled by trolley contact conductor on the same street or highway.

d In communities where 21 feet has been established, this clearance may be continued if carefully maintained. The elevation of the contact conductor should be the same in the crossing and next adjacent spans. (See rule 289 D, 2, for conditions which must be met where uniform height above rail is impracticable.)

e In communities where 16 feet has been established for trolley contact conductors 0 to 750 volts or 18 feet for trolley contact conductors exceeding 750 volts, this clearance may be continued if carefully maintained.

f Where a guy crosses a street or alley in urban districts and the section of the guy above the street or alley is effectively insulated against the highest voltage to which it is exposed, up to 7,500 volts, the clearance may be reduced to 16 feet at the side of the traveled way.

g This clearance may be reduced as follows:

	Feet
(1) For communication conductors of circuits limited to 160 volts to ground and carrying not more than 50 watts	8
(2) For conductors of other communication circuits	10
(3) For guys	8

h This clearance may be reduced as follows:

(1) Supply wires (except trolley contact wires) limited to 300 volts to ground	12
(2) Supply wires (except trolley contact wires) limited to 150 volts to ground and located at entrances to buildings	10
(3) Where supply circuits of 550 volts or less, with transmitted power of 1,600 watts or less are run along fenced (or otherwise guarded) private rights of way in accordance with the provisions specified in rule 220, B, 3	10

i Trolley contact conductors for industrial railways when not along or crossing over roadways may be placed at a less height if suitably guarded.

j Where a pole line along a road is located relative to fences, ditches, embankments, etc., so that the ground under the line will never be traveled except by pedestrians, this clearance may be reduced as follows:

	Feet
(1) Communication conductors limited to 160 volts to ground and transmitted power of 50 watts	8
(2) Supply conductors	12

k No clearance from ground is required for anchor guys not crossing streets, driveways, roads, or pathways nor for anchor guys provided with traffic guards and paralleling sidewalk curbs.

l This clearance may be reduced to 13 feet for communication conductors where no part of the line overhangs any part of the highway which is ordinarily traveled, and where it is unlikely that loaded vehicles will be crossing under the line into the fields.

232. VERTICAL CLEARANCE OF WIRES ABOVE GROUND OR RAILS—Continued.

B. Increased Clearances.

Greater clearances than given in Table 1 (rule 232, A) shall be provided under the following conditions. The increases required in 1, 2, and 3 below are cumulative where more than one applies.

1. SPANS EXCEEDING 150 FEET.

Exception.—Trolley contact conductors are exempted from this rule.

(*a*) GENERAL. For spans exceeding 150 feet the clearance shall be increased by 0.1 foot for each 10 feet of the excess over 150 feet. See (c) below.

(*b*) AT RAILROAD CROSSINGS. Where the clearance of conductors is determined by the presence of railroad or railway tracks in the span, the increase in clearance may be determined by the following:

Where the distance from the nearer crossing support to the farthest track rail does not exceed 75 feet, no increase is required.

Where this distance exceeds 75 feet, 0.2 foot for each 10 feet of excess. See (*c*) below.

(*c*) MAXIMUM INCREASE IN CLEARANCE. The increase in clearance given by (*a*) or (*b*) above need not exceed the limiting values given in the table below provided conductor sags are such that the maximum tension in the conductor does not exceed the specified percentages of its breaking load:

Percentage of breaking load of conductor	Limiting clearance increase in feet for different loading districts.		
	Heavy	Medium	Light
50	2. 5	3. 0	4. 0
60	2. 5	4. 0	5. 0

232. VERTICAL CLEARANCE OF WIRES ABOVE GROUND OR RAILS—Continued.

B. Increased Clearances—Continued.

2. VOLTAGES EXCEEDING 50,000.

For these voltages the clearances given in Table 1 (rule 232, A) shall be increased at the rate of 0.5 inch for each 1,000 volts of the excess.

3. CONDUCTORS SUPPORTED BY SUSPENSION-TYPE INSULATORS AT CROSSINGS OVER TRACK RAILS.

The clearance shall be increased by such an amount that the values specified in Table 1 (rule 232, A) will be maintained in case of a broken conductor in either adjoining span, if the conductor is supported as follows:

(*a*) At one support by suspension-type insulators in a suspended position, and at the other support by insulators which are not free to swing (including semistrain-type insulators).

(*b*) At one support by strain insulators and at the other support by semistrain-type insulators.

4. METHODS OF AVOIDING THIS INCREASE OF CLEARANCE.

Any of the following construction methods will avoid the necessity for the increase in clearance required by rule 232, B, 3.

(*a*) *Suspension-type insulators* in a suspended position at both supports.

(*b*) *Semistrain-type insulators* at both supports.

(*c*) *Arrangement of insulators* so that they are restrained from displacement toward the crossing.

232. VERTICAL CLEARANCE OF WIRES ABOVE GROUND OR RAILS—Continued.

C. Supply Pole Wiring at Underground Risers.

Supply wires connecting to underground systems shall not be run open closer to the ground than is indicated by Table 2:

Table 2.—Clearance Above Ground for Open Supply Wiring

Location on pole	Voltage		
	0 to 750 volts	750 to 15,000 volts	More than 15,000 volts
	Feet	*Feet*	*Feet*
Side of pole adjacent to vehicular traffic	14	16	18
Side of pole not adjacent to vehicular traffic	8	11	13

233. WIRE CROSSING CLEARANCES.

The clearance between any two wires crossing each other and carried on different supports shall be not less than the following:

A. Basic Clearances.

The clearances given in Table 3 below apply under the following conditions:

Temperature of 60° F., no wind.

Where the sum of the distances from the point of intersection of two crossing wires to the nearer supporting structure of each span does not exceed 100 feet.

Where the upper conductor or wire has fixed supports.

Conductors of lines operating at the voltages indicated at the heads of columns should, in general, be installed above those to the left of the table, where a clearance is given in boldface type.

233. Wire Crossing Clearances—Continued.

A. Basic Clearances—Continued.

Table 3.—Wire Crossing Clearances

[All voltages are between wires except for trolley contact wires where voltages are to ground]

[The insertion of a given clearance in italics indicates that in general the lines operating at the voltage named above this clearance should not cross over the lines at the voltage to the left of the clearance in italics]

Nature of wires crossed over	Communication wires	Open supply wires 0 to 750 volts and permanently grounded continuous-metal-sheath supply cables of all voltages		Open supply wires and service drops		Guys, messengers, span wires, lightning-protection wires [a]
		Line wires	Service drops	750 to 7,500 volts	7,500 to 50,000 volts	
	Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*
Communication, including cables and messengers	[b] 2	[c] 4	2	4	6	[b] 2
Supply cables having permanently grounded continuous metal sheath, all voltages	*4*	2	2	2	4	2
Open supply wires:						
0 to 750 volts	*4*	2	2	2	4	2
750 to 7,500 volts	*4*	*2*	*4*	2	4	4
7,500 to 50,000 volts	*6*	*4*	*6*	*4*	4	4
Trolley contact conductors	[d] 4	[d, e] 4	[d] 4	6	6	[d] 4
Guys, messengers, span wires, lightning-protection wires, service drops 0 to 750 volts	[b] 2	2	2	4	4	[b] 2

[a] Completely insulated sections of guys attached to supporting structures having no conductor of more than 7,500 volts may have less than this clearance from each other.

[b] The clearance of communication conductors and their guy, span, and messenger wires from each other in locations where no other classes of conductors are involved may be reduced by mutual consent of the parties concerned, subject to the approval of the regulatory body having jurisdiction, except for fire-alarm wires and wires used in the operation of railroads, or where one set of conductors is for public use and the other used in the operation of supply systems.

[c] A clearance of 2 feet may be permitted where the supply conductor is above the communication conductor, provided the crossing is not within 6 feet from any pole concerned in the crossing and the voltage to ground does not exceed 300 volts.

[d] Trolley-contact conductors of more than 750 volts should have at least 6 feet clearance. This clearance should also be provided over lower-voltage trolley-contact conductors unless the crossover conductors are beyond reach of a trolley pole leaving the trolley-contact conductor or are suitably protected against damage from trolley poles leaving the trolley-contact conductor.

[e] Trolley feeders are exempt from this clearance requirement for trolley-contact conductors if they are of the same nominal voltage and of the same system.

233. WIRE CROSSING CLEARANCES—Continued.

B. Increased Clearances.

Greater clearances than given in Table 3 (rule 233, A) shall be provided under the following conditions. The increases required in 1, 2, and 3 below are cumulative where more than one applies.

1. WHERE THE SUM OF THE DISTANCES FROM THE NEARER SUPPORTING STRUCTURE OF EACH SPAN TO THE POINT OF INTERSECTION EXCEEDS 100 FEET.

Under this condition the clearances given in Table 3 (rule 233, A) shall be increased by 0.1 foot for each 10 feet of the excess over 100 feet. This increase need not exceed the limiting values given below when the sag of the upper conductor is such that the maximum stress in that conductor will not exceed the specified percentage of its ultimate stress.

Percentage of ultimate conductor stress	Maximum increase in feet for different loading territories		
	Heavy	Medium	Light
50	2. 5	3. 0	4. 0
60	2. 5	4. 0	5. 0

2. VOLTAGES EXCEEDING 50,000.

For these voltages the clearances given in Table 3 (rule 233, A) shall be increased at the rate of 0.5 inch for each 1,000 volts of the excess.

233. Wire Crossing Clearances—Continued.

B. Increased Clearances—Continued.

3. CONDUCTORS SUPPORTED BY SUSPENSION-TYPE INSULATORS AT CROSSINGS OVER COMMUNICATION WIRES.

For such conductors the clearance shall be increased by such an amount that the values specified in Table 3 (rule 233, A) will be maintained in case of a broken conductor in either adjacent span, provided such conductor is supported as follows:

(*a*) At one support by suspension-type insulators in a suspended position, and at the other support by insulators not free to swing (including semistrain-type insulators).

(*b*) At one support by a strain insulator, and at the other support by a semistrain-type insulator.

4. METHODS OF AVOIDING THIS INCREASE OF CLEARANCE.

Any of the following construction methods will avoid the necessity for the increase in clearance required by rule 233, B, 3.

(*a*) *Suspension-type insulators* in a suspended position at both supports.

(*b*) *Semistrain-type insulators* at both supports.

(*c*) *Arrangement of insulators* so that they are restrained from displacement toward the crossing.

234. Clearances of Conductors of One Line from Other Conductors and Structures.

A. Clearances from Conductors of Another Line.

The clearance in any direction between any conductor of one line and any conductor of a second and conflicting line shall be not less than the largest value required by 1, 2, or 3 below at 60° F. and no wind.

1. Four feet.
2. The values required by rule 235, A, 2, (*a*) (1) or (2) for separation between conductors on the same support.
3. The apparent sag of the conductor having the greater sag, plus 0.2 inch per kilovolt of the highest voltage concerned.

B. Clearances from Supporting Structures of Another Line.

Conductors of any line passing near a pole or similar supporting structure of a second line without being attached thereto, shall have clearances from any part of such structure not less than the larger value required by either 1 or 2 below at 60° F. and no wind.

1. Three feet if practicable.
2. The values required by rule 235, A, 2, (*a*) (1) and (2) for separation between similar conductors on the same support, increased by 1 inch for each 2 feet of the distance from the supporting structure of the second line to the nearest supporting structure of the first line.

The climbing space on the structure of the second line shall in no case be reduced by a conductor of the first line.

234. Clearances of Conductors of One Line from Other Conductors and Structures—Continued.

C. Clearances from Buildings.

1. GENERAL.

Conductors shall be arranged and maintained so as to hamper and endanger firemen as little as possible in the performance of their duties.

2. LADDER SPACE.

Where buildings exceed three stories (or 50 feet) in height, overhead lines should be arranged where practicable so that a clear space or zone at least 6 feet wide will be left, either adjacent to the building or beginning not over 8 feet from the building, to facilitate the raising of ladders where necessary for fire fighting.

Exception.—This requirement does nor apply where it is the unvarying rule of the local fire departments to exclude the use of ladders in alleys or other restricted places which are generally occupied by supply lines.

3. OPEN SUPPLY CONDUCTORS ATTACHED TO BUILDINGS.

Where the permanent attachment of open supply conductors of any class to buildings is necessary for an entrance, such conductors shall meet the following requirements:

(*a*) Conductors of more than 300 volts to ground shall not be carried along or near the surface of the building unless they are guarded or made inaccessible.

(*b*) Clearance of wires from building surface shall be not less than those required in Table 9 (rule 235, A, 3, (*a*)) for clearance of conductors from pole surfaces.

234. CLEARANCES OF CONDUCTORS OF ONE LINE FROM OTHER CONDUCTORS AND STRUCTURES—Continued.

C. Clearances from Buildings—Continued.

4. CONDUCTORS PASSING BY OR OVER BUILDINGS.

(*a*) MINIMUM CLEARANCES. Unguarded or accessible supply conductors carrying voltages in excess of 300 volts shall not come closer to any building or its attachments (balconies, platforms, etc.) than listed below.

(1) SPANS 0 TO 150 FEET.

Table 4.—Clearances of Supply Conductors from Buildings

Voltage of supply conductors	Horizontal clearance	Vertical clearance
	Feet	*Feet*
300 to 7,500	3	8
7,500 to 15,000	8	8
15,000 to 50,000	10	10
Exceeding 50,000	10 plus 0.5 inch per kv. in excess.	10 plus 0.5 inch per kv. in excess.

(2) SPANS EXCEEDING 150 FEET. Where span lengths exceed 150 feet, the increased clearances required by rule 232, B, 1 shall be provided.

Exception.—These increased clearances are not required where the voltage of the supply conductors is from 300 to 7,500 volts.

234. CLEARANCES OF CONDUCTORS OF ONE LINE FROM OTHER CONDUCTORS AND STRUCTURES—Continued.

C. Clearances from Buildings—Continued.

(*b*) CROSSING ROOFS. Supply conductors exceeding 7,500 volts should not be carried over buildings not concerned in the operation of the utility owning them, if this can be avoided.

(*c*) GUARDING OF SUPPLY CONDUCTORS. Supply conductors of 300 volts or more shall be properly guarded by grounded conduit, barriers, or otherwise, under the following conditions:

(1) Where the clearances set forth in Table 4 (rule 234, C, 4, (*a*), (1)) can not be obtained.

(2) Where such supply conductors are placed near enough to windows, verandas, fire escapes, or other ordinarily accessible places, to be exposed to contact by persons.

Note.—Supply conductors in grounded metal-sheathed cable are considered to be guarded within the meaning of this rule.

234. Clearances of Conductors of One Line from Other Conductors and Structures—Continued.

D. Clearances from Bridges.

1. CLEARANCES OF CONDUCTORS FROM BRIDGES.

Supply conductors, not installed in grounded conduit or metal-sheath cable, which pass under, over, or near a bridge shall have clearances therefrom not less than given in Table 5.

Table 5.—Clearances from Bridges

Operating voltages	Readily accessible portions (other than traveled ways [a]) of any bridge, including wing walls or bridge attachments		From ordinarily inaccessible portions [b] of bridges (other than brick, concrete, or masonry) and from abutments	
	For conductors attached to bridge [c]	For conductors not attached to bridge	For conductors attached to bridge [c]	For conductors not attached to bridge [d]
	Feet	*Feet*	*Feet*	*Feet*
0 to 2,500	3.0	3.0	0.5	3.0
Over 2,500 to 5,000	3.0	3.0	1.0	3.0
Over 5,000 to 7,500	3.0	3.0	3.0	3.0
Over 7,500 to 15,000	5.0	5.0	5.0	5.0
Over 15,000 to 25,000	7.5	7.5	7.5	7.5
Over 25,000 to 35,000	7.5	9.0	7.5	9.0
Over 35,000 to 50,000	7.5	12.0	7.5	12.0

[a] Where over traveled ways on or near bridges the clearances of rule 232 apply.
[b] Bridge seats of steel bridges carried on masonry, brick, or concrete abutments which require frequent access for inspection shall be considered as readily accessible portions.
[c] Conductors should have clearance not less than given in this column, where practicable.
[d] Conductors should have the clearances given in this column increased as much as practicable.

234. CLEARANCES OF CONDUCTORS OF ONE LINE FROM OTHER CONDUCTORS AND STRUCTURES—Continued.

D. Clearances from Bridges—Continued.

2. GUARDING TROLLEY CONTACT CONDUCTORS LOCATED UNDER BRIDGES.

(*a*) WHERE GUARDING IS REQUIRED. Guarding is required where the trolley contact conductor is located so that a trolley pole leaving the conductor can make simultaneous contact between it and the bridge structure.

(*b*) NATURE OF GUARDING. Guarding shall consist of a substantial inverted trough of non-conducting material located above the contact conductor, or of other suitable means of preventing contact between the trolley pole and the bridge structure.

235. MINIMUM LINE-CONDUCTOR CLEARANCES AND SEPARATIONS AT SUPPORTS.

A. Separation Between Conductors on Pole Lines.

1. APPLICATION OF RULE.

(*a*) MULTI-CONDUCTOR WIRES OR CABLES. Cables, and duplex, triple or paired conductors supported on insulators or messengers, whether single or grouped, are for the purposes of this rule considered single conductors even though they may contain individual conductors not of the same phase or polarity.

235. MINIMUM LINE-CONDUCTOR CLEARANCES AND SEPARATIONS AT SUPPORTS—Continued.

A. Separation Between Conductors on Pole Lines— Continued.

1. APPLICATION OF RULE—continued.

(*b*) CONDUCTORS SUPPORTED BY MESSENGERS OR SPAN WIRES. Clearances between individual wires or cables supported by the same messenger, or between any group and its supporting messenger, or between a trolley feeder supply conductor, or communication conductor, and their respective supporting span wires, are not subject to the provisions of this rule.

(*c*) MEASUREMENT OF CLEARANCES. The clearances and separations stated may be measured from the center of the supporting insulator instead of from the conductor itself.

2. HORIZONTAL SEPARATIONS BETWEEN LINE CONDUCTORS.

(*a*) FIXED SUPPORTS. Line conductors attached to fixed supports shall have horizontal separations from each other not less than the larger value required by either (1) or (2) below for the situation concerned.

Exception 1.—The pin spacing at buckarm construction may be reduced as specified in rule 236, F, to provide climbing space.

Exception 2.—The pin spacing at bridge fixtures may be reduced as specified in rule 235, C.

Exception 3.—Grades D, E, and N need meet only the requirements of (1) below.

235. MINIMUM LINE-CONDUCTOR CLEARANCES AND SEPARATIONS AT SUPPORTS—Continued.

A. **Separation Between Conductors on Pole Lines**—Continued.

2. HORIZONTAL SEPARATIONS BETWEEN LINE CONDUCTORS—continued.

(*a*) FIXED SUPPORTS—Continued.

(1) MINIMUM HORIZONTAL SEPARATION BETWEEN LINE CONDUCTORS OF THE SAME OR DIFFERENT CIRCUITS. Separations shall be not less than given in Table 6.

Table 6.—Minimum Horizontal Separation at Supports Between Line Conductors of the Same or Different Circuits

Class of circuit	Separation	Notes
Communication conductors	*Inches* 6	Preferable minimum. Does not apply at conductor transposition points.
	3	Permitted where pin spacings less than 6 inches have been in regular use. Does not apply at conductor transposition points.
Railway feeders: 0 to 750 volts, No. 4/0 or larger	6	
0 to 750 volts, smaller than No. 4/0	12	Where 10 to 12 inch separation has already been established by practice, it may be continued, subject to the provisions of rule 235, A, 2, (*a*), (2), for spans having apparent sags not over 3 feet and for voltages not exceeding 7,500.
750 volts to 7,500 volts	12	
Other supply conductors: 0 to 7,500 volts	12	
For all conductors of more than 7,500 volts add for each 1,000 volts in excess of 7,500 volts	0.4	

235. MINIMUM LINE-CONDUCTOR CLEARANCES AND SEPARATIONS AT SUPPORTS—Continued.

A. Separation Between Conductors on Pole Lines—Con.

2. HORIZONTAL SEPARATIONS BETWEEN LINE CONDUCTORS—continued.

(*a*) FIXED SUPPORTS—Continued.

(2) SEPARATIONS ACCORDING TO SAGS. The separation at the supports of conductors of the same or different circuits of grades A, B, or C shall in no case be less than the values given by the following formulas, at 60° F. without wind. The requirements of rule 235, A, 2, (*a*), (1) apply if they give a greater separation than this rule.

For line conductors smaller than No. 2. A. W. G.:

$$\text{Separation} = 0.3 \text{ inch per kilovolt} + 7\sqrt{\frac{S}{3} - 8}.$$

For line conductors of No. 2. A. W. G. or larger:

$$\text{Separation} = 0.3 \text{ inch per kilovolt} + 8\sqrt{\frac{S}{12}}$$

where S is the apparent sag in inches of the conductor having the greater sag, and the separation is in inches.

Table 7.—Separation in Inches Required for Line Conductors Smaller Than No. 2 A. W. G.

Voltages	Sag (in inches)						
	36	48	72	96	120	180	240
750	14.0	20.0	28.0	34.5	40.0	50.5	59.5
2,200	14.5	20.5	28.5	35.0	40.5	51.0	60.0
6,600	16.0	22.0	30.0	36.5	41.5	52.5	61.5
13,200	18.0	24.0	32.0	38.5	43.5	54.5	63.5
22,000	20.5	26.5	34.5	41.0	46.0	57.0	66.0
33,000	24.0	29.5	38.0	44.0	49.5	60.5	69.5
44,000	27.0	33.0	41.0	47.5	53.0	63.5	72.5
66,000	--------	39.5	48.0	54.0	59.5	70.5	79.0

235. MINIMUM LINE-CONDUCTOR CLEARANCES AND SEPARATIONS AT SUPPORTS—Continued.

A. Separation Between Conductors on Pole Lines— Continued.

2. HORIZONTAL SEPARATIONS BETWEEN LINE CONDUCTORS—continued.

(*a*) FIXED SUPPORTS—Continued.

Table 8.—Separation in Inches Required for Line Conductors of Size No. 2 A. W. G. or Larger

Voltages	Sag (in inches)						
	36	48	72	96	120	180	240
750	14.0	16.0	20.0	23.0	25.5	31.0	36.0
2,200	14.5	16.5	20.5	23.5	26.0	31.5	36.5
6,600	16.0	18.0	21.5	24.5	27.5	33.0	38.0
13,200	18.0	20.0	23.5	26.5	29.5	35.0	39.5
22,000	20.5	22.5	26.0	29.0	32.0	37.5	42.5
33,000	24.0	26.0	29.5	32.5	35.0	41.0	45.5
44,000	27.0	29.0	33.0	36.0	38.5	44.0	49.0
66,000	--------	36.0	39.5	42.5	45.0	51.0	55.5

(*b*) SUSPENSION INSULATORS NOT RESTRAINED FROM MOVEMENT. Where suspension insulators are used and are not restrained from movement, the conductor separation shall be increased so that one string of line insulators may swing transversely through an angle of 45° from a vertical position without reducing the values given in (*a*) above.

235. MINIMUM LINE-CONDUCTOR CLEARANCES AND SEPARATIONS AT SUPPORTS—Continued.

A. **Separation Between Conductors on Pole Lines—** Continued.

3. CLEARANCES IN ANY DIRECTION FROM LINE CONDUCTORS TO SUPPORTS, AND TO VERTICAL OR LATERAL CONDUCTORS, SPAN OR GUY WIRES, ATTACHED TO THE SAME SUPPORT.

(*a*) FIXED SUPPORTS. Clearances shall be not less than given in Table 9.

Table 9.—Minimum Clearance in Any Direction from Line Conductors to Supports, and to Vertical or Lateral Conductors, Span or Guy Wire, Attached to the Same Support

Clearance of line conductors from—	Communication lines		Supply lines		
			0 to 7,500 volts		Exceeding 7,500 volts add for each 1,000 volts of excess
	In general	On jointly used poles	In general	On jointly used poles	
	Inches	*Inches*	*Inches*	*Inches*	*Inches*
Vertical and lateral conductors:					
Of same circuit	3	3	3	3	0.25
Of other circuits	3	3	6	6	.4
Span and guy wires attached to same pole:					
General	3	[a] 6	6	6	.4
When parallel to line	([b])	([b])	([b])	([b])	.4
Lightning protection wires parallel to line	([b])	([b])	([b])	([b])	.4
Surfaces of cross arms	[c] 3	[c] 3	3	3	.25
Surfaces of poles	[c] 3	[c] 5	3	[d] 5	.25

[a] If practicable.

[b] Clearance shall not be less than the separation required by Table 6 or rule 235, A, 2, (*a*), (2) between two line conductors of the voltage concerned.

[c] Communication conductors may be attached to supports on the sides or bottoms of cross arms or surfaces of poles if at least 40 inches from any supply line of less than 7,500 volts and at least 60 inches from any supply line of more than 7,500 volts carried on the same pole.

[d] This clearance applies only to supply conductors carried on cross arms below communication conductors on joint poles. Where supply conductors are above communication conductors the clearance shall be at least 3 inches.

235. MINIMUM LINE-CONDUCTOR CLEARANCES AND SEPARATIONS AT SUPPORTS—Continued.

A. Separation Between Conductors on Pole Lines— Continued.

3. CLEARANCES IN ANY DIRECTION FROM LINE CONDUCTORS TO SUPPORTS, AND TO VERTICAL OR LATERAL CONDUCTORS, SPAN OR GUY WIRES, ATTACHED TO THE SAME SUPPORT—continued.

(*b*) SUSPENSION INSULATORS NOT RESTRAINED FROM MOVEMENT. Where suspension insulators are used and are not restrained from movement, the conductor clearances from surfaces of supports, from span or guy wires, or from vertical or lateral conductors shall be such that the values of clearances required by (*a*) above will be maintained with an insulator swing of 45° from the vertical position.

4. CONDUCTOR SEPARATION—VERTICAL RACKS.

Conductors or cables may be carried on vertical racks at one side of the pole with a vertical separation of at least 4 inches if all the following conditions are met:

(*a*) The voltage of conductors shall be not more than 750 volts, except that cables having permanently grounded continuous metal sheath may carry any voltage.

(*b*) Conductors shall be of the same material or materials.

(*c*) Spans shall not average more than 150 feet.

(See Table 9, rule 235, A, 3, for necessary clearances from pole surfaces and rule 236, G, 1, for method of providing climbing space.)

235. MINIMUM LINE-CONDUCTOR CLEARANCES AND SEPARATIONS AT SUPPORTS—Continued.

A. Separation Between Conductors on Pole Lines— Continued.

5. SEPARATION BETWEEN SUPPLY LINES OF DIFFERENT VOLTAGE CLASSIFICATIONS ON THE SAME CROSS ARM.

Supply lines of any one voltage classification as given in Table 11 (rule 238, A, 1) may be maintained on the same cross arm with supply lines of the next consecutive voltage classification only under the following conditions:

(*a*) If they occupy pin positions on opposite sides of the pole.

(*b*) If in bridge-arm or side-arm construction they are separated by a distance of not less than the climbing space required for the higher voltage concerned and provided for in rule 236.

(*c*) If the higher-voltage conductors occupy the outer pin positions and the lower-voltage conductors the inner pin positions.

(*d*) If series lighting or similar circuits, which are ordinarily dead during periods of work on or above the cross arm concerned, occupy the inner pin position and the lower-voltage conductors occupy the outer pin position.

(*e*) If the two lines concerned are communication lines used in the operation of supply lines, and supply lines of less than 7,500 volts, and are owned by the same utility, provided they are installed as in (*a*) or (*b*) above.

235. MINIMUM LINE-CONDUCTOR CLEARANCES AND SEPARATIONS AT SUPPORTS—Continued.

B. Separation Between Conductors Attached to Buildings.

Separation of wires from each other shall not be less than those required in Table 6 (rule 235, A, 2, (*a*), (1)) for separation of conductors from each other at supports.

Exception.—Conductors on vertical racks meeting the requirements of rule 235, A, 4, may have a separation of 4 inches.

C. Separation Between Conductors Attached to Bridges.

Supply conductors attached to bridges and supported at frequent intervals may have less separation at supports than required by rule 235, A, 2, (*a*), (1), and (2). The separation shall not be less than the clearance between supply conductors and the surfaces of poles or cross arms required by rule 235, A, 3, (*a*), or less than the following:

Span length:	Separation inches
0 to 20 feet	6
20 to 50 feet	9

236. CLIMBING SPACE.

A. Location and Dimensions.

1. A climbing space having the horizontal dimensions specified in rule 236, E, shall be provided past any conductors, cross arms, or other parts.
2. The climbing space need be provided on one side or corner of the pole only.
3. The climbing space shall extend vertically past any conductor or other part between levels above and below the conductor as specified in rule 236, E, F, G, and I, but may otherwise be shifted from any side or corner of the pole to any other side or corner.

236. CLIMBING SPACE—Continued.

B. Portions of Supporting Structures in Climbing Space.

Portions of the pole or structure when included in one side or corner of the climbing space at buck or reverse-arm construction are not considered to obstruct the climbing space.

C. Cross Arm Location Relative to Climbing Space.

Recommendation.—Cross arms should be located on the same side of the pole.

Exception.—This recommendation does not apply where double cross arms are used on any pole or where cross arms on any pole are not all parallel.

D. Location of Supply Apparatus Relative to Climbing Space.

Transformers, regulators, lightning arresters, and switches when located below conductors or other attachments shall be mounted outside of the climbing space.

E. Climbing Space Through Conductors on Cross Arms.

1. CONDUCTORS OF SAME VOLTAGE CLASSIFICATION ON SAME CROSS ARM.

Climbing space between conductors shall be of the horizontal dimensions specified in Table 10 (rule 236, E, 3), and shall be provided both along and across the line, and shall be projected vertically not less than 4 feet above and below the limiting conductors. Where communication conductors are above supply conductors of more than 7,500 volts, the climbing space shall be projected vertically at least 6 feet above the highest supply conductor.

Exception.—This rule does not apply if it is the unvarying practice of the employers concerned to prohibit employees from ascending beyond the conductors of the given line, unless the line is killed.

236. CLIMBING SPACE—Continued.

E. Climbing Space Through Conductors on Cross Arms—Continued.

2. CONDUCTORS OF DIFFERENT VOLTAGE CLASSIFICATIONS ON THE SAME CROSS ARM.

The climbing space shall be that required by Table 10 (rule 236, E, 3) for the highest voltage of any conductor bounding the climbing space.

3. HORIZONTAL CLIMBING SPACE DIMENSIONS.

Table 10.—Minimum Horizontal Dimensions of Climbing Space

Character of conductors adjacent to climbing space	Voltage of conductors		Horizontal dimensions of climbing space (inches)			
			On poles used solely by—		On jointly used poles	
	To ground	Between wires	Communication conductors	Supply conductors	Supply conductors above communication conductors	Communication conductors above supply conductors [a]
Communication conductors.	0 to 150		No requirement.		([b])	No requirement.
	Exceeding 150.		24 recommended.		([b])	24 recommended.
Supply conductors.	Less than 300.			24	24	30
	300 to	7,500		30	30	30
		7,500 to 15,000.		36	36	36
		Exceeding 15,000.		More than [c] 36.	More than [c] 36.	More than [c] 36.

[a] This relation of levels is not, in general, desirable and should be avoided where practicable.
[b] The climbing space shall be the same as required for the supply conductors immediately above.
[c] Where practicable. Attention is called to the operating requirements of rule 422.

236. CLIMBING SPACE—Continued.

F. Climbing Space on Buckarm Construction.

The full width of climbing space shall be maintained on buckarm construction and shall extend vertically in the same position at least 4 feet (or 6 feet where required by rule 236, E, 1) above and below any limiting conductor.

Method of Providing Climbing Space on Buckarm Construction.

With circuits of less than 7,500 volts and span lengths not exceeding 150 feet and sags not exceeding 15 inches for wires of No. 2 and larger sizes, or 30 inches for wires smaller than No. 2, a six-pin cross arm having pin spacing of 14½ inches may be used to provide a 30-inch climbing space on one corner of a junction pole by omitting the pole pins on all arms, and inserting pins midway between the remaining pins so as to give a spacing of 7¼ inches, provided that each conductor on the end of every arm is tied to the same side of its insulator, and that the spacing on the next pole is not less than 14½ inches.

G. Climbing Space for Longitudinal Runs.

1. GENERAL.

The full width of climbing space shall be provided past longitudinal runs and shall extend vertically in the same position from 4 feet below the run to a point 4 feet above (or 6 feet where required by rule 236, E, 1). The width of climbing space shall be measured from the longitudinal run concerned.

236. CLIMBING SPACE—Continued.

G. Climbing Space for Longitudinal Runs—Continued.

1. GENERAL—continued.

Exception.—If a supply longitudinal run is placed on the side or corner of the pole where climbing space is provided, the width of climbing space shall be measured horizontally from the center of the pole to the nearest supply conductors on cross arms, under the following conditions:

Where the longitudinal run consists of open supply conductors carrying not more than 750 volts or of permanently grounded continuous metal-sheathed supply cable carrying any voltage, and is supported close to the pole as by brackets, racks, or pins close to the pole, and

Where the nearest supply conductors on cross arms are parallel to and on the same side of the pole as the longitudinal run and within 4 feet above or below the run.

2. PROTECTION OF LONGITUDINAL RUNS.

If a longitudinal run is located between points 2 feet and 6 feet below supply line conductors carried on cross arms, it shall be protected by a suitable guard arm securely fastened to the pole, or by substantial insulating conduit. Such protection shall extend to the following distances from the pole center:

	Inches
Longitudinal runs in general	20
Longitudinal runs of grounded metal-sheath cable uninsulated from metal supports attached to the pole	24

H. Climbing Space Past Vertical Conductors.

Vertical runs incased in suitable conduit or other protective covering and securely attached to the surface of the pole or structure are not considered to obstruct the climbing space.

236. CLIMBING SPACE—Continued.

I. Climbing Space Near Ridge-Pin Conductors.

The climbing space specified in rule 236, E, 3 shall be provided above the top cross arm and past the ridge-pin conductor.

Exception.—Where a single cross arm carrying only two conductors is mounted so that the conductors are 2 feet below a single ridge-pin conductor, the climbing space specified in rule 236, E, 3 shall be carried up to the ridge-pin conductor, but need not be carried past it.

237. LATERAL WORKING SPACE.

A. Location of Working Spaces.

Working spaces shall be provided on the climbing face of the pole at each side of the climbing space.

B. Dimensions of Working Spaces.

1. ALONG THE CROSS ARM.

The working space shall extend from the climbing space to the outmost pin position on the cross arm.

2. PERPENDICULAR TO THE CROSS ARM.

The working space shall have the same dimension as the climbing space (see rule 236, E). This dimension shall be measured from the face of the cross arm.

3. VERTICALLY.

The working space shall have a height not less than that required by rule 238 for the vertical separation of line conductors carried at different levels on the same support.

237. LATERAL WORKING SPACE—Continued.

C. Location of Vertical and Lateral Conductors Relative to Working Spaces.

The working spaces shall not be obstructed by vertical or lateral conductors. Such conductors shall be located on the opposite side of the pole from the climbing side or on the climbing side of the pole at a distance from the cross arms at least as great as the width of climbing space required for the highest-voltage conductors concerned. Vertical conductors inclosed in suitable conduit may be attached on the climbing side of the pole.

D. Location of Buck Arms Relative to Working Spaces.

Buck arms may be used under any of the following conditions, provided the climbing space is maintained. Climbing space may be obtained as in rule 236, F.

1. STANDARD HEIGHT OF WORKING SPACE.

Lateral working space of the height required by Table 11 (rule 238, A, 1) may be provided between the buck arms and adjacent line arms to which conductors on the buck arms are not attached.

Method of meeting requirements. This may be accomplished by increasing the spacing between the line cross arm gains.

237. LATERAL WORKING SPACE—Continued.

D. Location of Buck Arms Relative to Working Spaces—Continued.

2. REDUCED HEIGHT OF WORKING SPACE.

Where no circuits exceeding 7,500 volts between conductors are involved, and the clearances of rules 235, A, 2, (*a*), (1) and (2) are maintained, buck arms may be placed between line arms having normal spacing, even though such buck arms obstruct the normal working space; provided that a working space of not less than 18 inches in height is maintained either above or below each line arm and each buck arm.

238. VERTICAL SEPARATION BETWEEN LINE CONDUCTORS, CABLES, AND EQUIPMENT LOCATED AT DIFFERENT LEVELS ON THE SAME POLE OR STRUCTURE.

All line conductors, cables, or equipment located at different levels on the same pole or structure shall have the vertical separations set forth below.

A. Vertical Separations Between Horizontal Cross Arms.

Cross arms supporting line conductors shall be spaced in accordance with Table 11.

1. BASIC SEPARATIONS.

The separations given in the following table are for cross arms carrying conductors of 0 to 50,000 volts attached to fixed supports.

Table 11.—Vertical Separation of Cross Arms Carrying Conductors

Conductors usually at lower levels	Supply conductors; preferably at higher levels				
	0 to 750 volts and permanently grounded continous metal-sheath cables of all voltages	750 to 7,500 volts	7,500 to 15,000 volts	15,000 to 50,000 volts: Same utility	15,000 to 50,000 volts: Different utilities
Communication conductors:					
General	[a] [b] 4	4	6	....	6
Used in operation of supply lines	2	[c] 2	4	4	6
Supply conductors:					
0 to 750 volts	2	[d] 2	4	4	6
750 volts to 7,500 volts	....	[d] 2	4	4	6
7,500 volts to 15,000 volts—					
If worked on alive with long-handled tools, and adjacent circuits are neither killed nor covered with shields or protectors	....	....	4	4	6
If not worked on alive except when adjacent circuits (either above or below) are killed or covered by shields or protectors, or by the use of long-handled tools not requiring linemen to go between live wires	....	....	2	[e] 4	[e] 4
Exceeding 15,000 volts, but not exceeding 50,000 volts	....	....	....	[e] 4	[e] 4

[a] Where supply circuits of 550 volts or less, with transmitted power of 1,600 watts or less, are run below communication circuits in accordance with rule 220, B, 3 the clearance may be reduced to 2 feet.

[b] In localities where the practice has been established of placing on jointly used poles, cross arms carrying supply circuits of less than 300 volts to ground and cross arms carrying communication circuits at a vertical separation less than specified in the table, such existing construction may be continued until the said poles are replaced provided that—

The minimum separation between existing cross arms is not less than 2 feet, and that—

Extensions to the existing construction shall conform to the clearance requirements specified in Table 11.

When communication conductors are all in cable, a supply cross arm carrying only wires of not more than 300 volts to ground may be placed at not less than 2 feet above the point of attachment of the cable to the pole provided that—

The nearest supply wire on such cross arm shall be at least 30 inches horizontally from the center of the pole, and that—

The cable be placed so as not otherwise to obstruct the climbing space.

[c] This shall be increased to 4 feet when the communication conductors are carried above supply conductors unless the communication-line-conductor size is that required for grade C supply lines.

[d] Where conductors are operated by different utilities, a minimum vertical spacing of 4 feet is recommended.

[e] These values do not apply to adjacent cross arms carrying phases of the same circuit or circuits.

238. VERTICAL SEPARATION BETWEEN LINE CONDUCTORS, CABLES, AND EQUIPMENT LOCATED AT DIFFERENT LEVELS ON THE SAME POLE OR STRUCTURE—Continued.

A. Vertical Separations Between Horizontal Cross Arms—Continued.

2. INCREASED SEPARATIONS FOR VOLTAGES EXCEEDING 50,000.

For voltages greater than 50,000, the clearances of Table 11 shall be increased at the rate of 0.4 inch per 1,000 volts of the excess.

B. Vertical Separation Between Line Conductors on Horizontal Cross Arms.

Where line conductors are supported on horizontal cross arms spaced as required in rule 238, A the vertical separation between such conductors shall be not less than the following:

1. WHERE CONDUCTORS ON THE CROSS ARM ARE OF THE SAME VOLTAGE CLASSIFICATION.

Under these conditions, the vertical separation required by Table 11 may be reduced as follows:

Where cross arm separation required by Table 11 is—	Separation between conductors may be reduced to—
2 feet	16 inches.
4 feet	40 inches.
6 feet	60 inches.

2. WHERE CONDUCTORS OF DIFFERENT VOLTAGE CLASSIFICATIONS ARE ON SAME CROSS ARM.

Under these conditions, the vertical separation between conductors on adjacent cross arms shall be that required by Table 11 (rule 233 A, 1) above for the highest voltage classification concerned.

238. VERTICAL SEPARATION BETWEEN LINE CONDUCTORS, CABLES, AND EQUIPMENT LOCATED AT DIFFERENT LEVELS ON THE SAME POLE OR STRUCTURE—Continued.

B. **Vertical Separation Between Line Conductors on Horizontal Cross Arms**—Continued.

3. CONDUCTORS OF DIFFERENT SAGS ON SAME SUPPORT.

(*a*) VARIATION IN CLEARANCE. Line conductors supported at different levels on the same structure and strung to different sags shall have vertical spacings at the supporting structures so adjusted that the minimum spacing at any point in the span, at 60° F. with no wind, shall not be reduced more than 25 per cent from that required at the supports by rules 235, A, 2, (*a*), (1) and (2) and this rule.

(*b*) READJUSTMENT OF SAGS. Sags should be readjusted when necessary to accomplish the foregoing, but not reduced sufficiently to conflict with the requirements of rule 261, F, 4. In cases where conductors of different sizes are strung to the same sag for the sake of appearance or to maintain unreduced clearance throughout storms, the chosen sag should be such as will keep the smallest conductor involved in compliance with the sag requirements of rule 261, F, 4.

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238. VERTICAL SEPARATION BETWEEN LINE CONDUCTORS, CABLES, AND EQUIPMENT LOCATED AT DIFFERENT LEVELS ON THE SAME POLE OR STRUCTURE—Continued.

C. Separation in Any Direction.

The separation in any direction between conductors of the same or different voltage classification when carried on the same structure, but on cross arms which are not horizontal, shall not be less than the values given in Table 11 (rule 238, A, 1 and 2) for vertical separation.

The separation in any direction shall not in any case be less than the horizontal separation specified in rule 235, A, 2, (*a*), (1) and (2).

D. Vertical Separation for Line Conductors Not Carried on Cross Arms.

The vertical separation between conductors not carried on cross arms shall be the same as required in rule 238, A, 1 and 2 for cross arms.

Exception.—Conductors on vertical racks may have a vertical separation of 4 inches under the conditions specified in rule 235, A, 4.

E. Vertical Separation Between Conductors and Noncurrent-Carrying Metal Parts of Equipment.

For the purpose of measuring these separations metal supports for conductors are considered as noncurrent-carrying metal parts of equipment.

1. BETWEEN SUPPLY CONDUCTORS AND COMMUNICATION EQUIPMENT.

The vertical separations specified in Table 11 (rule 238, A, 1) as 4 feet, may be reduced to 40 inches where the voltage of the supply conductors does not exceed 750, or where supply conductors of any voltage are in permanently grounded continuous-metal-sheath cable.

238. VERTICAL SEPARATION BETWEEN LINE CONDUCTORS, CABLES, AND EQUIPMENT LOCATED AT DIFFERENT LEVELS ON THE SAME POLE OR STRUCTURE—Continued.

E. Vertical Separation Between Conductors and Non-current-Carrying Metal Parts of Equipment—Continued.

2. BETWEEN COMMUNICATION CONDUCTORS AND SUPPLY EQUIPMENT.

The vertical separations specified in Table 11 (rule 238, A, 1) as 4 and 6 feet, may be reduced to 40 inches and 60 inches, respectively.

3. BETWEEN SUPPLY AND COMMUNICATION EQUIPMENT.

(*a*) GENERAL. The vertical separation specified in Table 11 (rule 238, A, 1) as 4 and 6 feet, may be reduced to 40 inches and 60 inches, respectively.

(*b*) SPECIAL SEPARATIONS FOR SPAN WIRES OR BRACKETS. Span wires or brackets for lamps or trolley contact conductors shall have at least the vertical separation from communication equipment set forth below.

From cross arms carrying communication conductors	2 feet
From messenger wires carrying communication cables	1 foot
From terminal box of communication cables, if practicable	1 foot

Exception.—Where it is not practicable to obtain a clearance of 1 foot from terminal boxes of communication cables, all metal parts of terminals shall have the greatest practicable separation from fixtures or span wires, including all supporting screws and bolts of both attachments.

238. VERTICAL SEPARATION BETWEEN LINE CONDUCTORS, CABLES, AND EQUIPMENT LOCATED AT DIFFERENT LEVELS ON THE SAME POLE OR STRUCTURE—Continued.

E. Vertical Separation Between Conductors and Non-current-Carrying Metal Parts of Equipment—Con.

4. SUPPLY CROSS-ARM BRACES CONSIDERED AS EQUIPMENT.

Where supply cross-arm braces are less than 1 inch from transformer cases or hangers, the vertical separation from communication equipment shall be measured from the nearest part of this supply equipment, including the cross-arm brace.

F. Vertical Separation Between Communication Conductors Carried at Different Levels on Railroad Crossing Poles.

At crossings of communication lines over railroads, the vertical clearance between conductors supported on the same pole or structure and at different levels shall in no case be less than 12 inches and preferably shall be 24 inches.

Exception.—Transpositions are excepted.

239. CLEARANCES OF VERTICAL AND LATERAL CONDUCTORS FROM OTHER WIRES AND SURFACES ON THE SAME SUPPORT.

Vertical and lateral conductors shall have the clearances and separations required by this rule from other conductors, wires, or surfaces on the same support.

Exception 1.—This rule does not prohibit the placing of supply circuits of the same or next voltage classification in the same iron pipe, if each circuit or set of wires be inclosed in a metal sheath.

Exception 2.—This rule does not prohibit the placing of paired communication conductors in rings attached directly to the pole or to suspension strand.

239. CLEARANCES OF VERTICAL AND LATERAL CONDUCTORS FROM OTHER WIRES AND SURFACES ON THE SAME SUPPORT—Continued.

A. Location of Vertical or Lateral Conductors Relative to Climbing Spaces, Working Spaces, and Pole Steps.

Vertical or lateral conductors shall be located so that they do not obstruct climbing spaces, or lateral working spaces between line conductors at different levels or interfere with the safe use of existing pole steps.

Exception 1.—This rule does not apply to portions of the pole which workmen do not ascend while the conductors in question are alive.

Exception 2.—This rule does not apply to vertical runs incased in suitable conduit or other protective covering. (See rule 236, H.)

B. Conductors not in Conduit.

Conductors not incased in conduit shall have the same clearances from conduits as from other surfaces of structures.

C. Mechanical Protection near Ground.

Where within 8 feet from the ground, all vertical conductors, cables, and grounding wires shall be protected by a covering which gives suitable mechanical protection. For grounding wires from lightning arresters, the protective covering specified above shall be of wood molding, or other insulating material giving equivalent protection.

Exception 1.—This covering may be omitted for armored cables or cables installed in a grounded metal conduit.

Exception 2.—This covering may be omitted for lead-sheathed cables in rural districts.

Exception 3.—This covering may be omitted for communication circuits on private fenced rights of way in the case of conductors or cables from underground systems.

239. CLEARANCES OF VERTICAL AND LATERAL CONDUCTORS FROM OTHER WIRES AND SURFACES ON THE SAME SUPPORT—Continued.

C. Mechanical Protection near Ground—Continued.

Exception 4.—This covering may be omitted for grounding wires in rural districts having triple-braid weather-proof covering, or where such grounding wire is one of a number of grounding wires used to provide multiple grounds.

D. Requirements for Vertical and Lateral Supply Conductors on Supply Line Poles or Within Supply Space on Jointly Used Poles.

1. GENERAL CLEARANCES

In general, clearances shall be not less than the values specified in Table 12.

Table 12

Clearance of vertical and lateral conductors	Clearances (in inches) for highest voltage concerned in the clearance	
	0 to 7,500 volts	Exceeding 7,500 volts (add the following for each 1,000 in excess)
From surfaces of supports	3	0.25
From span, guy or messenger wires	6	.4
From line conductors rigidly supported on fixed supports, such conductors being of— Same circuit	3	.25
Different circuits	6	.4
From line conductors not rigidly supported on fixed supports	[a]	[a]

[a] The clearances shall be increased beyond the values given above from line conductors on fixed supports (See rule 235, A, 2, (*b*), and 3, (*b*)).

239. CLEARANCES OF VERTICAL AND LATERAL CONDUCTORS FROM OTHER WIRES AND SURFACES ON THE SAME SUPPORT—Continued.

D. Requirements for Vertical and Lateral Supply Conductors on Supply Line Poles or Within Supply Space on Jointly Used Poles—Continued.

2. SPECIAL CASES.

The following apply only to portions of a pole which workmen ascend while the conductors in question are alive.

(*a*) Vertical conductors of not more than 7,500 volts shall clear pole centers by not less than 15 inches for a distance of not less than 4 feet above and below any open supply line conductors which are not of more than 7,500 volts when the latter are carried on or within 4 feet from the pole. If the vertical conductors are of more than 7,500 volts, this clearance shall be at least 20 inches. If the supply conductors are of more than 7,500 volts, the clearance from the pole center shall apply for a distance of not less than 6 feet above and below, except as noted in (*b*), (*c*), and (*d*) below.

(*b*) Vertical and lateral supply conductors, including grounding wires which are inclosed in insulated conduit or in metal conduit or cable protected by an insulating covering (or wood molding if wire be used having triple-braid weather-proof covering), whenever within 4 feet of open supply lines of less than 7,500 volts or within 6 feet from open supply lines of more than 7,500 volts may have less than the clearances specified in (*a*) above, except as provided in (*c*) and (*d*) below.

239. CLEARANCES OF VERTICAL AND LATERAL CONDUCTORS FROM OTHER WIRES AND SURFACES ON THE SAME SUPPORT—Continued.

D. Requirements for Vertical and Lateral Supply Conductors on Supply Line Poles or Within Supply Space on Jointly Used Poles—Continued.

2. SPECIAL CASES—continued.

(*c*) Vertical conductors in metal-sheathed cables and grounding wires may be run without the insulating protection specified in (*b*) above when installed on poles used only for supply lines and employing side-arm construction, if the line conductors are carried only on the side of the pole opposite to the vertical conductors, and if climbing space is provided on the line conductor side of the pole.

(*d*) Vertical and lateral conductors of less than 7,500 volts when on poles used only for supply lines may be run on the street side of the pole in multiple-conductor cable having suitable substantial insulating covering, if such cable is held taut on standard insulators supported on pins and brackets and is arranged so that the cable shall be held at a distance of approximately 5 inches from the surface of the pole, or from any pole step.

E. Requirements for Vertical and Lateral Communication Conductors on Communication Line Poles or Within the Communication Space on Joint Poles.

1. CLEARANCES FROM WIRES.

The clearances and separations of vertical and lateral conductors from other conductors (except those in the same ring run) and from guy, span, or messenger wires shall be 3 inches.

239. CLEARANCES OF VERTICAL AND LATERAL CONDUCTORS FROM OTHER WIRES AND SURFACES ON THE SAME SUPPORT—Continued.

E. Requirements for Vertical and Lateral Communication Conductors on Communication Line Poles or Within the Communication Space on Joint Poles— Continued.

2. CLEARANCES FROM POLE AND CROSS ARM SURFACES.

Vertical and lateral communication conductors may be attached directly to the pole or cross arm by means of rings, knobs, or brackets provided that they are rubber-insulated paired conductors and that in the case of joint poles, the clearances from open supply lines required by Table 11 (rule 238, A, 1) are observed.

F. Requirements for Vertical Supply Conductors Passing Through Communication Space on Jointly Used Poles.

Vertical supply conductors, including grounding wires, which pass through communication line space on joint poles shall be installed as follows:

1. METAL-SHEATHED SUPPLY CABLES.

Metal-sheathed supply cables shall be covered as follows:

(*a*) EXTENT OF COVERING. Covering shall extend from the lowest points of such cables up to the following distances above the highest communication conductors.

Kind of supply cable	Supply voltage	Distance
		Inches
Metal-sheathed	0 to 7,500	[a] 40
	Over 7,500	60
Permanently grounded continuous-metal-sheathed.	All voltages	40

[a] This distance may be reduced to 24 inches for supply cables less than 300 volts to ground where a vertical joint-use separation of 2 feet exists or is permissible. (See footnote [b] to Table 11 for conditions under which this separation is permitted.)

239. CLEARANCES OF VERTICAL AND LATERAL CONDUCTORS FROM OTHER WIRES AND SURFACES ON THE SAME SUPPORT—Continued.

F. Requirements for Vertical Supply Conductors Passing Through Communication Space on Jointly Used Poles—Continued.

1. METAL-SHEATHED SUPPLY CABLES—continued.

(*b*) NATURE OF COVERING. The covering shall consist of wood molding or other suitable insulating material at points higher than 8 feet above the ground.

Exception 1.—Iron pipe may be used without insulating covering at points more than 6 feet below the lowest communication wire or railway feeder or attachment.

Exception 2.—Iron pipe may be used throughout if covered with wood molding or other suitable insulating covering from a point 6 feet below the lowest communication wire or railway feeder or attachment to a point 40 inches or 60 inches above the highest communication wire, depending on the supply voltage.

2. SUPPLY CONDUCTORS.

Supply conductors shall be installed in one of the following ways.

(*a*) IN CONDUIT. Conductors of all voltages may be inclosed in the same way and to the same extent as required in 1 above for metal-sheathed cables.

(*b*) ON PINS AND INSULATORS. Vertical and lateral conductors of street-lighting circuits and service leads of less than 750 volts may be run on the street side of the pole in multiple-conductor cable having suitable substantial insulating covering if such cable is held taut on standard insulators supported

239. Clearances of Vertical and Lateral Conductors from Other Wires and Surfaces on the Same Support—Continued.

F. Requirements for Vertical Supply Conductors Passing Through Communication Space on Jointly Used Poles—Continued.

2. Supply conductors—continued.

on pins or brackets and arranged so that the cable shall be held at a distance of approximately 5 inches away from the surface of the pole or from any pole steps.

3. SUPPLY GROUNDING WIRES.

Supply grounding wires shall be covered with wood molding or other suitable insulating covering to the extent required for metal-sheathed cables in 1 above, the "voltage" of the grounding wire being taken as the voltage of the supply circuit with which it is associated.

4. SEPARATION FROM THROUGH BOLTS.

Vertical runs of supply conductors shall be separated from the ends of through bolts associated with communication line equipment by one-eighth of the circumference of the pole where practicable, but in no case less than 2 inches.

G. Requirements for Vertical Communication Conductors Passing Through Supply Space on Jointly Used Poles.

All vertical runs of communication conductors passing through supply space shall be installed as follows:

1. METAL-SHEATHED COMMUNICATION CABLES.

Metal-sheathed communication cables shall be covered with wood molding or other suitable insulating covering from a point not more than 8 feet above the ground to the following points above the highest supply conductor.

239. CLEARANCES OF VERTICAL AND LATERAL CONDUCTORS FROM OTHER WIRES AND SURFACES ON THE SAME SUPPORT—Continued.

G. Requirements for Vertical Communication Conductors Passing Through Supply Space on Jointly Used Poles—Continued.

1. METAL-SHEATHED COMMUNICATION CABLES—continued.

Nature of supply circuit	Voltage of supply circuit	Distance
		Inches
Permanently grounded continuous-metal-sheathed cable.	All voltages	40
Open wire and other cable	0 to 7,500	[a] 40
Open wire and other cable	Exceeding 7,500	60

[a] This distance may be reduced to 24 inches for supply voltages less than 300 volts to ground where a vertical joint-use separation of 2 feet exists or is permissible. (See footnote [b] to Table 11 for conditions under which this separation is permitted.)

2. COMMUNICATION CONDUCTORS.

Vertical and lateral runs of rubber-insulated paired conductors shall be covered with wood molding or other suitable insulating covering when within 48 or 72 inches from supply conductors of 7,500 volts or less, or more than 7,500 volts, respectively.

3. COMMUNICATION GROUNDING WIRES.

Grounding wires of communication lines shall be covered with wood molding or other suitable insulating covering to the extent required for metal-sheathed cables in 1 above.

4. SEPARATION FROM THROUGH BOLTS.

Vertical runs of communication conductors shall be separated from the ends of through bolts associated with supply-line equipment by one-eighth of the circumference of the pole where practicable, but in no case less than 2 inches.

SEC. 24. GRADES OF CONSTRUCTION

240. GENERAL.

For the purposes of section 26, "Strength requirements," and section 27, "Line insulators," conductors and their supporting structures are classified under the grades specified in this section on the basis of the relative hazard existing.

241. APPLICATION OF GRADES OF CONSTRUCTION TO DIFFERENT SITUATIONS.

A. Supply Cables.

For the purposes of these rules supply cables are divided into two classes as follows:

1. SPECIALLY INSTALLED CABLES.

In this class are included metal-sheathed supply cables installed in accordance with rule 261, G, 1.

Note.—Such cables are sometimes permitted to have a lower grade of construction than open-wire supply conductors of the same voltage.

2. OTHER CABLES.

In this class are included all other supply cables.

Note.—Such cables are required to have the same grade of construction as open-wire supply conductors of the same voltage.

B. Two or More Conditions.

In any case where two or more conditions affecting the grade of construction exist, the grade of construction used shall be the highest one required by any of the conditions.

241. APPLICATION OF GRADES OF CONSTRUCTION TO DIFFERENT SITUATIONS—Continued.

C. Order of Grades.

For supply and communication conductors and supporting structures, the relative order of grades is A, B, C, and N, grade A being the highest. Where grades D, E, and N are specified for communication lines, grade D is the highest.

Note.—Grades D and E can not be directly compared with the series A, B, and C, but rule 241, D, 3, (*c*) provides for cases where these two conditions are present.

D. At Crossings.

1. GRADE OF UPPER LINE.

Conductors and supporting structures of a line crossing over another line shall have the grade of construction specified in rules 241, D, 3; 242, and 243.

2. GRADE OF LOWER LINE.

Conductors and supporting structures of a line crossing under another line need only have the grades of construction which would be required if the line at the higher level were not there.

241. APPLICATION OF GRADES OF CONSTRUCTION TO DIFFERENT SITUATIONS—Continued.

D. At Crossings—Continued.

3. MULTIPLE CROSSINGS.

(*a*) WHERE A LINE CROSSES IN ONE SPAN OVER TWO OTHER LINES. The grade of construction of the uppermost line shall be not less than the highest grade which would be required of either one of the lower lines if it crossed the other lower line.

Example.—If a 2,300-volt line crosses in the same span over a communication line and a direct-current trolley contact conductor of more than 750 volts, the 2,300-volt line is required to comply with grade A construction at the crossing.

This is a double crossing and introduces a greater hazard than where the upper supply line crosses the communication line only.

(*b*) WHERE ONE LINE CROSSES OVER A SPAN IN ANOTHER LINE, WHICH SPAN IS IN TURN INVOLVED IN A SECOND CROSSING. The grade of construction for the highest line shall be not less than that required for the next lower line.

Exception.—This requirement does not apply when the two upper lines are of such a nature and have such circuit protection that the danger of causing a break in the lower of these two lines by mechanical or electrical contact is eliminated.

241. APPLICATION OF GRADES OF CONSTRUCTION TO DIFFERENT SITUATIONS—Continued.

D. **At Crossings**—Continued.

3. MULTIPLE CROSSINGS—continued.

(*c*) WHERE COMMUNICATION CONDUCTORS CROSS OVER SUPPLY CONDUCTORS AND RAILROAD TRACKS IN THE SAME SPAN. The grades of construction shall be in accordance with Table 13.

Table 13

When crossing over—	Communication conductor grades	
	Major lines	Minor lines
Main tracks and supply line of 0 to 750 volts	D	D
Main tracks and supply line exceeding 750 volts	A	A
Minor tracks and supply line of 0 to 750 volts	E	E
Minor tracks and supply line of 750 to 7, 500 volts	B	B
Minor tracks and supply line exceeding 7, 500 volts	A	B

Recommendation.—It is recommended that the placing of communication conductors above supply conductors at crossings, conflicts, or on jointly used poles be avoided unless the supply conductors are trolley contact conductors and their associated feeders.

241. APPLICATION OF GRADES OF CONSTRUCTION TO DIFFERENT SITUATIONS—Continued.

E. **Conflicts.**

1. HOW DETERMINED.

Where two lines are adjacent (except at crossing spans) the distance between them and the relative heights above ground of poles and of conductors on each line determine whether conflict exists, and, if so, whether the conflict is a structure conflict (see Definition) or a conductor conflict (see Definition), or both.

2. CONDUCTOR CONFLICT.

At conductor conflicts the grade of construction of the conflicting conductor shall be as required by rules 241, D, 3, and 242.

3. STRUCTURE CONFLICT.

At structure conflicts, the grade of construction of the conflicting structure shall be as required by rule 243.

242. GRADES OF CONSTRUCTION FOR CONDUCTORS.

The grades of construction required for conductors of all classes in different situations are given in Tables 14 and 15. For the purpose of these tables certain classes of circuits are treated as follows:

A. **Status of Constant-Current Circuits.**

In determining grades of construction where constant-current circuits are involved with communication circuits and are not in specially installed cable, the constant-current circuits shall be considered on the basis of their current rating. In all other cases constant-current circuits shall be considered on the basis of their nominal full-load voltage.

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242. GRADES OF CONSTRUCTION FOR CONDUCTORS—Contd.

B. Status of Railway Feeders and Trolley Contact Conductors.

In determining grades of construction where railway feeders and trolley contact conductors are involved they shall be considered as other supply conductors of the same voltage.

Exception.—Direct-current trolley circuits exceeding 750 volts to ground shall have grade A construction where crossing over, conflicting with, or on joint poles with and above major communication circuits, and grade B where similarly situated with respect to minor communication circuits.

C. Status of Communication Circuits Used Exclusively in the Operation of Supply Lines.

In determining grades of construction where communication circuits used exclusively in the operation of supply lines are concerned, they shall be considered as ordinary communication circuits when run as such (see rule 288, C) and as supply circuits when run as such. (See rule 288, D.)

Exception.—Communication circuits located below supply circuits with which they are used shall not require such supply circuits to meet any rules for grade of construction other than that the sizes of such supply conductors shall not be less than required for grade C (see rule 261, F, 2).

D. Status of Fire-Alarm Conductors.

In determining grades of construction where fire-alarm conductors are concerned, they shall be considered as other communication circuits.

Exception.—Fire-alarm conductors shall always meet grade D where the span length is from 0 to 150 feet, and grade C where the span length exceeds 150 feet.

Table 14.—Grades of Construction for Supply Conductors alone, at Crossings, at Conflicts, or on Same Poles with other Conductors

Supply conductors at higher level[a] / Conductors, tracks, and rights of way at lower levels		Constant-potential supply conductors other than D.C. railway feeders													Constant-current supply conductors						Direct-current railway feeders				Communication conductors used exclusively in the operation of, and run as, supply lines	
		0 to 750 volts[b]		750 to 5000 volts[c]			5000 to 7500 volts[d]				Exceeding 7500 volts[e]				0 to 7.5 amperes		7.5 to 10 amperes		Exceeding 10 amperes		0 to 750 volts		Exceeding 750 volts			
		Urban	Rural	Urban		Rural	Urban		Rural		Urban		Rural													
		Open or Cable	Open or Cable	Open	Cable	Open or Cable	Open	Cable	Open	Cable	Open	Cable	Open	Cable	Open	Cable	Open	Cable	Open	Cable	Open	Cable	Open	Cable	Open	Cable
Lines on fenced rights of way		N	N	[f]N	N	N	[f]N	N	N	N	[f]N	[f]N	N	N	B,C,or N. See rule 242,A						B, C, or N. See rule 242,B				C or N. See rule 242,C	
Lines not on fenced rights of way		N	N	C	N	N	C	N	N	N	B	C	N	N												
Railroad tracks	Main	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	Minor	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Street-railway tracks having no overhead contact conductor		N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Constant-potential supply conductors: 0 to 750 volts[b]	Open	N	N	C	N	N	C	N	N	N	B	C	[g]C	N	B, C, or N See rule 242,A						B, C, or N See rule 242,B				B, C, or N See rule 242,C	
	Cable	N	N	C	N	N	C	N	N	N	B	C	[g]C	N												
750 to 5000 v.[c]	Open	[h]C	N	C	C	N	C	C	N	N	B	C	N	N												
	Cable	N	N	C	N	N	C	N	N	N	B	C	N	N												
5000 to 7500 volts[d]	Open	[h]C	N	C	C	N	C	C	N	N	B	C	N	N												
	Cable	N	N	C	N	N	C	N	N	N	B	C	N	N												
Exceeding 7500 volts[e]	Open	[h]B	[h]C	B	B	N	B	B	N	N	B	C	N	N												
	Cable	[h]C	N	C	N	N	C	N	N	N	B	C	N	N												
Constant-current supply conductors open, or cable		B, C, or N. See rule 242,A													B, C,or N. See rule 242,A						B,C,or N. See rules 242,A,B				B,C,or N. See rules 242,A,C	
Direct-current railway feeders open or cable		B, C, or N See rule 242,B													B,C,or N. See rules 242,A and B						B,C,or N. See rule 242,B				B,C,or N. See rules 242,B,C	
Trolley contact conductors A.C. or D.C.		B, C, or N. See rule 242,B													B,C, or N. See rules 242,A and B.						B,C, or N. See rule 242,B				B,C, or N. See rules 242,B,C	
Communication conductors, open or cable, used exclusively in the operation of supply lines		A,B,C, or N. See rule 242,C													A,B,C, or N. See rules 242A and C						A,B,C, or N. See rules 242,B,C.				B,C, or N. See rule 242,C	
Communication conductors, urban or rural, open or cable	Major[i]	N	N	C	C	C	B	C	B	C	A	C	A	C	C	C or N See rule 242A	B	C or N See rule 242A	A	C or N See rule 242A	N	N	A	C	B,C, or N. See rule 242,C	
	Minor[i]	N	N	C	C	C	C	C	C	C	B	C	B	C	C		C		B		N	N	B	C		

[a] The words "open" and "cable" appearing in the column headings have the following meanings as applied to supply conductors: "Cable" means the specially installed cables described in rule 241, A, 1. "Open" means open wire and also supply cables not "specially installed."

[b] Voltages to neutral or ground of 0 to 440 volts.

[c] Voltages to neutral or ground of 440 to 2,900 volts.

[d] Voltages to neutral or ground of 2,900 to 4,400 volts.

[e] Voltages to neutral or ground exceeding 4,400 volts.

[f] Where lines are located so that they can fall outside the fenced right of way into urban districts the construction shall comply with the grades specified for lines not on fenced rights of way for corresponding voltage.

[g] Grade N if crossing over or conflicting with supply services.

[h] If the wires are service drops, they may have grade N sizes and sags as set forth in Tables 32 and 33 (rule 263, E).

[i] Where the communication conductors consist of individual paired conductors only, supply conductors in the upper position need only be grade N due to this condition.

242. Grades of Construction For Conductors—Contd.

Table 15.—Grades of Construction for Communication Conductors Alone, or in Upper Position at Crossings, at Conflicts, or on Joint Poles

Conductors, tracks and rights of way at lower levels / Communication conductors at higher level[a]			Communication conductors, rural or urban, open or cable, including communication conductors run as such, but used exclusively in the operation of supply lines: Major	Minor
Lines on fenced rights of way			N	N
Lines not on fenced rights of way			N	N
Railroad tracks		Main	D	D
		Minor	E	E
Street-railway tracks having no overhead contact wire			N	N
Constant-potential supply conductors[b]	0 to 750 volts[c]	Open or cable	N	N
	750 to 5000 v.[d]	Open or cable	C	C
	5000 to 7500 v.[e]	Open	B	[g]C
		Cable	C	C
	Exceeding 7500 volts[f]	Open	A	B
		Cable	C	C
Constant-current supply conductors[b]	0 to 7.5 amp.	Open[i]	C	C
	7.5 to 10 amp.	Open[i]	B	[g]C
	Exceeding 10 amp.	Open[i]	A	B
Direct-current railway feeders[b]	0 to 750 volts	Open or cable	N	N
	Exceeding 750 v.	Open or cable	A	B
Trolley contact conductors[b]	0 to 750 volts	A.C. or D.C.	[h]D	[h]D
	Exceeding 750 volts	A.C.	A, B, or C	See rule 242,B
		D.C.	A	B
Communication conductors, open or cable used exclusively in the operation of Supply lines			B, C, or N See rule 242,C	
Communication conductors, open or cable, urban or rural, major or minor			N	N

[a] It is recommended that the placing of communication conductors above supply conductors at crossings, conflicts, or jointly used poles be avoided, unless the supply conductors are trolley contact conductors and their associated feeders.

[b] The words "open" and "cable" appearing in the headings have the following meaning as applied to supply conductors: "Cable" means the specially installed cables described in rule 241, A, 1. "Open" means open wire and also supply cables not specially installed.

[c] Voltages to neutral or ground of 0 to 440 volts.

[d] Voltages to neutral or ground of 440 to 2,900 volts.

[e] Voltages to neutral or ground of 2,900 to 4,400 volts.

[f] Voltages to neutral or ground exceeding 4,400 volts.

[g] For spans 150 feet or less in length, grade C supply-conductor sizes and sags shall apply instead of grade D as permitted by rule 261, H.

[h] Applies only to line-conductor sizes and sags in spans 0 to 150 feet long with following exceptions: Copper or steel, spans 0–100 feet, use No. 12 wire; steel, spans 125 to 150 feet, use No. 9 wire. For spans exceeding 150 feet, grade C supply-conductor sizes and sags shall be met. For paired conductors, grade C paired-conductor requirements shall be met.

[i] Where constant-current circuits are in specially installed cable, they are considered on the basis of the nominal full-load voltage.

243. Grades of Supporting Structures.

A. Poles or Towers.

The grade of construction shall be that required for the highest grade of conductors supported.

Exception 1.—The grade of construction of joint poles, or poles used only by communication lines, need not be increased merely because of the fact that communication wires carried on such poles cross over trolley contact conductors of 0 to 750 volts.

Exception 2.—Poles carrying grade C or D fire-alarm conductors, where alone, or where concerned only with other communication conductors, need meet only the requirements of grade N.

Exception 3.—Poles carrying supply service loops of 0 to 750 volts shall have at least the grade of construction required for supply line conductors of the same voltage.

Exception 4.—Where communication lines cross over supply conductors and a railroad in the same span and grade A or B is required by rule 241, D, 3, (*c*) for the communication conductors, due to the presence of railroad tracks, the grade of the poles or towers shall be D or E.

Exception 5.—At structure conflicts even though no conductor conflict exists, the grade of construction which would be required by rule 242, if the conductors were in conflict, shall be applied to the pole or tower.

Note.—This requirement may result in a higher grade of construction for the pole or tower than for the conductors carried thereon.

Exception 6.—In the case where a structure conflict does not exist, but any conductor is in conductor conflict, the grade of constructure of the pole or tower is not required to meet the conductor grade due to the conductor conflict.

243. GRADES OF SUPPORTING STRUCTURES—Continued.

B. Cross Arms.

The grade of construction shall be that required for the highest grade of conductors carried by the cross arm concerned.

Exception 1.—The grade of construction of cross arms carrying only communication conductors need not be increased merely because of the fact that such conductors cross over trolley contact conductors of 0 to 750 volts.

Exception 2.—Cross arms carrying grade C or D fire-alarm conductors, where alone or where concerned with other communication conductors need meet only the requirements for grade N.

Exception 3.—Cross arms carrying supply service loops of 0 to 750 volts shall have at least the grade of construction required for supply line conductors of the same voltage.

Exception 4.—Where communication lines cross over supply conductors and a railroad in the same span and grades A or B is required by rule 241, D, 3, (*c*) for the communication conductors due to the presence of railroad tracks, the grade of the cross arm shall be D or E.

C. Pins, Insulators, and Conductor Fastenings.

The grade of construction shall be that required for the conductor concerned.

Exception 1.—The grade of construction of pins, insulators, and conductor fastenings carrying only communication conductors need not be increased merely because of the fact that such conductors cross over trolley contact conductors of 0 to 750 volts.

Exception 2.—In case of grade C or D fire-alarm conductors where alone or where concerned only with other communication conductors, pins, insulators, and conductor fastenings need meet only the requirements for grade N.

243. GRADES OF SUPPORTING STRUCTURES—Continued.

C. Pins, Insulators, and Conductor Fastenings—Con.

Exception 3.—In the case of supply service loops of 0 to 750 volts, pins, insulators, and conductor fastenings shall have at least the same grade of construction as required for supply line conductors of the same voltage.

Exception 4.—Where communication lines cross over supply conductors and a railroad in the same span, and grade A or B is required by rule 241, D, 3, (*c*) for the communication conductors due to the presence of railroad tracks, the grade of pins, insulators, and conductor fastenings shall be D or E.

Exception 5.—In case communication conductors are required to meet grade A, B, or C, the insulators need meet only the requirements for mechanical strength for these grades.

SEC. 25. LOADING FOR GRADES A, B, C, D, AND E

250. LOADING MAP.

Three degrees of severity are recognized for the loading, due to weather conditions, and are designated, respectively, as heavy, medium, and light loading. The districts in which these loadings apply are determined by weather reports as to wind and ice and by local experience of utilities using overhead lines. It is expected that detailed districting will be carried out by State authorities, but a general districting for the entire United States is given in the map (fig. 1).

Note.—The localities in the different groups are classed according to the relative prevalence of high wind velocity and thickness of ice which accumulates on wires, light loading being, in general, for places where little, if any, ice ever accumulates on wires.

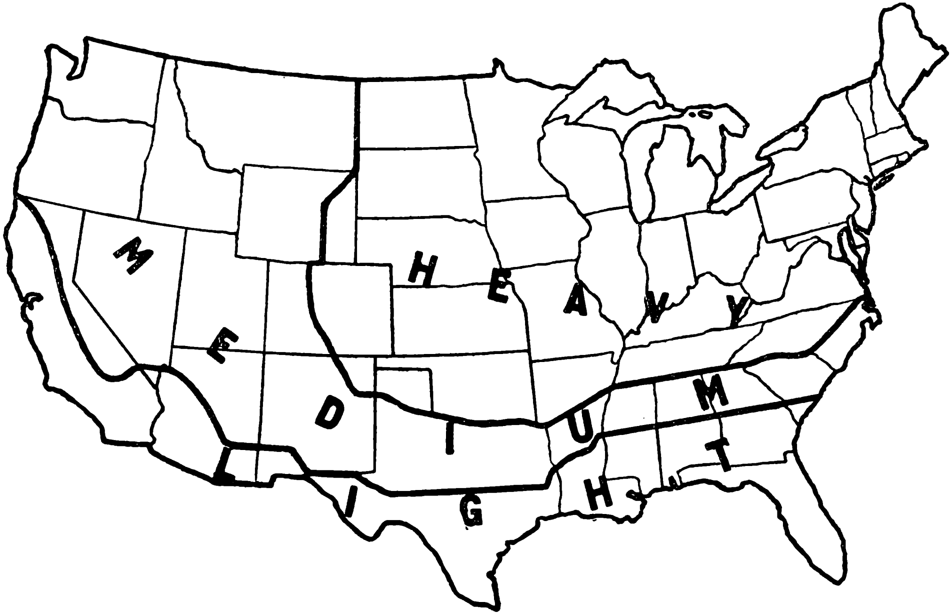

FIG. 1.—*District loading map, showing territorial division of the United States with respect to loading of overhead lines*

250. LOADING MAP—Continued.

Where high wind velocities are frequent in a given place the loading for that place may be classed as heavy even though ice does not accumulate to any greater extent than at some other place having less severe winds which has been classed as a medium loading district.

251. ASSUMED WEATHER CONDITIONS.

The following weather conditions are assumed to act simultaneously in different loading districts:

	Thickness of ice	Horizontal wind pressure on projected area of cylindrical surface	Temperature
	Inches	*Lbs. per sq. ft.*	°*F.*
Heavy loading districts (H)	0. 50	8	0
Medium loading districts (M)	. 25	8	+15
Light loading districts (L)	None.	12	+30

252. MODIFICATION OF LOADING.

In the absence of any action by the administrative authority fixing the loadings for any given territory, the classification of loadings shown on the map (fig. 1), shall apply unless the party or parties responsible for the line concerned secure approval from the administrative authority for modification, based upon local experience, or weather records, or both.

253. CONDUCTOR LOADING.

The loading on conductors shall be assumed as in A, B, or C below, according to the climatic conditions of the locality concerned.

Where cables are concerned, the specified loadings shall be applied to both cable and messenger.

253. Conductor Loading—Continued.

In applying loadings to bare stranded conductors, the coating of ice shall be considered as a hollow cylinder touching the outer strands.

Ice is assumed to weigh 57 pounds per cubic foot.

A. Heavy Loading (H).

The resultant loading, due to the weight of the conductor plus the added weight of a layer of ice 0.5 inch in radial thickness, combined with a transverse horizontal wind pressure of 8 pounds per square foot on the projected area of the ice-covered conductor, shall be called heavy loading. The minimum temperature shall be assumed as 0°F.

B. Medium Loading (M).

The resultant loading due to the weight of the conductor plus the added weight of a layer of ice 0.25 inch in radial thickness, combined with a transverse horizontal wind pressure of 8 pounds per square foot on the projected area of the ice-covered conductor, shall be called medium loading. The minimum temperature shall be assumed as +15° F.

C. Light Loading (L).

The resultant loading due to the weight of the conductor without ice combined with a transverse horizontal wind load of 12 pounds per square foot on the projected area of the conductor, shall be called light loading. The minimum temperature shall be assumed as +30°F.

254. Loads upon Line Supports.

A. Assumed Vertical Loading.

The vertical loads upon poles, towers, foundations, cross arms, pins, insulators, and conductor fastenings shall be their own weight plus the superimposed weight which they support, including all wires and cables, ice-coated in heavy and medium loading districts, together with the effect of any difference in elevation of supports. The radial thickness of ice shall be computed only upon wires, cables, and messengers, and shall be taken as the following:

Heavy loading districts (H), 0.50 inch of ice.
Medium loading districts (M), 0.25 inch of ice.
Light loading districts (L), no ice.

Ice is assumed to weigh 57 pounds per cubic foot.

Note.—The weight of ice upon supports is ignored for the sake of simplicity. (See Appendix E, Table 81, for vertical loads of conductors.)

B. Assumed Transverse Loading.

In computing the stresses in poles, towers, and side guys the loading shall be taken as one of the following according to climatic conditions of the locality concerned.

1. HEAVY LOADING (H).

A horizontal wind pressure, at right angles to the direction of the line, of 8 pounds per square foot upon the projected area of cylindrical surfaces of all supported conductors and messengers, when covered with a layer of ice 0.5 inch in radial thickness and on surfaces of the poles and towers without ice covering, shall be called heavy loading. (See 4 and 5 following.)

254. LOADS UPON LINE SUPPORTS—Continued.

B. Assumed Transverse Loading—Continued.

1. HEAVY LOADING (H)—continued.

For supporting structures carrying more than 10 wires, not including cables supported by messengers, where the pin spacing does not exceed 15 inches, the transverse load shall be calculated on two-thirds of the total number of such wires with a minimum of 10 wires.

2. MEDIUM LOADING (M).

A horizontal wind pressure at right angles to the direction of the line, of 8 pounds per square foot upon the projected area of cylindrical surfaces of all supported conductors and messengers when covered with a layer of ice 0.25 inch in radial thickness and on the surfaces of the poles and towers without ice covering, shall be called medium loading. (See 4 and 5 following.)

For supporting structures carrying more than 10 wires not including cables supported by messengers, where the pin spacing does not exceed 15 inches, the transverse load shall be calculated on two-thirds of the total number of such wires with a minimum of 10 wires.

3. LIGHT LOADING (L).

A horizontal wind pressure at right angles to the direction of the line of 12 pounds per square foot upon the projected area of cylindrical surfaces of all supported conductors and messengers, poles and towers without ice covering, shall be called light loading. (See 4 and 5 following.)

254. Loads upon Line Supports—Continued.

B. Assumed Transverse Loading—Continued.

4. TROLLEY CONTACT CONDUCTORS.

When a trolley contact conductor is supported on a commonly used pole it shall be included in the computation of the transverse load on the structure.

5. FLAT SURFACES.

For flat surfaces the assumed unit wind pressure shall be increased by 60 per cent. Where latticed structures are concerned the actual exposed area of one lateral face shall be increased by 50 per cent to allow for the pressure on the opposite face; this total, however, need not exceed the pressure which would occur on a solid structure of the same outside dimensions. The results obtained by more exact calculations may be substituted for the values obtained by this simple rule.

6. ANGLES.

In cases where, due to change in direction of conductors, an unbalanced side pull is imposed on the supporting structure, a transverse load shall be assumed equal to the resultant of all conductor and messenger tensions, as determined by the loadings of rule 253.

C. Assumed Longitudinal Loading.

1. CHANGE IN GRADE OF CONSTRUCTION.

The longitudinal loading upon supporting structures, including poles, towers, cross arms, pins, and conductor fastenings, at ends of sections required to be of grade A or B construction when

254. LOADS UPON LINE SUPPORTS—Continued.

C. **Assumed Longitudinal Loading**—Continued.

1. CHANGE IN GRADE OF CONSTRUCTION—continued.

located in lines of a lower grade of construction, shall be taken as an unbalanced pull in the direction of the higher-grade section equal to the total pull in one direction of all conductors and cables supported thereon, the conductor loading to be that given in rule 253.

Exception.—For such higher-grade sections having no span exceeding 500 feet in length where the total pull in the direction of the higher-grade section exceeds 30,000 pounds, the assumed loading is modified to 30,000 pounds, plus one-fourth the excess above 30,000 pounds, with a maximum of 50,000 pounds.

2. SAME GRADE OF CONSTRUCTION THROUGHOUT.

Where lines are built throughout their length, or between dead-ended points, of grade A or B construction, respectively, although not so required, the longitudinal loading upon supporting structures (including poles, towers, cross arms, pins, and conductor fastenings) at crossings, at ends of sections of joint use, and at ends of conflicts required to be of grade A or B construction, respectively, shall be taken as an unbalanced pull in the direction of the crossing, conflict, or joint-use section equal to the pull of one-third of the total number of conductors carried (not including overhead ground wires), such one-third of the conductors being selected so as to produce the maximum stress in the supports. If the application of the above results in a fractional part of a conductor, the nearest whole number shall be used

254. LOADS UPON LINE SUPPORTS—Continued.

C. **Assumed Longitudinal Loading**—Continued.

3. JOINTLY USED POLES AT CROSSINGS OVER RAILROADS OR COMMUNICATION LINES.

Where a joint line crosses over a railroad or a communication line and grade A or B is required for the crossing span, the tension in the communication conductors of the joint line may be considered as limited to one-half their breaking strength, provided they are smaller than No. 8 Stl. W. G., if of steel, or No. 6 A. W. G., if of copper, regardless of how small the initial sags of the communication conductors at 60° F.

4. DEAD ENDS.

The longitudinal loading upon supporting structures shall be taken as an unbalanced pull equal to the tensions of all conductors and messengers under the conditions of loading specified in rule 253.

5. COMMUNICATION CONDUCTORS ON UNGUYED SUPPORTS AT RAILROAD CROSSINGS.

The longitudinal load shall be assumed equal to an unbalanced pull in the direction of the crossing, of all conductors supported, the pull of each conductor being taken as one-half its ultimate strength.

254. Loads upon Line Supports—Continued.

D. Average Span Lengths.

1. GENERAL.

The calculated transverse loads, upon poles, towers, and cross arms, except as provided in 2 below, shall be based upon the average span length of a section of line that is reasonably uniform as to height, number of wires, grade, and span length. In no case shall the average value taken be less than 75 per cent or more than 125 per cent of the actual average of the two spans adjacent to the structure concerned.

2. CROSSINGS.

In the case of crossings over railroads or communication lines (other than minor communication lines) the actual lengths of the two spans adjacent to the two structures concerned shall be used.

E. Simultaneous Application of Loads.

1. When calculating transverse strength, the assumed transverse and vertical loads shall be taken as acting simultaneously.
2. In calculating longitudinal strength, the assumed longitudinal loads shall be taken without consideration of the vertical or transverse loads.

SEC. 26. STRENGTH REQUIREMENTS

260. PRELIMINARY ASSUMPTIONS.

In calculation of stresses no allowance shall be made for deformaton, deflection, or displacement of any part of the supporting structure, including suspension insulators.

261. GRADES A, B, AND C CONSTRUCTION.

A. Poles and Towers.

The strength requirements for poles and towers may be met by the structures alone or with the aid of guys or braces.

1. AVERAGE STRENGTH OF THREE POLES.

A pole (single-base structure) not individually meeting the transverse strength requirements will be permitted when reinforced by a stronger pole on each side, if the average strength of the three poles meets the transverse strength requirements, and the weak pole has not less than 75 per cent of the required strength.

An extra pole inserted in a normal span for the purpose of supporting a service loop may be ignored, if desired, in the calculation of the strength of the line.

Exception for crossing poles.—In the case of crossings over railroads or communication lines (other than minor communication lines), the actual strengths of the crossing poles shall be used.

2. REINFORCED-CONCRETE POLES.

Reinforced-concrete poles shall be of such material and dimensions as to withstand for transverse strength the loads assumed in rules 254, A and B and for longitudinal strength the loads in rule 254, C without exceeding the following percentages of their ultimate strength. (Where guys are used, see rule 261, C.)

261. Grades A, B, and C Construction—Continued.

A. Poles and Towers—Continued.

	Percentage of ultimate strength for different grades		
	Grade A	Grade B	Grade C
For transverse strength (when installed)	33⅓	50	75
For longitudinal strength (at all times) in general	100	100	--------
At dead-ends	33⅓	50	75

3. STEEL SUPPORTING STRUCTURES.

Steel supports, steel towers, and metal poles shall be designed and constructed so as to meet the following requirements:

(*a*) Transverse Strength.—Under the transverse and vertical loads assumed in rule 254, A and B the calculated stresses in steel members shall not exceed the allowable stresses for transverse strength given in (*d*) below.

(*b*) Longitudinal Strength.

Grades A and B. Under the longitudinal loads assumed in rule 254, C the calculated steel members shall not exceed the allowable stresses for longitudinal strength given in (*d*) below.

Grade C. No longitudinal-strength requirements except at dead-ends.

(*c*) Minimum Strength. Steel towers shall have strength sufficient to withstand a transverse load on the towers without conductors due to three times the specified transverse wind pressure, without exceeding the allowable stresses for longitudinal strength in Table 16.

261. GRADES A, B, AND C CONSTRUCTION—Continued.

A. **Poles and Towers**—Continued.

3. STEEL SUPPORTING STRUCTURES—continued.

(*d*) ALLOWABLE UNIT STRESSES; STEEL. The values in Table 16 for structural steel are for material having an ultimate tensile stress between 55,000 and 65,000 pounds per square inch and yield point not less than 50 per cent of the ultimate stress.

In the case of special steels having higher yield points, purchased under rigid specification and inspection conditions, an allowance above the tabular stresses in proportion to the respective yield points will be permitted.

As the unit stresses in Table 16 are the maximum allowable, sufficient allowance should be made in the design to insure that in the completed structure the specified unit stresses will not be exceeded.

Table 16.—Allowable Unit Stresses in Steel for Transverse and Longitudinal Strengths

	Allowable stresses for transverse strength			Allowable stresses for longitudinal strength	
	Grade A	Grade B	Grade C	Grades A and B crossings	Grades A and B except at crossings
	Lbs. per sq. in.	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs. per sq. in.*
Structural steel:					
Tension	20,000	26,000	30,000	30,000	33,000
Compression	20,000 $-80\ L/R$	26,000 $-90\ L/R$	30,000 $-100L/R$	30,000 $-100L/R$	33,000 $-100L/R$
Bolts:					
Shear	20,000	24,000	35,000	35,000	40,000
Bearing	40,000	48,000	70,000	70,000	80,000
Rivets:					
Shear	18,000	22,000	30,000	30,000	33,000
Bearing	36,000	44,000	60,000	60,000	66,000

261. Grades A, B, and C Construction—Continued.

A. Poles and Towers—Continued.

3. Steel supporting structures—continued.

(*e*) Thickness of Steel. Steel poles or towers shall have no less thickness of metal in members than the following:

Table 17.—Thickness of Steel

Kind of member	Thickness of main members of cross arms and legs	Thickness of other members
Galvanized:	*Inches*	*Inches*
For localities where experience has shown deterioration of galvanized material is rapid	¼	3/16
For other localities	3/16	⅛
Painted	¼	[a] ¼

[a] Painted bracing members having L/R not exceeding 125 may be 3/16 inch in thickness.

(*f*) Unsupported Length of Compression Members. The ratio of L, the unsupported length of a compression member, to R, the least radius of gyration of the member, shall not exceed the following: (These figures do not apply to the complete structure.)

Table 18.—L/R for Compression Members

Kind of compression member	L/R
Leg members	150
Other members having figured stresses	200
Secondary members without figured stresses	250

261. GRADES A, B, AND C CONSTRUCTION—Continued.

A. Poles and Towers—Continued.

3. STEEL SUPPORTING STRUCTURES—continued.

(*g*) SPLICES FOR MAIN LEG MEMBERS. In splices for main leg members where under the application of the values in Table 16, rule 261, A, 3, (*d*) four or more bolts or rivets are called for, the number of bolts or rivets shall be increased by 10 per cent with a minimum of one additional bolt or rivet.

(*h*) ADDITIONAL REQUIREMENT FOR ANCHOR TOWERS. When steel supports or towers are used which are not capable of withstanding approximately as great a force longitudinally as transversely, anchor towers shall be placed at intervals not greater than 10 spans. These anchor towers shall be able to withstand the combined longitudinal tension of all conductors under the loads specified in rule 253 up to 10,000 pounds plus one-half the excess above 10,000 pounds, without exceeding their ultimate strength.

(*i*) GENERAL CONSTRUCTION FEATURES. Steel poles or towers, including parts of footings above ground, shall be constructed so that all parts are accessible for inspection, cleaning, and painting, and so that pockets are not formed in which water can collect.

Recommendation.—Unless sample structures, or similar ones, have been tested to assure the compliance of structures in any line with these requirements, it is recommended that structures be designed to have a computed strength at least 10 per cent greater than that required by these rules.

261. GRADES A, B, AND C CONSTRUCTION—Continued.

A. Poles and Towers—Continued.

3. STEEL SUPPORTING STRUCTURES—continued.

(*j*) PROTECTIVE COVERING OR TREATMENT. All iron or steel poles, towers, or supporting structures shall be protected by galvanizing, painting, or other treatment which will effectively retard corrosion.

4. WOOD POLES.

Wood poles shall be of such material and dimensions as to meet the following requirements. Where guys are used, see rule 261, C.

(*a*) TRANSVERSE STRENGTH. Wood poles shall withstand the transverse and vertical loads assumed in rule 254, A and B without exceeding at the ground line for unguyed poles, or at the point of guy attachment for guyed poles, the appropriate allowable fiber stresses given in Table 20.

(*b*) LONGITUDINAL STRENGTH.

Grades A and B. The longitudinal strength of wood poles shall be maintained at all times so that they will withstand the longitudinal loading specified in rule 254, C without exceeding at the ground line for unguyed poles, or at the point of guy attachment for guyed poles, the appropriate ultimate fiber stress given in Table 19.

Grade C. No longitudinal-strength requirements except at dead-ends.

261. GRADES A, B, AND C CONSTRUCTION—Continued.

A. **Poles and Towers**—Continued.

4. WOOD POLES—continued.

(*c*) ULTIMATE FIBER STRESS. Different kinds of wood poles are considered as having the ultimate fiber stresses given in Table 19. These ultimate fiber stresses are given so as to identify different kinds of pole timbers with the ultimate fiber stress appearing at the heads of the columns in Table 20.

Table 19.—Ultimate Fiber Stresses of Wood Poles

Kind of wood	Ultimate fiber stress
	Lbs. per sq. in.
Dense yellow pine (meeting standard of A.S.T.M., see Appendix G)	6, 500
Other yellow pine Chestnut Western cedar (western red cedar) Cypress	5, 000
Eastern cedar (northern white cedar) Redwood	3, 600

Tests are under way to determine ultimate stresses of woods and when values for ultimate stresses have been adopted as standard by the American Engineering Standards Committee, the values thus determined shall be applied under this code and the values in Table 20 adjusted proportionately.

261. GRADES A, B, AND C CONSTRUCTION—**Continued.**

A. Poles and Towers—Continued.

4. WOOD POLES—continued.

(*d*) TREATED POLES. The use of treated poles is not required. However, under certain circumstances Table 20 permits higher allowable stresses for treated poles than for untreated poles. Treated poles are poles meeting the following requirements:

(1) PRESERVATIVES. The preservative used shall be coal-tar creosote or other preservative equally satisfactory with regard to electrical resistance, retention of the preservative within the timber, and efficiency as a preservative. In the case of poles which are butt-treated only, the electrical resistance of the preservative may be disregarded.

(2) FULL-LENGTH TREATMENT. Pine and other timber subject to rapid decay above ground shall be treated full length by a pressure process or some other equally effective method.

(3) BUTT TREATMENT. Cedar, chestnut, and other timber not subject to rapid decay above ground shall be treated by any process which will produce impregnation of most of the sapwood from at least 2 feet below the ground line to at least 1 foot above the ground line. In the case of treatments which require perforation, no method shall be used which results in perforation to the cross section required at replacement.

261. Grades A, B, and C Construction—Continued.

A. Poles and Towers—Continued.

4. WOOD POLES—continued.

(e) Allowable Fiber Stresses. The allowable fiber stresses to be used in computing the strength of treated and untreated poles to withstand vertical and transverse loads are given in Table 20.

Table 20.—Allowable Fiber Stresses (in Pounds per Square Inch) for Wood Poles Under Vertical and Transverse Loading

	When installed					At replacement		
	Treated poles			Untreated poles		Treated or untreated poles		
	For ultimate fiber stress of—			For ultimate fiber stress of—		For ultimate fiber stress of—		
	6, 500	5, 000	3, 600	5, 000	3, 600	6, 500	5, 000	3, 600
At crossings: Poles in lines of one grade of construction throughout— Grade A	2, 170	1, 670	1, 200	1, 670	1, 200	3, 250	2, 500	1, 800
Grade B	3, 250	2, 500	1, 800	2, 500	1, 800	4, 870	3, 750	2, 700
Grade C	4, 870	3, 750	2, 700	3, 750	2, 700	9, 750	7, 500	5, 400
Poles in isolated sections of higher grade of construction in lines of a lower grade of construction— Grade A	2, 170	1, 670	1, 200	1, 250	900	3, 250	2, 500	1, 800
Grade B	3, 250	2, 500	1, 800	1, 670	1, 200	4, 870	3, 750	2, 700
Grade C	4, 870	3, 750	2, 700	3, 000	2, 160	9, 750	7, 500	5, 400
Elsewhere than at crossings: Grade A	2, 600	2, 000	1, 440	1, 670	1, 200	3, 900	3, 000	2, 160
Grade B	3, 900	3, 000	2, 160	2, 500	1, 800	6, 500	5, 000	3, 600
Grade C	6, 500	5, 000	3, 600	3, 750	2, 700	9, 750	7, 500	5, 400

261. GRADES A, B, AND C CONSTRUCTION—Continued.

A. Poles and Towers—Continued.

4. WOOD POLES—continued.

(*f*) FREEDOM FROM DEFECTS. Wood poles shall be selected timber free from observable defects that would decrease their strength and durability.

(*g*) MINIMUM POLE SIZES. Wood poles shall have nominal top diameters not less than the following:

Table 21.—Minimum Top Diameters for Wood Poles

Grade of construction	Minimum top diameters for different loading districts		
	Heavy	Medium	Light
	Inches	*Inches*	*Inches*
A	7	7	6
B	6	6	6
C	6	6	6

(*h*) SPLICED POLES. Spliced poles shall not be used at crossings, conflicts, or joint-use sections requiring grade A, B, or C construction.

5. TRANSVERSE STRENGTH REQUIREMENTS FOR STRUCTURES WHERE SIDE GUYING IS REQUIRED, BUT CAN ONLY BE INSTALLED AT A DISTANCE.

Grades A and B. In the case of structures where, because of very heavy or numerous conductors or relatively long spans, the transverse-strength requirements of this section can not be met ex-

261. GRADES A, B, AND C CONSTRUCTION—Continued.

A. Poles and Towers—Continued.

5. TRANSVERSE STRENGTH REQUIREMENTS FOR STRUCTURES WHERE SIDE GUYING IS REQUIRED, BUT CAN ONLY BE INSTALLED AT A DISTANCE—continued.

cept by the use of side guys or special structures, and it is physically impracticable to employ side guys, the transverse-strength requirements may be met by side-guying the line at each side of, and as near as practicable to, the crossing or other transversely weak structure, and with a distance between such side-guyed structures of not over 800 feet, provided that:

(*a*) The side-guyed structures for each such section of 800 feet or less shall be constructed to withstand the calculated transverse load due to wind on the supports and ice-covered conductors, on the entire section between the side-guyed structures.

(*b*) The line between such side-guyed structures shall be substantially in a straight line and the average length of span between the side-guyed structures shall not be in excess of 150 feet.

(*c*) The entire section between the transversely strong structures shall comply with the highest grade of construction concerned in the given section, except as to the transverse strength of the intermediate poles or towers.

Grade C. The above provision is not applicable to grade C.

261. GRADES A, B, AND C CONSTRUCTION—Continued.

A. Poles and Towers—Continued.

6. **LONGITUDINAL-STRENGTH REQUIREMENTS FOR SECTIONS OF HIGHER GRADE IN LINES OF A LOWER GRADE OF CONSTRUCTION.**

(*a*) METHODS OF PROVIDING LONGITUDINAL STRENGTH.

Grades A and B. The longitudinal-strength requirements for sections of line of higher grade in lines of a lower grade (see for assumed longitudinal loading rule 254, C, 1) are usually met by placing supporting structures of the required longitudinal strength at either end of the higher-grade section of the line.

Where this is impracticable, the supporting structures of the required longitudinal strength may be located one or more span lengths away from the section of higher grade, within 500 feet on either side and with not more than 800 feet between the longitudinally strong structures, provided such structures and the line between them meet the requirements, as to transverse strength and stringing of conductors, of the highest grade occurring in the section, and provided that the line between the longitudinally strong structures is approximately straight or suitably guyed.

The requirements may also be met by distributing the head guys over two or more structures on either side of the crossing, such structures and the line between them complying with the requirements for the crossing

261. Grades A, B, and C Construction—Continued.

A. Poles and Towers—Continued.

as to transverse strength and as to conductors and their fastenings.

Where it is impracticable to provide the longitudinal strength, the longitudinal loads shall be reduced by increasing the conductor sags. This may require greater conductor separations. (See rule 235, A, 2, (*a*).)

Grade C. The above provision is not applicable to grade C.

(*b*) Flexible Supports.

Grades A and B. When supports of the section of higher grade are capable of considerable deflection in the direction of the line, as with wood or concrete poles, or some types of metal poles and towers, it may be necessary to increase the normal clearances specified in section 23, or to provide head guys or special reinforcement to prevent such deflection.

So-called flexible steel towers or frames, if used at such locations, shall be adequately reinforced to meet the requirements of rule 261, A, 3 (*b*).

When the situation is one involving an isolated crossing of higher grade in a line of lower-grade construction, then the structure shall, when practicable, be head-guyed or otherwise reinforced to prevent reduction in the clearances required in section 23.

Grade C. The above provision is not applicable to grade C.

261. GRADES A, B, AND C CONSTRUCTION—Continued.

A. **Poles and Towers**—Continued.

7. STRENGTH AT ANGLES AND DEAD-ENDS.

In cases where, due to change of direction of the line or because of dead ends, the longitudinal tensions in the conductors are not normally balanced, the construction shall be such as to withstand the total combined load without exceeding the working stresses for transverse strength.

Where the section of higher grade is not in line with the line beyond this section, suitable guys shall be placed to withstand the resulting transverse forces.

B. **Foundations.**

1. USE OF FOUNDATIONS.

(*a*) WOOD AND REINFORCED-CONCRETE POLES. No special foundation construction is generally required.

(*b*) STEEL POLES OR TOWERS. Steel poles or towers should preferably be placed on concrete or other suitable foundations extending above the ground line. If, however, the steel is set in earth, it shall be suitably protected against injurious corrosion at and below the ground line.

2. STRENGTH OF FOUNDATIONS.

(*a*) STEEL SUPPORTS. The foundations shall be so designed and constructed as to withstand the stresses due to the loads assumed in rule 254. The calculated stresses in any steel parts shall not exceed the stresses specified in rule 261, A, 3, (*d*).

261. GRADES A, B, AND C CONSTRUCTION—Continued.

B. Foundations—Continued.

2. STRENGTH OF FOUNDATIONS—continued.

Since in many localities the soil and climatic conditions are such as to alter the strength of foundations considerably from time to time, there should usually be provided a considerable margin of strength in foundations above that which (by calculation) will just withstand the loads under the assumption of average conditions of climate and soil.

(*b*) WOOD AND CONCRETE POLES. Foundations for poles shall be of such material and dimensions as to withstand the loads assumed in rule 254, A, B, and C without exceeding the following percentages of their ultimate strength.

	Percentages of ultimate strength for different grades		
	Grade A	Grade B	Grade C
For transverse loads (when stalled)	50	50	75
For longitudinal loads (at all times) in general	100	100	--------
At dead ends	50	50	75

C. Guys.

1. GENERAL.

The general requirements for guys are covered under "Miscellaneous requirements for overhead construction" (sec. 28).

261. GRADES A, B, AND C CONSTRUCTION—Continued.

C. **Guys**—Continued.

2. FOR LINES IN EXPOSED LOCATIONS.

Grades A and B. In exposed situations, such as open country in rural districts, the transverse strength of wood or reinforced-concrete crossing poles in sections of higher grade in lines of a lower grade of construction shall, where practicable, be obtained by the use of side guys in the following situations:

Where more than ten wires are carried, for all span lengths.

Where more than six wires are carried if the span length exceeds 150 feet.

Grade C. The above provisions do not apply to grade C.

3. ON STEEL STRUCTURES.

The use of guys to obtain compliance with these requirements is regarded as generally undesirable. When guys are necessarily used, the steel supports or towers, unless capable of considerable deflection, shall be regarded as taking all of the load up to their allowable working load, and the guys shall have sufficient strength to take the remainder of the assumed maximum load. (See rule 261, A, 6, (*b*) for flexible supports.)

4. ON WOOD OR CONCRETE POLES.

When guys are used to meet the strength requirements for wood or concrete poles, they shall be considered as taking the entire load in the direction in which they act, the poles acting as struts only.

261. Grades A, B, and C Construction—Continued.

C. Guys—Continued.

5. STRENGTH OF GUYS.

Guys, when used, shall be of such material and dimensions as will withstand the transverse load assumed in rule 254, B and the longitudinal load assumed in rule 254, C without exceeding the following percentages of their ultimate strength:

	Percentages of ultimate strength for different grades		
	Grade A	Grade B	Grade C
For transverse strength (when installed)	50	50	75
For longitudinal strength (at all times) in general	100	100	--------
At dead-ends	50	50	75

D. Cross Arms.

1. VERTICAL STRENGTH.

Cross arms shall, when installed, withstand the vertical loads specified in rule 254, A without the stress under these loads exceeding 50 per cent of the assumed ultimate stress of the material.

Exception.—For built-up steel cross arms on steel structures, see rule 261, A, 3, (*d*) for allowable working stresses in steel.

261. GRADES A, B, AND C CONSTRUCTION—Continued.

D. Cross Arms—Continued.

2. BRACING.

Cross arms shall be securely supported by bracing, if necessary, so as to support safely all other loads to which they may be subjected in use, including linemen working on them. Any cross arm or buck arm except the top one shall be capable of supporting a vertical load of 225 pounds at either extremity in addition to the weight of the conductors.

3. LONGITUDINAL STRENGTH.

(*a*) GENERAL. Cross arms shall withstand any unbalanced longitudinal loads to which they are exposed, with a limit of unbalanced tension where conductor pulls are normally balanced, of 700 pounds at the outer pin.

(*b*) AT ENDS OF HIGHER-GRADE CONSTRUCTION IN LINE OF LOWER GRADE.

Grades A and B. Wood cross arms shall be of sufficient strength to withstand at all times, without exceeding their ultimate strengths, an unbalanced pull in the direction of the higher-grade section equal to the tension in all supported conductors under assumed maximum loading as given in rule 254, C, 1. Steel arms shall withstand this load without exceeding the working stresses for longitudinal loads given in rule 261, A, 3, (*d*).

Grade C. The above provisions do not apply to Grade C.

261. Grades A, B, and C Construction—Continued.

D. Cross Arms—Continued.

3. LONGITUDINAL STRENGTH—continued.

(*c*) At Ends of Transversely Weak Sections.

Grades A and B. The cross arms connected to the structure at each end of the transversely weak section, such as described in rule 261, A, 5, shall be such as to withstand at all times without exceeding their ultimate strengths, under the conditions of loading prescribed in rule 254, C, 1, an unbalanced load equivalent to the combined pull in the direction of the transversely weak section of all the conductors supported.

Grade C. The above provision does not apply to grade C.

(*d*) Methods of Meeting Rules 261, D, 3, (*b*) and (*c*).

Grades A and B. Where conductor tensions are limited to a maximum of 2,000 pounds per conductor, double wood cross arms fitted with spacing bolts equipped with spacing nuts and washers, pipe spacers, or similar construction, or with spacing blocks or plates, will be considered as meeting the strength requirements in (*b*) and (*c*) preceding.

Grade C. The above provisions do not apply to grade C.

261. Grades A, B, and C Construction—Continued.

D. Cross Arms—Continued.

4. DIMENSIONS OF CROSS ARMS OF SELECTED YELLOW PINE OR FIR.

The cross-sectional dimensions of selected yellow pine or fir cross arms shall be not less than the values of Table 22.

Table 22.—Cross-arm Cross Sections

Number of pins	Grades A and B	Grade C	
		Supply	Communication
	Inches	*Inches*	*Inches*
2 or 4	3 by 4	2¾ by 3¾	
6 or 8	3¼ by 4¼	3 by 4	
6			2¾ by 3¾
10			3 by 4

5. DOUBLE CROSS ARMS AT ANGLES OR DEAD ENDS.

Grades A and B. Where conductors are supported on pin insulators, double cross arms shall be used at unbalanced corners and dead ends in order to permit conductor fastenings at two insulators and so prevent slipping.

Grade C. The above provision does not apply to grade C.

6. LOCATION.

In general, cross arms should be maintained at right angles to the axis of the pole and to the direction of the attached conductors. At crossings, cross arms should be attached to that face of the structure away from the crossing, unless special bracing or double cross arms are used.

261. GRADES A, B, AND C CONSTRUCTION—Continued.

E. Pins and Conductor Fastenings.

1. LONGITUDINAL STRENGTH.

(*a*) GENERAL. Pins and ties or other conductor fastenings shall have sufficient strentgh to withstand an unbalanced tension in the conductor, up to a limit of 700 pounds per pin or fastening.

(*b*) AT ENDS OF HIGHER-GRADE CONSTRUCTION IN LINE OF LOWER GRADE.

Grades A and B. Pins and ties or other conductor fastenings connected to the structure at each end of the higher-grade section shall be of sufficient strength to withstand at all times without exceeding their ultimate strength, an unbalanced pull in the direction of the higher-grade section due to the loading specified in rule 254, C, 1.

Grade C. The above provisions do not apply to grade C.

(*c*) AT ENDS OF TRANSVERSELY WEAK SECTIONS.
Grades A and B. Pins and ties or other conductor fastenings connected to the structure at each end of the transversely weak section as described in rule 261, A, 5 shall be such as to withstand at all times without exceeding their ultimate strength under conditions of loading prescribed in rule 254, C, 1 the unbalanced pull in the direction of the transversely weak section of the conductor supported.
Grade C. The above provisions do not apply to grade C.

261. GRADES A, B, AND C CONSTRUCTION—Continued.

E. Pins and Conductor Fastenings—Continued.

1. LONGITUDINAL STRENGTH—continued.

(*d*) METHOD OF MEETING RULES 261, E, 1, (*b*), AND (*c*).

Grades A and B. Where conductor tensions are limited to 2,000 pounds and such conductors are supported on pin insulators, double pins, and ties or equivalent fastenings will be considered to meet the requirements (*b*) and (*c*) preceding.

Grade C. The above provision does not apply to grade C.

2. SHARP EDGES ON FASTENINGS.

Tie wires or fastenings shall have no sharp edges or burrs at contacts with the conductors.

3. HEIGHT OF PIN.

The height of the pin and the conductor fastenings and the material and cross section of the pin should be chosen so as to afford the required strength.

Note.—The method of attaching conductors by suitable ties to single pin-type insulators mounted on 1½ by 9 inch wood pins of locust or equivalent wood will usually provide strength up to 1,000 pounds conductor tension with the conductor 3.5 inches above the cross arm. Steel pins may afford greater strength both for the pins and for the cross arms.

261. GRADES A, B, AND C CONSTRUCTION—Continued.

F. Open Supply Conductors.

1. MATERIAL.

Conductors shall be of copper, aluminum (with or without steel reinforcement), copper-covered steel, or other material which will not corrode excessively under the prevailing conditions.

Recommendation.—It is recommended that medium-hard-drawn copper wire (conforming to the specifications of the American Society for Testing Materials) be used instead of soft in new construction, especially for sizes smaller than No. 2.

Note.—Soft copper wire has a yield point less than one-half that of medium-drawn copper, and hence stretches permanently with a correspondingly lighter loading of ice and wind.

Copper wire does not have so sharply defined a yield point as steel, but for practical purposes, the yield point may be considered as that point beyond which the wire is permanently elongated and the sag permanently increased.

If the wire when first strung is pulled to a tension approximately equal to half its breaking strength and then released and tied, its yield point is thereby raised and it will be less likely to stretch and its sag to increase materially under moderate loading of ice and wind.

2. MINIMUM SIZES OF SUPPLY CONDUCTORS.

Supply conductors shall be not smaller than indicated in Table 23.

Exception 1.—Longer spans than specified in the table may be used with any listed conductor size if the separations and clearances of section 23 and the sags of Appendix B are correspondingly increased.

261. Grades A, B, and C Construction—Continued.

F. Open Supply Conductors—Continued.

Exception 2.—Supply service leads of 0 to 750 volts may have the sizes set forth in rule 263, E.

Exception 3.—Where the short-span method of construction is employed in accordance with rule 261, K, the conductor sizes and sags herein specified are not required.

Table 23.—Minimum Allowable Conductor Sizes

[Sizes are A. W. G. for copper, copper-covered steel, and aluminum; Stl. W. G. for steel]

Kind of wire	Loading district	Grade of construction	Wire sizes for span lengths up to and including the following limits (in feet)								
			150	175	200	250	300	400	500	700	1,000
Covered wires: Copper, medium or hard-drawn. Copper-covered steel.	Heavy	A and B	6	4	4	----	2	----	----	----	----
		C	8	6	4	----	2	----	----	----	----
	Medium	A	6	4	4	----	2	----	----	----	----
		B	8	6	4	----	2	----	----	----	----
		C	8	6	4	----	2	----	----	----	----
	Light	A	6	6	4	----	2	----	----	----	----
		B	8	6	6	----	2	----	----	----	----
		C	8	8	6	----	2	----	----	----	----
Bare wires: Copper, medium or hard-drawn. Copper-covered steel.	Heavy	A and B	6	4	4	----	4	2	2	----	----
		C	8	6	4	----	4	2	2	----	----
	Medium	A	6	6	4	----	4	4	2	2	00
		B	8	6	4	----	4	4	2	2	00
		C	8	6	4	----	4	4	2	2	00
	Light	A	6	6	6	----	4	4	4	2	1
		B	8	6	6	----	4	4	4	2	1
		C	8	8	6	----	4	4	4	2	1
Covered or bare wires: Copper, soft-drawn.	Heavy	A	4	2	1	----	----	----	----	----	----
		B	4	2	2	----	----	----	----	----	----
		C	6	2	2	----	----	----	----	----	----
	Medium	A and B	4	4	2	1	----	----	----	----	----
		C	6	4	2	1	----	----	----	----	----
	Light	A, B, and C	6	4	4	2	1	----	----	----	----
				Exceeding 150							
Steel wire	All	A and B	6	4							
		C	9	6							
Stranded aluminum wire: Without steel reinforcement.	All	A, B, and C	1	0							
With steel reinforcement.	All	A, B, and C	6	4							

261. GRADES A, B, AND C CONSTRUCTION—Continued.

F. Open Supply Conductors—Continued.

3. LIGHTNING PROTECTION WIRES.

Lightning protection wires paralleling the line conductors shall be regarded in respect to size, material, separation, and stringing requirements as supply conductors with which they are associated.

4. SAGS AND TENSIONS.

(*a*) MINIMUM ALLOWABLE SAG. Conductor sags shall be such that, under the assumed loading of rule 253 for the district concerned, the tension in the conductor shall not be more than 50 per cent of its breaking strength for grades A and B, nor more than 60 per cent for grade C.

Note.—The sag tables of Appendix B are based upon a stringing temperature of 30, 60, or 90° F. to comply with these requirements.

Recommendation.—It is recommended that conductors of hard, medium, and soft-drawn copper have normal sags, at 60° F. and no wind, as near as practicable to those given in the tables of Appendix A.

Note.—The sags given for copper in the tables are based upon experience and are designed to give the best results from the standpoint of safety and continuity of service.

In order to minimize the danger from wires swinging together and to permit the moderate pin spacings and cross-arm spacings sanctioned by modern good practice in overhead line construction, it is necessary to assign a limit to the sag, and hence to the recommended length of span of the smaller sized wires, as indicated by the blank spaces in the tables,

261. GRADES A, B, AND C CONSTRUCTION—Continued.

F. Open Supply Conductors—Continued.

4. SAGS AND TENSIONS—continued.

(*b*) TWO-THOUSAND-POUND LIMITATION FOR CONDUCTOR TENSIONS. In order to apply the methods given in rule 261, D, 3, (*d*) and rule 261, E, 1, (*d*) it is necessary that conductor tensions be limited to 2,000 pounds. The curves given in Appendix C show sags based on these limitations for conductors having an ultimate strength of 4,000 pounds or more.

5. SPLICES AND TAPS.

Grades A and B. Splices shall not be made in the crossing span and preferably not in the adjacent spans, which are depended upon for withstanding the longitudinal tension of the crossing conductors. Taps shall not be made in the crossing span. If a splice or tap is made in any conductor in the span next to the crossover span, it shall, where practicable, be placed at a point nearer to the crossover support than is the nearest conductor crossed over.

Exception.—In the case of large-gauge conductors where the application of this rule would work a hardship and where proper methods are available for making high-strength splices, such splices may be used in the crossing span provided they are of a type which has been shown by tests and experience to be at least as strong as the conductor.

Grade C. The above does not apply to grade C.

6. TROLLEY CONTACT CONDUCTORS.

In order to provide for wear, no trolley contact conductor shall be installed of less size than No. 0, if of copper, or No. 4, if of silicon bronze.

261. GRADES A, B, AND C CONSTRUCTION—Continued.

G. Supply Cables.

1. SPECIALLY INSTALLED SUPPLY CABLES.

Cables having permanently grounded continuous metal sheath or armor, where located on joint poles, or where located on other poles and having a grade of construction less than that required for open wire supply lines of the same voltage, shall meet the requirements of (*a*), (*b*), (*c*), and (*d*) below.

(*a*) MESSENGERS. Messengers shall be stranded and of galvanized or copper-covered steel with strengths and sags as specified in rule 262, J for grade D, or if of other sizes shall not be stressed beyond half their ultimate strength under the loadings specified in rule 253.

(*b*) GROUNDING OF CABLE SHEATH AND MESSENGER. Each section of cable between splices shall be suitably and permanently bonded to the messenger wire at not less than two places. The messenger wire shall be grounded at the ends of the line and at intermediate points not exceeding 800 feet apart. (See section 9 for method.)

(*c*) CABLE SPLICES. Splices in the cable shall be made so that their insulation is not materially weaker than the remainder of the cable. The sheath or armor at the splice shall be made electrically continuous.

261. Grades A, B, and C Construction—Continued.

G. **Supply Cables**—Continued.

1. SPECIALLY INSTALLED SUPPLY CABLES—continued.

(*d*) Cable Insulation. The conductors of the cable shall be insulated so as to withstand a factory potential test of at least twice the operating voltage at operating frequency applied continuously for five minutes between conductors and between any conductor and the sheath or armor.

2. OTHER SUPPLY CABLES.

The following requirements apply to all supply cables not included in 1 above.

(*a*) Messenger. The messenger shall have such strength and sag that it will not be stressed beyond the following percentages of its ultimate strength under the loadings specified in rule 253:

Grade of construction:	Percentage of ultimate strength
A and B	50
C	60

(*b*) Cable. There are no strength requirements for cables supported by messengers.

H. **Open Communication Conductors.**

Open-wire communication conductors in grade A, B, or C construction shall have the sizes and sags given in rule 261, F, 2 and 4 for supply conductors of the same grade.

Exception.—Where the span length is 150 feet or less, conductors may have grade D sizes and sags instead of grade C sizes and sags except as provided in Note [g] to Table 15, rule 242.

261. GRADES A, B, AND C CONSTRUCTION—Continued.

I. Communication Cables.

1. METAL-SHEATHED COMMUNICATION CABLES.

There are no strength requirements for such cables supported by messengers.

2. MESSENGER.

The messenger shall have such strength and sag that it will not be stressed beyond the following percentages of its ultimate strength under the loading specified in rule 253:

Grade of construction:	Percentage of ultimate strength
A and B	50
C	60

J. Paired Communication Conductors.

1. PAIRED CONDUCTORS SUPPORTED ON MESSENGER.

(*a*) USE OF MESSENGER. A messenger may be used for supporting paired conductors in any location, but is only required for paired conductors crossing over trolley contact conductors of more than 7,500 volts.

(*b*) SAG OF MESSENGER. Messenger used for supporting paired conductors required to meet grade A or B construction because of crossing over trolley contact conductors shall meet the sag requirements for grade D messengers.

(*c*) SIZE AND SAG OF CONDUCTORS. There are no requirements for paired conductors when supported on messenger.

261. Grades A, B, and C Construction—Continued.

J. Paired Communication Conductors—Continued.

2. PAIRED CONDUCTORS NOT SUPPORTED ON MESSENGER.

(a) Above Supply Lines.

Grades A and B. Sizes and sags shall not be less than those required by rule 261, F, 2 and 4 for supply conductors of similar grade.

Grade C.

Spans 0 to 100 feet. No sag requirements. Sizes shall be not less than the following:

Hard-drawn copper	No. 14 AWG.
Bronze	No. 17 AWG.
Copper-covered steel	No. 17 AWG.

Spans 100 to 150 feet. Sizes and sags shall be not less than required for grade D communication conductors.

Spans exceeding 150 feet. Sizes and sags shall be not less than required for Grade C supply conductors.

(b) Above Trolley Contact Conductors.

Grades A and B. Sizes and sags shall not be less than the following:

Spans 0 to 100 feet. No size requirements. Sags shall be not less than for No. 8 A. W. G. hard-drawn copper as given in Appendix B.

Spans exceeding 100 feet. Sizes shall be not less than the following:

Hard-drawn copper	No. 14 AWG.
Bronze	No. 17 AWG.
Copper-covered steel	No. 17 AWG.

261. GRADES A, B, AND C CONSTRUCTION—Continued.

J. Paired Communication Conductors—Continued.

Sags shall be not less than for No. 8 A. W. G. hard-drawn copper as given in Appendix B.

Grade C. Sizes and sags shall be as follows:

Spans 0 to 100 feet. No requirements.

Spans exceeding 100 feet. No sag requirements. Size shall be not less than the following:

Hard-drawn copper	No. 14 AWG.
Bronze	No. 17 AWG.
Copper-covered steel	No. 17 AWG.

K. Short-Span Crossing Construction.

Where supply lines cross over railways or communication lines by the short-span method, the requirements for grade A, B, or C conductor sags and sizes are waived, in so far as such grades are required by the crossing, provided that a permanently grounded guard arm is installed at each crossover support in such a manner as to prevent conductors which break in either adjoining span from swinging back into the conductors crossed over, or in the case of a railroad crossing into the space between the crossing supports.

Explanation.—The short-span method of crossing requires the crossover span to be of such a height that a conductor breaking in that span can not come within 15 feet of the ground or rails at a railroad crossing or make contact with any wires crossed over at a wire crossing.

This character of construction is facilitated where the crossover supports can be placed quite near together and in the case of wire crossings where the span crossed over is at a minimum elevation above ground.

261. GRADES A, B, AND C CONSTRUCTION—Continued.

L. Cradles at Supply-Line Crossings.

Cradles should not be used.

Note.—It is less expensive and better to build the supply line strong enough to withstand extreme conditions than to build a cradle of sufficient strength to catch and hold the supply line if it falls.

M. Protective Covering or Treatment for Metal Work.

All hardware, including bolts, washers, guys, anchor rods, and similar parts of material subject to injurious corrosion under the prevailing conditions, shall be protected by galvanizing, painting, or other treatment which will effectively retard corrosion.

262. GRADES D AND E CONSTRUCTION.

A. Poles.

1. STRENGTH OF UNGUYED POLES.

Unguyed poles, at the time of installation, shall withstand the vertical and transverse loads specified in rule 254, A and B and the longitudinal loads specified in rule 254, C without exceeding the following percentages of their ultimate strength.

	Percentages of ultimate strength for different grades	
	Grade D	Grade E
For transverse strength	25	37. 5
For longitudinal strength (for poles carrying not more than two wires)	50	75

262. GRADES D AND E CONSTRUCTION—Continued.

A. **Poles**—Continued.

2. STRENGTH OF GUYED POLES.

Where poles are guyed, the poles shall be considered as acting as struts, resisting the vertical component of the tension in the guy calculated as in rule 262, C combined with the vertical load.

3. STRENGTH REQUIREMENTS FOR POLES WHERE GUYING IS REQUIRED, BUT CAN ONLY BE INSTALLED AT A DISTANCE.

Where on account of physical conditions it is impracticable to guy or brace the crossing poles as specified in rule 262, C the requirements there given may be met by head-guying and side-guying the line as near as practicable to the crossing, but at a distance not exceeding 500 feet from the nearest crossing pole, provided that the line is approximately straight and that a stranded steel wire of strength equivalent to that of the head guy is run between the two guyed poles, being attached to the guyed poles at the point at which the head guys are attached, this wire being securely attached to every pole between the guyed poles.

4. POLE LOCATIONS AT CROSSINGS.

Where communication lines cross over railroads, the poles shall be located as follows:

(*a*) The poles supporting the crossing span and the adjacent spans should be located in a straight line, if practicable. Where the poles supporting the crossing span and the adjacent spans are not in line, additional guying shall be placed to take care of the unbalanced load.

262. GRADES D AND E CONSTRUCTION—Continued.

A. **Poles**—Continued.

4. POLE LOCATIONS AT CROSSINGS—continued.

(*b*) The crossing span shall be as short as practicable, and, in general, shall not be longer than the normal span of the line. No crossing span shall exceed 125 feet in length if this can be avoided.

5. FREEDOM FROM DEFECTS.

Wood poles supporting the crossing span shall be selected timber, sound and reasonably straight.

6. MINIMUM POLE SIZES.

Poles shall have top diameters not smaller than the values given in Table 24 below.

Table 24.—Minimum pole sizes for grades D and E

Number of wires carried by pole	Diameter of top of pole	
	Grade D	Grade E
	Inches	*Inches*
1 to 20	6	6
21 to 40	7	6
More than 40	8	7

7. SPLICED POLES.

Spliced poles shall not be used at grade D or E crossings or conflicts.

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262. Grades D and E Construction—Continued.

A. **Poles**—Continued.

8. POLES LOCATED AT CROSSINGS OVER SPUR TRACKS.

Where a communication line paralleling a railroad track on the right of way of the railroad crosses a spur or stub track without any change in the general direction of line, the transverse strength requirements for grade E construction may be met without the use of side guys, providing the pole is not stressed beyond one-half its ultimate strength. No requirements for longitudinal strength are made if the conductor tensions are balanced. Where conductor tensions are not balanced, due to a small angle in the line at one or both poles, or to dead-ending any of the wires, either guys or braces shall be installed capable of withstanding such unbalanced tensions.

9. HEIGHT OF POLES ADJACENT TO CROSSING POLES.

The height of poles adjacent to crossing poles shall be such that the vertical distance from the top cross arm of the crossing pole to a straight line connecting the top cross arms of the next adjacent poles on either side of this crossing pole shall not exceed the values given below:

Average Length of Span:	Allowable vertical distance *Feet*
Less than 100 feet	4
100 to 130 feet	5
Exceeding 130 feet	6

262. GRADES D AND E CONSTRUCTION—Continued.

B. Pole Settings.

Poles shall be set to such a depth and in such a manner and back filling shall be so thoroughly tamped that the applied load will break the pole before the butt is pulled loose from its setting.

Recommendation.—A table of recommended depths of setting is given in Appendix F.

C. Guys.

1. GENERAL.

The general requirements for guys are covered under "Miscellaneous requirements for overhead construction" (sec. 28).

2. WHERE USED.

Side guys or braces shall be used on poles supporting the crossing span to withstand the loads put upon them in accordance with the conditions specified in rule 254, B.

Head guys shall be installed in accordance with Table 25.

Exception 1.—Side guys are not required where the crossing poles have the transverse strength specified in rule 262 A, 1. Head guys are not required where the crossing poles carry not more than two wires and have the strength specified in rule 262 A, 1.

Exception 2.—This rule does not apply to crossing poles under the special conditions set forth in rule 262 A, 3, above.

Exception 3.—Where an overhead crossing which makes an angle with the tracks of less than 45° involves at either crossing pole an angle in the pole line, the side guy within the angle may be omitted.

Exception 4.—Guying may be omitted where communication lines cross over spur or stub tracks as provided in rule 262 A, 8.

262. GRADES D AND E CONSTRUCTION—Continued.

C. Guys—Continued.

3. GUYS USED FOR TRANSVERSE STRENGTH.

Guys shall be considered as taking the entire load in the direction in which they act, without exceeding the following percentages of the ultimate strength of the material.

	Per cent
Grade D	50
Grade E	75

4. GUYS USED FOR LONGITUDINAL STRENGTH.

(*a*) DIRECTION OF HEAD GUYS. Poles supporting the crossing span shall be head-guyed away from the crossing.

(*b*) SIZE AND NUMBER OF HEAD GUYS. Guys for various wire loads shall be supplied as per Table 25.

Exception.—This rule does not prevent the omission of head guys where the crossing poles have the strength specified in rule 262, A, 1 above and carry not more than two wires.

Table 25.—Strength (in Pounds) of Head Guys Required for Loading Districts Indicated

[Combinations of standard-size guys may be used]

Number of wires	Ratio of guy lead to height not less than—				
	1¼	1	¾	⅔	½
GRADE D, HEAVY LOADING					
2	4,000	4,000	4,000	4,000	4,000
6	4,000	4,000	4,000	4,000	6,000
10	6,000	6,000	6,000	10,000	10,000
20	10,000	10,000	12,000	16,000	16,000
30	16,000	16,000	20,000	20,000	26,000
40	20,000	20,000	26,000	26,000	32,000
50	20,000	20,000	30,000	32,000	42,000
60	26,000	30,000	36,000	36,000	48,000
70	30,000	30,000	40,000	48,000	60,000
80	36,000	40,000	48,000	60,000	70,000

Table 25.—Strength (in Pounds) of Head Guys Required for Loading Districts Indicated—Continued

[Combinations of standard-size guys may be used]

Number of wires	Radio of guy lead to height not less than—				
	1¼	1	¾	⅝	½
GRADE D, MEDIUM LOADING, AND GRADE E, HEAVY LOADING					
2	4,000	4,000	4,000	4,000	4,000
6	4,000	4,000	4,000	4,000	4,000
10	4,000	4,000	6,000	6,000	6,000
20	6,000	10,000	10,000	10,000	12,000
30	10,000	10,000	12,000	16,000	16,000
40	12,000	16,000	16,000	16,000	20,000
50	16,000	16,000	20,000	20,000	26,000
60	20,000	20,000	26,000	26,000	30,000
70	20,000	20,000	26,000	30,000	36,000
80	26,000	26,000	30,000	32,000	40,000
GRADE D, LIGHT LOADING, AND GRADE E, MEDIUM LOADING					
2	4,000	4,000	4,000	4,000	4,000
6	4,000	4,000	4,000	4,000	4,000
10	4,000	4,000	4,000	4,000	4,000
20	4,000	6,000	6,000	6,000	10,000
30	6,000	10,000	10,000	10,000	12,000
40	10,000	10,000	10,000	12,000	16,000
50	10,000	10,000	16,000	16,000	20,000
60	12,000	16,000	16,000	16,000	20,000
70	16,000	16,000	20,000	20,000	26,000
80	16,000	20,000	20,000	26,000	30,000
GRADE E, LIGHT LOADING					
2	4,000	4,000	4,000	4,000	4,000
6	4,000	4,000	4,000	4,000	4,000
10	4,000	4,000	4,000	4,000	4,000
20	4,000	4,000	4,000	4,000	6,000
30	6,000	6,000	6,000	6,000	10,000
40	6,000	6,000	10,000	10,000	10,000
50	6,000	6,000	10,000	10,000	12,000
60	10,000	10,000	10,000	12,000	16,000
70	10,000	10,000	12,000	16,000	16,000
80	10,000	12,000	16,000	16,000	20,000

See note on page 126.

262. GRADES D AND E CONSTRUCTION—Continued.

C. **Guys**—Continued.

4. GUYS USED FOR LONGITUDINAL STRENGTH—continued.

Note to Table 25.—This table is based on ultimate or breaking strength of guys equal to seven-sixths of the nominal strengths shown in the table and a wire load of 50 per cent No. 8 B. W. G. iron and 50 per cent No. 9 A. W. G. copper with an average pull of 408.75 pounds per wire.

No guy will be required for cable, since the suspension strand serves as a head guy.

5. LOCATION OF GUY ANCHORS.

Guy anchors shall, where possible, be located so that the horizontal distance from the ground line of the pole to the guy or guy rod will be not less than the height above ground of the attachment of the guy to the poles for head guys, and not less than one-third that height for side guys.

6. ATTACHMENT OF GUYS TO POLES.

The guys shall be attached as near to the center of the load as practicable.

7. MAINTENANCE.

The guys and anchors shall be maintained so that the guys are kept taut.

D. **Cross Arms.**

1. MATERIAL.

Wood cross arms supporting the crossing span shall be of yellow pine, fir, or other suitable timber

262. Grades D and E Construction—Continued.

D. Cross Arms—Continued.

2. MINIMUM SIZE.

(*a*) Wood Cross Arms. Wood cross arms shall have a cross section not less than the following:

Length of arm:	Cross section (inches)
6 feet or less	$2\frac{3}{4}$ by $3\frac{3}{4}$
More than 6 feet	3 by 4

Exception.—In rural districts in arid regions where the practice has been established of using $2\frac{3}{4}$ by $3\frac{3}{4}$ inch arms in 8 and 10 pin lengths, this practice may be continued where conductors are not larger than No. 10.

(*b*) Steel or Iron Cross Arms. Galvanized or painted iron or steel cross arms of strength equal to wood cross arms may be used.

3. DOUBLE CROSS ARMS.

Cross arms and insulators shall be double on the crossing poles. The cross arms shall be held together with properly fitted spacing blocks or bolts placed immediately adjoining the outside pins. Double cross arms shall not support more than 10 conductors.

E. Brackets and Racks.

Brackets or racks may be used only if used in duplicate or otherwise designed so as to afford two points of support for each conductor.

Exception.—For supporting paired conductors, a single metal bracket, designed to safely withstand the full dead-end pull of the wires, may be used.

262. GRADES D AND E CONSTRUCTION—Continued.

F. Pins.

1. MATERIAL.

Insulator pins shall be of steel, wrought iron, malleable cast iron, or locust or equivalent wood.

2. STRENGTH.

Insulator pins shall have sufficient strength to withstand the loads to which they may be subjected.

3. SIZE.

(*a*) WOOD PINS. Wood pins shall be sound and straight-grained with a diameter of shank not less than 1¼ inches.

(*b*) METAL PINS. Steel or iron pins shall have diameter of shank not less than one-half inch.

G. Insulators.

Each insulator shall be of such pattern, design, and material that when mounted it will withstand without injury and without being pulled off the pin, the ultimate strength of the conductor attached to the insulator.

H. Attachment of Conductor to Insulator.

The conductors shall be securely tied to each supporting insulator.

I. Conductors.

1. MATERIAL.

Conductors shall be of hard-drawn copper, copper-covered steel, galvanized steel, or other hard-drawn corrosion-resisting metal, provided, however, that galvanized steel shall not be used in localities where excessive corrosion would result.

262. Grades D and E Construction—Continued.

I. Conductors—Continued.

2. SIZE.

Conductors of the crossing span, if of hard-drawn copper or galvanized steel, shall have sizes not less than specified in (*a*) and (*b*) below. Conductors of material other than the above shall be of such size and so erected as to have a mechanical strength not less than that of the sizes of copper conductors given in (*a*) and (*b*) below.

(*a*) Spans not Exceeding 150 Feet. The sizes in Table 26 apply.

Table 26.—Grades D and E Minimum Wire Sizes

[A. W. G. for copper; Stl. W. G. for steel]

Conductor	Loading district	Spans of 125 feet or less		Spans 125 feet to 150 feet	
		Grade D	Grade E	Grade D	Grade E
Copper, hard-drawn	Heavy	10	10	9	10
	Medium	10	12	9	10
	Light	10	12	9	10
Steel, galvanized: In general	All	10	12	8	10
In rural districts of arid regions	All	12	12	10	10

(*b*) Spans Exceeding 150 Feet. If spans in excess of 150 feet are necessary, the size of conductors specified above or the sags of the conductors shall be correspondingly increased.

262. GRADES D AND E CONSTRUCTION—Continued.

I. **Conductors**—Continued.

3. PAIRED CONDUCTORS WITHOUT MESSENGERS.

Paired wires without a supporting messenger shall be eliminated as far as practicable and where used shall meet the following requirements:

(*a*) MATERIAL. Each conauctor shall be made of bronze, hard-drawn copper, or copper-covered steel, and shall be tinned.

(*b*) SIZE. Each wire shall be not smaller than the following:

Hard-drawn copper	No. 14 A. W. G.
Bronze	No. 17 A. W. G.
Copper-covered steel	No. 17 A. W. G.

(*c*) LIMITING SPAN LENGTHS. Paired wires shall in no case be used without a supporting messenger in longer spans than the following:

	Feet
For grade D construction	100
For grade E construction	125

4. SAGS.

Conductors of the crossing span shall be strung with sags not less than shown in Table 27.

Table 27.—Minimum Stringing Sags of Bare Hard-Drawn Copper Wire or Steel Wire for Loading Districts Indicated

HEAVY LOADING

Length of span (in feet)	Sag (in inches)					
	100° F.	80° F.	60° F.	40° F.	20° F.	0° F.
75	5½	5	4	3¼	2¾	2¼
80	6½	5½	4½	3½	3	2½
90	8	7	5½	4½	3½	3
100	10	8½	7	5½	4½	4
110	12	10	8½	6½	5½	5
120	14	12	10	8	6½	6
130	17	14	12	9½	8	7
140	20	17	14	11	9½	8
150	23	20	16	13	11	9

MEDIUM LOADING

	100° F.	80° F.	60° F.	40° F.	20° F.	0° F.
75	4	3½	3	2½	2¼	1¾
80	5	4	3½	3	2½	2
90	6	5	4	3½	3	2½
100	7½	6	5	4½	3½	3
110	9	7½	6	5½	4½	3¾
120	11	9	7	6½	5½	4½
130	13	10½	8½	7½	6½	5½
140	15	12	10	8½	7½	6½
150	17	14	12	10	8½	7½

LIGHT LOADING

	120° F.	100° F.	80° F.	60° F.	40° F.	20° F.
75	4	3½	3	2½	2	1¾
80	5	4	3½	3	2½	2
90	6	5	4	3½	3	2½
100	7	6	5	4	3½	3
110	8½	7	6	5	4	3½
120	10	8½	7	6	5	4
130	12	10	8½	7	6	5
140	14	12	10	8½	7	6
150	16	14	12	10	8	7

262. GRADES D AND E CONSTRUCTION—Continued.

I. **Conductors**—Continued.

5. SPLICES AND TAPS.

Splices and taps shall not be made in the crossing span and preferably not in the adjacent spans.

6. SIMULTANEOUS CROSSING OVER RAILROAD AND SUPPLY LINE.

Where conductors cross in the same span over a railroad track and a supply line carrying from 750 volts alternating current (440 volts to neutral or ground) to 5,000 volts alternating current (2,900 volts to neutral or ground) the minimum allowable conductor sizes shall be the same as required by rule 261, F, 2 for grades A and B construction when crossing main and minor tracks, respectively.

J. **Messengers.**

1. MINIMUM SIZE.

(*a*) SPANS NOT EXCEEDING 150 FEET. Table 28 gives the minimum sizes of galvanized steel-strand messenger to be used for supporting different sizes of cables:

Table 28.—Minimum Sizes of Messenger

Size of cable in weight per foot	Messenger (nominal breaking load)
	Pounds
Less than 2.25 pounds	6, 000
2.25 to 5 pounds	10, 000
Exceeding 5 and less than 8 pounds	16, 000

262. GRADES D AND E CONSTRUCTION—Continued.

J. **Messengers**—Continued.

1. MINIMUM SIZE—continued.

(*b*) SPANS EXCEEDING 150 FEET. For spans exceeding 150 feet or for heavier cables a proportionately larger messenger or other proportionately stronger means of support shall be used.

2. SAGS AND TENSIONS.

Multiple-wire cables and their messengers shall be suspended with a normal sag at 60°F., so that when they are subjected to the loading prescribed in rule 253 the tension in the messenger will not exceed the following values of safe working tension:

Table 29.—Safe Working Tension in Messengers

Nominal breaking load of messenger (in pounds)	Safe working tension of messenger
	Pounds
6,000	3, 500
10,000	5, 900
16,000	9, 500

K. **Inspection.**

All parts of the supporting structures of the crossing span shall be examined annually by the owner and all defective parts shall be promptly restored to a safe condition.

263. GRADE N CONSTRUCTION.

A. Poles and Towers.

Poles used for lines for which neither grade A, B, C, D, or E is required shall be of such initial size and so guyed or braced, where necessary, as to withstand safely the loads to which they may be subjected, including linemen working on them.

B. Guys.

The general requirements for guys are covered under "Miscellaneous requirements for overhead construction" (sec. 28).

C. Cross-Arm Strength.

Cross arms shall be securely supported, by bracing if necessary, so as to support safely loads to which they may be subjected in use, including linemen working on them. Any cross arm, or buck arm, except the top one, shall be capable of supporting a vertical load of 225 pounds at either extremity in addition to the weight of the conductors.

Note.—Double cross arms are generally used at crossings, unbalanced corners, and dead-ends in order to permit conductor fastenings at two insulators, and so prevent slipping, although single cross arms might provide sufficient strength. To secure extra strength, double cross arms are frequently used, and cross-arm guys are sometimes used.

D. Supply-line Conductors.

1. MATERIAL.

All supply conductors shall be of copper, aluminum (with or without steel reinforcement), copper-covered steel, or other material which will not corrode excessively under the prevailing conditions.

263. GRADE N CONSTRUCTION—Continued.

D. Supply-line Conductors—Continued.

2. SIZE.

Supply-line conductors shall be not smaller than the following:

Table 30.—Grade N Minimum Gauge Sizes for Supply-Line Conductors

[A. W. G. for copper and aluminum; Stl. W. G. for steel]

	Urban	Rural
Soft copper	6	8
Medium or hard-drawn copper	8	8
Steel	9	9

Stranded aluminum	Urban and rural	
	Spans 150 feet or less	Spans exceeding 150 feet
Not reinforced	1	0
Steel-reinforced	6	4

Recommendation.—It is recommended that except as modified in Table 23, rule 261, F, 2, these minimum sizes for copper and steel be not used in spans longer than 150 feet for heavy-loading districts, and 175 feet for medium and light loading districts.

263. GRADE N CONSTRUCTION—Continued.

E. **Supply Services.**

1. MATERIAL.

All supply-service conductors shall be of copper, aluminum (with or without steel reinforcement), copper-covered steel, or other material which will not corrode excessively under the prevailing conditions.

2. SIZE OF OPEN-WIRE SERVICES.

(*a*) SEVEN HUNDRED AND FIFTY VOLTS OR LESS. Supply-service leads of 750 volts or less shall be not smaller than required by (1) or (2) below.

(1) SPANS NOT EXCEEDING 150 FEET—

Table 31.—Minimum Sizes of Service Leads Carrying 750 Volts or Less

[A. W. G. for copper; Stl. W. G. for steel]

Situation	Copper wire		Steel wire
	Soft-drawn	Medium or hard-drawn	
Alone	10	12	12
Concerned with communication conductors	10	12	12
Over supply conductors of—			
0 to 750 volts	10	12	12
750 to 7,500 volts [a]	8	10	12
Exceeding 7,500 volts [a]	6	8	9
Over trolley contact conductors—			
0 to 750 volts a. c. or d. c.	8	10	12
Exceeding 750 volts d. c.	6	8	9

[a] Installation of service leads of not more than 750 volts over supply lines of more than 750 volts should be avoided where practicable.

263. GRADE N CONSTRUCTION—Continued.

E. Supply Services—Continued.

2. SIZE OF OPEN-WIRE-SERVICES—continued.

(*a*) Open-wire services of 750 volts or less—Con.

(2) SPANS EXCEEDING 150 FEET. Sizes shall not be smaller than required for Grade C. (Rule 261, F, 2.)

(*b*) EXCEEDING 750 VOLTS. Sizes of supply-service leads of more than 750 volts shall be not less than required for supply-line conductors of the same voltage.

3. SAG, OPEN-WIRE SERVICES.

(*a*) SEVEN HUNDRED AND FIFTY VOLTS OR LESS. Supply service leads of 750 volts or less shall have sags not less than the following:

Table 32.—Sags for Open-Wire Services

Span lengths (in feet)	Sag
	Inches
100 or less	12.
100 to 125	18.
125 to 150	27.
Exceeding 150	Grade C sags. (See tables of Appendix B.)

(*b*) EXCEEDING 750 VOLTS. Supply service leads of more than 750 volts shall comply as to sags with the requirements for supply line conductors of the same voltage.

263. Grade N Construction—Continued.

E. Supply Services—Continued.

4. CABLED SERVICES.

Supply service leads may be grouped together in a cable, provided the following requirements are met.

(*a*) Size. The size of each conductor shall be not less than required for leads of separate conductors (rule 263, E, 2).

(*b*) Sag. The sag of the cable should be not less than required for leads of separate conductors (rule 263, E, 3).

(*c*) Insulation. The insulation should be sufficient to withstand twice the normal operating voltage.

F. Lightning Protection Wires.

Lightning protection wires paralleling the line conductors shall be regarded, in respect to size and material requirements, as supply conductors.

G. Trolley Contact Conductors.

In order to provide for wear, no trolley contact conductors shall be installed of less size than No. 0, if of copper, or No. 4, if of silicon bronze.

H. Cradles at Supply-Line Crossings.

Cradles should not be used.

Note.—It is less expensive and better to build the supply line strong enough to withstand extreme conditions than to build a cradle of sufficient strength to catch and hold the supply line if it falls.

I. Communication Conductors.

There are no specific requirements for grade N communication line conductors or service drops.

SEC. 27. LINE INSULATORS

270. APPLICATION OF RULE.

These requirements apply only to situations where grade A or B construction is required. They do not apply to line insulators in grades C, D, E, or N construction.

271. MATERIAL AND MARKING.

Insulators for operation on supply lines at voltages of 2,300 and above shall be of porcelain, made by the wet process or one equally suitable as regards electrical and mechanical properties, or other material which will give equally good results in respect to mechanical and electrical performance and durability. These insulators should be marked by the maker with a classification number and maker's name or trademark, the marks being applied so as not to reduce the electrical or mechanical strength of the insulator.

272. ELECTRICAL STRENGTH OF INSULATORS IN STRAIN POSITION.

Where insulators are used in strain position they shall have not less electrical strength than the insulators generally used on the line when under the normal mechanical stresses imposed by the loadings specified in section 25.

273. RATIO OF FLASH OVER TO PUNCTURE VOLTAGE.

Insulators shall be designed so that their dry flash-over voltage is not more than 75 per cent of their puncture voltage at a frequency of 60 cycles per second.

274. Test Voltages.

Insulators when tested under American Institute of Electrical Engineers' specifications shall flash over at values not less than given in Table 33.

Table 33.—Test Voltage Requirements

[Based on Line Conditions of Rule 276, B, 1]

Nominal line voltage	Minimum test dry flash-over voltage of insulators
750	5, 000
2,300	20, 000
4,000	30, 000
6,600	40, 000
11,000	50, 000
22,000	75, 000
33,000	100, 000
44,000	125, 000
55,000	150, 000
66,000	175, 000
88,000	220, 000
110,000	315, 000
132,000	390, 000
150,000	420, 000
200,000	560, 000
(Interpolate for intermediate values)	

275. FACTORY TESTS.
Each insulator or part thereof for use on lines operating at voltages in excess of 15,000 volts shall be subjected to a routine flash-over dry test at the factory for a period of three minutes at a frequency of 60 cycles per second or to any other test sanctioned by good modern practice, such as high-frequency tests.

276. SELECTION OF INSULATORS.

A. Insulation of Constant-Current Circuits.
The insulation for constant-current circuits shall be determined on the basis of their nominal full-load voltage.

B. Insulators for Nominal Line Voltages.
In selecting insulators of the test voltage to be used for any nominal line voltage, consideration shall be given to the conditions under which the line will operate and to the presence of crossings as follows:

1. Where the system is of moderate extent with grounded neutral in open country subject to intermittent rains and moderate lightning and uses wood poles with suspension or pin-type insulators, insulators of the flash-over voltage required in Table 33 for the contemplated line voltage shall be used.
2. Where operating conditions are more severe than set forth in 1 above, due to steel construction, extent of system, use of ungrounded neutral, prevalence of exceptionally severe lightning, bad atmosphere due to chemical fumes, smoke, cement, dust, salt fog, or other foreign matter, or to a long dry season with heavy dust accumulation followed by moisture, larger insulators than the minimum specified in Table 33 should be used. The amount of increase is to be determined by local experience.

276. SELECTION OF INSULATORS—Continued.

B. Insulators for Nominal Line Voltages—Continued.

3. At crossings over steam railroads or over communication lines other than minor communication lines where grounded construction or ungrounded metallic pin or cross-arm construction is used, but where the line elsewhere is of wood-pin construction the insulator shall have a dry flash-over test voltage of not less than 25 per cent greater than given in Table 33.

Exception.—The 25 per cent increase does not apply if all the insulators in the line are of the suspension type or if construction in accordance with rule 278 below is employed.

277. PROTECTION AGAINST ARCING.

In installing the insulators and conductors, such precautions as are sanctioned by good modern practice shall be taken to prevent, as far as possible, any arc from forming or to prevent any arc which might be formed from injuring or burning any parts of the supporting structures, insulators or conductors which might render the conductors liable to fall.

278. COMPLIANCE WITH RULE 277 AT CROSSINGS.

At crossings, construction in accordance with the following methods will be considered as a means of meeting the requirements of rule 277 above.

A. Pin-Type Insulators.

1. DOUBLE CONSTRUCTION.

Double cross arms, pins, insulators, and conductor fastenings on the crossing supports.

278. COMPLIANCE WITH RULE 277 AT CROSSINGS—Continued.

A. **Pin-Type Insulators**—Continued.

2. INSULATION AT CROSSING SUPPORTS.

(*a*) Insulators which meet the minimum values as given in Table 33 and have a rating not less than those in the remainder of the line, under the following conditions:

(1) Wood pins, ungrounded at the crossing supports, with wood or metal pins grounded or ungrounded throughout the line.

(*b*) Insulators which have a rating of 25 per cent greater than the requirements of Table 33, but not less than the insulators in the remainder of the line, under the following conditions:

(1) Wood pins, grounded at the crossing supports and throughout the line.

(2) Metal pins, grounded or ungrounded at crossing supports and throughout the line.

(*c*) Insulators at the crossing support which have a rating 50 per cent greater than those in the rest of the line, but not less than 25 per cent greater than required by Table 33 under the following conditions:

(1) Wood pins, grounded at crossing support and pins ungrounded throughout the remainder of the line.

(2) Metal pins, grounded at the crossing support and pins ungrounded throughout the remainder of the line.

(3) Metal pins, ungrounded at the crossing support with wood pins ungrounded throughout the remainder of the line.

278. Compliance with Rule 277 at Crossings—Continued.

B. Suspension Insulators.

1. DOUBLE CROSS ARMS.

Double cross arms on crossing supports.

Exception.—This does not apply to latticed or trussed steel cross arms nor to steel cross arms used with a single string of insulators as per 2 (*b*) following.

2. NUMBER OF INSULATOR STRINGS.

(*a*) Double Insulator Strings. Double strings of the insulators used on the crossing supports except under the special conditions covered in (*b*) following.

(*b*) Single Insulator Strings. Where preferred single strings of insulators may be used if all the following conditions obtain.

(1) Steel cross arms on steel poles or structures.

(2) Hardware throughout providing a factor of safety of not less than 2 against the assumed maximum tension in the conductor in one direction.

(3) A high-strength clamp which will prevent the conductor under assumed maximum loading conditions from slipping into the crossing span.

(4) An extra unit where strings of 5 or less are used elsewhere in the line and 2 extra units where strings of 6 or more are normally used, these extra units to be provided in addition to those in 4 below.

278. COMPLIANCE WITH RULE 277 AT CROSSINGS—Continued.

B. Suspension Insulators—Continued.

3. POSITION OF INSULATOR STRINGS.

Insulators of the suspension type on crossing supports preferably should be used in the suspension or semistrain position except where conditions are such as to require the insulators to be used in the full-strain position.

4. INSULATORS IN SUSPENDED POSITION.

(*a*) UNGROUNDED CROSSING SUPPORTS. Insulators which meet the requirements of Table 33. In all cases the insulation at the crossing to be at least equal to that elsewhere in the line.

(*b*) GROUNDED SUPPORTS AT THE CROSSING AND ELSEWHERE IN THE LINE. Where supports throughout the line are grounded, insulators which meet the requirements of Table 33 with one extra unit in each string normally requiring 5 or less and 2 extra units in each string normally requiring 6 or more; in all cases, the insulation at the crossing to be at least equal to that elsewhere in the line.

(*c*) GROUNDED SUPPORTS AT CROSSING ONLY. Insulator strings which have one extra unit where the strings in other portions of the line normally have 5 or less and 2 extra units where the strings elsewhere in the line have 6 or more units; in all cases the insulators to meet (*b*) above.

5. INSULATORS IN STRAIN POSITION.

Where insulators are used in the strain position, one more unit than in 4 above to be used in each string.

278. COMPLIANCE WITH RULE 277 AT CROSSINGS—Continued.

B. Suspension Insulators—Continued.

6. LIMIT FOR INCREASED NUMBER OF INSULATORS.

In no case is the application of the above paragraphs to result in the addition of more than 2 disks to strings normally requiring 5 or less, nor more than 3 disks to strings normally requiring 6 or more.

SEC. 28. MISCELLANEOUS REQUIREMENTS FOR OVERHEAD LINES

280. SUPPORTING STRUCTURES.

A. Poles and Towers.

1. RUBBISH.

Poles and towers shall be placed, guarded, and maintained so as to be exposed as little as practicable to brush, grass, rubbish, or building fires.

2. GUARDING POLES.

(*a*) PROTECTION AGAINST MECHANICAL INJURY. Where poles and towers are exposed to abrasion by traffic or to other damage which would materially affect their strength, they shall be protected by guards.

(*b*) PROTECTION AGAINST CLIMBING. On closely latticed poles or towers carrying supply conductors exceeding 300 volts to ground, either guards or warning signs shall be used except as follows:

Exception 1.—Where the right of way is completely fenced.

Exception 2.—Where the right of way is not completely fenced, provided the poles or towers are not adjacent to roads, regularly traveled thoroughfares, or places where people frequently gather, such as schools or public playgrounds.

280. SUPPORTING STRUCTURES—Continued.

A. **Poles and Towers**—Continued.

3. WARNING SIGNS.

(*a*) ON POLES OR TOWERS. For warning signs on poles or towers, see rule 280, A, 2, (*b*).

(*b*) ON BRIDGE FIXTURES. Structures attached to bridges for the purpose of supporting conductors shall be plainly marked with the name, initials, or trade-mark of the utility responsible for the attachment and, in addition, where the voltage exceeds 750 volts, by the following sign or its equivalent.

"Danger—Do Not Touch."

4. GROUNDING METAL POLES.

Metal poles not guarded or isolated shall always be specially grounded where in contact with metal-sheathed cable or the metal cases of equipment operating at voltages exceeding 750 volts.

Metal poles not guarded, isolated, or specially grounded should always be considered as imperfectly grounded and the insulators supporting line conductors as well as the strain insulators in attached span wires should, therefore, have a suitable margin of safety and be maintained with special care to prevent leakage to the pole as far as practicable.

5. POLE STEPS.

(*a*) METAL STEPS. Steps closer than 6½ feet from the ground or other readily accessible place shall not be placed on poles.

280. Supporting Structures—Continued.

A. **Poles and Towers**—Continued.

5. POLE STEPS—continued.

(*b*) Wood Blocks. One wood block (or on private right of way more than one) may be placed on poles carrying communication cables or paired conductors below supply conductors; but the lowest block is not to be less than 3½ feet from the ground or other readily accessible place. On poles carrying only communication conductors, additional wood blocks may be used.

6. IDENTIFICATION OF POLES.

Poles, towers and other supporting structures on which are maintained electrical conductors shall be so constructed, located, marked, or numbered as to facilitate identification by employees authorized to work thereon. Date of installation of such structures shall be recorded where practicable by the owner.

7. OBSTRUCTIONS.

All poles should be kept free from posters, bills, tacks, nails, and other unnecessary obstructions, such as through bolts not properly trimmed.

B. **Cross Arms.**

1. LOCATION.

In general, cross arms should be maintained at right angles to the axis of the pole and to the direction of the attached conductors, and at crossings should be attached to that face of the structure away from the crossing, unless special bracing or double cross arms are used.

280. SUPPORTING STRUCTURES—Continued.

B. Cross Arms—Continued.

1. LOCATION—continued.

Note.—Double cross arms are generally used at crossings, unbalanced corners, and dead ends in order to permit conductor fastenings at two insulators and so prevent slipping, although single cross arms might provide sufficient strength. To secure extra strength, double cross arms are frequently used and cross arm guys are sometimes used.

2. BRACING.

Cross arms shall be securely supported, by bracing if necessary, so as to support safely loads to which they may be subjected, including linemen working on them. Any cross arm or buck arm, except the top one, shall be capable of supporting a vertical load of 225 pounds at either extremity in addition to the weight of the conductors.

C. Unusual Conductor Supports.

Where conductors are attached to structures other than those used solely or principally for supporting the lines, all rules shall be complied with as far as they apply and such additional precautions as may be deemed necessary by the administrative authority shall be taken to avoid injury to such structures or to the person using them. The supporting of conductors on trees and roofs should be avoided where practicable.

281. TREE TRIMMING.

A. General.

Where trees exist near supply-line conductors, they shall be trimmed, if practicable, so that neither the movement of the trees nor the swinging or increased sagging of conductors in wind or ice storms or at high temperatures will bring about contact between the conductors and the trees.

Exception.—For the lower-voltage conductors, where trimming is difficult, the conductor may be protected against abrasion and against grounding through the tree by interposing between it and the tree a sufficiently nonabsorptive and substantial insulating material or device.

B. At Wire Crossings and Railroad Crossings.

The crossing span and the next adjoining spans shall be kept free, as far as practicable, from overhanging or decayed trees which might fall into the line.

282. GUYING.

A. Where Used.

When the loads to be imposed on poles, towers, or other supporting structures are greater than can be safely supported by the poles or towers alone, additional strength shall be provided by the use of guys, braces or other suitable construction.

Guys shall be used also, where necessary, whereever conductor tensions are not balanced, as at corners, angles, dead ends, and changes of grade of construction.

Note.—This is to prevent undue increase of sags in adjacent spans as well as to provide sufficient strength for those supports on which the loads are considerably unbalanced.

282. GUYING—Continued.

B. Strength.

The strength of the guy shall meet the requirements of section 26 for the grade of construction that applies.

When guys are used with wood or other poles or towers capable of considerable deflection before failure, the guys shall be able to support the entire load in the direction in which they act, the pole acting simply as a strut.

C. Point of Attachment.

The guy should be attached to the structure as near as practicable to the center of the conductor load to be sustained.

D. Guy Fastenings.

Guys should be standard and where attached to anchor rods should be protected by suitable guy thimbles or their equivalent. Cedar and other soft wood poles to which any guy having a strength of 10,000 pounds or more is attached should be protected by the use of suitable guy shims and, where there is a tendency for the guy to slip off the shim, guy hooks or other suitable means of preventing this action should be used. Shims are not necessary in the case of supplementary guys, such as storm guys.

E. Guy Guards.

The ground end of all guys attached to ground anchors exposed to traffic shall be provided with a substantial and conspicuous wood or metal guard not less than 8 feet long.

Recommendation.—It is recommended that in exposed or poorly lighted locations such guards be painted white or some other conspicuous color.

282. GUYING—Continued.

F. Insulating Guys from Metal Poles.

Where anchors would otherwise be subject to electrolysis, guys attached to metal poles or structures and not containing guy insulators should be insulated from the metal pole or structure by suitable blocking.

G. Anchor Rods.

Anchor rods shall be installed so as to be in line with the pull of the attached guy when under load, except in rock or concrete. The anchor rod shall have an ultimate strength in the eye and shank equal to that required of the guy.

H. Grounding.

The anchored end of guys attached to wood poles carrying circuits of more than 15,000 volts shall be permanently grounded (see section 9 for method) wherever this part of the guy has a clearance of less than 8 feet to ground.

Exception 1.—This does not apply to guys in rural districts.

Exception 2.—This does not apply if the guy contains an insulator which will meet the requirements of rule 283, A, 2 for the highest voltage liable to be impressed on it.

283. GUY INSULATORS.

A. Properties of Guy Insulators.

1. MATERIAL.

(*a*) GRADES A AND B. Guy insulators shall be made by the wet-porcelain process or a process equally suitable as regards electrical and mechanical properties.

(*b*) GRADES C, D, E, AND N. No requirements are made for material.

283. GUY INSULATORS—Continued.

A. Properties of Guy Insulators—Continued.

2. ELECTRICAL STRENGTH.

Guy insulators shall have a dry flash-over voltage at least double the normal line voltage and a wet flash-over voltage at least as high as the normal line voltage between conductors.

3. MECHANICAL STRENGTH.

Guy insulators shall have a mechanical strength at least equal to that required of the guys in which they are installed.

B. Use of Guy Insulators.

1. ONE INSULATOR.

An insulator shall be located in each guy which is attached to a pole or structure carrying any supply conductors of more than 300 volts to ground and not more than 15,000 volts between conductors, or in any guy which is exposed to such voltages. This guy insulator shall be located from 8 to 10 feet above the ground.

Exception.—A guy insulator is not required where the guy is grounded under the conditions set forth in 4 following.

2. TWO INSULATORS.

Where a guy attached to any pole carrying communication or supply conductors or both, is carried over or under overhead supply conductors of more than 300 volts to ground and where hazard would otherwise exist, two or more guy insulators shall be placed so as to include the exposed section of the guy between them as far as possible. Neither insulator shall be within 8 feet of the ground.

Exception.—These insulators are not required where the guy is grounded under the conditions set forth in 4 following.

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283. GUY INSULATORS—Continued.

B. Use of Guy Insulators—Continued.

3. RELATIVE LOCATION OF INSULATORS IN GUYS LOCATED ONE ABOVE THE OTHER.

Where guys in which it is necessary to install insulators are so arranged that one crosses or is above another, insulators shall be so placed that in case any guy sags down upon another the insulators will not become ineffective.

4. CONDITIONS NOT REQUIRING GUY INSULATORS.

Insulators are not required in guys under the following conditions:

(*a*) Where the guy is electrically connected to grounded steel structures or to a ground connection on wood poles.

(*b*) Where the guys are uniformly permanently grounded throughout any system of overhead lines.

284. SPAN-WIRE INSULATORS.

A. Mechanical Strength.

Span-wire insulators shall have a mechanical strength at least equal to that required of the span wire in which they are installed.

B. Use of Span-Wire Insulators.

All span wires, including bracket span wires, shall have a suitable strain insulator (in addition to an insulated hanger if used) inserted between each point of support of the span wire and the lamp or trolley contact conductor supported, except that single insulation, as provided by an insulated hanger, may be permitted when the span wire or bracket is supported on wooden poles supporting

284. SPAN-WIRE INSULATORS—Continued.

B. Use of Span-Wire Insulators—Continued.

only trolley, railway feeder, or communication conductors used in the operation of the railway concerned. In case insulated hangers are not used, the strain insulator shall be located so that in the event of a broken span wire the energized part of the span wire can not be reached from the ground.

Exception.—This rule does not apply to insulated feeder taps used as span wires.

285. CONDUCTORS.

A. Identification.

All conductors of electrical supply and communication lines should be arranged to occupy definite positions throughout, as far as practicable, or shall be so constructed, located, marked, or numbered as to facilitate identification by employees authorized to work thereon. This does not prohibit systematic transposition of conductors.

B. Branch Connections.

1. ACCESSIBILITY.

Connections of branches to supply circuits, service loops, and equipment in overhead construction shall be readily accessible to authorized employees. When possible, connections shall be made at poles or other structures.

2. CLEARANCE.

Branch connections shall be supported and placed so that swinging or sagging can not bring them in contact with other conductors, or interfere with the safe use of pole steps, or reduce the climbing or lateral working space.

286. EQUIPMENT ON POLES.

A. Identification.

All equipment of electrical supply and communication lines should be arranged to occupy definite positions throughout, as far as practicable, or shall be constructed, located, marked, or numbered so as to facilitate identification by employees authorized to work thereon.

B. Location.

Transformers, regulators, lightning arresters, and switches when located below conductors or other attachments shall be mounted outside of the climbing space.

C. Guarding.

Current-carrying parts of switches, automatic circuit-breakers, and lightning arresters shall be suitably inclosed or guarded if all the following conditions apply.

1. If of more than 300 volts to ground, and,
2. If located on the climbing side of the pole less than 20 inches from the pole center, and,
3. If located below the top cross arm.

D. Hand Clearance.

All current-carrying parts of switches, fuses, lightning arresters, also transformer connections and other connections which may require operation or adjustment while alive and are exposed at such times, shall be arranged so that in their adjustment while alive the hand need not be brought nearer to any other current-carrying part at a different voltage than the clearances from pole surfaces required in Table 9, rule 235, A, 3, (*a*), for conductors of corresponding voltages. (See also rules 422 A, B, and C, pt. 4, NES Code, for Clearances from Live Parts.)

286. Equipment on Poles—Continued.

E. Street-Lighting Equipment.

1. CLEARANCE FROM POLE SURFACE.

All exposed metal parts of lamps and their supports (unless effectively insulated from the current-carrying parts) shall be maintained at the following distances from the surface of wood poles:

	Inches
(*a*) In general	20
(*b*) If located on the side of the pole opposite the designated climbing side	5

Exception.—This does not apply where lamps are located at pole tops.

2. CLEARANCE ABOVE GROUND.

Street lamps shall be mounted at not less than the following heights above ground.

	Feet
(*a*) Over walkways	10
(*b*) Over roadways—	
Connected to circuits of 150 volts or less	14
Connected to circuits of more than 150 volts	15

3. HORIZONTAL CLEARANCES.

Arc and incandescent lamps in series circuits should have at least 3 feet horizontal clearance from windows, porches, and other spaces accessible to the general public.

4. MATERIAL OF SUSPENSION.

The lowering rope or chain for lighting units arranged to be lowered for examination or maintenance shall be of a material and strength designed to withstand climatic conditions and to sustain the lighting unit safely. The lowering rope or chain, its supports, and fastenings shall be examined periodically.

286. EQUIPMENT ON POLES—Continued.

E. Street-Lighting Equipment—Continued.

5. INSULATORS IN SUSPENSION ROPES.
Effective insulators as specified in rule 283, A, should be inserted at least 8 feet from the ground in metallic suspension ropes or chains supporting lighting units of series circuits.

6. ARC-LAMP DISCONNECTORS.
A suitable device shall be provided by which each arc lighting unit on series circuits of more than 300 volts to ground may be safely and entirely disconnected from the circuit before the lamp is handled unless the lamps are always worked on from suitable insulating stools, platforms, or tower wagons, or handled with suitable insulating tools, and treated as under full voltage of the circuit concerned.

287. PROTECTION FOR EXPOSED COMMUNICATION LINES.

A. Open Wire.

Communication lines for public use and fire-alarm lines shall be treated as follows if at any point they are exposed to supply (including trolley) lines of more than 400 volts to ground.

1. At stations for public use they shall be protected by one of the methods specified in part 3, section 39.
2. Elsewhere they shall be isolated by elevation or otherwise guarded so as to be inaccessible to the public.

B. Metal-Sheathed Cable.

Metal-sheathed cables and messengers shall be isolated or grounded in conformity with the general requirements of section 21.

288. Communication Circuits Used Exclusively in the Operation of Supply Lines.

A. Choice of Method.

Communication circuits used exclusively in the operation of supply lines may be run either as ordinary communication circuits or as supply circuits under the conditions specified in rule 288, C and D, respectively. After selection of the type of communication-circuit construction and protection for any section which is isolated, or is separated by transformers, such construction and protection shall be consistently adhered to throughout the extent of such isolated section of the communication system.

B. Guarding.

Communication circuits used in the operation of supply lines shall be isolated by elevation or otherwise guarded at all points so as to be inaccessible to the public.

C. Where Ordinary Communication Line Construction May Be Used.

Communication circuits used in the operation of supply lines may be run as ordinary communication conductors under the following conditions:

1. Where such circuits are below supply conductors in the operation of which they are used (including high voltage trolley feeders) at crossings, conflicts, or on commonly used poles, provided:
   (*a*) Such communication circuits occupy a position below all other conductors or equipment at crossings, conflicts or on commonly used poles.
   (*b*) Such communication circuits and their connected equipment are adequately guarded and are accessible only to authorized persons.
   (*c*) The precautions of section 39, part 3, and section 44, part 4, have been taken.

288. COMMUNICATION CIRCUITS USED EXCLUSIVELY IN THE OPERATION OF SUPPLY LINES—Continued.

C. **Where Ordinary Communication Line Construction May Be Used**—Continued.

2. Where such circuits are below supply conductors in the operation of which they are used and are above other supply or communication conductors at wire crossings, conflicts, or on the same poles, provided the communication circuits are protected by fuseless lightning arresters, drainage coils, or other suitable devices to prevent the communication circuit voltage from normally exceeding 400 volts to ground.

   Note.—The grades of construction for communication conductors with inverted levels apply.

D. **Where Supply Line Construction Must Be Used.**

Communication circuits used in the operation of supply lines shall comply with all requirements for the supply lines with which they are used, where they do not comply with the provisos of C, 1 above or the proviso of C, 2 above.

Exception 1.—Where the voltage of the supply conductors concerned exceeds 7,500, the communication conductors need only meet the requirements for a 7,500-volt supply circuit.

Exception 2.—Where the supply conductors are required to meet grade C, the size of the communication conductors may be the same as for grade D (see rule 262, I, 2) for spans up to 150 feet.

289. Electric Railway Construction.

A. Trolley Contact Conductor Supports.

All overhead trolley contact conductors shall be supported and arranged so that the breaking of a single contact conductor fastening will not allow the trolley conductor, live span wire, or current-carrying connection to come within 10 feet (measured vertically) from the ground, or from any platform accessible to the general public.

Span-wire insulation for trolley contact conductors shall comply with rule 284.

B. High-Voltage Contact Conductors.

Every trolley contact conductor of more than 750 volts in urban districts where not on fenced right of way shall be suspended so as to minimize the liability of a break and, as far as practicable, so that if broken at a single point, it can not fall within 12 feet (measured vertically) from the ground or any platform accessible to the general public.

C. Third Rails.

Third rails shall be protected where not on fenced rights of way by adequate guards composed of wood or other suitable material.

D. Prevention of Loss of Contact at Railroad Crossings.

Trolley contact conductors shall be arranged as set forth in either 1 or 2 following, at grade crossings with interurban or other heavy-duty or high-speed railroad systems.

1. The trolley contact conductor shall be provided with live trolley guards of suitable construction, or,

289. ELECTRIC RAILWAY CONSTRUCTION—Continued.

D. Prevention of Loss of Contact at Railroad Crossings—Continued.

2. The trolley contact conductor shall be as far as practicable at the same height above its own track throughout the crossing span and the next adjoining spans. Where a uniform height above rail is not adhered to, the change shall be made in a very gradual manner. Where the crossing span exceeds 100 feet, catenary construction shall be used.

Exception.—This rule does not apply where the system is protected by interlocking derails or by gates.

E. Guards Under Bridges.

1. WHERE GUARDING IS REQUIRED.

Guarding is required where the trolley contact conductor is so located that a trolley pole leaving the conductor can make simultaneous contact between it and the bridge structure.

2. NATURE OF GUARDING.

Guarding shall consist of a substantial inverted trough of nonconducting material located above the contact conductor, or other suitable means of preventing contact between the trolley pole and the bridge structure.

SEC. 29. RULES FOR UNDERGROUND LINES

290. LOCATION OF DUCT SYSTEMS AND MANHOLES.

A. General Location.

Underground systems of electrical conductors should be located so as to be subject to the least practicable disturbance. All railway tracks and all underground structures, including catch basins, gas pipes, etc., should be avoided where practicable. Conductors and cables carried underground under railways shall be placed in suitable ducts.

B. Ducts.

The ducts between adjacent manholes or other outlets should be installed in straight lines. If curves are necessary, they should be of the longest practicable radius, and the spacing between adjacent manholes should be reduced proportionately.

C. Manholes.

Manholes shall, where practicable, be located so as to provide convenient access and so that the least horizontal distance from any track rail to the nearest edge of the manhole opening will be not less than 3 feet. At crossings under railroads, manholes, pull boxes, and terminals shall be located away from the roadbed (preferably outside the fenced right of way).

291. CONSTRUCTION OF DUCT SYSTEMS.

A. Material, Size, and Finish of Ducts.

Ducts shall be of such material, size, mechanical strength, and finish as to facilitate the installation and maintenance of conductors or cables. Ducts shall be freed from burrs before laying and shall have clear bores.

291. CONSTRUCTION OF DUCT SYSTEMS—Continued.

B. Grading of Ducts.

Grade of ducts shall be such as to drain toward manholes or handholes. A grade of not less than 3 inches in 100 feet of length shall be provided where practicable.

C. Alignment of Ducts.

Ducts shall be laid so as to prevent inside shoulders at joints.

D. Duct Joints.

Joints in duct runs shall be made mechanically secure to maintain individual ducts in alignment.

E. Protection.

1. SETTLING.

Ducts should be suitably reinforced or be laid on suitable foundations of sufficient mechanical strength where necessary to protect them from settling.

2. DAMAGE.

Ducts should be protected by concrete or other covering where necessary to prevent being damaged by workmen when digging, or by other causes.

F. Clearances.

1. GENERAL.

The clearances between duct systems and other underground structures, particularly gas lines paralleling them, shall be as great as practicable. The distance between the top covering of the duct system and the pavement surface, or other surface under which the duct system is constructed, shall be sufficient to protect the duct system from injury.

291. Construction of Duct Systems—Continued.

F. Clearances—Continued.

2. RAILROAD TRACKS.

The distance between the top of the duct system structure and the base of the rail shall be not less than 30 inches in the case of street railways and not less than 42 inches in the case of steam and electric railroads.

Exception 1.—Where the ballast section subject to working and cleaning is less than 42 inches, the clearance may be reduced for street railways to not less than 18 inches; and for steam and electric railroads to not less than 30 inches; but in no case to less than the depth of ballast section plus 6 inches. In lieu of the additional depth of 6 inches, a 1½-inch creosoted plank, or 3 inches of concrete, or iron pipe may be provided.

Note.—The above clearances are based on a duct system, the width of which is not more than 3 creosoted wood ducts, 4 vitrified clay ducts, 4 impregnated fiber ducts or 4 iron or mild steel pipes. These clearances do not apply to bridge-type structures designed to sustain the weight of the roadbed and the operating load.

When a wider duct system is contemplated, additional strength of construction and protection should be provided, or the duct system should be placed at a greater depth.

Where unusually hard digging, as in rock, or when obstructions are encountered, a conduit run may be spread to a width of six ducts, so as to maintain the required clearance beneath the base of the rail.

Exception 2.—Where physical and chemical conditions will permit, a duct system consisting of not more than two iron pipes, not exceeding 3 inches in diameter, or two creosoted wood

291. CONSTRUCTION OF DUCT SYSTEMS—Continued.

F. Clearances—Continued.

2. RAILROAD TRACKS—continued.

ducts, not exceeding 4½ inches square, used for communication lines or for service supply lines not exceeding 750 volts, may be laid in the ground beneath the tracks without any other form of protection at a depth not less than 18 inches below the base of the rail unless the worked ballast section of the roadbed exceeds 18 inches, in which case the duct system shall be laid below the ballast section.

G. Separation Between Supply and Communication Duct Systems.

1. GENERAL.

Duct systems, including laterals, to be occupied by communication conductors for public use should be separated, where practicable, from duct systems, including laterals, for supply conductors by not less than 3 inches of concrete, 4 inches of brick masonry, or 12 inches of well-tamped earth.

Exception.—Extensions may, however, be made to existing interconnected or jointly owned and jointly occupied duct systems used in common by municipalities, communication companies, or power companies with less effective separations than above specified.

2. ENTERING MANHOLES.

Where communication conductors and supply conductors occupy ducts terminating in the same manhole, the two classes of ducts should be separated as widely as practicable and where practicable should enter the manhole at opposite sides.

Explanation.—This requirement is made so that cables can be racked along side walls with a minimum of crosses between the two classes of conductors.

291. CONSTRUCTION OF DUCT SYSTEMS—Continued.

H. Duct Entrances into Manholes.

1. CLEARANCES.

Duct entrances into manholes should, where practicable, have a clearance above the floor or below the roof line of not less than 6 inches, and from either side wall of at least 4 inches.

2. SMOOTH OUTLET.

Iron pipe conduit terminating in manholes, handholes, or other permanent openings of underground systems, shall be provided with an effective shield, bushing or other smooth outlet.

I. Sealing Laterals.

Lateral ducts for service connections to buildings, through which gas or water may enter buildings or other duct systems should be effectively plugged or cemented by the use of asphaltum, pitch, or other suitable means.

J. Duct Arrangement for Dissipation of Heat.

Duct systems intended to carry supply cables of large current capacity should be arranged where practicable, so that ducts carrying such cables, will not dissipate their heat solely through other ducts.

292. CONSTRUCTION OF MANHOLES.

A. Minimum Strength.

The design and construction of manholes and handholes shall provide sufficient strength to sustain, with a suitable margin of safety, the loads which may reasonably be imposed on them.

292. CONSTRUCTION OF MANHOLES—Continued.

B. Dimensions.

Manholes should meet the following requirements where practicable:

1. WIDTH.

The least horizontal inside dimension should be not less than 3 feet 6 inches.

2. WORKING SPACE.

A clear working space should be provided. The horizontal dimension should be not less than 3 feet. The vertical dimension should be not less than 6 feet except in manholes where the opening is within 1 foot on each side of the full size of the manhole.

Exception.—The dimensions specified in 1 and 2 above are not necessary in service boxes, handholes, or in manholes serving a small number of ducts, or in manholes used exclusively for communication system equipment and cables.

C. Drainage.

Where drainage is into sewers, suitable traps shall be provided to prevent entrance of sewer gas into manholes.

D. Ventilation.

Adequate ventilation to open air shall be provided for manholes from which any openings exist into subways entered by the public.

Exception.—Subways under water or in other locations where it is impracticable to comply.

E. Manhole Openings.

The opening to any manhole should be not less than 24 inches minimum dimension.

Recommendation. — Round openings are recommended.

292. CONSTRUCTION OF MANHOLES—Continued.

F. Manhole Covers.

Manholes and handholes, while not being worked in, shall be securely closed by covers of sufficient strength to sustain such loads as reasonably may be imposed upon them.

G. Supports for Cables.

Supports shall be provided, where necessary, for all cables at each manhole, handhole, or other permanent opening.

Note.—In handholes which reach the top line of ducts only, or in small manholes, the duct line itself may serve as sufficient support for the cables.

293. MANHOLE LOCATION.

Manhole openings, shall where practicable, be located so that barriers or other suitable guards can be placed to protect the opening effectively when uncovered.

294. LOCATION OF CONDUCTORS.

A. Accessibility.

Cables in manholes shall be reasonably accessible from the clear working space at all times. When cables pass by or cross over other cables, sufficient clearance shall be provided between them to prevent abrasion and to permit reasonable access to any cable for inspection or repair.

B. Clearance from Manhole Floor.

Each cable shall be maintained at a vertical clearance above the manhole floor of at least 6 inches, where practicable.

C. Conductors Carrying Large Currents.

Conductors intended to carry large currents should be located, where practicable, in outside ducts so that they will not necessarily dissipate heat solely through adjacent ducts.

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294. LOCATION OF CONDUCTORS—Continued.

D. Separation Between Conductors.

1. CABLES OF DIFFERENT VOLTAGES.

Cables shall be arranged and supported in ducts and manholes so that those operating at higher voltages will be separated as far as practicable from those operating at lower voltages.

2. CABLES OF DIFFERENT SYSTEMS.

Cables belonging to different systems, particularly supply distribution and communication systems, shall not be installed in the same duct.

3. CONDUCTORS OF SUPPLY AND COMMUNICATION SYSTEMS.

(*a*) GENERAL. Supply conductors and communication conductors for public use should, in general, be maintained in separate duct systems, and particularly in separate manholes.

Exception.—Cable extensions may be made to existing interconnected or jointly owned and jointly occupied duct systems used in common by municipalities, communication companies or power companies.

(*b*) IN THE SAME MANHOLE. Supply conductors and communication conductors for public use occupying the same manhole should be maintained at opposite sides of the manhole.

Where supply and communication cables must cross, a separation of at least 1 foot shall be maintained.

295. PROTECTION OF CONDUCTORS IN DUCT SYSTEMS AND MANHOLES.

A. Protection Against Moisture.

Cables shall be provided with a water-tight metal sheath or other waterproof covering over their insulating coverings.

Exception.—This requirement does not apply to rubber-insulated cables nor to cables used as ground connections or neutrals.

B. Protection Against Arcing.

A suitable fire-resisting covering should be placed on the following cables to prevent injury from arcing:

1. Closely grouped lead-sheathed supply cables of more than 7,500 volts, or of large-current capacity operating at more than 750 volts a. c. or 300 volts d. c.
2. Communication cables and supply cables of large current capacity if they are within the the same manhole and within arcing distance of each other.
3. Communication cables and supply cables which cross each other in the same manhole. In this case the protective covering above specified is mandatory.

C. Mechanical Protection.

1. CROSSINGS OF SUPPLY AND COMMUNICATION CABLES.

Special mechanical protection shall be provided against abrasion where supply and communication conductors must cross in the same manhole.

295. PROTECTION OF CONDUCTORS IN DUCT SYSTEMS AND MANHOLES—Continued.

C. Mechanical Protection—Continued.

2. IRON PIPE CONDUIT.

Iron pipe conduit, terminating in manholes, handholes, or other permanent openings of underground systems, shall be provided with an effective shield, bushing, or other smooth outlet.

296. GUARDING OF LIVE PARTS IN MANHOLES.

A. Conductor Joints or Terminals.

Joints or terminals of conductors or cables of supply systems shall be arranged so that there are no bare ungrounded current-carrying metal parts exposed to accidental contact within manholes or handholes.

B. Apparatus.

1. GENERAL.

Live parts of protective, control, or other apparatus of supply lines installed and maintained in manholes or handholes shall be inclosed in suitable grounded cases.

2. CONTINUITY BETWEEN CABLE SHEATH AND APPARATUS CASES.

The metal sheathing of all conductors or cables shall be made mechanically and electrically continuous with the metal cases of protective, control, or other apparatus.

297. Construction at Risers from Underground.

A. Separation Between Risers of Communication and Supply Systems.

The placing of risers for communication systems and risers for supply systems on the same pole should be avoided where practicable. If it is necessary to use the same pole for the risers of both systems, they shall be placed on opposite semicircumferences of the pole where practicable.

B. Mechanical Protection of Conductors.

All conductors or cables from underground systems which connect to overhead systems shall be protected by a covering which gives suitable mechanical protection up to a point 8 feet above the ground.

Exception 1.—Armored cables or cables installed in a grounded metal conduit.

Exception 2.—Communication circuits on private fenced rights of way.

C. Grounding of Riser Pipes.

Exposed metal riser pipes containing supply conductors shall be grounded unless such conductors are covered with a grounded metal sheath or are themselves grounded.

D. Conductor Terminal Construction.

The terminals of underground cables operating at more than 750 volts to ground and connecting to overhead open-wire systems shall meet the following requirements:

1. PROTECTION AGAINST MOISTURE.

Protection shall be provided so that moisture will not enter the cable.

297. CONSTRUCTION AT RISERS FROM UNDERGROUND—Con.

D. Conductor Terminal Construction—Continued.

2. INSULATION OF CONDUCTORS.

Conductors shall be properly insulated from the grounded metal sheath. In addition, the conductors of multiple conductor cable shall be properly separated and insulated from each other.

Note.—These requirements may be fulfilled by the use of potheads or other equivalent devices, such as oil switches, if incidentally they accomplish the same purpose.

E. Clearance Above Ground for Open Supply Wiring. Supply wires connecting to underground systems shall not be run open closer to the ground than is indicated by the following table:

Table 34.—Clearance Above Ground for Open Supply Wiring

Location on pole	Voltage		
	0 to 750 volts	750 to 15,000 volts	Exceeding 15,000 volts
	Feet	*Feet*	*Feet*
Side of pole adjacent to vehicular traffic	14	16	18
Side of pole not adjacent to vehicular traffic	8	11	13

298. IDENTIFICATION OF CONDUCTORS.

Cables shall be permanently identified by tags or otherwise at each manhole, handhole, or other permanent opening of the underground system.

Exception.—This requirement does not apply where the position of a cable, in conjunction with diagrams supplied to workmen, gives sufficient identification, or where the manhole is occupied solely by the communication cables of one utility.

299. IDENTIFICATION OF APPARATUS CONNECTED IN MULTIPLE.

Where transformers, regulators, or other similar apparatus not located in the same manhole operate in multiple, special tags, diagrams, or other suitable means shall be used to indicate that fact.

Exception.—This requirement does not apply where disconnecting devices are provided to permit cutting such equipment completely off the system.

APPENDIXES TO PART 2
NATIONAL ELECTRICAL SAFETY CODE

Appendix A.—RECOMMENDED NORMAL SAGS OF COPPER OVERHEAD LINE CONDUCTORS, WITH CORRESPONDING TENSIONS AND STRESSES

While the following sags are those generally recommended, circumstances will sometimes call for modifications. For instance, where many large conductors are carried by a pole line, greater sags than those listed for the large conductors will sometimes be advisable, to reduce the loads on poles at turns and dead ends, and to permit smaller longitudinal guys where such guying is called for by the rules. (See rule 254 C.)

The figures given for the sags and tensions have been rounded off to the nearest value which can be readily measured by methods and instruments in practical use for this purpose. Simple and fairly accurate methods for measuring sags will be given in a future supplementary volume.

The sags are intended to apply to both solid and stranded conductors. The corresponding tensions and stresses, however, have been computed only for solid conductors.

Table 35.—Sags for Hard and Medium-Drawn Bare Copper Wire for Different Span Lengths

[At 30, 60, and 90° F.—wires without load]

HEAVY LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Temperature	Sags for span length of—								
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.	400 ft.	500 ft.
		° F.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
8	C	30	8	11	22	------	------	------	------	------	------
		60	12	18	27	------	------	------	------	------	------
		90	16	22	32	------	------	------	------	------	------
6	A	30	8	11	22	------	------	------	------	------	------
		60	12	18	27	------	------	------	------	------	------
		90	16	22	32	------	------	------	------	------	------
6	B	30	6	10.5	16	------	------	------	------	------	------
		60	10	15	22	------	------	------	------	------	------
		90	14	19.5	27	------	------	------	------	------	------
6	C	30	6	10.5	16	28	------	------	------	------	------
		60	10	15	22	33	------	------	------	------	------
		90	14	19.5	27	39	------	------	------	------	------
4	All	30	6	10.5	16	22	32	64	109	------	------
		60	10	15	21	28	38	71	115	------	------
		90	14	19.5	26.5	34	45	77	120	------	------
2	All	30	6	10.5	13	16	18.5	35	59	129	218
		60	10	15	18	21	24	44	68	137	226
		90	14	19.5	23.5	28	31	51	75	144	234
1	All	30	6	10.5	13	16	18.5	32	51	113	195
		60	10	15	18	21	24	40	59	120	203
		90	14	19.5	23.5	28	31	47	67	130	212
0	All	30	6	10.5	13	16	18.5	31	45	100	170
		60	10	15	18	21	24	38	55	110	180
		90	14	19.5	23.5	28	31	46	63	120	190
00	All	30	6	10.5	13	16	18.5	29	42	92	157
		60	10	15	18	21	24	36	50	102	168
		90	14	19.5	23.5	28	31	44	58	111	179
0000	All	30	6	10.5	13	16	18.5	26	34	73	118
		60	10	15	18	21	24	32	42	84	132
		90	14	19.5	23.5	28	31	40	50	94	142

Table 35.—Sags for Hard and Medium-Drawn Bare Copper Wire for Different Span Lengths—Continued

MEDIUM LOADING DISTRICTS

Size A.W.G. No.	Grade of construction	Temperature	Sags for span length of—										
			100 feet	125 feet	150 feet	175 feet	200 feet	250 feet	300 feet	400 feet	500 feet	700 feet	1,000 feet
		°*F*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
8	C	30	5.5	8.5	13	-----	-----	-----	-----	-----	-----	-----	-----
		60	8	12	18	-----	-----	-----	-----	-----	-----	-----	-----
		90	12	17	23.5	-----	-----	-----	-----	-----	-----	-----	-----
6	All	30	5.5	8.5	13	18.5	-----	-----	-----	-----	-----	-----	-----
		60	8	12	18	24	-----	-----	-----	-----	-----	-----	-----
		90	12	17	23.5	30	-----	-----	-----	-----	-----	-----	-----
4	All	30	5.5	8.5	13	18.5	25	35	61	134	-----	-----	-----
		60	8	12	18	24	32	42	69	141	-----	-----	-----
		90	12	17	23.5	30	39	50	77	149	-----	-----	-----
2	All	30	5.5	8.5	13	16.5	20	29	41	78	139	313	-----
		60	8	12	18	22	26	36	50	88	150	324	-----
		90	12	17	23.5	28	33	44	58	100	161	334	-----
1	All	30	5.5	8.5	13	15.5	18.5	24.5	32	62	111	275	-----
		60	8	12	18	21	24	31	40	72	124	286	-----
		90	12	17	23.5	28	31	39	48	83	135	298	-----
0	All	30	5.5	8.5	13	15.5	18	23.5	29	54	95	218	-----
		60	8	12	18	20.5	23	29	37	64	108	239	-----
		90	12	17	23.5	27.5	29.5	36	44	74	120	253	-----
00	All	30	5.5	8.5	13	15	17	21.	27	47	80	177	396
		60	8	12	18	20	22	27	33	55	92	192	415
		90	12	17	23.5	26	28	34	41	65	104	208	429
0000	All	30	5.5	8.5	13	14.5	16	19	23	41	66	140	304
		60	8	12	18	19	21	24	27	48	76	154	323
		90	12	1	23.5	25	27	30	33	57	88	171	340

Table 35.—Sags for Hard and Medium-Drawn Bare Copper Wire for Different Span Lengths—Continued

LIGHT LOADING DISTRICTS

Size A.W.G. No.	Grade of construction	Temperature	Sags for span length of—										
			100 feet	125 feet	150 feet	175 feet	200 feet	250 feet	300 feet	400 feet	500 feet	700 feet	1,000 feet
		°*F*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
8	C	30	4.5	6.5	9.5	15	----	----	----	----	----	----	----
		60	6	9	13	20	----	----	----	----	----	----	----
		90	9	13	18	26	----	----	----	----	----	----	----
6	All	30	4.5	6.5	9.5	13.5	18.5	----	----	----	----	----	----
		60	6	9	13	18	24	----	----	----	----	----	----
		90	9	13	18	24	30	----	----	----	----	----	----
4	All	30	4.5	6.5	9.5	13.5	17	20	32	69	126	----	----
		60	6	9	13	18	22	25	40	80	137	----	----
		90	9	13	18	24	28	32	48	90	148	----	----
2	All	30	4.5	6.5	9.5	13.5	14	16.5	24.5	50	86	193	----
		60	6	9	13	18	18	20	30	59	98	208	----
		90	9	13	18	24	23.5	25	37	69	110	222	----
1	All	30	4.5	6.5	9.5	13.5	14	16.5	23	44	74	163	362
		60	6	9	13	18	18	20	28	52	85	178	380
		90	9	13	18	24	23.5	25	34	61	96	193	396
0	All	30	4.5	6.5	9.5	13.5	14	16.5	23	41	68	146	316
		60	6	9	13	18	18	20	27	49	79	159	335
		90	9	13	18	24	23.5	25	33	58	89	175	353
00	All	30	4.5	6.5	9.5	13.5	14	16.5	22	39	62	125	276
		60	6	9	13	18	18	20	26	46	72	140	290
		90	9	13	18	24	23.5	25	32	54	83	154	309
0000	All	30	4.5	6.5	9.5	13.5	14	16.5	20	37	57	113	225
		60	6	9	13	18	18	20	24	43	66	126	246
		90	9	13	18	24	23.5	25	29	51	76	141	264

Table 36.—Sags for Hard and Medium-Drawn Covered Copper Wire for Different Span Lengths

[At 30, 60, and 90° F.—wires without load]

HEAVY LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Temperature	Sags for span length of— 100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.
		°F.	In.	In.	In.	In.	In.	In.	In.
8	C	30	15	23	36	------	------	------	------
		60	18	27	40	------	------	------	------
		90	21.5	31	44	------	------	------	------
6	A	30	15	23	36	------	------	------	------
		60	18	27	40	------	------	------	------
		90	21.5	31	45	------	------	------	------
6	B	30	11	17.5	27	------	------	------	------
		60	15	22	33	------	------	------	------
		90	18	26	38	------	------	------	------
6	C	30	8.5	14	22	31	------	------	------
		60	12	18	27	36	------	------	------
		90	15.5	22.5	32	40	------	------	------
4	All	30	8.5	14	21.5	31	43	------	------
		60	12	18	27	36	48	------	------
		90	17	22.5	32	41	54	------	------
2	All	30	8.5	14	21.5	23.5	30	53	89
		60	12	18	27	30	36	60	96
		90	17	22.5	32	35	42	67	103
1	All	30	8.5	13.5	21	23	27	44	72
		60	12	18	26	29	33	52	80
		90	15.5	22.5	31	34	39	59	87
0	All	30	8.5	13.5	20.5	22.5	26	42	66
		60	12	18	26	28	32	49	72
		90	15.5	22.5	31	34	38	56	82
00	All	30	8.5	13.5	20	22.5	25	38	57
		60	12	18	25	28	31	46	66
		90	16	22.5	30	34	38	53	73
0000	All	30	8.5	13.5	18.5	21	24.5	31	43
		60	12	18	24	27	30	38	50
		90	16	22.5	29	33	36	46	59

Table 36.—Sags for Hard and Medium-Drawn Covered Copper Wire for Different Span Lengths—Continued

MEDIUM LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Temperature	Sags for span length of—						
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.
		°F.	In.	In.	In.	In.	In.	In.	In.
8	C	30	11.5	18	29				
		60	15	22	33				
		90	18.5	26	37				
6	A	30	11.5	18	28				
		60	15	22	33				
		90	18.5	26	37				
6	B	30	8.5	14	22	31			
		60	12	18	27	36			
		90	15.5	22	32	41			
6	C	30	7.5	11	17.5	25			
		60	10	15	22	30			
		90	13.5	19	27	36			
4	All	30	7	11.5	17.5	24	33		
		60	10	15	22	30	39		
		90	13.5	19.5	27	36	45		
2	All	30	7	11.5	17.5	22.5	26	43	68
		60	10	15	22	27	32	50	76
		90	13.5	19.5	27	34	38	57	83
1	All	30	7	11	17	19.5	23.5	33	52
		60	10	15	22	25	29	39	60
		90	14	19.5	27	30	35	46	68
0	All	30	7	11	17.5	19.5	21.5	30	46
		60	10	15	22	24	27	36	54
		90	14	19.5	27	31	33	43	62
00	All	30	7	11	17	19	21	27	40
		60	10	15	22	24	26	33	48
		90	14	19.5	27	30	32	40	56
0000	All	30	7	11	17	18	19	23.5	33
		60	10	15	22	23	24	29	40
		90	13.5	19.5	27	29	30	35	47

Table 36.—Sags for Hard and Medium-Drawn Covered Copper Wire for Different Span Lengths—Continued

LIGHT LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Temperature	Sags for span length of—						
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.
		°F.	In.	In.	In.	In.	In.	In.	In.
8	C	30	8.5	14	22.5	31			
		60	12	18	27	36			
		90	15.5	22.5	32	41			
6	A	30	8.5	14	22	31			
		60	12	18	27	36			
		90	15.5	22.5	32	41			
6	B	30	7	11.5	17.5	25	32		
		60	10	15	22	30	38		
		90	13	19.5	27	36	44		
6	C	30	6	9	14	19.5	26		
		60	8	12	18	24	32		
		90	11	16	22.5	29	38		
4	All	30	6.5	9	14	19	26		
		60	8	12	18	24	32		
		90	11.5	16	22	30	38		
2	All	30	6.5	9	14	17.5	21	28	45
		60	8	12	18	22	26	34	52
		90	11.5	16	22	27	32	41	60
1	All	30	5.5	9	13.5	16.5	19	26	38
		60	8	12	18	21	24	31	45
		90	11.5	16	23	26	30	38	53
0	All	30	5.5	9	14	16.5	18	24.5	34
		60	8	12	18	21	23	30	41
		90	11.5	16.5	23	27	28	36	47
00	All	30	5.5	9	13.5	16	17.5	23	31
		60	8	12	18	20	22	28	37
		90	11.5	16	23	25	28	35	45
0000	All	30	5.5	8.5	13.5	16	16.5	20.5	27
		60	8	12	18	19	21	25	32
		90	11	16	23	24.5	26	31	39

Table 37.—Sags for Soft-Drawn Covered Copper Wires for Different Span Lengths

[At 30, 60, and 90° F.—wires without load]

HEAVY LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Temperature	Sags for span length of—				
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.
		°F	In.	In.	In.	In.	In.
6	C	30	18	28	44		
		60	21	32	48		
		90	24	36	51		
4	A	30	17.5	28	45		
		60	21	32	48		
		90	24	35	51		
4	B and C	30	14.5	23	36		
		60	18	27	40		
		90	21.5	31	44		
2	A	30	14.5	23	36	49	
		60	18	27	40	54	
		90	21.5	31	44	58	
2	B and C	30	11	17.5	28	40	55
		60	15	22	33	45	60
		90	18.5	26	38	50	64
1	A	30	10.5	17.5	28	40	55
		60	15	22	33	45	60
		90	18.5	26	37	50	65
1	B and C	30	8.5	13.5	21.5	31	43
		60	12	18	27	37	48
		90	15.5	22.5	32	42	53
0	All	30	8.5	13.5	20.5	29	39
		60	12	18	26	35	45
		90	15.5	22.5	31	39	51
00	All	30	8.5	13.5	20	28	36
		60	12	18	25	33	42
		90	15.5	22.5	30	38	48
0000	All	30	8.5	13.5	18.5	24.5	30
		60	12	18	24	30	36
		90	16	22.5	29	36	42

Table 37.—Sags for Soft-Drawn Covered Copper Wires for Different Span Lengths—Continued

MEDIUM LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Temperature	Sags for span length of— 100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.
		°F.	In.	In.	In.	In.	In.	In.
6	C	30	14.5	22	36	-------	-------	-------
		60	18	27	40	-------	-------	-------
		90	21	31	44	-------	-------	-------
4	All	30	11	18	28	44	-------	-------
		60	15	22	33	48	-------	-------
		90	18.5	26	37	53	-------	-------
2	All	30	8.5	13.5	22.5	31	43	-------
		60	12	18	27	36	48	-------
		90	15.5	22	32	41	53	-------
1	All	30	8.5	13.5	20	28	36	53
		60	12	18	25	33	42	60
		90	15.5	22.5	30	38	48	67
0	All	30	8.5	13.5	19	25	33	47
		60	12	18	24	31	39	54
		90	15.5	22.5	29	37	45	61
00	All	30	8.5	13.5	19	24.5	30	41
		60	12	18	24	30	36	48
		90	15.5	22.5	29	36	42	55
0000	All	30	8.5	13.5	18.5	24.5	30	41
		60	12	18	24	30	36	48
		90	16	22.5	29	36	42	55

Table 37.—Sags for Soft-Drawn Covered Copper Wires for Different Span Lengths—Continued

LIGHT LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Temperature	Sags for span length of—					
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.
		°F.	In.	In.	In.	In.	In.	In.
6	A	30	14	23	36	--------	--------	--------
		60	18	27	40	--------	--------	--------
		90	21.5	31	44	--------	--------	--------
6	B and C	30	11	17.5	29	--------	--------	--------
		60	15	22	33	--------	--------	--------
		90	18.5	26	37	--------	--------	--------
4	All	30	8.5	13.5	20	26	36	--------
		60	12	18	25	32	42	--------
		90	15.5	22.5	30	37	47	--------
2	All	30	7	11	16	22	30	41
		60	10	15	21	27	36	48
		90	13.5	19.5	26	33	42	55
1	All	30	7	11	15	19.5	24	35
		60	10	15	20	25	30	42
		90	14	19.5	25	31	36	49
0	All	30	7	11	15.5	20	24.5	35
		60	10	15	20	25	30	42
		90	14	19.5	25	31	36	49
00	All	30	7	11	15	19.5	24	35
		60	10	15	20	25	30	42
		90	14	19.5	25	31	36	49
0000	All	30	7	10.5	15.5	19.5	24	35
		60	10	15	20	25	30	42
		90	14	19.5	25	31	36	49

Table 38.—Tensions in Hard and Medium-Drawn Bare Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 35

HEAVY LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Tensions for span length of—								
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.	400 ft.	500 ft.
		°F.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
8	C	30 no load	94	92	76						
		60 no load	63	65	62						
		90 no load	47	53	54						
		0 loaded	442	503	520						
6	A	30 no load	150	145	120						
		60 no load	99	105	99						
		90 no load	74	85	86						
		0 loaded	570	630	670						
6	B	30 no load	180	180	165						
		60 no load	120	125	120						
		90 no load	84	95	100						
		0 loaded	590	650	710						
6	C	30 no load	180	180	165	125					
		60 no load	120	125	120	110					
		90 no load	84	95	100	96					
		0 loaded	590	650	710	740					
4	All	30 no load	290	280	270	260	240	185	160		
		60 no load	190	200	200	210	200	170	150		
		90 no load	135	150	160	175	170	155	145		
		0 loaded	740	840	900	960	1,000	1,000	990		
2	All	30 no load	460	450	510	590	650	540	470	380	350
		60 no load	300	310	380	440	500	430	400	350	340
		90 no load	210	240	290	340	400	370	370	340	330
		0 loaded	1,000	1,100	1,250	1,350	1,450	1,550	1,550	1,600	1,600

Table 38.—Tensions in Hard and Medium-Drawn Bare Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 35—Continued

HEAVY LOADING DISTRICTS—Continued

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Tensions for span length of—								
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.	400 ft.	500 ft.
		°F.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	All	30 no load	580	520	650	740	820	730	670	540	490
		60 no load	380	400	470	550	630	600	580	510	470
		90 no load	270	300	370	430	500	500	520	480	450
		0 loaded	1, 200	1, 250	1, 450	1, 600	1, 700	1, 800	1, 900	1, 900	1, 900
0	All	39 no load	730	720	820	930	1, 050	970	950	760	710
		60 no load	480	500	600	700	800	790	790	710	670
		90 no load	340	380	460	540	630	660	690	650	630
		0 loaded	1, 400	1, 500	1, 650	1, 850	2, 000	2, 150	2, 200	2, 300	2, 250
00	All	30 no load	920	910	1, 050	1, 150	1, 300	1, 300	1, 300	1, 050	960
		60 no load	600	630	750	880	1, 000	1, 050	1, 100	950	910
		90 no load	430	480	580	680	790	850	930	880	850
		0 loaded	1, 700	1, 750	1, 950	2, 150	2, 350	2, 550	2, 900	2, 650	2, 650
0000	All	30 no load	1, 450	1, 450	1, 650	1, 850	2, 050	2, 300	2, 500	2, 100	2, 000
		60 no load	960	1, 000	1, 200	1, 400	1, 600	1, 850	2, 050	1, 850	1, 850
		90 no load	680	770	930	1, 100	1, 250	1, 500	1, 700	1, 650	1, 700
		0 loaded	2, 500	2, 500	2, 800	3, 100	3, 350	3, 750	4, 100	4, 000	4, 150

MEDIUM LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Tensions for span length of—										
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.	400 ft.	500 ft.	700 ft.	1,000 ft.
		° *F.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
8	C	30 no load	140	140	130	--------	--------	--------	--------	--------	--------	--------	--------
		60 no load	94	97	94	--------	--------	--------	--------	--------	--------	--------	--------
		90 no load	63	71	73	--------	--------	--------	--------	--------	--------	--------	--------
		15 loaded	330	360	390	--------	--------	--------	--------	--------	--------	--------	--------
6	All	30 no load	230	220	200	200	--------	--------	--------	--------	--------	--------	--------
		60 no load	150	155	150	150	--------	--------	--------	--------	--------	--------	--------
		90 no load	100	110	115	125	--------	--------	--------	--------	--------	--------	--------
		15 loaded	430	470	500	540	--------	--------	--------	--------	--------	--------	--------
4	All	30 no load	360	360	320	320	300	340	280	230	--------	--------	--------
		60 no load	240	250	240	240	240	280	250	220	--------	--------	--------
		90 no load	160	180	185	200	200	240	220	200	--------	--------	--------
		15 loaded	580	630	660	690	720	820	820	810	--------	--------	--------
2	All	30 no load	570	570	510	550	600	650	650	620	540	480	--------
		60 no load	380	390	380	420	460	520	540	550	500	460	--------
		90 no load	260	280	300	290	370	430	470	460	470	450	--------
		15 loaded	830	860	900	970	1,050	1,150	1,250	1,350	1,350	1,350	--------
1	All	30 no load	720	710	650	740	840	950	1,050	980	850	680	--------
		60 no load	480	490	470	550	630	760	850	850	770	650	--------
		90 no load	320	360	370	420	490	610	700	740	700	620	--------
		15 loaded	1,000	1,050	1,050	1,150	1,300	1,500	1,650	1,700	1,700	1,600	--------
0	All	30 no load	910	900	820	940	1,050	1,300	1,450	1,400	1,250	1,050	--------
		60 no load	600	620	600	710	830	1,050	1,200	1,200	1,100	980	--------
		90 no load	400	450	470	540	650	830	980	1,050	1,000	930	--------
		15 loaded	1,200	1,250	1,250	1,450	1,550	1,850	2,050	2,200	2,100	2,100	--------
00	All	30 no load	1,150	1,150	1,050	1,250	1,400	1,750	2,000	2,050	1,850	1,650	1,550
		60 no load	760	780	750	920	1,100	1,400	1,650	1,750	1,650	1,550	1,450
		90 no load	510	570	590	720	850	1,150	1,350	1,500	1,450	1,450	1,400
		15 loaded	1,450	1,500	1,500	1,750	1,950	2,350	2,650	2,850	2,850	2,850	2,850

Table 38.—Tensions in Hard and Medium-Drawn Bare Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 35—Continued

MEDIUM LOADING DISTRICTS—Continued

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Tensions for span length of—										
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.	400 ft.	500 ft.	700 ft	1,000 ft.
		°F.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
0000	All	30 no load	1,800	1,800	1,650	2,050	2,400	3,150	3,800	3,800	3,650	3,350	3,150
		60 no load	1,200	1,250	1,200	1,550	1,800	2,500	3,200	3,200	3,150	3,050	3,000
		90 no load	810	900	940	1,200	1,400	2,000	2,600	2,700	2,750	2,750	2,850
		15 loaded	2,250	2,300	2,250	2,700	3,000	3,800	4,500	4,650	4,700	4,700	4,700

LIGHT LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.	400 ft.	500 ft.	700 ft	1,000 ft.
8	C	30 no load	180	180	175	150	....	....	....	....	....	....	....
		60 no load	125	130	130	115	....	....	....	....	....	....	....
		90 no load	82	91	94	90	....	....	....	....	....	....	....
		30 loaded	210	220	230	220	....	....	....	....	....	....	....
6	All	30 no load	280	290	280	270	260	....	....	....	....	....	....
		60 no load	200	210	210	200	200	....	....	....	....	....	....
		90 no load	130	145	150	155	160	....	....	....	....	....	....
		30 loaded	310	340	340	350	350	....	....	....	....	....	....
4	All	30 no load	450	460	450	430	450	590	520	440	380	....	....
		60 no load	320	330	330	320	340	470	430	380	340	....	....
		90 no load	210	230	240	240	270	370	350	340	320	....	....
		30 loaded	490	500	510	510	540	700	660	630	610	....	....
2	All	30 no load	710	730	710	680	870	1,150	1,100	960	870	760	....
		60 no load	510	520	520	510	670	940	900	820	770	710	....
		90 no load	330	370	380	390	510	750	730	700	680	660	....
		30 loaded	750	780	790	770	940	1,200	1,250	1,150	1,150	1,100	....

1	All	30 no load	900	920	890	860	1,100	1,450	1,450	1,400	1,300	1,150	1,050
		60 no load	640	660	650	640	840	1,200	1,200	1,150	1,100	1,050	1,000
		90 no load	410	460	480	490	650	940	990	990	980	970	970
		30 loaded	940	970	980	940	1,200	1,500	1,550	1,550	1,550	1,500	1,450
0	All	30 no load	1,150	1,150	1,150	1,100	1,400	1,800	1,900	1,800	1,750	1,600	1,500
		60 no load	800	830	830	810	1,050	1,500	1,600	1,550	1,500	1,450	1,450
		90 no load	520	580	600	620	820	1,200	1,300	1,300	1,350	1,350	1,350
		30 loaded	1,200	1,200	1,200	1,200	1,450	1,900	2,050	2,050	2,000	2,000	2,050
00	All	30 no load	1,450	1,450	1,400	1,350	1,750	2,300	2,500	2,450	2,400	2,350	2,200
		60 no load	1,000	1,050	1,050	1,050	1,350	1,900	2,100	2,100	2,100	2,100	2,100
		90 no load	660	730	760	780	1,050	1,500	1,700	1,800	1,800	1,900	1,950
		30 loaded	1,500	1,500	1,500	1,450	1,800	2,350	2,600	2,650	2,650	2,700	2,750
0000	All	30 no load	2,200	2,350	2,250	2,150	2,750	3,650	4,300	4,200	4,200	4,150	4,250
		60 no load	1,600	1,650	1,650	1,650	2,100	3,000	3,600	3,550	3,600	3,700	3,900
		90 no load	1,050	1,150	1,200	1,250	1,650	2,400	2,950	3,000	3,150	3,350	3,650
		30 loaded	2,300	2,350	2,350	2,250	2,900	3,700	4,300	4,400	4,400	4,550	4,750

Table 39.—Tensions in Hard and Medium-Drawn Covered Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 36

HEAVY LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Tensions for span length of—						
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.
		°*F.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
8	C	30 no load	77	77	72				
		60 no load	62	65	63				
		90 no load	54	58	59				
		0 loaded	470	520	560				
6	A	30 no load	115	115	105				
		60 no load	94	98	95				
		90 no load	81	87	87				
		0 loaded	580	640	670				
6	B	30 no load	155	155	135				
		60 no load	110	120	115				
		90 no load	94	105	105				
		0 loaded	600	680	720				
6	C	30 no load	195	190	170	165			
		60 no load	140	145	140	145			
		90 no load	108	120	120	130			
		0 loaded	640	710	760	820			
4	All	30 no load	270	280	260	240	230		
		60 no load	210	210	210	210	210		
		90 no load	155	170	175	185	185		
		0 loaded	820	900	950	1,000	1,050		
2	All	30 no load	430	440	410	500	530	460	400
		60 no load	330	340	330	400	430	410	370
		90 no load	250	270	280	340	380	370	320
		0 loaded	1,100	1,150	1,200	1,350	1,500	1,550	1,500
1	All	30 no load	560	540	510	630	710	660	590
		60 no load	400	410	410	500	570	570	540
		90 no load	310	330	350	430	490	510	490
		0 loaded	1,200	1,300	1,350	1,550	1,700	1,700	1,850
0	All	30 no load	710	690	670	820	930	910	870
		60 no load	510	530	530	660	750	780	770
		90 no load	390	430	450	550	630	680	680
		0 loaded	1,450	1,550	1,600	1,850	2,000	2,050	2,200
00	All	30 no load	890	860	840	1,000	1,200	1,200	1,200
		60 no load	630	650	680	830	970	1,000	1,050
		90 no load	480	520	570	680	810	890	910
		0 loaded	1,700	1,800	1,850	2,100	2,350	2,500	2,600
0000	All	30 no load	1,350	1,350	1,400	1,650	1,850	2,250	2,450
		60 no load	960	1,000	1,100	1,300	1,550	1,900	2,050
		90 no load	730	810	920	1,100	1,300	1,600	1,750
		0 loaded	2,450	2,500	2,650	3,000	3,300	3,850	4,200

Table 39.—Tensions in Hard and Medium-Drawn Covered Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 36—Continued

MEDIUM LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Tensions for span length of—						
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.
		°*F.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
8	C	30 no load	98	98	89				
		60 no load	75	80	76				
		90 no load	61	68	69				
		15 loaded	330	400	390				
6	A	30 no load	150	150	135				
		60 no load	115	120	115				
		90 no load	93	100	105				
		15 loaded	420	460	480				
6	B	30 no load	195	190	170	170			
		60 no load	140	145	140	145			
		90 no load	110	120	120	130			
		15 loaded	450	490	520	550			
6	C	30 no load	230	230	220	210			
		60 no load	170	175	170	175			
		90 no load	125	140	140	150			
		15 loaded	480	530	560	590			
4	All	30 no load	350	340	320	290	300		
		60 no load	250	260	250	250	250		
		90 no load	180	200	210	210	220		
		15 loaded	620	680	710	750	780		
2	All	30 no load	560	540	510	530	600	560	520
		60 no load	390	410	400	440	490	490	470
		90 no load	290	320	330	360	410	430	430
		15 loaded	870	930	950	1,050	1,150	1,200	1,200
1	All	30 no load	670	670	620	750	820	900	830
		60 no load	470	490	490	580	660	760	710
		90 no load	350	390	390	480	540	640	630
		15 loaded	1,000	1,100	1,100	1,250	1,350	1,550	1,550
0	All	30 no load	870	850	790	950	1,100	1,250	1,200
		60 no load	610	630	620	710	900	1,050	1,000
		90 no load	440	490	510	610	730	880	890
		15 loaded	1,250	1,300	1,300	1,500	1,700	1,950	1,950
00	All	30 no load	1,050	1,050	990	1,200	1,450	1,750	1,650
		60 no load	750	780	770	960	1,150	1,400	1,400
		90 no load	550	610	630	780	950	1,200	1,200
		15 loaded	1,500	1,550	1,500	1,750	2,000	2,350	2,400
0000	All	30 no load	1,700	1,650	1,500	1,950	2,400	3,050	3,100
		60 no load	1,150	1,200	1,200	1,550	1,900	2,450	2,600
		90 no load	840	920	970	1,250	1,550	2,100	2,200
		15 loaded	2,200	2,250	2,150	2,600	3,150	3,750	3,950

Table 39.—Tensions in Hard and Medium-Drawn Covered Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 36—Continued

LIGHT LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Tensions for span length of—						
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.
		°F.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
8	C	30 no load	130	125	115	115			
		60 no load	94	97	94	96			
		90 no load	73	79	79	84			
		30 loaded	220	240	260	270			
6	A	30 no load	195	190	170	170			
		60 no load	140	150	140	145			
		90 no load	110	120	120	130			
		30 loaded	310	330	340	360			
6	B	30 no load	250	230	220	210	200		
		60 no load	170	175	175	170	180		
		90 no load	130	140	140	145	155		
		30 loaded	340	360	380	400	420		
6	C	30 no load	290	290	270	270	260		
		60 no load	210	220	210	220	210		
		90 no load	155	165	170	180	180		
		30 loaded	380	410	420	440	450		
4	All	30 no load	430	430	390	390	380		
		60 no load	310	320	310	310	310		
		90 no load	220	240	230	250	260		
		30 loaded	530	560	570	600	620		
2	All	30 no load	690	680	630	690	740	870	790
		60 no load	490	510	490	540	600	720	670
		90 no load	340	380	360	430	490	600	590
		30 loaded	770	810	810	900	970	1,150	1,100
1	All	30 no load	840	840	790	890	1,000	1,150	1,100
		60 no load	600	620	600	700	790	960	950
		90 no load	410	460	470	560	640	790	810
		30 loaded	920	960	940	1,050	1,200	1,400	1,400
0	All	30 no load	1,050	1,050	990	1,100	1,350	1,550	1,600
		60 no load	760	790	750	890	1,050	1,250	1,350
		90 no load	540	590	590	700	850	1,050	1,150
		30 loaded	1,150	1,200	1,150	1,300	1,550	1,750	1,850
00	All	30 no load	1,350	1,350	1,250	1,450	1,700	2,050	2,150
		60 no load	950	990	940	1,150	1,350	1,650	1,800
		90 no load	660	730	740	900	1,100	1,350	1,550
		30 loaded	1,300	1,450	1,400	1,650	1,900	2,250	2,400
0000	All	30 no load	2,150	2,100	1,900	2,400	2,750	3,500	3,850
		60 no load	1,450	1,500	1,450	1,850	2,200	2,850	3,200
		90 no load	1,050	1,100	1,150	1,450	1,750	2,350	2,700
		30 loaded	2,150	2,200	2,050	2,500	2,900	3,700	4,050

Table 40.—Tensions in Soft-Drawn Covered Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 37

HEAVY LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Tensions for span length of— 100 ft.	125 ft.	150 ft.	175 ft.	200 ft.
		°*F.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
6	C	30 no load	97	94	87		
		60 no load	82	85	80		
		90 no load	71	76	75		
		0 loaded	540	590	610		
4	A	30 no load	140	140	125		
		60 no load	120	120	115		
		90 no load	105	115	110		
		0 loaded	670	710	720		
4	B and C	30 no load	175	165	155		
		60 no load	140	145	140		
		90 no load	115	130	130		
		0 loaded	720	770	800		
2	A	30 no load	280	270	250	240	
		60 no load	220	230	220	225	
		90 no load	185	200	200	210	
		0 loaded	900	970	970	1,050	
2	B and C	30 no load	350	350	310	300	290
		60 no load	260	280	270	270	260
		90 no load	210	240	240	240	240
		0 loaded	980	1,050	1,100	1,100	1,150
1	A	30 no load	430	430	380	370	350
		60 no load	320	340	330	330	320
		90 no load	260	290	290	300	300
		0 loaded	1,100	1,200	1,200	1,250	1,250
1	B and C	30 no load	560	540	490	470	450
		60 no load	390	410	400	400	400
		90 no load	310	330	340	350	360
		0 loaded	1,250	1,300	1,350	1,400	1,450
0	All	30 no load	710	690	670	630	630
		60 no load	510	530	530	530	540
		90 no load	460	430	450	480	480
		0 loaded	1,450	1,550	1,600	1,600	1,700
00	All	30 no load	890	860	850	840	840
		60 no load	630	650	680	700	720
		90 no load	490	520	570	600	640
		0 loaded	1,700	1,800	1,850	1,900	2,000
0000	All	30 no load	1,350	1,350	1,400	1,450	1,550
		60 no load	960	1,000	1,100	1,200	1,300
		90 no load	730	810	900	1,000	1,100
		0 loaded	2,400	2,500	2,600	2,750	3,000

Table 40.—Tensions in Soft-Drawn Covered Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 37—Continued

MEDIUM LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Tensions for span length of—					
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.
		° *F.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
6	C	30 no load	120	120	105			
		60 no load	95	99	96			
		90 no load	80	88	88			
		15 loaded	390	420	440			
4	All	30 no load	220	220	195	170		
		60 no load	165	175	170	160		
		90 no load	135	145	150	145		
		15 loaded	530	580	590	580		
2	All	30 no load	450	450	390	390	370	
		60 no load	330	340	330	330	330	
		90 no load	250	280	280	290	300	
		15 loaded	800	850	860	900	880	
1	All	30 no load	560	540	540	530	530	560
		60 no load	400	410	430	440	450	500
		90 no load	310	330	360	380	400	450
		15 loaded	920	970	1,050	1,050	1,100	1,200
0	All	30 no load	710	690	720	730	740	810
		60 no load	510	530	560	600	620	700
		90 no load	390	430	470	510	540	630
		15 loaded	1,100	1,150	1,250	1,300	1,350	1,500
00	All	30 no load	890	860	900	950	1,000	1,150
		60 no load	630	650	700	770	840	980
		90 no load	480	520	590	650	720	860
		15 loaded	1,300	1,350	1,400	1,500	1,650	1,850
0000	All	30 no load	1,350	1,350	1,400	1,450	1,550	1,750
		60 no load	960	1,000	1,100	1,200	1,300	1,500
		90 no load	730	810	900	1,000	1,100	1,300
		15 loaded	1,900	1,900	2,000	2,100	2,150	2,450

Table 40.—Tension in Soft-Drawn Covered Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 37—Continued

LIGHT LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Tensions for span length of—					
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.
		° *F.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
6	A	30 no load	120	115	105			
		60 no load	95	99	97			
		90 no load	80	88	89			
		30 loaded	250	260	270			
6	B and C	30 no load	150	150	135			
		60 no load	115	120	115			
		90 no load	92	105	105			
		30 loaded	280	300	300			
4	All	30 no load	290	280	280	280	280	
		60 no load	210	220	220	230	230	
		90 no load	155	175	185	210	210	
		30 loaded	430	450	470	510	520	
2	All	30 no load	560	550	540	550	520	600
		60 no load	390	410	410	440	440	510
		90 no load	290	320	340	370	700	440
		30 loaded	680	710	740	770	780	900
1	All	30 no load	690	680	700	740	790	850
		60 no load	480	490	530	580	630	710
		90 no load	350	390	430	480	730	610
		30 loaded	790	830	890	950	1,050	1,150
0	All	30 no load	860	850	890	940	990	1,100
		60 no load	600	630	690	750	810	910
		90 no load	440	490	550	610	670	780
		30 loaded	980	1,000	1,100	1,150	1,250	1,350
00	All	30 no load	1,100	1,050	1,100	1,150	1,250	1,350
		60 no load	760	780	840	920	1,000	1,100
		90 no load	550	610	680	760	840	960
		30 loaded	1,150	1,200	1,300	1,350	1,450	1,600
0000	All	30 no load	1,700	1,650	1,700	1,800	1,900	2,050
		60 no load	1,150	1,200	1,300	1,400	1,550	1,700
		90 no load	840	930	870	1,150	1,250	1,450
		30 loaded	1,750	1,800	1,900	2,000	2,150	2,350

Table 41.—Stresses in Hard and Medium-Drawn Bare Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 35

HEAVY LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Stresses for span length of—										
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.	400 ft.	500 ft.	700 ft.	1,000 ft.
		°*F.*	*Lbs./in.*^{2}	*Lbs./in.*^{2}	*Lbs./in.*^{2}	*Lbs./in.*^{2}	*Lbs./in.*^{2}	*Lbs./in.*^{2}	*Lbs./in.*^{2}	*Lbs./in.*^{2}	*Lbs./in.*^{2}	*Lbs./in.*^{2}	*Lbs./in.*^{2}
8	C	30 no load	7,200	7,150	5,900	-	-	-	-	-	-	-	-
		60 no load	4,800	5,000	4,800	-	-	-	-	-	-	-	-
		90 no load	3,600	4,100	4,150	-	-	-	-	-	-	-	-
		0 loaded	34,100	38,800	40,250	-	-	-	-	-	-	-	-
6	A	30 no load	7,200	7,150	5,900	-	-	-	-	-	-	-	-
		60 no load	4,800	5,000	4,800	-	-	-	-	-	-	-	-
		90 no load	3,600	4,100	4,150	-	-	-	-	-	-	-	-
		0 loaded	27,400	30,500	32,350	-	-	-	-	-	-	-	-
6	B	30 no load	8,800	8,700	8,000	-	-	-	-	-	-	-	-
		60 no load	5,800	6,000	5,900	-	-	-	-	-	-	-	-
		90 no load	4,100	4,650	4,850	-	-	-	-	-	-	-	-
		0 loaded	28,400	31,750	34,400	-	-	-	-	-	-	-	-
6	C	30 no load	8,800	8,700	8,000	6,150	-	-	-	-	-	-	-
		60 no load	5,800	6,000	5,900	5,350	-	-	-	-	-	-	-
		90 no load	4,100	4,650	4,850	4,650	-	-	-	-	-	-	-
		0 loaded	28,400	31,750	34,400	35,900	-	-	-	-	-	-	-
4	All	30 no load	8,800	8,700	8,200	8,000	7,200	5,600	4,850	-	-	-	-
		60 no load	5,800	6,000	6,150	6,300	6,100	5,100	4,550	-	-	-	-
		90 no load	4,100	4,650	4,950	5,350	5,250	4,700	4,400	-	-	-	-
		0 loaded	22,700	25,700	27,400	29,400	30,500	30,600	30,300	-	-	-	-
2	All	30 no load	8,800	8,700	9,850	11,200	12,400	10,300	8,950	7,250	6,650	-	-
		60 no load	5,800	6,000	7,200	8,400	9,600	8,250	7,700	6,800	6,500	-	-
		90 no load	4,100	4,650	5,600	6,450	7,600	7,150	7,000	6,500	6,250	-	-
		0 loaded	19,400	21,000	23,650	26,000	28,100	29,300	30,200	30,500	30,900	-	-

1........	All........	30 no load.....	8,800	8,700	9,850	11,200	12,400	11,150	10,250	8,250	7,500	....	....
		60 no load.....	5,800	6,000	7,200	8,400	9,600	9,100	8,850	7,750	7,150	....	....
		90 no load.....	4,100	4,650	5,600	6,450	7,600	7,600	7,850	7,300	6,850	....	....
		0 loaded.......	18,200	19,250	21,700	24,000	26,000	27,500	28,700	28,900	29,000	....	....
0........	All........	30 no load.....	8,800	8,700	9,850	11,200	12,400	11,700	11,400	9,200	8,550	....	....
		60 no load.....	5,800	6,000	7,200	8,400	9,600	9,500	9,500	8,500	8,050	....	....
		90 no load.....	4,100	4,650	5,600	6,450	7,600	7,900	8,250	7,800	7,600	....	....
		0 loaded.......	17,100	18,200	20,200	22,200	24,150	26,000	26,800	27,500	27,000	....	....
00.......	All........	30 no load.....	8,800	8,700	9,850	11,200	12,400	12,400	12,500	10,100	9,250	....	....
		60 no load.....	5,800	6,000	7,200	8,400	9,600	10,000	10,400	9,100	8,650	....	....
		90 no load.....	4,100	4,650	5,600	6,450	7,600	8,150	8,950	8,400	8,100	....	....
		0 loaded.......	16,100	16,800	18,800	20,800	22,500	24,200	27,600	25,400	25,400	....	....
0000.....	All........	30 no load.....	8,800	8,700	9,850	11,200	12,400	13,850	15,100	12,550	12,150	....	....
		60 no load.....	5,800	6,000	7,200	8,400	9,600	11,250	12,350	11,050	11,000	....	....
		90 no load.....	4,100	4,650	5,600	6,450	7,600	9,050	10,350	9,850	10,150	....	....
		0 loaded.......	15,000	15,100	16,900	18,600	20,100	22,700	24,600	24,000	24,850	....	....

MEDIUM LOADING DISTRICTS

8........	C..........	30 no load.....	10,900	10,850	9,850	....	....	....	....	....	....	....	....
		60 no load.....	7,250	7,500	7,200	....	....	....	....	....	....	....	....
		90 no load.....	4,900	5,450	5,650	....	....	....	....	....	....	....	....
		15 loaded......	25,200	27,900	30,200	....	....	....	....	....	....	....	....
6........	All........	30 no load.....	10,900	10,850	9,850	9,600	....	....	....	....	....	....	....
		60 no load.....	7,250	7,500	7,200	7,400	....	....	....	....	....	....	....
		90 no load.....	4,900	5,450	5,650	6,000	....	....	....	....	....	....	....
		15 loaded......	20,700	22,700	24,400	26,000	....	....	....	....	....	....	....
4........	All........	30 no load.....	10,900	10,850	9,850	9,600	9,250	10,450	8,650	6,950	....	....	....
		60 no load.....	7,250	7,500	7,200	7,400	7,250	8,600	7,600	6,600	....	....	....
		90 no load.....	4,900	5,450	5,650	6,000	6,050	7,250	6,850	6,250	....	....	....
		15 loaded......	17,800	19,300	20,150	21,300	22,050	25,000	25,050	24,700	....	....	....
2........	All........	30 no load.....	10,900	10,850	9,850	10,650	11,450	12,400	12,550	11,900	10,400	9,190	....
		60 no load.....	7,250	7,500	7,200	8,000	8,900	10,000	10,300	10,500	9,650	8,800	....
		90 no load.....	4,900	5,450	5,650	5,650	7,000	8,150	8,950	8,900	9,000	8,600	....
		15 loaded......	15,800	16,550	17,150	18,600	20,200	22,400	23,950	26,000	25,750	25,500	....

Table 41.—Stresses in Hard and Medium-Drawn Bare Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 35—Continued

MEDIUM LOADING DISTRICTS—Continued

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Stresses for span length of—										
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.	400 ft.	500 ft.	700 ft.	1,000 ft.
		°F.	Lbs./in.^{2}	Lbs./in.^{2}	Lbs./in.^{2}	Lbs./in.^{2}	Lbs./in.^{2}	Lbs./in.^{2}	Lbs./in.^{2}	Lbs./in.^{2}	Lbs./in.^{2}	Lbs./in.^{2}	Lbs./in.^{2}
1	All	30 no load	10,900	10,850	9,850	11,250	12,700	14,500	15,900	14,950	12,950	10,300	--------
		60 no load	7,250	7,500	7,200	8,350	9,600	11,550	12,900	12,850	11,700	9,850	--------
		90 no load	4,900	5,450	5,650	6,450	7,500	9,350	10,700	11,200	10,700	9,500	--------
		15 loaded	15,050	15,900	16,200	17,900	19,500	22,700	24,900	26,250	25,800	24,750	--------
0	All	30 no load	10,900	10,850	9,850	11,350	12,900	15,550	17,600	17,150	15,250	12,550	--------
		60 no load	7,250	7,500	7,200	8,600	10,000	12,400	14,200	14,500	13,300	11,800	--------
		90 no load	4,900	5,450	5,650	6,500	7,850	10,000	11,800	12,500	12,000	11,150	--------
		15 loaded	14,600	15,250	15,300	17,200	18,900	22,050	24,650	26,350	25,600	25,300	--------
00	All	30 no load	10,900	10,850	9,850	11,750	13,550	16,900	19,200	19,750	17,850	16,000	14,750
		60 no load	7,250	7,500	7,200	8,800	10,450	13,300	15,650	16,750	15,700	14,800	14,100
		90 no load	4,900	5,450	5,650	6,900	8,150	10,800	12,750	14,300	13,900	13,850	13,650
		15 loaded	14,100	14,600	14,600	16,550	18,750	22,400	25,250	27,300	27,250	27,300	27,400
0000	All	30 no load	10,900	10,850	9,850	12,250	14,300	18,850	22,800	22,750	21,850	20,250	19,050
		60 no load	7,250	7,500	7,200	9,250	10,950	15,000	19,150	19,200	18,900	18,300	18,000
		90 no load	4,900	5,450	5,650	7,150	8,500	12,000	15,650	16,200	16,400	16,650	17,050
		15 loaded	13,550	14,000	13,500	16,300	18,000	22,850	27,150	28,000	28,200	28,200	28,450

8	C	30 no load	13,700	14,000	13,550	11,750	--------	--------	--------	--------	--------	--------	--------
		60 no load	9,700	10,000	9,950	8,800	--------	--------	--------	--------	--------	--------	--------
		90 no load	6,300	7,000	7,250	6,900	--------	--------	--------	--------	--------	--------	--------
		30 loaded	16,200	17,150	17,950	17,250	--------	--------	--------	--------	--------	--------	--------
6	All	30 no load	13,700	14,000	13,550	13,000	12,450	--------	--------	--------	--------	--------	--------
		60 no load	9,700	10,000	9,950	9,800	9,600	--------	--------	--------	--------	--------	--------
		90 no load	6,300	7,000	7,250	7,450	7,600	--------	--------	--------	--------	--------	--------
		30 loaded	15,250	16,350	16,600	16,750	17,000	--------	--------	--------	--------	--------	--------
4	All	30 no load	13,700	14,000	13,550	13,000	13,600	18,000	15,850	13,400	11,500	--------	--------
		60 no load	9,700	10,000	9,950	9,800	10,500	14,400	12,950	11,550	10,500	--------	--------
		90 no load	6,300	7,000	7,250	7.450	8,200	11,400	10,700	10,300	9,750	--------	--------
		30 loaded	15,000	15,350	15,600	15,600	16,500	21,200	20,250	19,400	18,700	--------	--------
2	All	30 no load	13,700	14,000	13,550	13,000	16,600	21,900	21,100	18,400	16,700	14,650	--------
		60 no load	9,700	10,000	9,950	9,800	12,750	18,000	17,250	15,650	14,750	13,650	--------
		90 no load	6,300	7,000	7,250	7,450	9,850	14,300	14,000	13,450	13,100	12,700	--------
		30 loaded	14,350	15,000	15,050	14,700	18,050	23,450	23,500	22,400	21,900	21,100	--------
1	All	30 no load	13,700	14,000	13,550	13,000	16,600	21,900	22,350	21,000	19,500	17,800	16,000
		60 no load	9,700	10,000	9,950	9,800	12,750	18,000	18,500	17,650	16,950	15,800	15,250
		90 no load	6,300	7,000	7,250	7,450	9,850	14,300	15,000	15,050	14,900	14,700	14,700
		30 loaded	14,400	14,800	14,900	14,350	18,000	23,200	23,850	23,950	23,400	22,800	22,500
0	All	30 no load	13,700	14,000	13,550	13,000	16,600	21,900	22,800	21,850	21,150	19,400	18,300
		60 no load	9,700	10,000	9,950	9,800	12,750	18,000	19,150	18,900	18,250	17,750	17,250
		90 no load	6,300	7,000	7,250	7,450	9,850	14,300	15,650	15,900	16,050	16,150	16,500
		30 loaded	14,200	14,650	14,550	14,350	17,650	22,900	24,500	24,600	24,300	24,000	24,850
00	All	30 no load	13,700	14,000	13,550	13,000	16,600	21,900	23,850	23,700	23,100	22,500	20,900
		60 no load	9,700	10,000	9,950	9,800	12,750	18,000	20,000	20,050	19,900	20,200	19,900
		90 no load	6,300	7,000	7,250	7,450	9,850	14,300	16,350	17,000	17,350	18,300	18,700
		30 loaded	14,200	14,350	14,400	14,100	17,400	22,700	25,000	25,250	25,450	26,000	26,250
0000	All	30 no load	13,700	14,000	13,550	13,000	16,600	21,900	25,700	25,150	25,250	25,000	25,600
		60 no load	9,700	10,000	9,950	9,800	12,750	18,000	21,550	21,400	21,700	22,400	23,500
		90 no load	6,300	7,000	7,250	7,450	9,850	14,300	17,850	18,150	18,850	20,000	21,850
		30 loaded	14,000	14,300	14,100	13,700	17,150	22,400	25,800	26,350	26,500	27,300	28,550

Table 42.—Stresses in Hard and Medium-Drawn Covered Copper Wire for Different Span Lengths Corresponding to Recommended Sags of Table 36

HEAVY LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Stresses for span length of—						
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.
		°*F.*	*Lbs./in.²*	*Lbs./in.²*	*Lbs./in.²*	*Lbs./in.²*	*Lbs./in.²*	*Lbs./in.²*	*Lbs./in.²*
8	C	30 no load	5, 900	5, 900	5, 550				
		60 no load	4, 800	5, 050	4, 900				
		90 no load	4, 150	4, 500	4, 550				
		0 loaded	35, 900	40, 000	42, 800				
6	A	30 no load	5, 550	5, 600	5, 150				
		60 no load	4, 550	4, 750	4, 600				
		90 no load	3, 900	4, 200	4, 250				
		0 loaded	28, 000	30, 800	32, 500				
6	B	30 no load	7, 400	7, 400	6, 500				
		60 no load	5, 450	5, 950	5, 600				
		90 no load	4, 550	5, 000	5, 000				
		0 loaded	29, 300	33, 100	34, 800				
6	C	30 no load	9, 400	9, 150	8, 250	8, 050			
		60 no load	6, 800	7, 100	6, 800	6, 950			
		90 no load	5, 250	5, 750	5, 800	6, 250			
		0 loaded	31, 000	34, 600	37, 000	39, 800			
4	All	30 no load	8, 300	8, 500	7, 800	7, 450	7, 000		
		60 no load	6, 250	6, 550	6, 250	6, 400	6, 250		
		90 no load	4, 800	5, 250	5, 400	5, 700	5, 650		
		0 loaded	24, 900	27, 400	28, 900	30, 700	31, 700		
2	All	30 no load	8, 300	8, 500	7, 800	9, 550	10, 200	8, 750	7, 650
		60 no load	6, 250	6, 550	6, 250	7, 650	8, 350	7, 800	7, 050
		90 no load	4, 800	5, 250	5, 400	6, 500	7, 200	7, 150	6, 150
		0 loaded	20, 800	22, 300	23, 000	26, 250	28, 300	29, 300	29. 000
1	All	30 no load	8, 550	8. 200	7, 700	9, 650	10 800	10, 050	9, 000
		60 no load	6, 050	6. 300	6, 250	7, 650	8, 700	8, 700	8, 150
		90 no load	4, 650	5, 000	5, 250	6, 500	7, 400	7, 700	7, 500
		0 loaded	18, 600	20, 000	20, 800	23. 700	26, 050	26, 000	28, 000
0	All	30 no load	8, 600	8, 350	8, 050	9, 950	11, 200	11, 000	10, 350
		60 no load	6, 150	6, 350	6, 450	8, 000	9, 100	9, 400	9, 250
		90 no load	4, 700	5, 150	5, 400	6, 600	7, 650	8, 200	8, 200
		0 loaded	17, 650	18, 500	19, 000	22, 100	24, 300	24. 500	26, 500
00	All	30 no load	8, 450	8, 200	8, 000	9, 800	11, 300	11, 550	11, 150
		60 no load	6, 000	6, 250	6, 450	7, 900	9, 250	9, 750	9, 850
		90 no load	4, 550	5, 000	5, 450	6, 500	7, 700	8, 500	8, 750
		0 loaded	16, 300	17, 100	17, 700	20, 250	22, 550	24, 200	25, 100
0000	All	30 no load	8, 150	8, 000	8, 500	9, 850	11, 200	13, 650	14, 600
		60 no load	5, 800	6, 050	6, 600	7, 900	9, 250	11, 350	12, 450
		90 no load	4, 400	4, 850	5, 500	6, 500	7, 700	9, 550	10, 550
		0 loaded	14, 650	15, 000	15, 800	17, 900	19, 950	23, 200	25, 250

Table 42.—Stresses in Hard and Medium-Drawn Covered Copper Wire for Different Span Lengths Corresponding to Recommended Sags of Table 36—Continued

MEDIUM LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Stresses for span length of—						
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.
		°*F.*	*Lbs./in.²*	*Lbs./in.²*	*Lbs./in.²*	*Lbs./in.²*	*Lbs./in.²*	*Lbs./in.²*	*Lbs./in.²*
8	C	30 no load	7,600	7,600	6,850				
		60 no load	5,800	6,200	5,900				
		90 no load	4,700	5,250	5,300				
		15 loaded	25,500	31,000	30,050				
6	A	30 no load	7,200	7,200	6,500				
		60 no load	5,500	5,850	5,600				
		90 no load	4,500	4,950	5,000				
		15 loaded	20,400	22,400	23,200				
6	B	30 no load	9,500	9,200	8,300	8,250			
		60 no load	6,850	7,150	6,850	6,950			
		90 no load	5,250	5,850	5,800	6,200			
		15 loaded	21,850	24,000	25,350	26,800			
6	C	30 no load	11,350	11,350	10,500	10,150			
		60 no load	8,250	8,500	8,300	8,400			
		90 no load	6,050	6,650	6,900	7,150			
		15 loaded	23,200	25,500	27,250	28,800			
4	All	30 no load	10,700	10,400	9,700	8,800	9,150		
		60 no load	7,500	7,800	7,700	7,600	7,700		
		90 no load	5,500	6,150	6,350	6,500	6,750		
		15 loaded	19,000	20,900	21,900	22,850	24,050		
2	All	30 no load	10,700	10,400	9,700	10,100	11,500	10,750	9,900
		60 no load	7,500	7,800	7,650	8,500	9,400	9,350	8,950
		90 no load	5,500	6,150	6,350	6,800	7,900	8,250	8,200
		15 loaded	16,700	17,750	18,200	19,750	21,650	22,800	22,750
1	All	30 no load	10,150	10,250	9,400	11,350	12,400	13,650	12,600
		60 no load	7,200	7,500	7,400	8,850	9,950	11,500	10,850
		90 no load	5,250	5,900	6,000	7,300	8,200	9,750	9,600
		15 loaded	15,500	16,500	16,700	18,800	20,800	23,600	23,600
0	All	30 no load	10,500	10,250	9,500	11,400	13,400	15,250	14,300
		60 no load	7,300	7,600	7,500	8,500	10,800	12,700	12,250
		90 no load	5,300	5,850	6,100	7,300	8,850	10,600	10,750
		15 loaded	14,850	15,600	15,600	18,300	20,200	23,250	23,300
00	All	30 no load	10,150	10,250	9,400	11,550	13,800	16,500	15,900
		60 no load	7,200	7,500	7,400	9,150	11,050	13,500	13,450
		90 no load	5,250	5,900	6,000	7,500	9,100	11,300	11,650
		15 loaded	14,300	14,750	14,500	16,900	19,350	22,750	23,200
0000	All	30 no load	10,100	9,900	9,150	11,700	14,550	18,300	18,800
		60 no load	6,950	7,150	7,150	9,250	11,450	14,850	15,500
		90 no load	5,050	5,550	5,800	7,450	9,250	12,100	13,250
		15 loaded	13,150	13,450	13,100	15,800	18,900	22,700	23,900

Table 42.—Stresses in Hard and Medium-Drawn Covered Copper Wire for Different Span Lengths Corresponding to Recommended Sags of Table 36—Continued

LIGHT LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Stresses for span length of—						
			100 ft.	125 ft.	150 ft.	175 ft.	200 ft.	250 ft.	300 ft.
		°*F*	*Lbs./in.*²	*Lbs./in.*²	*Lbs./in.*²	*Lbs./in.*²	*Lbs./in.*²	*Lbs./in.*²	*Lbs./in.*²
8	C	30 no load	9,950	9,500	8,750	8,750	--------	--------	--------
		60 no load	7,200	7,500	7,200	7,400	--------	--------	--------
		90 no load	5,650	6,150	6,150	6,500	--------	--------	--------
		30 loaded	17,400	19,000	19,750	20,750	--------	--------	--------
6	A	30 no load	9,500	9,200	8,300	8,250	--------	--------	--------
		60 no load	6,800	7,200	6,850	7,000	--------	--------	--------
		90 no load	5,250	5,800	5,800	6,200	--------	--------	--------
		30 loaded	15,100	16,150	16,350	17,450	--------	--------	--------
6	B	30 no load	11,950	11,250	10,550	10,200	10,150	--------	--------
		60 no load	8,200	8,500	8,400	8,350	8,600	--------	--------
		90 no load	6,350	6,700	6,900	7,100	7,500	--------	--------
		30 loaded	16,450	17,600	18,650	19,350	20,300	--------	--------
6	C	30 no load	14,200	14,200	13,200	13,050	12,450	--------	--------
		60 no load	10,300	10,650	10,200	10,450	10,250	--------	--------
		90 no load	7,450	8,100	8,200	8,650	8,700	--------	--------
		30 loaded	18,350	19,950	20,500	21,500	22,050	--------	--------
4	All	30 no load	13,200	13,050	12,000	11,850	11,500	--------	--------
		60 no load	9,400	9,750	9,350	9,500	9,450	--------	--------
		90 no load	6,600	7,300	6,850	7,750	8,000	--------	--------
		30 loaded	16,300	17,250	17,500	18,450	18,900	--------	--------
2	All	30 no load	13,200	13,050	12,000	13,200	14,250	16,700	15,100
		60 no load	9,400	9,750	9,350	10,300	11,450	13,800	12,950
		90 no load	6,600	7,300	6,850	8,300	9,350	11,550	11,250
		30 loaded	14,800	15,600	15,500	17,150	18,500	21,700	21,200
1	All	30 no load	12,800	12,800	12,000	13,600	15,300	17,550	17,100
		60 no load	9,100	9,450	9,050	10,600	12,000	14,550	14,450
		90 no load	6,300	7,000	7,150	8,500	9,750	12,100	12,250
		30 loaded	14,000	14,600	14,400	16,400	18,000	21,300	21,650
0	All	30 no load	12,950	12,800	11,900	13,550	16,000	18,750	19,550
		60 no load	9,200	9,500	9,050	10,700	12,750	15,250	16,400
		90 no load	6,450	7,100	7,150	8,500	10,300	12,700	14,000
		30 loaded	14,050	14,400	14,100	16,000	18,450	21,250	22,600
00	All	30 no load	12,800	12,800	11,750	13,900	16,350	19,500	20,700
		60 no load	9,100	9,450	9,000	10,950	13,000	15,900	17,300
		90 no load	6,300	7,000	7,050	8,650	10,400	12,950	14,750
		30 loaded	13,350	13,850	13,350	15,650	18,050	21,550	22,900
0000	All	30 no load	12,850	12,500	11,550	14,500	16,650	21,050	23,000
		60 no load	8,650	9,050	8,700	11,100	13,000	17,250	19,300
		90 no load	6,250	6,700	6,850	8,700	10,400	14,100	16,150
		30 loaded	13,000	13,350	12,350	15,150	17,600	22,250	24,300

Table 43.—Stresses in Soft-Drawn Covered Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 37

HEAVY LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Stresses for span length of—				
			100 feet.	125 feet.	150 feet.	175 feet.	200 feet.
		° F.	Lbs./in.²	Lbs./in.²	Lbs./in.²	Lbs./in.²	Lbs./in.²
6	C	30 no load	4,700	4,550	4,250		
		60 no load	3,950	4,100	3,900		
		90 no load	3,400	3,700	3,650		
		0 loaded	26,250	28,550	29,500		
4	A	30 no load	4,350	4,250	3,850		
		60 no load	3,600	3,750	3,550		
		90 no load	3,150	3,450	3,300		
		0 loaded	20,400	21,600	22,000		
4	B and C	30 no load	5,300	5,100	4,750		
		60 no load	4,200	4,400	4,300		
		90 no load	3,550	3,900	3,900		
		0 loaded	21,850	23,500	24,300		
2	A	30 no load	5,300	5,100	4,750	4,700	
		60 no load	4,200	4,400	4,300	4,300	
		90 no load	3,550	3,850	3,900	4,000	
		0 loaded	17,300	18,500	18,650	19,800	
2	B and C	30 no load	6,650	6,700	6,000	5,700	5,500
		60 no load	5,050	5,350	5,150	5,150	5,000
		90 no load	4,050	4,500	4,550	4,700	4,700
		0 loaded	18,750	20,300	20,800	21,500	21,750
1	A	30 no load	6,500	6,500	5,800	5,550	5,300
		60 no load	4,800	5,150	4,950	4,950	4,850
		90 no load	3,900	4,400	4,400	4,500	4,500
		0 loaded	17,050	18,400	18,550	18,850	18,950
1	B and C	30 no load	8,550	8,200	7,500	7,050	6,850
		60 no load	6,000	6,250	6,050	6,000	6,000
		90 no load	4,650	5,000	5,200	5,300	5,500
		0 loaded	18,800	20,100	20,500	21,300	21,800
0	All	30 no load	8,600	8,350	8,050	7,650	7,500
		60 no load	6,150	6,350	6,450	6,400	6,500
		90 no load	4,700	5,150	5,400	5,750	5,800
		0 loaded	17,650	18,500	19,000	19,600	20,250
00	All	30 no load	8,500	8,200	8,100	8,000	8,000
		60 no load	6,000	6,250	6,500	6,650	6,850
		90 no load	4,650	5,000	5,450	5,750	6,100
		0 loaded	16,400	17,000	17,750	18,300	19,000
0000	All	30 no load	8,150	8,100	8,350	8,700	9,250
		60 no load	5,750	6,100	6,550	7,150	7,650
		90 no load	4,400	4,850	5,450	6,000	6,550
		0 loaded	14,450	15,000	15,700	16,600	18,000

Table 43.—Stresses in Soft-Drawn Covered Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 37—Continued

MEDIUM LOADING DISTRICTS

Size A. W. G. No.	Grade of construction	Conditions of load and temperature	Stresses for span length of— 100 feet	125 feet	150 feet	175 feet	200 feet	250 feet
		°F	Lbs./in.²	Lbs./in.²	Lbs./in.²	Lbs./in.²	Lbs./in.²	Lbs./in.²
6	C	30 no load	5,750	5,850	5,150			
		60 no load	4,600	4,800	4,650			
		90 no load	3,900	4,250	4,250			
		15 loaded	18,750	20,400	21,200			
4	All	30 no load	6,650	6,700	6,000	5,250		
		60 no load	5,050	5,350	5,150	4,800		
		90 no load	4,100	4,550	4,600	4,350		
		15 loaded	16,300	17,850	18,000	17,800		
2	All	30 no load	8,700	8,550	7,500	7,500	7,000	
		60 no load	6,250	6,500	6,250	6,400	6,250	
		90 no load	4,800	5,300	5,300	5,650	5,700	
		15 loaded	15,300	16,300	16,550	17,150	16,900	
1	All	30 no load	8,550	8,200	8,200	8,000	8,000	8,500
		60 no load	6,000	6,250	6,600	6,750	6,850	7,550
		90 no load	4,650	5,000	5,550	5,750	6,100	6,850
		15 loaded	14,000	14,800	16,200	16,200	16,750	18,250
0	All	30 no load	8,600	8,350	8,650	8,800	8,900	9,750
		60 no load	6,150	6,350	6,800	7,250	7,500	8,500
		90 no load	4,700	5,150	5,700	6,150	6,500	7,550
		15 loaded	13,350	13,800	14,850	15,400	16,000	17,800
00	All	30 no load	8,500	8,200	8,550	9,050	9,750	10,900
		60 no load	6,000	6,250	6,750	7,350	8,000	9,400
		90 no load	4,600	5,000	5,650	6,250	6,850	8,200
		15 loaded	12,350	13,000	13,600	14,450	15,700	17,800
0000	All	30 no load	8,150	8,100	8,300	8,700	9,300	10,550
		60 no load	5,800	6,100	6,550	7,100	7,700	9,050
		90 no load	4,400	4,850	5,450	6,000	6,550	7,900
		15 loaded	11,400	11,550	12,150	12,700	13,000	14,900

Table 43.—Stresses in Soft-Drawn Covered Copper Wire for Different Span Lengths Corresponding to the Recommended Sags of Table 37—Continued

LIGHT LOADING DISTRICTS

Size A.W.G. No.	Grade of construction	Conditions of load and temperature	Stresses for span length of—					
			100 feet	125 feet	150 feet	175 feet	200 feet	250 feet
		°F.	Lbs./in.²	Lbs./in.²	Lbs./in.²	Lbs./in.²	Lbs./in.²	Lbs./in.²
6	A	30 no load	5,750	5,700	5,150			
		60 no load	4,600	4,800	4,700			
		90 no load	3,850	4,250	4,300			
		30 loaded	12,000	12,800	13,000			
6	B and C	30 no load	7,250	7,300	6,450			
		60 no load	5,500	5,900	5,650			
		90 no load	4,450	5,000	5,000			
		30 loaded	13,600	14,600	14,600			
4	All	30 no load	8,750	8,500	8,400	8,650	8,400	
		60 no load	6,250	6,600	6,800	7,150	7,150	
		90 no load	4,700	5,300	5,700	6,250	6,350	
		30 loaded	13,100	13,700	14,400	15,500	15,800	
2	All	30 no load	10,700	10,500	10,350	10,500	9,950	11,400
		60 no load	7,500	7,800	7,950	8,500	8,350	9,750
		90 no load	5,500	6,050	6,500	7,000	7,150	8,500
		30 loaded	12,950	13,500	14,150	14,750	15,000	17,200
1	All	30 no load	10,450	10,300	10,700	11,300	12,000	12,900
		60 no load	7,250	7,500	8,100	8,850	9,600	10,750
		90 no load	5,250	5,900	6,500	7,300	8,000	9,250
		30 loaded	12,050	12,600	13,600	14,450	15,700	17,400
0	All	30 no load	10,400	10,250	10,700	11,350	12,000	13,100
		60 no load	7,300	7,600	8,300	9,000	9,750	10,900
		90 no load	5,250	5,900	6,600	7,350	8,100	9,400
		30 loaded	11,850	12,200	13,000	13,850	15,000	16,400
00	All	30 no load	10,400	10,200	10,650	11,200	11,900	12,750
		60 no load	7,250	7,500	8,050	8,800	9,600	10,650
		90 no load	5,250	5,850	6,500	7,250	8,000	9,200
		30 loaded	11,200	11,500	12,300	13,000	14,000	15,450
0000	All	30 no load	10,100	9,850	10,150	10,750	11,450	12,350
		60 no load	6,950	7,200	7,800	8,450	9,200	10,250
		90 no load	5,050	5,600	6,250	6,950	5,650	8,850
		30 loaded	10,500	10,900	11,350	12,100	13,000	14,150

Appendix B.—MINIMUM PERMISSIBLE SAGS FOR LINE CONDUCTORS OF GRADES A, B, AND C, AND CORRESPONDING TENSIONS

Sags of line conductors of different materials at 30, 60, and 90° F. have been computed, such that when loaded according to the loading specification for the district, the resulting tension in the conductor will equal 50 per cent of its ultimate strength for grades A and B, and 60 per cent for grade C (see rule 261, F, 4).

Tables 44 to 46 present values of the sag in the conductor for various spans for hard-drawn and medium copper; Table 47 (pp. 220 to 222) for soft copper; Tables 48 to 53 (pp. 223 to 235) for three grades of steel; Tables 54 and 55 (pp. 236 to 238) for copper-covered steel designated as standard grade; Table 56 (pp. 239 to 241) for aluminum; and Table 57 (pp. 242 to 244) for aluminum cable with steel core. Tables 58 to 71 (pp. 245 to 278) give the corresponding stringing tensions in the various conductors.

The properties of the various conductors involved in the computation of sags and tensions are given in Appendix D. These sags and tensions are not applicable to conductor materials having properties which differ considerably from the values on which the tables are based. When such materials are used, the sags and tensions should be based upon the actual properties of the material concerned.

Table 44.—Sags for Medium and Hard-Drawn Bare Solid Copper Wire

HEAVY LOADING DISTRICT

[The sags being such that when loaded at 0° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B, and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags (inches) for span lengths (feet) of— 100	125	150	175	200	250	300	400	500
		°F.									
8	C	30	4.4	15.6	36.5	------	------	------	------	------	------
		60	6.5	20.4	40.7	------	------	------	------	------	------
		90	9.7	24.6	44.5	------	------	------	------	------	------
6	A and B	30	4.4	12.3	27.7	------	------	------	------	------	------
		60	6.5	16.9	32.8	------	------	------	------	------	------
		90	9.7	21.6	37.1	------	------	------	------	------	------
	C	30	2.6	5.1	10.6	22.7	------	------	------	------	------
		60	3.1	6.8	14.8	28.6	------	------	------	------	------
		90	4.1	9.4	19.8	34.2	------	------	------	------	------
4	A and B	30	3.0	5.5	10.6	19.3	33.1	66.6	109	------	------
		60	3.8	7.7	14.6	25.2	39.1	72.3	115	------	------
		90	5.3	10.8	19.6	31.5	45.1	78.4	121	------	------
	C	30	2.2	3.6	6.1	9.4	15.1	37.2	71.0	------	------
		60	2.6	4.5	7.2	11.9	19.4	44.7	79.0	------	------
		90	3.1	5.7	9.5	16.2	25.2	52.2	86.0	------	------
2	A and B	30	2.9	4.8	7.6	11.8	17.8	38.4	67.0	142	238
		60	3.5	6.2	9.7	15.5	23.0	45.6	74.5	150	252
		90	4.8	8.3	13.3	20.6	29.5	53.1	82.4	158	260
	C	30	2.1	3.4	5.4	7.6	11.0	21.0	38.9	97	172
		60	2.6	4.2	6.5	9.5	13.4	26.4	46.8	106	191
		90	3.1	5.3	7.9	11.8	17.3	33.3	55.4	117	202
1	A and B	30	2.9	4.6	7.0	10.5	15.4	30.6	53.6	118	203
		60	3.5	6.0	9.0	13.6	20.1	37.8	62.6	127	212
		90	4.8	7.9	12.4	18.1	25.4	45.6	70.6	135	220
	C	30	2.2	3.3	5.0	7.6	10.1	18.3	31.7	77.8	148
		60	2.6	3.9	6.5	9.0	12.5	22.8	38.9	88.4	157
		90	3.2	5.2	7.9	11.3	15.8	28.8	46.8	98.4	168
0	A and B	30	2.8	4.5	6.8	10.1	14.1	26.4	45.3	99.8	173
		60	3.5	6.0	9.0	13.0	18.2	33.6	53.2	109	184
		90	4.8	7.9	12.2	17.2	23.7	40.2	61.9	119	193
	C	30	2.2	3.3	5.2	7.6	10.1	17.4	28.4	65.8	122
		60	2.6	4.2	6.5	8.8	12.5	21.6	34.9	75.8	135
		90	3.4	5.3	7.9	11.6	15.6	26.7	42.5	86.4	146
00	A and B	30	2.9	4.8	6.8	9.6	13.7	24.6	40.0	86.9	152
		60	3.7	6.0	9.0	12.6	17.7	30.6	47.9	97.0	163
		90	5.0	8.1	11.9	16.8	23.0	37.5	56.5	107	171
	C	30	2.3	3.6	5.2	7.6	10.1	16.8	26.6	58.1	106
		60	2.8	4.3	6.3	9.0	12.2	21.0	32.4	68.2	117
		90	3.4	5.4	8.1	11.3	15.1	26.1	39.6	77.8	129
0000	A and B	30	3.1	5.0	7.2	10.1	13.2	22.8	35.7	71.1	121
		60	4.1	6.5	9.4	13.0	17.3	28.8	43.2	81.6	133
		90	5.5	8.7	12.8	17.0	22.3	35.7	51.8	91.2	144
	C	30	2.5	3.9	5.6	7.8	10.1	16.8	25.2	50.9	88.8
		60	3.0	4.8	6.8	9.5	12.7	20.4	30.6	60.0	101
		90	3.8	6.2	8.6	11.8	15.9	26.1	37.8	69.2	112

Table 44.—Sags for Medium and Hard-Drawn Bare Solid Copper Wire—Continued

MEDIUM LOADING DISTRICT

[The sags being such that when loaded at 15° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C]

Size A.W.G. No.	Grade of construction	Temperature	Sags (inches) for span lengths (feet) of—										
			100	125	150	175	200	250	300	400	500	700	1,000
		°F.											
8	B	30	2.8	5.3	10.1	-----	-----	-----	-----	-----	-----	-----	-----
		60	3.4	6.9	13.7	-----	-----	-----	-----	-----	-----	-----	-----
		90	4.4	9.4	18.7	-----	-----	-----	-----	-----	-----	-----	-----
	C	30	2.0	3.3	5.6	-----	-----	-----	-----	-----	-----	-----	-----
		60	2.3	3.9	6.7	-----	-----	-----	-----	-----	-----	-----	-----
		90	2.8	4.9	8.8	-----	-----	-----	-----	-----	-----	-----	-----
6	A and B	30	2.4	3.9	6.5	10.1	-----	-----	-----	-----	-----	-----	-----
		60	2.9	5.1	8.1	13.0	-----	-----	-----	-----	-----	-----	-----
		90	3.7	6.6	10.8	17.2	-----	-----	-----	-----	-----	-----	-----
	C	30	1.9	3.1	4.7	6.7	-----	-----	-----	-----	-----	-----	-----
		60	2.2	3.4	5.4	8.0	-----	-----	-----	-----	-----	-----	-----
		90	2.6	4.3	6.5	9.7	-----	-----	-----	-----	-----	-----	-----
4	A and B	30	2.3	3.3	5.4	8.0	11.0	20.4	36.0	86.4	-----	-----	-----
		60	2.8	4.3	6.7	9.6	13.9	25.8	43.9	96.5	-----	-----	-----
		90	3.4	5.5	8.6	12.4	17.8	32.1	52.2	106.0	-----	-----	-----
	C	30	1.9	3.0	4.5	6.1	8.2	13.5	21.9	53.8	-----	-----	-----
		60	2.2	3.3	5.0	6.9	9.4	16.2	26.6	63.4	-----	-----	-----
		90	2.6	3.9	5.9	8.2	11.3	19.5	32.4	74.4	-----	-----	-----
2	A and B	30	2.3	3.6	5.4	7.6	10.1	17.1	27.7	61.0	112.0	259	-----
		60	2.9	4.2	6.7	9.2	12.5	21.6	33.8	71.0	125.0	273	-----
		90	3.4	5.5	8.3	11.8	15.8	26.7	42.1	81.6	136.0	284	-----
	C	30	1.9	3.0	4.5	6.1	8.2	12.6	19.8	41.3	75.0	189	-----
		60	2.2	3.5	5.0	6.9	9.1	15.3	23.0	49.0	86.4	204	-----
		90	2.6	4.0	5.9	8.4	11.3	18.3	28.1	57.1	98.4	218	-----
1	A and B	30	2.4	3.6	5.4	7.6	10.1	17.1	25.9	54.7	99.1	227	-----
		60	2.9	4.5	6.7	9.2	12.5	21.3	31.7	64.3	111.0	242	-----
		90	3.6	5.7	8.5	11.8	15.9	26.1	38.9	74.9	122.0	255	-----
	C	30	2.0	3.1	4.3	5.7	8.2	13.2	19.4	38.4	68.4	166	-----
		60	2.3	3.4	5.0	7.1	9.1	15.0	23.0	45.1	78.6	181	-----
		90	2.8	4.2	6.3	8.4	11.3	18.6	27.3	53.2	90.0	196	-----
0	A and B	30	2.5	3.7	5.6	7.6	10.3	16.8	25.2	51.8	90.0	205	-----
		60	3.0	4.6	6.8	9.4	12.7	21.0	31.0	61.4	103.0	220	-----
		90	3.8	6.0	8.8	12.0	15.6	26.1	37.8	71.0	114.0	233	-----
	C	30	2.0	3.1	4.5	6.3	8.4	13.2	19.4	37.4	64.8	151	-----
		60	2.4	3.6	5.2	7.3	9.6	15.6	23.0	44.2	74.4	165	-----
		90	2.9	4.5	6.5	8.8	11.5	19.2	27.4	51.8	86.4	181	-----
00	A and B	30	2.6	3.9	5.8	7.8	10.6	17.1	25.2	50.4	85.2	190	422
		60	3.1	4.9	6.8	9.7	13.0	20.7	31.0	59.5	97.2	204	439
		90	4.1	6.3	9.0	12.2	16.3	26.4	37.8	69.1	109.0	218	455
	C	30	2.2	3.3	4.7	6.3	8.4	13.5	19.8	37.4	62.4	141	329
		60	2.5	3.7	5.4	7.6	10.1	15.9	23.4	44.6	72.0	154	346
		90	3.0	4.6	6.7	9.0	12.0	19.2	28.1	51.8	82.8	171	366
0000	A and B	30	2.6	4.2	6.1	8.2	11.0	17.4	25.9	49.6	81.6	171	374
		60	3.2	5.4	7.6	10.5	13.4	22.2	31.7	57.6	93.0	185	392
		90	4.4	6.9	10.1	13.4	17.5	27.0	38.9	67.6	104.0	201	410
	C	30	2.2	3.4	4.9	6.9	8.9	13.8	20.5	37.4	61.8	132	299
		60	2.8	4.0	5.8	8.0	10.8	16.8	24.1	44.6	70.8	146	317
		90	3.2	5.3	7.4	10.1	13.2	20.7	29.9	51.8	81.6	161	337

Table 44.—Sags for Medium and Hard-Drawn Bare Solid Copper Wire—Continued

LIGHT LOADING DISTRICT

[The sags being such that when loaded at 30° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B, and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags (inches) for span lengths (feet) of—										
			100	125	150	175	200	250	300	400	500	700	1,000
		° F.											
8	B	30	1.9	3.0	4.5								
		60	2.3	3.6	5.0								
		90	2.6	4.2	6.1								
	C	30	1.6	2.5	3.6	5.0							
		60	1.9	2.8	4.3	5.7							
		90	2.2	3.3	4.8	6.3							
6	A and B	30	2.0	3.1	4.7	6.1	8.2						
		60	2.3	3.4	5.2	7.1	9.4						
		90	2.8	4.3	6.3	8.4	11.5						
	C	30	1.7	2.7	4.0	5.0	6.7						
		60	2.0	3.0	4.5	5.9	7.7						
		90	2.2	3.4	4.9	6.7	8.6						
4	A and B	30	2.0	3.1	4.7	6.3	8.2	12.9	18.7	35.5	58.2		
		60	2.4	3.6	5.2	7.1	9.4	15.0	22.0	41.3	67.2		
		90	2.9	4.3	6.5	8.8	11.5	18.0	26.6	49.0	78.0		
	C	30	1.7	2.8	3.8	5.0	6.7	10.8	15.1	27.8	45.0		
		60	1.9	3.0	4.5	6.1	7.9	12.0	17.3	31.7	51.0		
		90	2.3	3.4	5.0	6.7	8.9	13.8	20.2	36.5	58.8		
2	A and B	30	2.2	3.3	4.9	6.3	8.4	13.2	19.4	35.5	58.2	124.0	
		60	2.5	3.6	5.4	7.6	10.1	15.6	22.3	41.3	67.2	138.0	
		90	3.0	4.6	6.5	9.0	12.0	18.9	27.0	49.5	76.8	153.0	
	C	30	1.7	2.7	4.3	5.5	7.0	10.8	15.8	28.8	45.6	97.4	
		60	2.0	3.3	4.7	6.1	8.2	12.6	18.0	33.1	52.2	107.0	
		90	2.4	3.4	5.2	7.1	9.1	15.3	20.9	37.9	60.0	122.0	
1	A and B	30	2.2	3.3	4.9	6.5	8.6	13.5	19.8	36.5	58.2	124.0	276
		60	2.6	3.9	5.8	7.6	10.1	16.2	23.0	42.2	67.2	139.0	294
		90	3.1	4.8	6.8	9.5	12.5	19.5	27.7	49.9	78.0	154.0	315
	C	30	1.8	2.7	4.1	5.5	7.2	11.1	15.8	29.3	46.2	97.4	216
		60	2.2	3.3	4.7	6.3	8.2	12.9	18.7	33.6	53.4	109.0	234
		90	2.5	3.8	5.4	7.4	9.6	15.0	22.0	39.4	61.2	122.0	252
0	A and B	30	2.2	3.3	5.0	6.7	8.6	13.8	20.2	36.9	60.0	124.0	274
		60	2.6	4.0	5.9	8.0	10.6	16.8	23.7	43.2	69.0	138.0	293
		90	3.2	5.1	7.2	9.9	13.0	20.4	28.8	50.9	79.2	154.0	312
	C	30	1.9	3.0	4.3	5.7	7.4	11.4	16.6	29.7	47.4	97.5	216
		60	2.2	3.3	4.9	6.5	8.6	13.5	19.1	34.5	54.6	109.0	234
		90	2.5	3.9	5.8	7.8	10.1	15.6	22.3	40.8	63.0	123.0	252
00	A and B	30	2.3	3.4	5.0	6.9	9.1	14.4	20.9	37.4	60.0	124.0	273
		60	2.8	4.4	6.3	8.4	11.0	16.8	24.5	44.2	69.6	139.0	291
		90	3.4	5.4	7.7	10.3	13.4	21.0	30.2	51.8	80.4	153.0	312
	C	30	1.9	3.2	4.5	5.9	7.7	12.0	17.3	30.7	48.6	99.2	216
		60	2.2	3.4	5.0	6.7	8.9	13.8	19.4	36.0	55.8	112.0	234
		90	2.6	4.1	5.9	8.0	10.6	16.2	23.0	41.3	64.2	125.0	252
0000	A and B	30	2.5	3.8	5.4	7.4	9.8	15.3	21.9	39.8	63.6	129.0	274
		60	3.0	4.6	6.5	8.8	11.8	18.6	26.3	46.1	73.2	144.0	293
		90	3.8	5.9	8.5	11.3	14.9	23.2	32.0	55.7	84.0	158.0	312
	C	30	2.1	3.3	4.7	6.3	8.2	12.6	18.0	32.6	51.6	104.0	222
		60	2.5	3.6	5.4	7.4	9.4	15.3	20.9	37.4	59.4	116.0	241
		90	2.9	4.5	6.5	8.8	11.5	17.7	25.2	44.6	69.0	131.0	259

Table 45.—Sags for Medium and Hard-Drawn Bare Stranded Copper Wire

HEAVY LOADING DISTRICT

[The sags being such that when loaded at 0° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B, and 60 per cent for grade C]

Size A.W.G. No.	Grade of construction	Temperature	Sags (inches) for span lengths (feet) of—								
			100	125	150	200	250	350	500	700	1,000
		°F.									
4	A and B	30	2.9	5.4	10.4	32.6	67.2	------	------	------	------
		60	3.6	7.2	14.4	39.4	72.6	------	------	------	------
		90	5.0	10.2	19.4	45.1	79.2	------	------	------	------
	C	30	2.2	3.6	5.7	14.9	36.0	------	------	------	------
		60	2.6	4.2	7.2	19.2	43.8	------	------	------	------
		90	3.1	5.4	9.4	25.0	51.6	------	------	------	------
2	A and B	30	2.6	4.5	7.2	16.8	36.0	99.1	240	------	------
		60	3.4	5.7	9.4	22.1	43.8	107.0	248	------	------
		90	4.3	7.8	13.0	28.3	51.6	115.0	256	------	------
	C	30	2.2	3.3	5.0	10.1	19.8	62.2	176	------	------
		60	2.4	3.9	5.7	12.5	25.2	72.2	186	------	------
		90	2.9	4.8	7.5	15.8	31.2	81.5	196	------	------
1	A and B	30	2.6	4.5	6.8	14.9	31.2	82.3	203	438	------
		60	3.4	5.7	9.0	19.7	36.6	90.7	212	447	------
		90	4.6	7.5	11.9	25.0	44.4	100.0	221	454	------
	C	30	2.2	3.3	5.0	10.1	17.4	51.2	146	338	761
		60	2.6	3.9	6.1	12.0	23.4	59.6	157	348	770
		90	3.1	5.1	7.9	15.4	27.6	69.7	167	358	780
0	A and B	30	2.6	4.2	6.5	12.5	23.4	63.0	161	349	787
		60	3.1	5.4	7.9	15.8	29.4	72.2	172	368	797
		90	4.3	6.9	10.8	21.1	37.2	82.3	181	378	806
	C	30	2.2	3.3	5.0	9.1	15.6	38.6	113	270	624
		60	2.4	3.9	5.8	11.0	19.8	47.0	119	282	634
		90	2.9	4.8	6.8	13.4	23.4	50.4	137	296	648
00	A and B	30	2.6	4.2	6.5	12.5	21.6	54.6	140	307	682
		60	3.4	5.4	7.9	15.4	27.0	63.8	144	319	691
		90	4.3	7.2	10.4	20.2	33.6	73.1	149	331	698
	C	30	2.2	3.3	4.7	9.1	15.0	36.1	96	232	535
		60	2.6	3.9	5.8	10.6	18.0	42.8	107	245	547
		90	3.1	4.8	7.2	13.0	22.2	51.2	120	259	562
0000	A and B	30	2.6	4.2	6.1	11.5	18.6	42.0	102	222	506
		60	3.1	5.1	7.6	13.9	22.8	50.4	114	244	523
		90	4.3	6.9	9.7	18.2	28.8	58.8	126	257	535
	C	30	2.2	3.3	4.7	8.6	13.8	30.2	73	160	396
		60	2.6	3.9	5.7	10.0	16.8	36.1	84	176	413
		90	3.1	4.8	6.8	12.5	21.0	43.7	96	188	432

Table 45.—Sags for Medium and Hard-Drawn Bare Stranded Copper Wire—Continued.

MEDIUM LOADING DISTRICT

[The sags being such that when loaded at 15° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B, and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags (inches) for span lengths (feet) of—								
			100	125	150	200	250	350	500	700	1,000
		°F.									
4	A and B	30	2.2	3.6	5.4	11.0	19.8	60.5	------	------	------
		60	2.6	4.2	6.5	13.4	25.8	69.7	------	------	------
		90	3.1	5.4	8.3	16.8	29.4	79.8	------	------	------
	C	30	1.9	3.0	4.3	8.2	13.2	36.1	------	------	------
		60	2.2	3.3	5.0	9.1	15.6	42.8	------	------	------
		90	2.4	3.9	5.7	11.0	19.8	49.6	------	------	------
2	A and B	30	2.4	3.6	5.0	10.1	16.8	41.2	112	260	590
		60	2.6	4.2	6.1	12.0	20.4	49.6	124	274	602
		90	3.4	5.4	7.9	15.4	25.2	58.8	133	286	614
	C	30	1.9	3.0	4.3	7.7	12.6	27.7	74.4	188	458
		60	2.2	3.3	5.0	9.1	14.4	33.6	85.2	203	473
		90	2.6	3.9	5.7	11.0	17.4	39.5	97.2	217	487
1	A and B	30	2.4	3.6	5.4	10.1	16.8	37.8	99.6	230	521
		60	2.9	4.5	6.5	12.0	19.8	45.4	112	244	538
		90	3.4	5.7	7.9	14.9	25.2	53.8	124	257	550
	C	30	1.9	3.0	4.3	7.7	12.6	27.7	68.4	166	403
		60	2.2	3.3	5.0	9.1	15.0	31.9	79.2	183	420
		90	2.6	4.2	6.1	11.0	17.4	38.6	90.0	197	437
0	A and B	30	2.4	3.6	5.0	9.6	15.6	34.4	85.2	191	446
		60	2.9	4.2	6.5	11.5	18.6	41.2	96.0	210	461
		90	3.4	5.4	7.9	14.4	23.4	49.6	109	225	475
	C	30	1.9	3.0	4.3	7.7	12.0	25.2	60.0	141	343
		60	2.2	3.3	5.0	8.6	14.4	30.2	69.6	156	360
		90	2.6	3.9	5.8	10.6	16.8	35.3	79.2	171	379
00	A and B	30	2.4	3.6	5.4	9.6	15.6	33.6	79.2	176	396
		60	2.9	4.5	6.5	11.5	18.6	40.3	91.2	191	415
		90	3.6	5.7	7.9	14.9	22.8	47.0	102	207	430
	C	30	1.9	3.0	4.3	7.7	12.6	26.0	58.8	133	305
		60	2.4	3.3	5.0	9.1	14.4	30.2	67.2	146	324
		90	2.9	4.2	6.1	11.0	16.8	39.5	76.8	161	343
0000	A and B	30	2.4	3.6	5.4	9.6	15.0	31.1	69.6	149	331
		60	2.9	4.5	6.5	11.5	18.0	37.8	80.4	173	350
		90	3.6	5.7	8.3	14.4	22.2	43.7	91.2	180	367
	C	30	1.9	3.0	4.3	7.7	12.0	25.2	52.8	114	259
		60	2.4	3.6	5.0	9.1	14.4	28.6	62.4	128	276
		90	2.6	4.2	6.1	10.6	16.8	34.4	72.0	143	298

Table 45.—Sags for Medium and Hard-Drawn Bare Stranded Copper Wire—Continued.

LIGHT LOADING DISTRICT

[The sags being such that when loaded at 30° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B, and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags (inches) for span lengths (feet) of—								
			100	125	150	200	250	350	500	700	1,000
		°F.									
4	A and B	30	1.9	3.0	4.3	7.7	12.0	25.2	61.2	-------	------
		60	2.4	3.6	5.0	9.1	14.4	30.2	70.8	-------	------
		90	2.9	4.2	6.1	11.0	17.4	37.0	81.6	-------	------
	C	30	1.7	2.4	3.6	6.7	10.2	21.0	45.6	-------	------
		60	1.9	3.0	4.3	7.2	11.4	23.5	52.8	-------	------
		90	2.2	3.3	4.7	8.6	13.8	27.7	60.0	-------	------
2	A and B	30	2.2	3.3	4.7	8.2	12.6	26.9	58.8	129	------
		60	2.4	3.6	5.4	9.6	15.0	30.2	67.2	143	------
		90	2.9	4.5	6.5	11.5	18.0	37.0	78.0	158	------
	C	30	1.7	2.4	4.0	6.7	10.2	21.0	45.6	99.1	------
		60	1.9	3.0	4.3	7.7	12.0	24.4	51.6	111	------
		90	2.4	3.6	5.0	9.1	13.8	27.7	60.0	124	------
1	A and B	30	2.2	3.3	4.7	8.2	13.2	26.9	46.8	128	290
		60	2.4	3.6	5.4	9.6	15.6	31.1	68.4	141	307
		90	2.9	4.8	6.8	12.0	19.2	38.6	78.0	156	328
	C	30	1.9	2.7	4.0	7.2	10.8	21.8	46.8	99.1	223
		60	2.2	3.0	4.3	8.2	12.6	25.2	54.0	111	242
		90	2.4	3.6	5.0	9.6	14.4	29.4	61.2	124	262
0	A and B	30	2.2	3.3	4.7	8.2	12.6	26.7	57.6	121	271
		60	2.4	3.6	5.4	9.6	15.0	30.2	66.0	134	290
		90	2.9	4.5	6.5	12.0	18.0	37.0	75.6	149	310
	C	30	1.7	2.7	4.0	6.7	10.8	21.8	45.6	95.8	211
		60	1.9	3.3	4.7	7.7	12.6	24.4	52.8	106	228
		90	2.4	3.6	5.4	9.1	14.4	28.6	60.0	119	247
00	A and B	30	2.2	3.3	4.7	8.2	13.2	26.9	57.6	102	264
		60	2.4	3.6	5.8	10.1	15.6	31.1	66.0	133	281
		90	3.1	4.8	6.8	12.0	19.2	37.8	76.8	148	302
	C	30	1.9	3.0	4.3	7.2	10.8	21.8	46.8	94.1	209
		60	2.2	3.3	4.7	8.2	12.6	25.2	52.8	106	226
		90	2.4	3.6	5.4	9.6	15.0	29.4	60.0	119	242
0000	A and B	30	2.2	3.3	4.7	8.6	13.2	26.9	56.4	116	247
		60	2.6	3.9	5.8	10.1	15.6	31.1	64.8	129	266
		90	3.1	4.8	6.8	12.5	19.2	37.0	74.4	143	286
	C	30	1.9	3.0	4.3	7.2	10.8	22.7	46.8	92.4	199
		60	2.2	3.3	4.7	8.2	12.6	25.2	52.8	104	216
		90	2.4	3.6	5.4	9.6	15.0	29.4	61.2	116	235

Table 46.—Sags for Medium and Hard-Drawn T. B. W. P. Solid Copper Wire

HEAVY LOADING DISTRICT

[The sags being such that when loaded at 0° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B, and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags (inches) for span lengths (feet) of—						
			100	125	150	175	200	250	300
		°F.							
8	C	30	10.2	29.7	50.4				
		60	13.3	31.5	53.6				
		90	17.2	35.1	56.6				
6	A and B	30	8.7	23.1	37.1				
		60	12.2	26.6	44.7				
		90	15.6	30.6	48.1				
	C	30	4.1	9.7	22.5	38.9			
		60	5.4	12.7	27.7	44.1			
		90	7.2	16.9	32.0	48.5			
4	A and B	30	4.4	9.6	18.4	32.8	48.7		
		60	6.1	12.4	23.0	38.0	54.2		
		90	8.2	16.6	28.1	42.9	58.8		
	C	30	2.9	5.3	9.2	16.2	26.4		
		60	3.7	6.6	11.5	20.2	32.6		
		90	4.6	8.4	15.1	25.4	38.9		
2	A and B	30	3.8	6.6	11.2	18.7	28.3	55.5	90.0
		60	5.0	8.7	14.8	23.1	34.1	62.4	97.2
		90	6.5	11.5	18.9	28.6	40.1	68.4	104
	C	30	3.0	4.8	7.4	11.3	16.3	33.3	60.2
		60	3.5	5.7	9.0	14.3	20.1	39.6	67.4
		90	4.3	7.1	11.5	17.2	25.0	46.2	75.6
1	A and B	30	3.6	6.1	9.7	15.5	22.6	44.4	73.4
		60	4.6	7.8	12.6	19.7	38.1	52.2	81.8
		90	6.2	10.8	16.7	24.6	34.1	58.2	88.2
	C	30	2.8	4.6	6.8	10.1	13.9	27.3	46.1
		60	3.2	5.5	8.5	12.2	17.7	33.6	55.1
		90	4.2	6.9	10.6	15.7	21.8	40.2	62.3
0	A and B	30	3.7	6.0	9.4	14.1	20.6	38.4	62.6
		60	4.8	7.8	12.1	17.8	25.4	45.0	70.6
		90	6.4	10.6	15.6	22.9	31.2	52.8	78.2
	C	30	2.8	4.6	6.8	9.9	13.7	24.6	41.0
		60	3.5	5.5	8.1	12.2	16.8	30.3	48.6
		90	4.4	6.7	10.1	14.9	20.9	35.7	55.8
00	A and B	30	3.6	6.0	9.0	13.2	18.5	33.6	54.0
		60	4.6	7.8	11.5	16.8	23.0	39.9	61.9
		90	6.1	10.5	15.1	21.4	28.5	46.8	70.9
	C	30	2.6	4.6	7.0	9.7	13.2	22.8	36.0
		60	3.2	5.5	8.3	11.8	16.1	27.6	43.6
		90	4.2	6.9	10.4	14.5	20.1	33.6	50.8
0000	A and B	30	3.7	6.0	9.0	12.6	17.5	28.8	45.0
		60	4.8	7.8	11.5	16.2	21.1	34.8	53.3
		90	6.6	10.5	15.1	20.4	27.1	42.0	61.2
	C	30	2.9	4.6	6.8	9.7	12.7	20.4	32.4
		60	3.6	5.7	8.5	11.8	15.6	25.5	38.9
		90	4.6	7.4	10.4	14.5	19.7	30.9	45.7

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Table 46.—Sags for Medium and Hard-Drawn T. B. W. P. Solid Copper Wire—Continued

MEDIUM LOADING DISTRICT

[The sags being such that when loaded at 15° F, the wires will be stressed to 50 per cent of their ultimate strength for grades A and B, and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags (inches) for span lengths (feet) of—						
			100	125	150	175	200	250	300
		°F.							
8	B	30	4.8	11.2	23.2				
		60	6.2	14.7	27.3				
		90	8.6	18.4	32.1				
	C	30	3.2	6.0	10.8				
		60	3.7	7.4	13.7				
		90	4.6	9.3	17.3				
6	A and B	30	3.6	6.6	11.5	19.7			
		60	4.4	8.3	14.8	24.4			
		90	5.8	10.8	19.1	29.6			
	C	30	2.8	4.6	7.2	11.1			
		60	3.1	5.4	8.6	13.6			
		90	3.6	6.6	10.6	16.8			
4	A and B	30	3.0	5.1	7.9	11.8	17.3		
		60	3.7	6.1	9.7	14.9	21.6		
		90	4.7	7.8	12.6	18.9	26.6		
	C	30	2.5	4.0	5.8	8.6	11.5		
		60	2.9	4.5	6.8	10.1	13.7		
		90	3.4	5.4	8.1	12.2	16.8		
2	A and B	30	3.0	4.8	7.2	10.7	14.4	25.8	41.8
		60	3.7	6.0	8.1	13.0	18.0	31.2	49.7
		90	4.7	7.6	11.2	16.4	22.1	37.5	56.9
	C	30	2.5	4.0	5.8	8.0	10.8	18.6	28.8
		60	2.9	4.5	6.7	9.2	12.7	21.0	33.8
		90	3.5	5.4	8.1	11.3	15.4	25.5	40.3
1	A and B	30	2.9	4.8	7.2	10.1	13.7	23.4	36.7
		60	3.6	5.8	8.6	12.2	16.8	28.5	43.9
		90	4.6	7.5	11.0	15.1	20.9	34.5	50.8
	C	30	2.5	4.0	5.8	7.8	10.3	17.4	26.6
		60	2.8	4.5	6.7	9.2	12.2	19.8	31.0
		90	3.4	5.4	7.9	10.9	14.9	24.3	36.7
0	A and B	30	3.1	4.9	7.2	10.1	13.7	23.4	34.5
		60	3.8	6.0	8.8	12.2	16.8	28.2	40.7
		90	4.9	7.8	11.2	15.5	20.9	34.2	49.0
	C	30	2.6	4.2	5.8	8.0	10.8	17.4	25.2
		60	3.0	4.8	6.8	9.2	12.7	20.4	29.5
		90	3.7	5.7	8.1	11.3	15.1	24.6	35.3
00	A and B	30	3.2	5.1	7.2	10.1	13.4	22.2	34.2
		60	4.0	6.0	9.0	12.6	16.6	26.7	40.3
		90	5.0	7.9	11.5	15.9	20.6	32.7	47.2
	C	30	2.5	4.1	5.8	8.2	10.6	17.1	25.9
		60	2.9	4.8	6.8	9.7	12.5	20.1	30.2
		90	3.6	5.7	8.3	10.8	15.4	24.3	35.6
0000	A and B	30	3.1	5.1	7.6	10.5	13.7	21.6	32.8
		60	4.1	6.5	9.4	12.6	16.8	26.4	39.2
		90	5.4	8.4	12.1	16.4	21.1	32.4	45.7
	C	30	2.6	4.2	6.1	8.4	10.8	16.8	25.9
		60	3.1	5.0	7.2	10.1	12.7	20.4	30.2
		90	3.9	6.2	9.0	12.2	15.8	24.6	36.0

Table 46.—Sags for Medium and Hard-Drawn T. B. W. P. Solid Copper Wire—Continued

LIGHT LOADING DISTRICT

[The sags being such that when loaded at 30° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags (inches) for span lengths (feet) of—						
			100	125	150	175	200	250	300
		°F.							
8	B	30	3.1	5.1	7.7	--------	--------	--------	--------
		60	3.6	6.0	9.4	--------	--------	--------	--------
		90	4.4	7.5	11.2	--------	--------	--------	--------
	C	30	2.4	3.9	5.9	8.2	--------	--------	--------
		60	2.9	4.6	6.7	9.2	--------	--------	--------
		90	3.2	5.3	7.7	11.3	--------	--------	--------
6	A and B	30	2.8	4.6	6.8	9.7	13.2	--------	--------
		60	3.0	5.4	8.1	11.6	15.8	--------	--------
		90	3.8	6.5	9.9	14.1	19.2	--------	--------
	C	30	2.4	3.8	5.6	7.6	10.1	--------	--------
		60	2.8	4.3	6.5	8.8	11.5	--------	--------
		90	3.0	4.9	7.4	10.5	13.7	--------	--------
4	A and B	30	2.8	4.2	6.3	8.6	11.8	--------	--------
		60	3.1	4.8	7.0	10.1	13.7	--------	--------
		90	3.7	5.9	8.6	12.2	16.6	--------	--------
	C	30	2.4	3.6	5.0	7.1	9.1	--------	--------
		60	2.6	3.9	5.8	8.0	10.3	--------	--------
		90	2.9	4.5	6.5	9.0	12.5	--------	--------
2	A and B	30	2.8	4.3	6.1	8.4	11.8	18.3	27.3
		60	3.2	5.1	7.2	10.1	13.4	21.9	32.0
		90	4.1	6.2	8.6	12.2	16.8	25.8	37.8
	C	30	2.4	3.6	5.0	7.1	9.6	15.0	21.6
		60	2.6	4.2	5.8	8.0	10.6	16.8	24.5
		90	2.9	4.8	6.8	9.7	12.5	19.8	28.8
1	A and B	30	2.6	4.2	6.1	8.4	11.3	17.4	26.6
		60	2.9	4.9	7.2	10.1	13.2	21.0	31.3
		90	4.0	6.2	8.6	12.2	16.3	25.5	36.7
	C	30	2.3	3.8	5.0	7.1	9.1	14.4	20.9
		60	2.6	4.0	5.8	7.8	10.6	16.8	24.5
		90	3.0	4.8	6.8	9.2	12.5	19.2	28.4
0	A and B	30	2.8	4.5	6.3	9.0	11.5	18.0	27.3
		60	3.4	5.3	7.6	10.7	13.9	21.6	32.0
		90	4.2	6.6	9.4	12.8	16.8	26.4	37.4
	C	30	2.4	3.8	5.2	7.1	9.6	15.0	22.0
		60	2.8	4.3	6.1	8.4	11.0	17.1	25.2
		90	3.1	5.1	7.2	10.1	13.0	20.1	29.1
00	A and B	30	2.8	4.5	6.5	8.8	11.5	18.3	27.0
		60	3.5	5.4	7.9	10.1	13.4	21.6	31.3
		90	4.3	6.6	9.7	12.8	16.6	26.7	37.4
	C	30	2.4	5.9	5.4	7.1	9.6	15.0	21.6
		60	2.6	4.2	6.5	8.2	11.0	17.1	25.2
		90	3.2	5.1	7.4	10.1	13.2	20.4	29.5
0000	A and B	30	2.9	4.5	6.7	8.8	11.5	18.6	27.3
		60	3.5	5.4	7.9	10.9	14.4	22.2	32.4
		90	4.6	7.2	9.9	13.6	17.7	27.0	38.6
	C	30	2.6	3.9	5.6	7.6	9.6	15.3	22.7
		60	2.8	4.5	6.5	9.0	11.3	17.4	26.3
		90	3.5	5.4	7.9	10.5	13.4	21.0	31.0

Table 47.—Sags for T. B. W. P. Solid Soft Copper Wire

HEAVY LOADING DISTRICT

[The sags being such that when loaded at 0° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags (inches) for span lengths (feet) of—					
			100	125	150	175	200	250
		°F.						
6	C	30	29.1	50.2	76.9			
		60	31.4	52.8	78.9			
		90	33.6	55.2	81.0			
4	A and B	30	22.8	39.3	60.1			
		60	25.8	42.5	62.8			
		90	28.4	45.3	65.5			
	C	30	14.5	28.3	45.5			
		60	18.1	32.0	48.9			
		90	21.6	35.0	50.4			
2	A and B	30	12.4	22.9	37.1	53.4	72.8	
		60	16.1	27.3	41.2	58.0	76.3	
		90	19.7	30.9	45.0	61.4	80.6	
	C	30	7.2	14.2	25.1	38.7	55.0	
		60	10.1	18.6	30.2	43.9	59.3	
		90	14.0	23.1	34.7	48.3	63.8	
1	A and B	30	9.6	17.9	28.8	43.3	58.1	
		60	12.6	22.5	33.6	47.9	63.6	
		90	17.0	26.2	37.8	52.3	68.4	
	C	30	6.0	10.9	18.4	29.8	42.2	
		60	8.0	14.7	23.8	34.9	48.0	
		90	11.7	19.2	28.4	40.3	53.6	
0	A and B	30	7.8	14.4	23.6	35.3	48.2	
		60	11.3	18.9	28.3	40.5	53.3	
		90	15.0	23.1	33.1	45.0	57.2	
	C	30	5.4	9.4	15.5	23.9	34.6	
		60	7.4	12.9	20.2	29.4	40.1	
		90	10.6	16.8	25.0	34.4	45.8	
00	A and B	30	6.8	12.0	19.1	28.8	39.8	
		60	9.6	16.2	24.3	34.0	45.6	
		90	13.6	20.5	28.8	39.5	51.4	
	C	30	4.8	8.3	13.0	19.3	27.6	
		60	6.6	11.2	17.5	24.4	33.3	
		90	9.5	15.3	22.0	30.3	40.1	
0000	A and B	30	5.8	9.6	14.8	21.4	28.8	
		60	8.2	13.3	19.3	26.7	35.3	
		90	11.3	17.4	24.5	32.8	40.8	
	C	30	4.4	7.2	10.8	15.5	20.6	
		60	5.9	9.7	14.2	20.0	26.4	
		90	8.5	13.3	18.5	25.2	32.2	

Table 47.—Sags for T. B. W. P. Solid Soft Copper Wire—Continued

MEDIUM LOADING DISTRICTS

[The sags being such that when loaded at 15° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B, and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags (inches) for span lengths (feet) of—					
			100	125	150	175	200	250
		° F.						
6	C	30	8.8	19.7	33.8			
		60	12.2	23.8	38.2			
		90	15.8	27.7	42.1			
4	A and B	30	8.3	16.8	28.3	42.2		
		60	11.9	21.0	32.6	47.1		
		90	15.5	25.5	37.1	51.0		
	C	30	5.5	10.0	18.0	28.4		
		60	7.6	13.8	22.5	34.1		
		90	10.6	18.0	27.9	38.7		
2	A and B	30	6.0	10.5	16.9	26.9	37.2	
		60	8.3	14.1	21.8	31.7	43.2	
		90	11.7	18.4	26.8	37.6	48.7	
	C	30	4.4	7.5	11.5	17.6	25.9	
		60	6.0	10.0	15.3	22.7	31.2	
		90	8.0	13.5	19.6	27.7	37.4	
1	A and B	30	5.5	9.3	14.4	21.8	31.2	53.4
		60	7.4	12.7	18.7	27.1	36.7	60.6
		90	10.7	16.8	24.1	33.2	43.0	66.9
	C	30	4.1	6.9	10.4	14.7	21.6	38.4
		60	5.5	8.9	13.3	19.1	26.8	45.0
		90	7.4	11.8	17.8	23.9	32.6	52.2
0	A and B	30	5.3	8.9	13.3	19.3	26.6	47.4
		60	7.3	11.7	18.0	23.9	32.4	53.7
		90	10.1	16.1	22.5	30.0	38.6	61.0
	C	30	4.1	6.6	10.1	14.3	19.7	34.2
		60	5.4	8.7	13.0	18.3	24.5	40.5
		90	7.4	11.7	16.9	23.1	30.3	47.7
00	A and B	30	4.9	8.1	12.2	17.2	23.5	39.6
		60	6.7	10.9	16.0	22.0	28.8	47.4
		90	9.6	14.7	20.9	27.3	35.8	54.0
	C	30	3.8	6.5	9.4	12.8	17.7	29.7
		60	4.9	8.3	12.1	16.4	22.3	35.4
		90	6.8	11.1	15.8	20.8	28.1	42.6
0000	A and B	30	4.6	7.4	10.8	15.3	20.3	33.3
		60	6.2	10.0	14.4	19.3	25.7	39.9
		90	9.0	13.6	18.9	25.0	31.7	47.4
	C	30	3.7	5.9	8.6	12.2	15.6	25.8
		60	4.8	7.5	11.2	15.1	19.9	31.5
		90	6.7	10.3	14.6	19.1	24.8	38.1

Table 47.—Sags for T. B. W. P. Solid Soft Copper Wire—Continued

LIGHT LOADING DISTRICT

[The sags being such that when loaded at 30° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B, and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags (inches) for span lengths (feet) of— 100	125	150	175	200	250
6	A and B	30	6.1	11.2	18.7	--------	--------	--------
		60	8.4	14.8	23.4	--------	--------	--------
		90	11.5	18.9	28.3	--------	--------	--------
	C	30	5.0	7.8	12.2	--------	--------	--------
		60	6.6	10.1	15.8	--------	--------	--------
		90	8.8	13.3	18.9	--------	--------	--------
4	A and B	30	4.8	8.4	12.8	19.7	28.3	--------
		60	6.5	11.1	16.6	24.1	34.1	--------
		90	9.1	14.7	21.2	29.8	40.3	--------
	C	30	4.0	6.2	9.4	13.8	19.2	--------
		60	4.9	7.9	11.9	17.6	23.9	--------
		90	6.6	10.5	15.5	22.0	29.7	--------
2	A and B	30	4.7	7.5	10.8	15.9	22.1	37.2
		60	6.0	9.6	14.2	20.0	26.8	43.8
		90	8.4	12.9	18.4	24.8	32.6	51.0
	C	30	3.7	5.7	8.5	11.8	16.6	27.6
		60	4.6	7.4	10.4	14.7	20.3	33.3
		90	6.2	9.6	13.7	18.9	25.0	39.3
1	A and B	30	4.3	6.9	10.3	13.8	19.2	33.0
		60	5.6	9.1	13.0	18.5	23.9	39.3
		90	7.8	12.3	17.3	23.1	29.7	47.1
	C	30	3.4	5.5	7.9	11.1	15.1	25.2
		60	4.3	6.9	10.1	13.8	18.2	30.3
		90	5.9	9.1	13.1	17.6	23.4	36.6
0	A and B	30	4.2	6.8	10.1	14.3	18.7	31.8
		60	5.8	8.9	12.8	17.4	23.7	37.2
		90	7.8	12.0	17.1	22.3	29.1	43.5
	C	30	3.7	5.5	7.9	11.1	14.9	24.3
		60	4.4	7.1	10.1	13.6	18.5	30.0
		90	6.0	9.1	13.0	17.4	23.0	36.0
00	A and B	30	4.1	6.3	9.7	13.0	17.5	29.4
		60	5.3	8.7	12.2	16.4	21.8	34.8
		90	7.6	11.7	16.0	21.4	27.6	42.0
	C	30	3.2	5.4	7.9	10.9	14.4	22.8
		60	4.2	6.6	9.7	13.4	17.5	27.6
		90	5.6	8.9	12.6	17.0	21.8	33.9
0000	A and B	30	3.8	6.0	9.0	12.4	16.3	25.8
		60	5.2	8.1	11.7	15.5	20.6	31.8
		90	7.2	10.8	15.5	20.2	25.9	38.4
	C	30	3.1	5.1	7.7	10.3	13.7	21.0
		60	4.1	6.3	9.4	12.6	16.8	25.8
		90	5.5	8.4	12.1	16.2	20.9	31.5

Table 48.—Sags for Ordinary Grade Steel Wire

HEAVY LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 0° F. the wire will be stressed to 50 per cent of ultimate strength for grades A and B and to 60 per cent for grade C]

Steel wire gage No.	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of—								
			100	125	150	175	200	250	300	400	500
		° F.									
8	C	30	4.1	12.5	26.0						
		60	6.2	16.5	30.0						
		90	11.1	20.0	33.5						
6	A and B	30	4.7	12.0	24.5						
		60	7.4	16.0	28.5						
		90	11.0	20.0	32.0						
	C	30	2.5	5.4	11.2	22.0	35.0	65.0	104	213	341
		60	3.6	7.7	15.5	27.0	40.5	70.0	109	216	344
		90	5.3	11.2	20.5	31.5	45.0	75.0	113	220	348
4	A and B	30	3.1	6.6	13.0	22.0	34.5	64.0	99	189	309
		60	4.7	9.8	17.5	27.5	40.0	69.0	104	193	314
		90	7.4	14.0	22.0	32.5	44.0	73.0	108	197	318
	C	30	2.2	3.7	6.3	11.1	18.0	41.0	71	147	245
		60	2.8	5.1	9.2	15.5	24.0	47.5	77	152	250
		90	4.0	7.2	12.5	20.5	29.5	53.0	82	158	256

MEDIUM LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 15° F. the wire will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

8	C	30	1.9	3.1	5.2						
		60	2.4	4.1	6.8						
		90	3.1	5.5	9.7						
6	A and B	30	2.2	3.9	6.3						
		60	2.9	5.3	8.6						
		90	4.3	7.5	12.0						
	C	30	1.7	2.7	4.3	6.3	9.4	18.5	34.5	85	161
		60	2.0	3.5	5.4	8.2	12.0	23.5	42.0	93	169
		90	2.6	4.5	7.2	11.1	16.0	30.5	49.5	101	177
4	A and B	30	2.0	3.4	5.4	7.8	11.3	22.0	38.5	88	150
		60	2.6	4.5	7.0	10.7	15.0	28.0	46.0	96	158
		90	3.8	6.3	9.9	14.5	20.0	34.5	53.0	104	166
	C	30	1.7	2.7	4.0	5.7	7.7	14.0	23.5	58	107
		60	2.0	3.3	4.9	6.9	9.6	17.5	29.0	67	117
		90	2.5	4.2	6.3	9.2	12.5	23.0	36.0	76	127

Table 48.—Sags for Ordinary Grade Steel Wire—Continued

LIGHT LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 30° F. the wire will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C.]

Steel wire gage No.	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of—								
			100	125	150	175	200	250	300	400	500
		° F.									
8	C	30	1.4	2.2	3.2	------	------	------	------	------	------
		60	1.7	2.8	4.0	------	------	------	------	------	------
		90	2.2	3.3	4.9	------	------	------	------	------	------
6	A and B	30	1.8	2.7	3.9	------	------	------	------	------	------
		60	2.3	3.5	5.0	------	------	------	------	------	------
		90	2.8	4.4	6.3	------	------	------	------	------	------
	C	30	1.4	2.2	3.2	4.6	5.8	9.6	14.5	27.5	48
		60	1.7	2.7	4.0	5.5	7.2	11.7	17	32.0	55
		90	2.2	3.3	4.7	6.5	8.9	14.0	21	39.0	64
4	A and B	30	1.7	2.7	4.0	5.5	7.2	11.7	17.5	33.5	54
		60	2.2	3.5	4.9	6.7	9.1	14.5	21.5	40.5	67
		90	2.8	4.5	6.3	8.8	11.5	18.5	26.5	48.0	77
	C	30	1.4	2.3	3.3	4.6	6.0	9.3	13.5	26.0	43
		60	1.7	2.7	4.0	5.5	7.2	11.4	17	30.5	50
		90	2.1	3.3	4.7	6.5	8.6	14.0	20	37.0	59

Table 49.—Sags for Siemens-Martin Steel Wire

HEAVY LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 0° F. the wire will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Steel wire gage No.	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of—							
			200	250	300	400	500	600	700	1,000
		° F.								
6	C	30	13.5	35.5	67.0	147	251	379	528	------
		60	18.5	42.5	73.0	152	256	384	533	------
		90	23.5	48.5	79.0	158	261	389	538	------
4	A and B	30	15.0	37.0	65.0	136	231	357	487	------
		60	20.5	43.5	72.0	143	237	362	492	------
		90	26.0	50.0	78.0	148	242	367	498	------
	C	30	8.2	17.5	36.0	94	172	268	382	815
		60	10.6	22.5	43.0	102	179	276	388	822
		90	14.0	29.0	51.0	110	188	282	395	830

Table 49.—Sags for Siemens-Martin Steel Wire—Continued

MEDIUM LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 15° F. the wire will be stressed to 50 per cent of ultimate strength for grades A and B and to 60 per cent for grade C]

Steel wire gage No.	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of—							
			200	250	300	400	500	600	700	1,000
		° F.								
6	C	30	5.5	10.5	17.5	48	100	161	242	559
		60	7.0	12.5	21.5	54	109	171	251	564
		90	8.7	16.0	27.0	63	119	181	262	578
4	A and B	30	7.2	12.5	21.0	52	98	162	235	534
		60	9.1	16.0	26.5	60	109	171	246	545
		90	11.5	20.0	33.0	70	118	182	255	555
	C	30	5.3	9.0	14.0	31	61	109	168	408
		60	6.3	11.1	17.0	37	71	120	182	420
		90	7.7	13.0	20.0	45	82	131	193	432

LIGHT LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 30° F. the wire will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

6	C	30	4.8	7.5	10.8	20.0	33.0	50	73	178
		60	5.3	8.4	12.5	23.0	38.0	58	83	196
		90	6.2	10.2	15.0	27.0	44.0	66	94	212
4	A and B	30	5.5	8.7	13.0	24.5	40.0	62	90	212
		60	6.7	10.8	15.5	29.0	47.5	72	103	229
		90	8.2	13.0	18.5	34.5	55.0	83	116	245
	C	30	4.8	7.2	10.4	18.5	32.0	49	69	158
		60	5.3	8.4	12.0	22.0	36.5	54	77	174
		90	6.2	9.9	14.5	26.0	42.0	62	86	192

Table 50.—Sags for High-Tension Steel Wire

HEAVY LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 0° F. the wire will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Steel wire gage No.	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of— 200	250	300	400	500	600	700	1,000
		° F.								
6	C	30	3.6	6.0	9.7	25.0	66.0	130	218	595
		60	4.0	6.8	11.2	30.0	75.0	143	231	602
		90	4.3	7.5	12.5	34.5	87.0	154	244	610
4	A and B	30	4.1	7.2	11.5	29.5	71.0	135	215	537
		60	4.7	8.2	13.5	34.5	82.0	147	225	547
		90	5.3	9.3	16.0	42.0	92.0	159	237	556
	C	30	3.4	5.2	7.9	16.5	34.0	68	126	394
		60	3.7	5.8	8.8	19.0	39.5	79	140	405
		90	4.1	6.4	9.7	21.5	45.5	89	154	419

MEDIUM LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 15° F. the wire will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

6	C	30	3.1	4.6	6.8	12.5	23.0	36.0	60	202
		60	3.4	5.2	7.5	14.0	25.0	41.0	67	216
		90	3.7	5.8	8.3	16.0	27.5	47.0	77	234
4	A and B	30	3.8	5.7	8.3	15.5	27.5	45.5	71	216
		60	4.2	6.4	9.4	18.0	32.0	52.0	82	233
		90	4.6	7.2	10.5	20.5	36.0	59.0	92	248
	C	30	3.1	4.8	6.8	12.0	20.0	31.0	46	132
		60	3.3	5.2	7.5	13.0	21.5	33.0	51	146
		90	3.6	5.7	8.3	14.5	24.0	37.5	57	162

LIGHT LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 30° F. the wire will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

6	C	30	2.9	4.5	6.5	11.1	18.0	26.0	35.5	75
		60	3.3	4.9	6.8	12.0	19.0	27.5	38.5	81
		90	3.6	5.3	7.5	13.0	20.5	29.5	42.0	90
4	A and B	30	3.6	5.7	7.9	13.5	20.5	29.5	41.5	95
		60	3.9	6.1	8.6	14.5	22.5	33.0	46.0	104
		90	4.3	6.6	9.4	16.0	24.5	37.5	52.0	114
	C	30	2.9	4.2	6.1	10.6	17.0	25.0	34.5	74
		60	3.1	4.8	6.8	11.8	18.5	27.5	38.0	80
		90	3.4	5.4	7.6	13.0	20.5	30.5	41.0	86

Table 51.—Sags for Ordinary Grade Steel Cable

HEAVY LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 0° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of—								
			100	125	150	175	200	250	300	400	500
		°F.									
¼	A and B	30	3.8	8.9	19.0	32.5	48.0	86.0	131	250	406
		60	5.4	12.5	23.0	36.5	52.0	90.0	135	254	409
		90	7.8	16.0	27.0	40.5	56.0	93.0	138	257	413
	C	30	2.3	4.5	8.5	16.0	28.0	58.0	97.0	195	323
		60	2.0	5.9	11.4	20.5	33.0	63.0	102	200	328
		90	3.8	7.8	15.0	25.0	38.0	68.0	106	205	332
5/16	A and B	30	2.6	4.8	7.9	13.0	20.5	43.0	72.0	147	241
		60	3.6	6.3	10.8	17.0	25.5	48.5	78.0	151	247
		90	4.7	8.4	14.0	21.0	31.0	54.0	83.0	157	252
	C	30	1.9	3.3	5.2	7.8	11.5	24.0	44.0	105	185
		60	2.3	4.1	6.3	9.9	14.5	29.0	51.0	112	191
		90	2.9	5.2	8.1	12.5	18.0	35.0	58.0	118	199
⅜	A and B	30	2.4	4.2	6.7	10.1	14.5	29.0	49.5	107	183
		60	3.1	5.4	8.6	13.0	18.5	35.0	56.0	114	190
		90	4.3	7.0	11.2	16.5	23.0	40.5	63.0	121	197
	C	30	1.9	3.1	4.7	6.7	9.6	17.5	30.0	73.0	134
		60	2.3	3.7	5.6	8.2	11.8	21.5	36.0	81.0	142
		90	2.8	4.6	7.0	10.3	14.5	26.5	42.0	89.0	151
7/16	A and B	30	2.3	3.9	5.8	8.4	11.5	21.0	34.0	75.0	131
		60	2.9	5.0	7.4	10.7	14.5	25.5	40.5	83.0	139
		90	3.8	6.3	9.7	13.5	18.5	31.0	47.5	91.0	148
	C	30	1.9	3.0	4.3	6.3	8.6	14.5	22.5	50.0	92
		60	2.2	3.5	5.2	7.4	10.1	17.0	27.0	57.0	102
		90	2.6	4.4	6.5	9.0	12.0	21.0	32.5	66.0	112
½	A and B	30	2.3	3.7	5.6	8.0	11.0	19.0	30.0	66.0	116
		60	2.9	4.8	7.0	10.1	13.5	23.5	36.5	74.0	125
		90	3.8	6.1	9.2	13.0	17.5	28.5	43.0	83.0	135
	C	30	1.9	3.0	4.3	6.1	8.2	13.5	21.0	44.0	80
		60	2.2	3.5	5.2	7.1	9.8	16.0	25.0	51.0	91
		90	2.5	4.2	6.3	8.8	12.0	19.5	30.0	59.0	100
9/16	A and B	30	2.3	3.6	5.4	7.6	10.3	17.0	26.5	54.0	94
		60	2.8	4.7	6.7	9.5	12.5	21.0	31.5	62.0	104
		90	3.7	6.0	8.6	12.0	16.0	26.0	37.5	70.0	113
	C	30	1.9	3.0	4.3	5.9	7.7	12.5	19.5	38.5	66
		60	2.2	3.5	5.0	6.9	9.4	15.0	23.0	44.5	75
		90	2.6	4.2	6.1	8.4	11.0	18.5	27.5	51.0	85
⅝	A and B	30	2.2	3.6	5.4	7.6	10.1	16.0	25.0	49.0	85
		60	2.8	4.5	6.5	9.3	12.0	20.0	29.5	57.0	94
		90	3.7	5.8	8.6	11.8	15.5	24.5	35.5	65.0	103
	C	30	1.9	3.0	4.3	5.9	7.7	12.5	18.5	35.5	61
		60	2.2	3.4	4.9	6.7	9.1	14.5	22.0	41.5	69
		90	2.5	4.2	6.1	8.4	11.0	17.5	26.0	48.0	78

Table 51.—Sags for Ordinary Grade Steel Cable—Continued

MEDIUM LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 15° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of—								
			100	125	150	175	200	250	300	400	500
		°F.									
1/4	A and B	30	2.3	3.9	6.1	9.9	14.5	30.5	55.0	117.0	201.0
		60	2.9	5.1	7.9	13.0	18.5	36.0	62.0	124.0	208.0
		90	3.8	6.4	10.4	16.0	23.5	42.5	68.0	130.0	214.0
	C	30	1.9	3.0	4.5	6.5	9.4	17.5	31.5	81.0	151.0
		60	2.2	3.5	5.4	8.0	11.0	21.5	37.5	88.0	160.0
		90	2.5	4.4	6.5	9.9	14.0	26.5	44.5	97.0	167.0
5/16	A and B	30	2.2	3.5	5.2	7.6	10.3	18.5	29.5	66.0	120.0
		60	2.6	4.2	6.5	9.2	12.5	22.5	35.5	75.0	130.0
		90	3.2	5.4	8.1	11.6	16.0	27.5	41.5	83.0	138.0
	C	30	1.9	2.8	4.1	5.7	7.7	13.0	20.0	43.5	82.0
		60	2.0	3.3	4.5	6.7	9.1	15.5	24.0	51.0	91.0
		90	2.3	3.9	5.8	8.0	10.8	18.5	28.5	58.0	101.0
3/8	A and B	30	2.0	3.3	4.9	6.9	9.3	15.5	25.0	52.0	94.0
		60	2.5	4.2	6.1	8.6	11.5	19.0	30.0	60.0	103.0
		90	3.2	5.3	7.7	10.9	14.0	24.0	35.5	68.0	113.0
	C	30	1.8	2.8	4.1	5.7	7.4	12.0	18.0	36.5	65.0
		60	2.0	3.2	4.7	6.5	8.6	14.0	21.5	42.0	73.0
		90	2.3	3.6	5.6	7.6	10.3	16.5	25.0	49.0	83.0
7/16	A and B	30	2.0	3.3	4.7	6.7	8.9	14.5	22.0	43.0	74.0
		60	2.5	4.0	5.8	8.2	10.8	17.5	26.5	50.0	84.0
		90	3.2	5.1	7.4	10.3	13.5	21.5	31.5	57.0	93.0
	C	30	1.8	2.8	4.0	5.5	7.2	11.4	16.5	31.5	55.0
		60	2.0	3.2	4.5	6.3	8.4	13.0	20.0	37.5	62.0
		90	2.3	3.8	5.4	7.6	9.8	15.5	23.0	43.0	70.0
1/2	A and B	30	2.0	3.3	4.9	6.7	8.9	14.0	21.5	41.0	69.0
		60	2.5	4.1	5.8	8.0	10.6	17.0	25.5	47.5	79.0
		90	3.2	5.1	7.4	10.1	13.0	21.0	30.0	55.0	88.0
	C	30	1.8	2.7	4.0	5.4	7.2	11.4	16.5	31.0	52.0
		60	2.0	3.1	4.5	6.3	8.4	13.0	19.0	36.0	59.0
		90	2.3	3.7	5.4	7.3	9.8	15.5	22.5	42.0	67.0
9/16	A and B	30	2.0	3.3	4.7	6.5	8.6	14.0	20.5	39.0	63.0
		60	2.4	3.9	5.8	8.0	10.6	16.0	24.0	44.5	71.0
		90	3.1	4.9	7.2	9.9	12.5	20.0	29.0	52.0	81.0
	C	.30	1.8	2.7	4.0	5.5	7.2	11.1	16.0	30.0	48.5
		60	2.0	3.0	4.5	6.3	8.2	12.5	18.5	34.0	55.0
		90	2.3	3.6	5.4	7.3	9.6	15.0	22.0	40.5	62.0
5/8	A and B	30	2.0	3.3	4.7	6.5	8.6	13.5	20.0	37.0	60.0
		60	2.4	3.9	5.6	7.8	10.3	16.0	23.5	42.5	69.0
		90	3.1	5.1	7.2	9.7	12.5	19.5	28.0	50.0	78.0
	C	30	1.8	2.7	4.0	5.4	7.0	10.8	16.0	29.0	47.5
		60	2.0	3.2	4.5	6.1	7.9	12.5	18.5	33.0	54.0
		90	2.3	3.8	5.4	7.4	9.6	14.5	21.5	39.0	61.0

Table 51.—Sags for Ordinary Grade Steel Cable—Continued

LIGHT LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 30° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of— 100	125	150	175	200	250	300	400	500
		°F.									
¼	A and B	30	1.9	3.0	4.5	6.3	8.5	14.0	21.0	41.5	74.0
		60	2.3	3.6	5.4	7.6	10.2	16.5	25.0	48.5	84.0
		90	2.8	4.6	6.5	9.0	12.0	19.5	29.5	56.0	94.0
	C	30	1.8	2.7	3.8	5.2	6.7	10.8	16.0	31.7	54.0
		60	1.9	3.0	4.5	6.1	7.9	12.5	18.5	36.0	61.0
		90	2.0	3.3	5.0	6.9	9.4	14.5	21.5	41.7	70.0
5/16	A and B	30	1.9	3.0	4.5	6.1	8.1	12.5	18.5	36.0	60.0
		60	2.2	3.6	5.4	7.3	9.6	15.0	22.5	42.0	68.0
		90	2.6	4.3	6.5	8.8	11.3	18.5	26.5	48.5	77.0
	C	30	1.7	2.7	3.8	5.0	6.7	10.2	15.0	28.5	47.0
		60	1.8	3.0	4.3	5.9	7.7	12.0	17.5	32.0	53.0
		90	2.0	3.3	4.9	6.7	8.9	14.0	20.0	37.0	60.0
⅜	A and B	30	1.9	3.0	4.3	5.9	7.9	12.5	18.5	34.5	57.0
		60	2.3	3.6	5.2	7.1	9.4	15.0	22.0	40.5	65.0
		90	2.8	4.3	6.3	8.6	11.3	17.5	26.0	46.5	73.0
	C	30	1.7	2.7	3.8	5.0	6.6	10.5	15.0	27.5	45.0
		60	1.9	3.0	4.3	5.7	7.4	11.7	17.5	31.0	51.0
		90	2.2	3.4	4.9	6.7	8.6	13.5	20.0	36.0	58.0
7/16	A and B	30	1.9	3.0	4.3	5.9	7.7	12.5	18.0	33.0	53.0
		60	2.2	3.5	5.0	7.1	9.4	14.5	21.0	38.5	61.0
		90	2.6	4.3	6.2	8.6	11.3	17.5	25.0	44.5	68.0
	C	30	1.7	2.7	3.8	5.0	6.5	10.2	15.0	27.0	43.0
		60	1.9	3.0	4.3	5.7	7.4	11.4	16.5	30.0	48.5
		90	2.2	3.3	4.9	6.7	8.7	13.5	19.5	34.5	55.0
½	A and B	30	1.8	3.0	4.3	5.9	7.7	12.5	18.0	32.5	53.0
		60	2.2	3.6	5.2	7.1	9.1	14.5	21.0	38.5	60.0
		90	2.6	4.3	6.1	8.6	11.0	17.0	25.0	44.0	68.0
	C	30	1.8	2.7	3.8	5.0	6.5	10.2	15.0	27.0	42.5
		60	1.9	3.0	4.3	5.7	7.4	11.7	16.5	30.0	48.0
		90	2.0	3.3	4.9	6.7	8.9	13.5	19.5	34.5	55.0
9/16	A and B	30	1.9	3.0	4.3	5.9	7.7	12.0	17.5	31.5	52.0
		60	2.2	3.5	5.0	6.9	9.1	14.0	21.0	37.5	58.0
		90	2.6	4.4	6.1	8.4	11.0	17.0	24.5	43.0	66.0
	C	30	1.8	2.7	3.8	5.0	6.5	10.2	15.0	26.0	42.0
		60	1.9	3.0	4.2	5.7	7.5	11.4	16.5	30.0	47.0
		90	2.0	3.3	4.8	6.5	8.6	13.0	19.0	34.0	53.0
⅝	A and B	30	1.9	3.0	4.3	5.9	7.7	12.0	17.5	31.5	50.0
		60	2.2	3.5	5.0	6.9	9.0	14.0	20.5	37.0	58.0
		90	2.6	4.2	6.2	8.4	11.0	17.0	24.5	43.0	65.0
	C	30	1.7	2.7	3.8	5.0	6.5	10.2	15.0	26.0	41.5
		60	1.9	3.0	4.3	5.7	7.4	11.4	16.5	30.0	47.0
		90	2.2	3.5	4.9	6.5	8.4	13.0	19.5	33.5	53.0

Table 52.—Sags for Siemens-Martin Steel Cable

HEAVY LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 0° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of—							
		° F.	200	250	300	400	500	600	700	1,000
5/16	A and B	30	10.3	20.5	39.5	96.0	166.0	270	381	792
		60	12.5	25.0	46.0	103.0	176.0	280	389	799
		90	16.0	31.0	53.0	110.0	188.0	287	396	806
	C	30	7.0	12.5	22.0	57.0	119.0	197	289	664
		60	8.2	15.5	26.0	66.0	127.0	205	297	672
		90	9.6	18.5	31.5	74.0	137.0	213	306	680
3/8	A and B	30	8.9	15.5	26.5	64.0	123.0	198	288	640
		60	10.6	19.0	32.0	72.0	131.0	208	295	649
		90	12.5	23.5	38.0	80.0	140.0	216	302	657
	C	30	6.5	10.8	17.5	39.5	77.0	137	208	499
		60	7.5	12.5	20.0	45.5	87.0	144	218	509
		90	8.6	14.5	24.0	52.0	96.0	155	229	520
7/16	A and B	30	7.9	13.0	21.0	45.0	84.0	140	203	479
		60	9.4	15.5	24.5	51.0	93.0	150	214	487
		90	11.3	19.0	29.5	59.0	103.0	159	224	496
	C	30	6.0	9.9	15.0	30.0	55.0	93	144	358
		60	6.9	11.4	17.5	35.0	63.0	104	154	370
		90	7.9	13.0	20.0	40.5	71.0	115	167	383
1/2	A and B	30	7.4	12.5	20.0	41.0	73.0	121	179	414
		60	9.1	15.5	23.5	47.0	83.0	131	190	426
		90	11.0	18.0	27.5	55.0	92.0	142	201	438
	C	30	6.2	9.9	15.0	29.0	50.0	82	123	312
		60	7.0	11.3	17.0	33.0	57.0	92	136	326
		90	7.9	12.5	19.0	37.5	65.0	102	148	340
9/16	A and B	30	7.4	12.0	18.0	35.0	61.0	98	145	337
		60	9.0	14.0	21.0	41.0	69.0	109	158	350
		90	10.6	17.0	25.0	47.5	79.0	119	170	364
	C	30	6.0	9.5	14.0	25.5	44.0	69	103	253
		60	6.8	10.9	16.0	30.0	51.0	78	113	269
		90	7.7	12.5	18.0	34.0	57.0	87	125	285
5/8	A and B	30	7.2	11.8	17.5	33.5	57.0	88	130	301
		60	8.7	14.0	20.5	39.5	64.0	98	140	315
		90	10.3	16.0	24.0	45.0	73.0	109	153	330
	C	30	5.8	9.4	13.5	25.5	42.0	64	93	227
		60	6.6	10.8	15.5	29.0	47.5	71	104	241
		90	7.4	12.0	17.5	32.5	53.0	81	115	260

Table 52.—Sags for Siemens-Martin Steel Cable—Continued

MEDIUM LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 15° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of— 200	250	300	400	500	600	700	1,000
		°F.								
5/16	A and B	30	7.2	12.0	18.5	40.0	75.0	124	186	442
		60	8.6	14.5	22.0	46.0	85.0	134	197	453
		90	10.1	17.0	25.5	53.0	94.0	145	208	465
	C	30	5.8	9.4	13.5	27.5	49.0	81	128	331
		60	6.6	10.7	16.0	31.5	55.0	91	139	344
		90	7.4	12.0	18.0	35.5	63.0	101	150	358
3/8	A and B	30	7.2	11.4	17.5	33.5	60.0	99	144	348
		60	8.4	13.0	20.0	40.5	69.0	109	157	361
		90	9.6	15.5	24.0	47.5	78.0	120	171	378
	C	30	5.8	9.3	13.5	25.0	42.5	67	102	256
		60	6.5	10.5	15.5	29.0	48.5	76	113	272
		90	7.2	11.7	17.5	32.5	54.0	85	124	287
7/16	A and B	30	6.7	10.8	16.0	30.0	51.0	79	114	273
		60	8.0	13.0	18.5	35.0	57.0	88	127	287
		90	9.4	15.0	21.5	40.0	65.0	98	137	301
	C	30	5.8	9.0	12.5	24.0	38.5	58	85	203
		60	6.5	10.0	14.5	27.0	44.0	65	93	216
		90	7.2	11.1	16.0	30.0	49.5	73	103	232
1/2	A and B	30	7.0	10.8	16.0	29.5	48.0	73	104	251
		60	8.2	12.5	18.5	34.0	55.0	84	117	268
		90	9.4	14.5	21.0	39.0	63.0	93	129	282
	C	30	5.7	8.7	12.5	23.5	37.0	56	81	188
		60	6.4	9.9	14.0	26.5	42.0	62	88	202
		90	7.2	11.1	16.0	29.5	47.5	69	98	219
9/16	A and B	30	6.7	10.5	15.5	28.0	46.0	68	98	221
		60	7.9	12.5	17.5	32.5	53.0	78	108	236
		90	9.1	14.0	20.5	37.5	59.0	86	119	251
	C	30	5.5	8.7	12.5	23.0	36.5	54	76	164
		60	6.3	9.9	14.0	26.0	41.0	60	83	181
		90	7.2	11.0	16.0	29.0	45.5	66	93	194
5/8	A and B	30	6.7	10.5	15.0	28.0	45.0	66	93	210
		60	7.9	12.0	17.5	32.0	51.0	75	104	222
		90	9.1	14.0	20.0	36.5	58.0	84	114	240
	C	30	5.5	8.7	12.5	22.5	36.0	53	73	162
		60	6.2	9.7	14.0	25.5	40.5	58	80	175
		90	7.0	10.8	16.0	28.5	45.0	65	89	189

Table 52.—Sags for Siemens-Martin Steel Cable—Continued

LIGHT LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 30° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of— 200	250	300	400	500	600	700	1,000
		° F.								
5/16	A and B	30	6.5	10.2	15.0	26.5	44.0	66.0	94	221
		60	7.4	11.7	17.0	30.5	50.0	74.0	104	235
		90	8.4	13.0	19.0	35.0	56.0	83.0	115	250
	C	30	5.3	8.1	11.9	21.5	35.0	51.0	73	165
		60	6.0	9.3	13.5	24.0	39.0	57.0	81	179
		90	6.7	10.5	15.0	27.0	43.0	63.0	88	194
3/8	A and B	30	6.2	9.9	14.5	26.0	43.0	63.0	90	203
		60	7.2	11.4	16.5	29.5	49.0	72.0	100	218
		90	8.2	13.0	19.0	33.5	55.0	81.0	110	234
	C	30	5.3	8.6	12.0	21.5	35.0	50.0	71	156
		60	6.0	9.6	13.5	24.0	39.0	57.0	78	170
		90	6.7	10.6	15.0	26.5	43.0	63.0	86	184
7/16	A and B	30	6.2	9.6	14.5	25.5	41.0	60.0	84	182
		60	7.2	11.1	16.5	29.5	46.5	67.0	93	198
		90	8.2	12.5	18.5	33.5	52.0	75.0	102	212
	C	30	5.3	8.5	11.9	20.5	33.5	48.0	67	145
		60	6.0	9.6	13.5	23.0	37.5	54.0	74	157
		90	6.7	10.7	15.0	26.0	41.5	59.0	82	170
1/2	A and B	30	6.2	9.7	14.0	25.5	41.0	60.0	83	180
		60	7.2	11.1	16.5	29.5	46.5	67.0	91	194
		90	8.2	12.5	18.5	33.5	52.0	75.0	102	210
	C	30	5.3	8.4	11.9	20.5	33.5	48.0	67	144
		60	5.9	9.5	13.5	23.0	37.0	54.0	74	156
		90	6.5	10.2	15.0	26.0	41.0	59.0	81	169
9/16	A and B	30	6.2	9.9	14.0	25.0	40.0	59.0	81	168
		60	7.2	11.3	16.0	28.5	45.5	66.0	90	184
		90	8.3	12.5	18.0	32.0	50.0	73.0	99	201
	C	30	5.3	8.1	11.5	20.0	33.0	47.5	66	138
		60	6.0	9.3	13.5	23.0	36.5	53.0	73	150
		90	6.7	10.5	14.5	26.0	40.0	58.0	80	163
5/8	A and B	30	6.2	9.9	14.0	25.0	39.5	58.0	80	169
		60	7.2	11.2	16.0	28.5	45.0	65.0	87	181
		90	8.2	12.5	18.0	32.5	50.0	72.0	98	198
	C	30	5.3	8.1	11.5	20.5	32.5	47.0	65	134
		60	5.9	9.1	13.0	23.0	36.5	53.0	72	147
		90	6.5	10.2	14.5	26.0	40.0	58.0	79	160

Table 53.—Sags for High-Tension Steel Cable

HEAVY LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 0° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature,	Sags (in inches) for span lengths (in feet) of— 200	250	300	400	500	600	700	1,000
		° F.								
5/16	A and B	30	4.3	6.9	10.4	22.0	43.0	78.0	134	391
		60	4.8	7.6	11.7	24.0	47.5	88.0	147	405
		90	5.3	8.4	13.0	27.0	54.0	97.0	159	418
	C	30	3.1	4.8	7.2	15.0	26.5	45.5	74.0	252
		60	3.4	5.4	7.9	16.5	30.0	50.0	82.0	270
		90	3.8	6.0	8.6	17.5	33.5	56.0	90.0	284
3/8	A and B	30	4.1	6.3	9.4	19.0	33.5	56.0	89.0	271
		60	4.5	7.2	10.8	21.0	37.0	62.0	99.0	286
		90	5.0	8.1	12.0	24.0	42.0	69.0	110.0	301
	C	30	3.1	5.4	7.6	14.5	23.5	37.0	57.0	162
		60	3.4	5.7	8.3	15.5	25.0	40.5	63.0	171
		90	3.8	6.3	8.9	16.5	28.0	44.5	70.0	180
7/16	A and B	30	4.0	6.3	9.0	17.5	29.0	44.5	67.0	181
		60	4.4	7.0	10.2	19.5	32.5	49.5	74.0	196
		90	4.8	7.8	11.4	21.5	35.5	55.0	81.0	211
	C	30	3.1	4.8	7.0	13.5	22.0	33.5	48.0	118
		60	3.3	5.2	7.5	14.5	23.5	36.0	51.0	127
		90	3.6	5.7	8.3	15.5	26.0	38.0	55.0	137
1/2	A and B	30	3.8	5.7	8.3	16.5	27.5	42.5	62.0	160
		60	4.3	6.6	9.7	18.0	30.5	47.5	69.0	173
		90	4.8	7.5	11.2	20.0	33.5	53.0	76.0	187
	C	30	3.1	5.0	7.2	13.5	21.5	32.5	45.5	109
		60	3.4	5.4	7.6	14.5	23.0	34.5	49.0	118
		90	3.6	5.7	8.2	15.5	24.0	36.5	52.0	126
9/16	A and B	30	3.8	5.7	8.3	15.5	26.5	39.5	57.0	134
		60	4.3	6.6	9.4	18.0	29.5	44.0	62.0	146
		90	4.8	7.5	10.8	20.0	32.5	48.0	69.0	158
	C	30	3.1	4.9	7.2	13.5	21.0	31.0	44.0	97
		60	3.4	5.4	7.7	14.5	22.0	33.0	46.0	106
		90	3.6	5.7	8.3	15.5	24.0	36.0	50.0	113
5/8	A and B	30	3.8	5.8	8.3	15.5	25.0	37.5	54.0	124
		60	4.3	6.6	9.4	17.5	28.0	42.0	60.0	134
		90	4.8	7.5	10.4	19.5	31.0	46.0	66.0	146
	C	30	3.1	4.9	7.2	13.0	21.0	30.5	43.0	90
		60	3.4	5.4	7.9	14.0	22.5	33.0	45.5	96
		90	3.6	5.8	8.6	15.0	24.0	35.0	48.0	106

Table 53.—Sags for High-Tension Steel Cable—Continued

MEDIUM LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 15° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of—							
			200	250	300	400	500	600	700	1,000
		°F.								
5/16	A and B	30	3.8	5.7	8.4	15.5	27.5	41.0	61.0	166
		60	4.2	6.3	9.4	17.5	30.0	45.5	68.0	180
		90	4.6	6.9	10.4	19.5	33.0	50.0	75.0	194
	C	30	3.1	4.8	6.8	13.0	21.0	31.0	45.0	108
		60	3.3	5.1	7.5	14.0	22.5	33.0	48.0	117
		90	3.6	5.7	8.3	15.0	24.0	35.5	50.0	126
3/8	A and B	30	3.8	6.0	8.6	15.5	25.0	37.5	54.0	132
		60	4.2	6.4	9.3	17.0	28.0	41.5	60.0	144
		90	4.6	6.9	10.1	18.5	31.0	46.0	66.0	156
	C	30	2.9	5.0	7.2	13.0	20.5	29.5	43.0	101
		60	3.1	5.4	7.7	14.0	22.0	32.5	45.5	109
		90	3.4	5.8	8.4	15.0	23.5	34.5	48.0	118
7/16	A and B	30	3.8	6.0	8.6	15.5	24.0	36.0	49.5	118
		60	4.2	6.4	9.3	16.5	26.5	39.5	55.0	127
		90	4.6	7.0	10.1	18.0	29.5	43.0	61.0	136
	C	30	3.1	5.0	7.2	12.5	20.0	29.5	40.5	88
		60	3.4	5.4	7.6	13.5	21.5	32.0	43.0	94
		90	3.6	5.7	8.0	14.5	23.0	34.0	46.0	101
1/2	A and B	30	3.8	5.7	8.2	15.5	24.0	35.5	49.0	112
		60	4.1	6.3	9.0	17.0	26.5	39.0	54.0	120
		90	4.3	6.9	10.1	18.0	29.0	42.5	60.0	128
	C	30	3.1	4.8	6.8	12.5	20.0	29.0	39.5	87
		60	3.4	5.4	7.6	13.5	21.0	31.0	43.0	93
		90	3.6	5.7	8.3	14.5	22.0	33.0	46.0	100
9/16	A and B	30	3.6	5.7	8.3	15.5	24.0	35.5	48.5	106
		60	4.1	6.3	9.0	16.5	26.0	37.5	52.0	114
		90	4.6	7.0	10.1	18.0	29.0	41.0	57.0	123
	C	30	2.9	4.8	6.8	12.5	19.5	29.0	39.5	84
		60	3.1	5.1	7.6	13.5	21.0	31.0	42.0	89
		90	3.4	5.4	8.3	14.5	23.0	33.0	44.5	95
5/8	A and B	30	3.6	5.9	8.3	15.0	23.5	34.5	48.0	103
		60	4.1	6.3	9.0	16.0	26.0	37.5	52.0	112
		90	4.6	7.1	9.7	18.0	29.0	41.0	57.0	120
	C	30	2.9	5.0	7.2	12.5	20.0	29.0	40.5	83
		60	3.1	5.3	7.6	13.5	21.0	31.0	43.0	88
		90	3.4	5.6	7.9	14.5	23.0	33.0	45.5	93

Table 53.—Sags for High-Tension Steel Cable—Continued

LIGHT LOADING DISTRICT

[At 30, 60, and 90° F, without load, the sags being such that when loaded at 30° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of— 200	250	300	400	500	600	700	1,000
		°F.								
5/16	A and B	30	3.6	5.7	8.0	14.5	23.0	34.0	47.0	104
		60	3.9	6.0	8.7	15.5	25.0	36.5	51.0	112
		90	4.3	6.6	9.4	17.0	27.0	40.5	55.0	120
	C	30	2.9	4.5	6.5	12.5	20.0	28.0	38.5	82
		60	3.1	4.8	7.0	13.0	21.0	30.0	41.5	87
		90	3.4	5.4	7.6	14.0	22.0	31.5	44.5	92
3/8	A and B	30	3.6	5.6	7.9	14.5	23.5	34.0	46.0	100
		60	3.9	6.0	8.4	16.0	25.0	36.5	50.0	107
		90	4.3	6.6	9.0	17.0	27.0	39.0	54.0	115
	C	30	2.9	4.5	6.5	12.0	19.0	27.5	38.5	81
		60	3.1	4.8	7.2	13.0	20.5	29.5	41.5	85
		90	3.4	5.2	7.9	14.0	22.0	31.5	44.5	90
7/16	A and B	30	3.4	5.7	8.3	14.5	23.0	33.0	46.0	96
		60	3.9	6.0	8.7	15.5	24.5	35.5	49.0	104
		90	4.3	6.3	9.0	16.5	26.5	38.0	52.0	112
	C	30	3.0	4.5	6.5	12.0	19.0	27.5	38.5	78
		60	3.2	4.9	7.2	13.0	20.5	29.0	40.5	83
		90	3.4	5.4	7.9	14.0	21.5	31.0	43.0	89
1/2	A and B	30	3.4	5.4	7.9	14.5	23.0	34.0	45.5	96
		60	3.8	6.0	8.6	15.5	24.5	35.5	48.5	104
		90	4.3	6.6	9.4	16.5	26.5	38.0	52.0	113
	C	30	2.9	4.8	6.8	12.0	18.5	27.5	38.0	78
		60	3.1	5.1	7.6	13.0	20.5	29.5	40.5	83
		90	3.4	5.5	8.3	14.0	22.0	31.5	43.0	88
9/16	A and B	30	3.6	5.7	8.3	14.5	23.0	33.0	45.5	95
		60	4.0	6.2	9.0	15.5	24.5	35.5	48.0	103
		90	4.3	6.6	9.4	16.5	26.5	37.5	51.0	110
	C	30	2.9	4.6	6.7	12.0	18.5	27.5	38.0	77
		60	3.1	4.9	7.2	13.0	20.0	29.0	40.5	83
		90	3.4	5.4	7.7	14.0	21.0	31.0	43.0	88
5/8	A and B	30	3.4	5.5	8.1	14.5	23.0	33.0	44.5	94
		60	3.8	6.0	8.5	15.5	24.0	35.5	48.0	102
		90	4.3	6.7	9.0	16.5	25.0	37.5	51.0	110
	C	30	2.9	4.5	6.5	12.0	19.0	27.5	37.0	77
		60	3.1	5.0	7.2	13.0	20.5	29.0	39.5	82
		90	3.4	5.4	7.9	14.0	21.5	31.0	43.0	88

Table 54.—Sags for Bare Copper-Covered Steel Wire (Ordinary Grade)

HEAVY LOADING DISTRICT

[The sags being such that when loaded at 0° F. the wires will be stressed to 50 per cent of their ultimate strength]

Size A. W. G. No.	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of—								
			100	125	150	175	200	250	300	400	500
		F.									
6	A and B	30	1.7	3.2	5.9	10.9	------	------	------	------	------
		60	2.0	3.8	7.2	13.7	------	------	------	------	------
		90	2.3	4.9	9.4	17.3	------	------	------	------	------
4	do	30	1.7	2.9	4.6	7.0	10.8	27.4	57.4	------	------
		60	1.9	3.4	5.4	8.6	13.7	34.6	64.2	------	------
		90	2.3	4.0	6.6	10.8	17.4	39.6	70.7	------	------

MEDIUM LOADING DISTRICT

[The sags being such that when loaded at 15° F. the wires will be stressed to 50 per cent of their ultimate strength]

8	B	30	1.4	2.3	3.6	------	------	------	------	------	------
		60	1.5	2.6	4.1	------	------	------	------	------	------
		90	1.7	2.9	4.7	------	------	------	------	------	------
6	A and B	30	1.4	2.2	3.3	4.8	------	------	------	------	------
		60	1.5	2.5	3.7	5.4	------	------	------	------	------
		90	1.6	2.8	4.3	6.3	------	------	------	------	------
4	do	30	1.4	2.3	3.4	4.7	6.4	10.9	17.6	41.7	------
		60	1.6	2.6	3.8	5.4	7.3	13.0	20.5	48.7	------
		90	1.9	3.0	4.4	6.3	8.4	14.8	24.2	56.5	------

LIGHT LOADING DISTRICT

[The sags being such that when loaded at 30° F. the wires will be stressed to 50 per cent of their ultimate strength]

8	B	30	1.2	------	2.6	------	------	------	------	------	------
		60	1.3	------	2.9	------	------	------	------	------	------
		90	1.4	------	3.3	------	------	------	------	------	------
6	A and B	30	1.2	------	2.8	------	5.0	------	------	------	------
		60	1.4	------	3.1	------	5.5	------	------	------	------
		90	1.5	------	3.5	------	6.2	------	------	------	------
4	do	30	1.3	------	3.0	------	5.4	------	12.2	22.7	37.0
		60	1.5	------	3.3	------	6.0	------	13.5	25.5	41.4
		90	1.7	------	3.8	------	6.8	------	15.7	28.8	46.7

Table 55.—Sags for Bare Copper-Covered Steel Cable

HEAVY LOADING DISTRICT

[The sags being such that when loaded at 0° F. the cable will be stressed to 50 per cent of its ultimate strength]

Diameter (inch)	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of—							
			200	250	300	400	500	600	800	1,000
		°F.								
5/16	A and B	30	5.6	9.3	15.0	34.6	73.8			
		60	6.2	10.4	17.1	39.9	83.4			
		90	7.0	11.9	19.7	45.6	93.4			
3/8	do	30	5.6	9.1	13.7	27.4	49.9	85.6	202	
		60	6.1	10.1	15.2	30.6	56.2	95.2	215	
		90	6.9	11.4	17.3	34.8	63.5	106.0	228	
7/16	do	30	5.7	9.2	13.8	26.6	46.8	77.0	172	316
		60	6.4	10.2	15.3	29.8	52.3	85.6	186	331
		90	7.2	11.5	17.2	33.6	58.8	95.0	200	345
1/2	do	30	5.7	9.1	13.4	25.2	42.7	67.0	146	265
		60	6.2	10.0	14.8	28.0	47.3	74.2	157	280
		90	7.0	11.1	16.5	31.2	52.8	82.2	171	295
9/16	do	30	5.8	9.1	13.4	25.1	41.3	63.7	131	234
		60	6.4	10.1	14.8	27.5	45.5	69.8	142	248
		90	7.1	11.2	16.5	31.1	50.4	77.0	154	262

Table 55.—Sags for Bare Copper-Covered Steel Cable—Continued

MEDIUM LOADING DISTRICT

[The sags being such that when loaded at 15° F. the cable will be stressed to 50 per cent of its ultimate strength]

Diameter (inch)	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of— 100	250	400	600	800	1,000
		°F.						
5/16	A and B	30	1.2	7.7	21.5	58.1	--------	--------
		60	1.3	8.5	23.9	64.7	--------	--------
		90	1.4	9.5	26.7	72.2	--------	--------
3/8	do	30	1.2	8.0	21.5	54.0	110.0	--------
		60	1.4	8.8	23.6	59.5	119.0	--------
		90	1.5	9.8	26.4	66.4	130.0	--------
7/16	do	30	1.3	8.3	22.0	53.4	104.0	178
		60	1.4	9.1	24.2	58.6	114.0	194
		90	1.6	10.1	26.7	64.7	124.0	208
1/2	do	30	1.3	8.3	21.9	52.1	99.5	168
		60	1.4	9.1	24.0	56.9	108.0	180
		90	1.6	10.1	26.5	62.8	117.0	193
9/16	do	30	1.3	8.5	22.3	52.5	98.5	163
		60	1.5	9.3	24.4	57.1	106.0	175
		90	1.6	10.3	26.8	62.4	115.0	188

LIGHT LOADING DISTRICT

[The sags being such that when loaded at 30° F. the cable will be stressed to 50 per cent of its ultimate strength]

5/16	A and B	30	1.1	7.0	18.5	43.2	81.5	--------
		60	1.2	7.8	20.2	47.2	88.8	--------
		90	1.4	8.6	22.6	51.8	97.1	--------
3/8	do	30	1.2	7.5	19.3	44.5	82.5	134
		60	1.3	8.2	21.2	49.0	89.5	144
		90	1.4	9.1	23.3	53.5	98.5	156
7/16	do	30	1.3	7.8	20.2	46.3	84.7	137
		60	1.4	8.5	22.0	50.4	91.8	147
		90	1.5	9.4	24.2	55.2	98.6	159
1/2	do	30	1.3	7.9	20.4	46.6	84.8	136
		60	1.4	8.6	22.2	50.6	91.6	146
		90	1.5	9.4	24.3	55.1	99.1	157
9/16	do	30	1.3	8.1	21.6	47.8	86.7	137
		60	1.4	8.8	22.7	51.8	93.4	148
		90	1.5	9.7	24.9	56.3	101.0	159

Table 56.—Sags for Bare Stranded Aluminum

HEAVY LOADING DISTRICT

[Sags being such that when loaded at 0° F. the conductor will be stressed to 50 per cent of its ultimate strength for grades A and B and 60 per cent for grade C]

Size A.W.G. No.	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of— 100	125	150	200	250	300	400	500	600
		°F.									
1	A and B	30	12.5	24.6	42.1	------	------	------	------	------	------
		60	18.2	30.3	47.2	------	------	------	------	------	------
		90	23.0	35.1	51.8	------	------	------	------	------	------
	C	30	4.3	12.3	26.6	------	------	------	------	------	------
		60	9.4	20.1	33.5	------	------	------	------	------	------
		90	16.1	26.4	39.6	------	------	------	------	------	------
0	A and B	30	7.4	16.2	31.0	63.4	109.0	170.0	294	------	------
		60	13.0	24.6	37.1	69.6	115.0	177.0	304	------	------
		90	19.7	30.0	44.6	75.4	120.0	182.0	310	------	------
	C	30	2.9	7.2	15.5	45.1	81.0	127.0	239	------	------
		60	6.2	14.1	25.2	53.3	88.8	133.0	246	------	------
		90	12.7	21.6	32.4	60.0	95.4	140.0	251	------	------
00	A and B	30	5.0	10.8	22.0	49.4	85.2	127.0	241	------	------
		60	10.8	18.6	29.5	56.6	91.2	133.0	247	------	------
		90	16.8	25.2	36.0	63.4	97.2	140.0	254	------	------
	C	30	2.6	5.1	9.7	29.7	60.6	96.5	189	------	462
		60	5.0	9.9	18.0	39.4	70.2	106.0	198	------	472
		90	10.8	17.4	26.3	48.0	78.0	114.0	207	------	479
000	A and B	30	3.8	7.5	14.0	37.4	73.2	102.0	197	------	469
		60	7.7	14.7	23.4	46.5	75.6	111.0	205	------	478
		90	14.6	21.9	31.0	54.2	84.0	119.0	213	------	487
	C	30	2.2	4.2	6.8	20.6	45.0	74.2	151	------	376
		60	3.8	7.5	13.3	31.2	56.4	92.2	161	------	387
		90	8.4	15.0	21.6	41.3	65.4	95.0	172	------	396
0000	A and B	30	3.1	6.0	10.4	29.3	53.4	83.5	165	------	395
		60	6.5	12.0	19.1	39.4	62.4	92.9	175	------	403
		90	13.2	19.5	27.0	48.0	74.4	102.0	183	------	413
	C	30	2.2	3.6	6.1	14.9	31.8	57.6	125	------	312
		60	3.6	6.3	10.4	24.9	43.8	70.5	137	------	324
		90	7.9	12.0	19.1	35.0	55.2	81.4	148	------	335

Table 56.—Sags for Bare Stranded Aluminum—Continued

MEDIUM LOADING DISTRICT

[Sags being such that when loaded at 15° F. the conductor will be stressed to 50 per cent of its ultimate strength for grades A and B, and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of— 100	125	150	200	250	300	400	500	600
		°F.									
1	A and B	30	2.6	5.4	10.4	------	------	------	------	------	------
		60	5.3	10.5	18.7	------	------	------	------	------	------
		90	11.3	18.6	27.4	------	------	------	------	------	------
	C	30	1.7	3.3	5.4	------	------	------	------	------	------
		60	2.9	5.4	9.4	------	------	------	------	------	------
		90	6.0	11.1	17.3	------	------	------	------	------	------
0	A and B	30	2.4	4.5	7.5	22.6	46.8	76.3	156	257	380
		60	4.3	8.1	14.0	33.1	57.6	90.7	165	265	392
		90	9.6	15.6	23.0	42.7	66.6	96.5	176	275	400
	C	30	1.9	3.0	4.7	11.0	24.6	47.5	113	196	297
		60	2.6	4.5	7.6	18.7	42.6	61.2	122	208	310
		90	5.0	8.7	14.0	29.3	49.2	73.4	138	220	321
00	A and B	30	2.2	3.9	6.1	16.3	33.0	59.0	122	210	314
		60	3.8	6.9	11.2	25.9	46.2	71.3	134	222	325
		90	8.4	13.5	19.8	36.5	56.4	82.8	146	233	337
	C	30	1.4	2.7	4.0	9.1	18.0	33.1	84.5	155	243
		60	2.4	4.2	6.5	13.9	28.2	48.2	99.8	170	259
		90	4.6	7.5	11.9	23.5	40.8	61.2	114	185	272
000	A and B	30	2.2	3.6	5.8	13.0	25.8	46.8	99.8	173	263
		60	3.6	6.3	9.7	21.1	37.2	60.5	113	187	276
		90	7.9	12.3	18.0	32.2	49.8	72.7	127	199	288
	C	30	1.7	2.7	4.3	8.2	15.0	25.9	65.3	124	199
		60	2.6	3.9	6.5	12.9	22.8	38.9	82.6	140	214
		90	4.6	7.2	10.8	21.6	34.8	52.6	97.9	156	232
0000	A and B	30	2.2	3.6	5.4	11.5	20.4	38.2	80.6	142	217
		60	3.4	6.0	9.0	19.2	31.8	51.8	96.0	158	233
		90	7.2	11.4	16.2	29.8	44.4	64.1	110	173	248
	C	30	1.4	2.7	4.3	7.2	13.8	22.3	50.9	101	160
		60	2.4	3.9	5.8	11.5	20.4	33.1	67.2	119	178
		90	4.3	6.9	10.4	19.2	31.8	46.8	84.5	137	199

Table 56.—Sags for Bare Stranded Aluminum—Continued

LIGHT LOADING DISTRICT

[Sags being such that when loaded at 30° F. the conductor will be stressed to 50 per cent of its ultimate strength for grades A and B, and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of—								
			100	125	150	200	250	300	400	500	600
		°F.									
1	A and B	30	1.7	2.7	4.3	------	------	------	------	------	------
		60	2.6	4.5	6.8	------	------	------	------	------	------
		90	5.0	8.1	12.6	------	------	------	------	------	------
	C	30	1.4	2.4	3.6	------	------	------	------	------	------
		60	1.9	3.0	4.7	------	------	------	------	------	------
		90	3.1	5.1	7.6	------	------	------	------	------	------
0	A and B	30	1.9	2.7	4.0	8.2	15.6	27.4	65.3	120	193
		60	2.9	4.2	6.5	13.0	22.2	38.9	82.6	138	210
		90	4.8	7.8	11.9	21.1	36.0	52.6	97.0	161	226
	C	30	1.7	2.4	3.2	6.2	11.4	17.3	40.3	81.6	141
		60	1.9	3.3	5.0	9.1	15.6	24.5	55.7	101	161
		90	2.9	4.8	7.9	14.4	23.4	36.7	72.0	120	180
00	A and B	30	1.7	2.7	4.0	8.2	13.8	23.8	55.7	103	166
		60	2.6	4.2	6.5	12.5	21.0	35.3	72.0	122	184
		90	4.8	7.5	11.2	20.2	32.4	49.0	89.3	139	203
	C	30	1.4	2.1	3.2	6.2	10.8	16.6	35.5	67.2	115
		60	1.9	3.0	4.7	8.6	14.4	23.0	49.0	88.8	138
		90	3.1	4.8	7.2	13.9	22.2	33.8	65.3	108	158
000	A and B	30	1.7	2.7	4.3	7.7	12.6	21.6	46.1	91.2	144
		60	2.6	3.9	6.1	11.0	19.8	31.0	62.4	109	164
		90	4.8	7.2	10.8	19.7	30.6	44.6	79.7	127	186
	C	30	1.4	2.4	3.2	6.2	9.6	15.1	30.7	58.8	97
		60	1.9	3.0	4.3	8.2	13.8	20.9	43.2	78.0	119
		90	3.1	4.8	7.2	13.0	21.0	31.0	58.6	97.2	143
0000	A and B	30	1.4	2.7	4.0	7.2	12.0	20.2	42.2	79.2	128
		60	2.4	3.9	6.1	11.0	18.6	28.8	58.6	98.4	150
		90	4.6	7.2	10.4	18.2	28.8	41.8	74.9	118	168
	C	30	1.2	2.1	3.2	6.2	9.6	15.1	29.8	54.0	89
		60	1.9	3.0	4.3	7.7	13.2	20.9	40.3	69.6	109
		90	2.9	4.8	6.8	12.5	20.4	30.2	54.7	88.8	132

Table 57.—Sags for Bare Stranded Aluminum, Steel-Reinforced

HEAVY LOADING DISTRICT

[Sags being such that when loaded at 0° F. the cable will be stressed to 50 per cent of its ultimate strength for grades A and B, and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags in (inches) for span lengths (in feet) of— 100	150	200	300	400	500	700	1,000
		°F.								
4	A and B	30	3.0	24.0	61.2	164.0	312	511		
		60	5.6	30.6	66.4	169.0	316	515		
		90	10.7	36.0	71.2	173.0	321	520		
	C	30	1.6	7.6	35.6	123.0	244	405		
		60	2.2	12.8	43.3	129.0	250	410		
		90	3.5	20.0	50.0	135.0	255	415		
2	A and B	30	1.9	6.9	25.4	95.3	192	319		
		60	2.7	11.4	34.0	103.0	199	325		
		90	4.7	18.4	41.8	110.0	206	332		
	C	30	1.3	3.7	9.7	58.9	141	245	555	
		60	1.7	5.1	14.6	69.3	150	254	562	
		90	2.3	7.6	22.4	78.7	158	262	570	
1	A and B	30	1.8	5.3	15.2	70.7	151	255	540	1,193
		60	2.5	8.0	23.2	79.6	159	263	548	1,200
		90	3.9	13.5	32.0	88.1	168	271	556	1,207
	C	30	1.3	3.3	7.4	36.5	103	190	424	944
		60	1.6	4.4	10.4	48.0	114	201	434	953
		90	2.2	6.3	15.6	59.2	125	211	443	962
0	A and B	30	1.6	4.5	10.5	48.6	115	202	435	954
		60	2.2	6.4	16.0	59.8	126	212	444	963
		90	3.5	10.4	24.2	70.0	136	221	454	972
	C	30	1.2	3.1	6.3	23.0	70.8	143	336	757
		60	1.5	4.0	8.3	32.1	84.5	156	348	768
		90	2.1	5.5	12.1	43.4	97.3	168	360	779
00	A and B	30	1.6	4.0	8.4	32.7	85.5	157	350	772
		60	2.0	5.4	12.4	44.0	98.2	169	362	783
		90	3.2	8.6	18.9	55.5	110	181	373	794
	C	30	1.3	2.9	5.6	17.0	47.0	103	262	607
		60	1.5	3.6	7.3	23.2	60.6	118	277	620
		90	2.0	5.0	10.1	32.4	74.7	133	291	634
000	A and B	30	1.3	3.9	7.7	24.1	63.2	122	284	636
		60	1.8	5.3	10.3	33.8	77.3	137	298	649
		90	3.0	8.0	15.9	45.2	90.5	150	311	662
	C	30	1.2	2.6	5.3	14.4	34.6	74.4	206	496
		60	1.4	3.5	6.6	18.9	45.7	90.7	223	512
		90	2.0	4.7	9.2	26.5	59.2	107	240	528
0000	A and B	30	1.5	3.7	6.6	19.4	47.0	93	230	524
		60	2.0	4.6	9.2	27.1	60.0	109	245	539
		90	2.8	7.0	14.1	37.6	74.9	125	260	554
	C	30	1.2	2.7	5.1	13.0	27.8	55.1	157	399
		60	1.5	3.5	6.4	16.7	36.1	69.8	177	418
		90	1.9	4.5	8.6	22.6	47.8	85.9	196	437

Table 57.—Sags for Bare Stranded Aluminum, Steel-Reinforced—Continued

MEDIUM LOADING DISTRICT

[Sags being such that when loaded at 15° F. the cable will be stressed to 50 per cent of the ultimate strength for grades A and B, and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of—							
			100	150	200	300	400	500	700	1,000
		°F.								
4	A and B	30	1.5	4.3	11.5	62.2	142	250	------	------
		60	2.0	6.1	17.8	72.3	151	252	------	------
		90	2.9	9.9	26.5	81.4	159	261	------	------
	C	30	1.1	2.9	6.3	28.9	92.8	179	------	------
		60	1.4	3.7	8.3	39.7	105	190	------	------
		90	1.8	5.0	12.1	51.3	116	200	------	------
2	A and B	30	1.3	3.4	7.1	26.1	75.2	145	------	------
		60	1.6	4.5	9.7	36.4	88.6	158	------	------
		90	2.2	6.6	14.6	48.0	101	170	------	------
	C	30	1.1	2.6	5.0	14.5	38.7	90	------	------
		60	1.3	3.2	6.2	19.0	50.9	106	------	------
		90	1.7	4.2	8.3	26.3	65.0	122	------	------
1	A and B	30	1.4	3.3	6.4	20.1	54.1	111	270	616
		60	1.7	4.3	8.6	27.8	68.2	126	285	629
		90	2.5	6.1	12.6	38.4	82.0	140	298	642
	C	30	1.1	2.6	4.8	12.7	29.5	63.9	190	475
		60	1.3	3.1	6.0	16.3	38.5	79.6	209	492
		90	1.7	4.0	7.7	21.9	50.7	96.1	226	509
0	A and B	30	1.4	3.2	6.0	16.6	40.2	83.2	216	505
		60	1.7	4.2	7.9	22.7	52.7	99.6	232	522
		90	2.4	5.8	11.3	31.7	66.8	115	248	537
	C	30	1.0	2.5	4.6	11.7	24.4	48.0	144	382
		60	1.3	3.0	5.7	14.5	31.3	61.0	163	402
		90	1.7	3.9	7.3	19.2	41.2	76.5	182	421
00	A and B	30	1.3	3.1	5.7	14.8	32.5	63.8	171	416
		60	1.7	4.0	7.5	19.7	42.8	79.6	190	435
		90	2.3	5.5	10.4	27.3	55.8	96.1	208	453
	C	30	1.0	2.4	4.4.	10.9	21.7	39.6	110	305
		60	1.3	3.0	5.5	13.5	27.2	49.9	131	329
		90	1.7	3.8	7.0	17.5	35.4	63.3	151	351
000	A and B	30	1.3	3.0	5.6	13.9	28.4	52.3	138	346
		60	1.7	3.9	7.1	18.0	37.0	66.7	159	368
		90	2.3	5.4	10.0	24.8	48.8	82.7	178	388
	C	30	1.0	2.5	4.4	10.5	20.2	35.0	89	248
		60	1.3	3.0	5.3	12.9	25.0	43.7	108	273
		90	1.7	4.0	6.9	16.6	32.2	55.4	128	298
0000	A and B	30	1.3	3.0	5.4	13.0	25.8	45.5	114	289
		60	1.6	3.8	6.9	16.9	33.2	57.8	134	313
		90	2.3	5.2	9.6	23.0	43.8	72.8	155	336
	C	30	1.0	2.4	4.3	10.2	19.2	32.3	71.8	203
		60	1.3	2.9	5.3	12.5	23.5	39.7	86.8	229
		90	1.6	3.7	6.8	15.9	30.0	50.0	105	255

Table 57.—Sags for Bare Stranded Aluminum, Steel-Reinforced—Continued

LIGHT LOADING DISTRICT

[Sags being such that when loaded to 30° F. the cable will be stressed to 50 per cent of the ultimate strength for grades A and B, and 60 per cent for grade C]

Size A.W.G. No.	Grade of construction	Temperature	Sags (in inches) for span lengths (in feet) of— 100	150	200	300	400	500	700	1,000
		°F.								
4	A and B	30	1.2	2.8	5.2	13.8	31.5	65.6	-------	------
		60	1.5	3.5	6.7	18.0	41.5	81.7	-------	------
		90	2.0	4.7	9.0	25.2	54.3	98.0	-------	------
	C	30	1.0	2.3	4.1	10.1	20.6	38.9	-------	------
		60	1.2	2.7	5.0	12.4	25.8	48.9	-------	------
		90	1.5	3.4	6.2	16.0	33.3	62.0	-------	------
2	A and B	30	1.2	2.7	5.0	12.3	25.3	47.0	-------	------
		60	1.5	3.4	6.2	15.7	32.3	59.7	-------	------
		90	1.9	4.5	8.3	20.9	42.6	75.0	-------	------
	C	30	1.0	2.2	4.0	9.5	18.4	31.8	-------	------
		60	1.2	2.7	4.9	11.5	22.3	39.1	-------	------
		90	1.5	3.3	6.0	14.4	28.2	49.2	-------	------
1	A and B	30	1.2	2.7	4.9	12.0	23.9	42.7	113	298
		60	1.5	3.4	6.2	15.2	30.4	54.0	133	322
		90	2.0	4.5	8.2	20.2	39.8	68.4	153	344
	C	30	1.0	2.2	4.0	9.5	17.9	30.3	73.4	206
		60	1.2	2.7	4.8	11.4	21.7	36.9	88.7	232
		90	1.5	3.3	6.0	14.2	27.2	46.1	107	258
0	A and B	30	1.2	2.7	5.0	11.7	22.6	39.1	97.8	259
		60	1.5	3.3	6.0	14.7	28.4	49.2	117	284
		90	2.0	4.4	8.0	19.4	37.1	62.5	138	308
	C	30	1.0	2.2	4.0	9.3	17.3	28.9	66.4	178
		60	1.1	2.6	4.8	11.1	20.9	34.8	80.0	204
		90	1.4	3.3	5.9	13.9	26.0	43.4	97.0	230
00	A and B	30	1.2	2.7	4.9	11.3	21.5	36.5	86.9	226
		60	1.4	3.3	6.0	14.2	27.0	45.7	105	252
		90	2.0	4.4	7.9	18.6	35.0	57.9	125	277
	C	30	1.0	2.2	4.0	9.1	16.9	27.7	61.3	157
		60	1.1	2.6	4.8	10.9	20.2	33.2	73.7	181
		90	1.4	3.3	5.9	13.6	25.1	41.2	89.2	207
000	A and B	30	1.2	2.6	4.8	11.2	20.9	34.9	79.2	201
		60	1.4	3.3	5.9	13.9	26.1	43.2	96.3	227
		90	1.9	4.3	7.8	18.2	33.7	54.7	115	253
	C	30	1.0	2.2	3.9	8.8	16.7	26.9	58.2	142
		60	1.1	2.6	4.6	10.8	19.8	32.4	69.4	165
		90	1.4	3.3	5.8	13.5	24.5	39.8	84.0	190
0000	A and B	30	1.2	2.6	4.7	11.1	20.4	33.5	73.8	180
		60	1.5	3.3	5.9	13.7	25.2	41.3	89.3	206
		90	1.9	4.3	7.7	17.8	32.5	52.3	108	232
	C	30	1.0	2.2	3.9	8.8	16.4	26.3	55.7	131
		60	1.1	2.6	4.7	10.7	19.6	31.4	66.0	152
		90	1.4	3.2	5.8	13.3	24.0	38.6	79.7	176

Table 58.—Stringing Tensions for Medium and Hard-Drawn Bare Solid Copper Wire

HEAVY LOADING DISTRICT

[The tensions being such that when loaded at 0° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C]

Size A.W.G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—								
			100	125	150	175	200	250	300	400	500
		°F.									
8	C	30	168	76	46	------	------	------	------	------	------
		60	116	57	41	------	------	------	------	------	------
		90	77	48	38	------	------	------	------	------	------
6	A and B	30	268	152	97	------	------	------	------	------	------
		60	185	111	82	------	------	------	------	------	------
		90	124	87	72	------	------	------	------	------	------
	C	30	478	367	251	161	------	------	------	------	------
		60	385	277	183	128	------	------	------	------	------
		90	297	196	137	105	------	------	------	------	------
4	A and B	30	640	525	401	297	228	179	156	------	------
		60	496	391	293	233	192	163	148	------	------
		90	355	274	215	184	166	146	140	------	------
	C	30	891	823	721	614	502	320	240	------	------
		60	748	676	581	483	387	264	218	------	------
		90	597	535	447	359	300	228	197	------	------
2	A and B	30	1,104	1,023	911	791	678	496	412	339	313
		60	875	788	700	590	522	417	365	323	305
		90	639	577	511	449	409	349	331	311	295
	C	30	1,448	1,377	1,305	1,226	1,122	896	700	496	417
		60	1,216	1,143	1,080	997	903	723	584	454	397
		90	976	913	851	794	705	572	491	418	378
1	A and B	30	1,379	1,304	1,205	1,113	988	780	636	518	472
		60	1,080	1,008	944	852	754	622	544	481	455
		90	803	753	688	642	590	518	484	452	432
	C	30	1,788	1,742	1,676	1,575	1,500	1,277	1,080	780	645
		60	1,486	1,435	1,386	1,290	1,228	1,035	878	684	602
		90	1,191	1,149	1,100	1,021	970	812	731	615	563
0	A and B	30	1,732	1,657	1,566	1,471	1,350	1,143	954	771	692
		60	1,375	1,276	1,214	1,131	1,056	900	812	700	655
		90	1,007	954	896	854	808	750	692	646	622
	C	30	2,221	2,171	2,080	1,994	1,919	1,740	1,521	1,168	979
		60	1,848	1,795	1,699	1,645	1,566	1,409	1,243	1,011	892
		90	1,476	1,434	1,351	1,302	1,247	1,135	1,018	892	825
00	A and B	30	2,128	2,055	1,982	1,878	1,763	1,538	1,366	1,116	1,001
		60	1,654	1,596	1,549	1,456	1,382	1,236	1,142	996	934
		90	1,215	1,178	1,142	1,095	1,058	1,001	960	908	882
	C	30	2,731	2,670	2,608	2,513	2,430	2,231	2,042	1,669	1,434
		60	2,243	2,198	2,145	2,066	1,967	1,827	1,696	1,420	1,289
		90	1,796	1,743	1,696	1,639	1,587	1,456	1,383	1,242	1,170
0000	A and B	30	3,171	3,107	3,080	2,948	2,890	2,658	2,432	2,168	1,985
		60	2,426	2,392	2,342	2,292	2,250	2,083	2,010	1,885	1,810
		90	1,735	1,718	1,718	1,726	1,735	1,694	1,676	1,694	1,676
	C	30	4,001	3,960	3,928	3,850	3,792	3,593	3,430	3,053	2,721
		60	3,270	3,238	3,188	3,129	3,070	2,948	2,831	2,581	2,390
		90	2,521	2,514	2,508	2,456	2,456	2,322	2,307	2,215	2,140

Table 58.—Stringing Tensions for Medium and Hard-Drawn Bare Solid Copper Wire—Continued

MEDIUM LOADING DISTRICT

[The tensions being such that when loaded at 15° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of — 100	125	150	175	200	250	300	400	500	700	1,000
		°F.											
8	B	30	284	229	168	----	----	----	----	----	----	----	----
		60	225	175	124	----	----	----	----	----	----	----	----
		90	169	125	89	----	----	----	----	----	----	----	----
	C	30	395	357	307	----	----	----	----	----	----	----	----
		60	338	299	249	----	----	----	----	----	----	----	----
		90	277	242	194	----	----	----	----	----	----	----	----
6	A and B	30	513	470	418	363	----	----	----	----	----	----	----
		60	421	375	330	281	----	----	----	----	----	----	----
		90	327	291	247	212	----	----	----	----	----	----	----
	C	30	664	634	597	559	----	----	----	----	----	----	----
		60	571	542	504	468	----	----	----	----	----	----	----
		90	477	449	414	379	----	----	----	----	----	----	----
4	A and B	30	855	832	783	742	682	584	471	350	----	----	----
		60	708	685	639	595	546	468	386	314	----	----	----
		90	562	544	502	470	424	377	326	285	----	----	----
	C	30	1,065	1,050	1,018	983	949	874	770	562	----	----	----
		60	922	905	872	840	807	736	644	481	----	----	----
		90	768	755	729	702	672	608	533	411	----	----	----
2	A and B	30	1,344	1,330	1,274	1,230	1,195	1,101	984	794	674	574	----
		60	1,104	1,096	1,046	1,007	974	888	804	686	606	548	----
		90	877	869	825	796	770	721	661	595	561	527	----
	C	30	1,659	1,642	1,615	1,571	1,540	1,477	1,382	1,184	1,010	786	----
		60	1,420	1,407	1,383	1,342	1,310	1,253	1,161	997	877	731	----
		90	1,180	1,169	1,148	1,112	1,080	1,039	971	849	773	682	----
1	A and B	30	1,650	1,625	1,585	1,539	1,510	1,408	1,303	1,106	963	826	----
		60	1,343	1,333	1,283	1,254	1,228	1,155	1,080	940	858	773	----
		90	1,057	1,040	1,005	990	973	914	878	813	773	734	----
	C	30	2,022	2,012	1,975	1,942	1,922	1,840	1,755	1,588	1,398	1,126	----
		60	1,729	1,719	1,690	1,664	1,637	1,565	1,484	1,349	1,207	1,027	----
		90	1,434	1,428	1,392	1,375	1,359	1,296	1,245	1,133	1,060	956	----
0	A and B	30	2,013	1,997	1,935	1,915	1,890	1,798	1,700	1,483	1,335	1,152	----
		60	1,636	1,620	1,575	1,554	1,536	1,471	1,400	1,251	1,168	1,076	----
		90	1,268	1,260	1,226	1,223	1,223	1,165	1,148	1,081	1,056	1,020	----
	C	30	2,450	2,445	2,433	2,400	2,384	2,292	2,220	2,055	1,844	1,567	----
		60	2,089	2,072	2,060	2,022	2,028	1,961	1,878	1,754	1,608	1,430	----
		90	1,704	1,706	1,691	1,670	1,674	1,604	1,566	1,484	1,396	1,301	----
00	A and B	30	2,432	2,425	2,410	2,369	2,322	2,233	2,139	1,925	1,768	1,565	1,445
		60	1,961	1,966	1,946	1,925	1,878	1,816	1,768	1,633	1,555	1,460	1,387
		90	1,503	1,508	1,508	1,503	1,482	1,460	1,440	1,398	1,388	1,362	1,340
	C	30	3,015	3,000	2,982	2,960	2,928	2,860	2,760	2,592	2,420	2,102	1,852
		60	2,520	2,525	2,515	2,489	2,462	2,436	2,322	2,200	2,100	1,914	1,753
		90	2,070	2,070	2,060	2,050	2,019	1,997	1,940	1,873	1,816	1,732	1,658
0000	A and B	30	3,688	3,612	3,570	3,553	3,520	3,453	3,320	3,148	2,948	2,764	2,582
		60	2,930	2,855	2,840	2,821	2,821	2,780	2,757	2,663	2,590	2,549	2,472
		90	2,200	2,174	2,167	2,182	2,209	2,232	2,224	2,266	2,308	2,358	2,372
	C	30	4,460	4,427	4,400	4,360	4,332	4,319	4,200	4,100	3,920	3,593	3,230
		60	3,728	3,679	3,652	3,644	3,620	3,628	3,552	3,488	3,388	3,070	3,053
		90	2,948	2,940	2,930	2,922	2,930	2,972	2,930	2,972	2,948	2,930	2,872

Table 58.—Stringing Tensions for Medium and Hard-Drawn Bare Solid Copper Wire—Continued

LIGHT LOADING DISTRICT

[The tensions being such that when loaded at 30° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—										
			100	125	150	175	200	250	300	400	500	700	1,000
		° F.											
8	B	30	405	399	395	-----	-----	-----	-----	-----	-----	-----	-----
		60	345	341	338	-----	-----	-----	-----	-----	-----	-----	-----
		90	287	282	281	-----	-----	-----	-----	-----	-----	-----	-----
	C	30	488	486	484	479	-----	-----	-----	-----	-----	-----	-----
		60	428	428	423	418	-----	-----	-----	-----	-----	-----	-----
		90	371	369	365	363	-----	-----	-----	-----	-----	-----	-----
6	A and B	30	628	622	618	612	600	-----	-----	-----	-----	-----	-----
		60	539	533	528	522	510	-----	-----	-----	-----	-----	-----
		90	443	438	437	434	421	-----	-----	-----	-----	-----	-----
	C	30	758	752	748	747	738	-----	-----	-----	-----	-----	-----
		60	662	658	656	653	646	-----	-----	-----	-----	-----	-----
		90	570	564	564	560	554	-----	-----	-----	-----	-----	-----
4	A and B	30	978	970	962	957	950	941	913	856	805	-----	-----
		60	835	830	820	815	805	796	780	738	701	-----	-----
		90	684	683	672	672	670	667	647	624	603	-----	-----
	C	30	1,180	1,175	1,165	1,157	1,155	1,142	1,128	1,089	1,050	-----	-----
		60	1,032	1,025	1,017	1,005	1,004	992	983	957	928	-----	-----
		90	877	882	871	861	860	856	845	829	803	-----	-----
2	A and B	30	1,500	1,492	1,487	1,480	1,461	1,440	1,417	1,357	1,297	1,187	-----
		60	1,258	1,255	1,255	1,240	1,234	1,229	1,203	1,169	1,135	1,073	-----
		90	1,030	1,023	1,028	1,020	1,013	1,010	1,004	985	979	976	-----
	C	30	1,795	1,790	1,783	1,777	1,777	1,748	1,740	1,690	1,644	1,535	-----
		60	1,557	1,545	1,545	1,540	1,540	1,521	1,513	1,474	1,443	1,372	-----
		90	1,328	1,318	1,313	1,310	1,310	1,292	1,286	1,279	1,260	1,217	-----
1	A and B	30	1,820	1,820	1,811	1,800	1,778	1,769	1,736	1,684	1,615	1,496	1,375
		60	1,526	1,523	1,523	1,506	1,506	1,504	1,465	1,445	1,412	1,343	1,294
		90	1,231	1,231	1,235	1,231	1,227	1,231	1,227	1,225	1,211	1,218	1,211
	C	30	2,208	2,192	2,184	2,178	2,170	2,154	2,129	2,086	2,034	1,910	1,760
		60	1,910	1,890	1,890	1,883	1,880	1,883	1,845	1,827	1,775	1,713	1,615
		90	1,605	1,595	1,592	1,589	1,589	1,599	1,569	1,566	1,556	1,526	1,507
0	A and B	30	2,245	2,230	2,218	2,204	2,204	2,183	2,147	2,092	2,010	1,894	1,756
		60	1,878	1,862	1,854	1,845	1,854	1,816	1,811	1,790	1,750	1,703	1,650
		90	1,487	1,492	1,492	1,487	1,496	1,496	1,500	1,520	1,512	1,534	1,546
	C	30	2,690	2,680	2,672	2,672	2,651	2,648	2,622	2,569	2,514	2,407	2,230
		60	2,317	2,300	2,296	2,300	2,283	2,275	2,270	2,238	2,192	2,153	2,051
		90	1,940	1,928	1,928	1,932	1,928	1,940	1,932	1,919	1,915	1,923	1,898
00	A and B	30	2,732	2,702	2,691	2,681	2,686	2,665	2,612	2,592	2,509	2,389	2,216
		60	2,250	2,230	2,230	2,230	2,230	2,233	2,212	2,191	2,170	2,140	2,081
		90	1,785	1,770	1,785	1,790	1,810	1,822	1,810	1,867	1,884	1,946	1,946
	C	30	3,281	3,270	3,253	3,243	3,253	3,230	3,192	3,145	3,100	2,972	2,806
		60	2,808	2,800	2,782	2,780	2,782	2,780	2,773	2,718	2,711	2,643	2,575
		90	2,351	2,335	2,325	2,320	2,335	2,335	2,331	2,346	2,346	2,372	2,388
0000	A and B	30	4,070	4,043	4,034	4,010	3,985	3,960	3,935	3,895	3,793	3,652	3,511
		60	3,320	3,311	3,303	3,295	3,288	3,279	3,279	3,338	3,295	3,295	3,303
		90	2,563	2,571	2,590	2,598	2,590	2,656	2,713	2,780	2,855	2,980	3,097
	C	30	4,850	4,800	4,800	4,790	4,800	4,818	4,790	4,740	4,632	4,550	4,334
		60	4,100	4,085	4,052	4,060	4,093	4,070	4,093	4,100	4,038	4,052	3,979
		90	3,352	3,343	3,329	3,343	3,388	3,402	3,429	3,479	3,492	3,629	3,710

Table 59.—Stringing Tensions for Medium and Hard-Drawn Bare Stranded Copper Wire

HEAVY LOADING DISTRICT

[The tensions being such that when loaded at 0° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C]

Size A.W.G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—								
			100	125	150	200	250	350	500	700	1,000
		°F.									
4	A and B	30	650	538	400	230	176	------	------	------	------
		60	506	403	294	195	160	------	------	------	------
		90	368	288	218	170	147	------	------	------	------
	C	30	909	835	730	506	323	------	------	------	------
		60	765	692	589	390	269	------	------	------	------
		90	621	550	454	301	228	------	------	------	------
2	A and B	30	1,149	1,061	941	712	525	374	322	------	------
		60	915	832	728	546	432	343	312	------	------
		90	692	619	536	426	374	322	302	------	------
	C	30	1,508	1,440	1,368	1,175	957	604	432	------	------
		60	1,274	1,206	1,139	957	764	520	411	------	------
		90	1,040	978	910	759	614	458	395	------	------
1	A and B	30	1,439	1,360	1,195	1,030	772	574	482	449	------
		60	1,142	1,069	983	785	653	515	462	442	------
		90	858	799	726	614	541	475	442	429	------
	C	30	1,960	1,802	1,729	1,551	1,340	917	673	574	535
		60	1,564	1,505	1,432	1,267	1,010	779	627	554	528
		90	1,267	1,208	1,148	1,010	865	673	587	541	521
0	A and B	30	1,884	1,801	1,710	1,519	1,278	938	764	681	647
		60	1,511	1,436	1,353	1,204	1,013	805	714	664	639
		90	1,145	1,087	1,013	921	822	722	681	647	631
	C	30	2,407	2,349	2,274	2,117	1,926	1,519	1,096	896	805
		60	2,034	1,975	1,909	1,760	1,486	1,262	988	863	789
		90	1,660	1,610	1,544	1,419	1,287	1,013	905	830	772
00	A and B	30	2,352	2,258	2,195	1,985	1,775	1,386	1,124	998	935
		60	1,869	1,806	1,733	1,565	1,418	1,187	1,008	966	924
		90	1,418	1,365	1,323	1,197	1,145	1,019	966	935	914
	C	30	2,972	2,908	2,867	2,772	2,531	2,111	1,628	1,323	1,176
		60	2,489	2,436	2,394	2,300	2,100	1,743	1,449	1,250	1,145
		90	2,016	1,974	1,932	1,869	1,701	1,460	1,302	1,176	1,113
0000	A and B	30	3,752	3,685	3,602	3.420	3,220	2,805	2,407	2,125	1,942
		60	2,988	2,955	2,888	2,756	2,590	2,341	2,158	1,975	1,892
		90	2,258	2,241	2,224	2,141	2,058	1,992	1,942	1,876	1,859
	C	30	4,665	4,631	4,598	4,465	4,233	3,868	3,503	2,988	2,490
		60	3,918	3,884	3,851	3,735	3,552	3,270	2,905	2,722	2,374
		90	3,171	3,137	3,104	3,038	2,888	2,706	2,556	2,523	2,291

Table 59.—Stringing Tensions for Medium and Hard-Drawn Bare Stranded Copper Wire—Continued

MEDIUM LOADING DISTRICT

[The tensions being such that when loaded at 15° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C]

Size A.W.G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of— 100	125	150	200	250	350	500	700	1,000
		°F.									
4	A and B	30	866	821	790	691	570	378	------	------	------
		60	722	677	650	557	454	326	------	------	------
		90	578	534	512	438	390	288	------	------	------
	C	30	1,085	1,056	1,030	957	864	650	------	------	------
		60	938	910	883	816	726	544	------	------	------
		90	794	768	742	678	598	451	------	------	------
2	A and B	30	1,383	1,352	1,316	1,217	1,128	910	692	580	528
		60	1,149	1,113	1,087	998	926	738	624	551	520
		90	915	889	858	796	738	629	580	530	510
	C	30	1,700	1,685	1,659	1,586	1,513	1,323	1,040	796	681
		60	1,472	1,451	1,425	1,360	1,290	1,123	902	744	655
		90	1,232	1,217	1,193	1,131	1,074	946	796	692	640
1	A and B	30	1,709	1,670	1,637	1,558	1,452	1,261	983	838	759
		60	1,406	1,373	1,346	1,274	1,195	1,049	871	799	739
		90	1,115	1,082	1,063	1,016	950	878	785	746	719
	C	30	2,086	2,066	2,039	1,987	1,894	1,709	1,432	1,162	977
		60	1,789	1,769	1,749	1,696	1,617	1,459	1,241	1,049	937
		90	1,485	1,472	1,452	1,406	1,346	1,221	1,089	983	898
0	A and B	30	2,170	2,158	2,100	2,034	1,930	1,726	1,436	1,257	1,112
		60	1,793	1,776	1,735	1,677	1,594	1,444	1,270	1,145	1,071
		90	1,419	1,411	1,374	1,345	1,282	1,179	1,129	1,071	1,046
	C	30	2,656	2,639	2,598	2,565	2,473	2,324	2,042	1,702	1,444
		60	2,283	2,266	2,233	2,204	2,117	2,000	1,776	1,544	1,361
		90	1,909	1,892	1,859	1,838	1,768	1,681	1,536	1,403	1,299
00	A and B	30	2,672	2,667	2,625	2,541	2,457	2,247	1,953	1,717	1,586
		60	2,189	2,184	2,158	2,090	2,037	1,880	1,712	1,575	1,502
		90	1,727	1,722	1,701	1,670	1,638	1,565	1,523	1,470	1,449
	C	30	3,287	3,266	3,213	3,166	3,108	2,930	2,657	2,300	2,037
		60	2,804	2,788	2,751	2,709	2,646	2,520	2,310	2,079	1,911
		90	2,331	2,315	2,279	2,252	2,205	2,121	2,006	1,880	1,827
0000	A and B	30	4,183	4,158	4,117	4,067	4,001	3,768	3,511	3,204	2,955
		60	3,436	3,420	3,386	3,353	3,320	3,204	3,046	2,922	2,805
		90	2,689	2,681	2,673	2,673	2,673	2,673	2,673	2,673	2,673
	C	30	5,113	5,063	5,046	5,030	4,980	4,764	4,631	4,183	3,801
		60	4,366	4,334	4,316	4,299	4,266	4,100	3,951	3,768	3,519
		90	3,619	3,586	3,586	3,586	3,569	3,469	3,420	3,370	3,303

Table 59.—Stringing Tensions for Medium and Hard-Drawn Bare Stranded Copper Wire—Continued

LIGHT LOADING DISTRICT

[The tension being such that when loaded at 30° F. the wire will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C]

Size, A.W.G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—								
			100	125	150	200	250	350	500	700	1,000
		°F.									
4	A and B	30	986	976	973	957	931	914	772		
		60	842	835	832	816	794	741	669		
		90	698	692	688	678	662	626	582		
	C	30	1, 194	1, 184	1, 181	1, 173	1, 152	1, 104	1, 030		
		60	1, 043	1, 037	1, 032	1, 029	1, 008	966	902		
		90	899	893	890	883	869	832	787		
2	A and B	30	1, 537	1, 534	1, 521	1, 503	1, 477	1, 417	1, 310	1, 160	
		60	1, 310	1, 305	1, 292	1, 274	1, 253	1, 204	1, 144	1, 050	
		90	1, 071	1, 066	1, 061	1, 050	1, 040	1, 019	988	946	
	C	30	1, 851	1, 846	1, 841	1, 812	1, 794	1, 752	1, 680	1, 524	
		60	1, 612	1, 607	1, 599	1, 570	1, 562	1, 534	1, 477	1, 362	
		90	1, 378	1, 373	1, 368	1, 342	1, 342	1, 321	1, 284	1, 217	
1	A and B	30	1, 888	1, 881	1, 868	1, 848	1, 815	1, 762	1, 643	1, 492	1, 350
		60	1, 591	1, 584	1, 577	1, 558	1, 535	1, 495	1, 429	1, 343	1, 274
		90	1, 294	1, 290	1, 287	1, 277	1, 271	1, 267	1, 234	1, 214	1, 195
	C	30	2, 270	2, 264	2, 254	2, 231	2, 218	2, 158	2, 072	1, 921	1, 736
		60	1, 960	1, 957	1, 954	1, 934	1, 921	1, 884	1, 815	1, 716	1, 597
		90	1, 667	1, 663	1, 660	1, 643	1, 637	1, 620	1, 584	1, 538	1, 485
0	A and B	30	2, 390	2, 374	2, 370	2, 349	2, 320	2, 258	2, 129	1, 975	1, 801
		60	2, 013	2, 004	2, 000	1, 992	1, 967	1, 921	1, 868	1, 772	1, 685
		90	1, 635	1, 631	1, 631	1, 631	1, 631	1, 631	1, 619	1, 602	1, 594
	C	30	2, 872	2, 864	2, 855	2, 847	2, 822	2, 764	2, 681	2, 523	2, 324
		60	2, 494	2, 482	2, 478	2, 473	2, 449	2, 415	2, 357	2, 258	2, 150
		90	2, 121	2, 117	2, 112	2, 108	2, 092	2, 075	2, 050	2, 021	1, 975
00	A and B	30	2, 945	2, 930	2, 924	2, 919	2, 877	2, 793	2, 667	2, 520	2, 342
		60	2, 462	2, 457	2, 452	2, 447	2, 426	2, 378	2, 326	2, 263	2, 184
		90	1, 995	1, 995	1, 995	1, 995	1, 995	2, 011	2, 011	2, 037	2, 048
	C	30	3, 528	3, 518	3, 512	3, 507	3, 497	3, 423	3, 339	3, 192	2, 982
		60	3, 056	3, 045	3, 035	3, 024	3, 014	2, 982	2, 930	2, 856	2, 741
		90	2, 573	2, 573	2, 573	2, 573	2, 573	2, 557	2, 557	2, 557	2, 520
0000	A and B	30	4, 590	4, 573	4, 565	4, 548	4, 532	4, 432	4, 333	4, 150	3, 951
		60	3, 843	3, 835	3, 826	3, 818	3, 810	3, 777	3, 760	3, 702	3, 677
		90	3, 088	3, 088	3, 088	3, 121	3, 154	3, 204	3, 254	3, 337	3, 428
	C	30	5, 528	5, 503	5, 486	5, 461	5, 445	5, 395	5, 279	5, 146	4, 930
		60	4, 772	4, 748	4, 739	4, 731	4, 714	4, 681	4, 631	4, 598	4, 548
		90	4, 034	4, 017	4, 000	4, 000	4, 000	4, 009	4, 034	4, 117	4, 175

Table 60.—Stringing Tensions for Medium and Hard-Drawn T. B. W. P. Solid Copper Wire

HEAVY LOADING DISTRICT

[The tensions being such that when loaded at 0° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C]

Size, A. W. G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—						
			100	125	150	175	200	250	300
		°F.							
8	C	30	114	63	50				
		60	86	57	47				
		90	66	50	44				
6	A and B	30	194	116	101				
		60	138	100	85				
		90	107	89	79				
	C	30	408	272	169	132			
		60	315	209	138	115			
		90	240	158	119	107			
4	A and B	30	554	411	301	225	195		
		60	414	310	238	197	178		
		90	301	231	195	174	168		
	C	30	840	738	602	476	362		
		60	692	592	481	375	300		
		90	551	465	365	297	251		
2	A and B	30	1,044	932	786	660	559	443	386
		60	810	716	592	517	459	402	355
		90	608	538	467	420	391	363	334
	C	30	1,391	1,318	1,198	1,093	978	739	590
		60	1,160	1,083	976	870	783	618	522
		90	928	875	776	694	629	522	470
1	A and B	30	1,327	1,217	1,090	964	845	678	586
		60	1,038	953	845	744	682	573	527
		90	773	694	642	600	557	511	485
	C	30	1,749	1,660	1,562	1,454	1,356	1,097	917
		60	1,454	1,363	1,294	1,198	1,087	888	780
		90	1,160	1,090	1,022	930	882	753	685
0	A and B	30	1,686	1,566	1,488	1,322	1,201	996	871
		60	1,325	1,230	1,148	1,053	974	858	767
		90	979	900	880	812	783	730	704
	C	30	2,180	2,098	1,990	1,920	1,807	1,575	1,334
		60	1,804	1,729	1,645	1,562	1,496	1,272	1,135
		90	1,438	1,372	1,293	1,256	1,185	1,077	978
00	A and B	30	2,108	1,977	1,883	1,754	1,657	1,404	1,252
		60	1,643	1,549	1,481	1,372	1,288	1,190	1,095
		90	1,221	1,132	1,116	1,064	1,064	1,001	970
	C	30	2,709	2,609	2,490	2,425	2,295	2,081	1,872
		60	2,228	2,139	2,060	1,977	1,899	1,727	1,550
		90	1,774	1,706	1,617	1,586	1,492	1,403	1,335
0000	A and B	30	3,130	3,021	2,957	2,858	2,715	2,508	2,309
		60	2,408	2,340	2,290	2,216	2,190	2,073	1,950
		90	1,751	1,717	1,735	1,735	1,726	1,701	1,710
	C	30	3,969	3,918	3,842	3,751	3,679	3,461	3,252
		60	3,238	3,187	3,120	3,052	3,029	2,847	2,680
		90	2,513	2,498	2,463	2,422	2,407	2,331	2,290

Table 60.—Stringing Tensions for Medium and Hard-Drawn T. B. W. P. Solid Copper Wire—Continued

MEDIUM LOADING DISTRICT

[The tensions being such that when loaded at 15° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B, and 60 per cent for grade C]

Size A.W.G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of— 100	125	150	175	200	250	300
		° F.							
8	B	30	232	182	133				
		60	160	121	97				
		90	111	94	79				
	C	30	364	300	237				
		60	305	243	188				
		90	250	194	148				
6	A and B	30	469	410	331	264			
		60	379	322	260	215			
		90	293	246	200	173			
	C	30	628	590	532	465			
		60	540	496	446	384			
		90	446	410	365	306			
4	A and B	30	820	766	703	641	571		
		60	677	626	572	514	456		
		90	533	492	440	406	372		
	C	30	1,043	1,010	956	916	862		
		60	892	864	809	771	718		
		90	748	720	674	638	595		
2	A and B	30	1,315	1,262	1,208	1,148	1,085	950	841
		60	1,078	1,035	984	948	877	792	713
		90	856	812	788	742	713	648	616
	C	30	1,628	1,589	1,552	1,515	1,453	1,356	1,225
		60	1,388	1,359	1,323	1,286	1,240	1,148	1,048
		90	1,161	1,127	1,094	1,075	1,025	958	877
1	A and B	30	1,611	1,552	1,523	1,465	1,415	1,278	1,163
		60	1,326	1,271	1,235	1,195	1,153	1,051	960
		90	1,031	996	984	941	921	862	839
	C	30	1,981	1,965	1,938	1,896	1,844	1,742	1,638
		60	1,694	1,676	1,651	1,598	1,576	1,484	1,385
		90	1,405	1,385	1,365	1,340	1,291	1,235	1,173
0	A and B	30	1,977	1,944	1,906	1,853	1,811	1,671	1,509
		60	1,616	1,592	1,555	1,517	1,496	1,389	1,276
		90	1,248	1,244	1,227	1,194	1,190	1,135	1,065
	C	30	2,459	2,425	2,402	2,354	2,291	2,218	2,092
		60	2,078	2,051	2,022	1,990	1,952	1,866	1,783
		90	1,704	1,691	1,683	1,654	1,596	1,563	1,484
00	A and B	30	2,405	2,384	2,352	2,290	2,242	2,139	2,030
		60	1,946	1,941	1,910	1,878	1,826	1,774	1,701
		90	1,497	1,514	1,492	1,461	1,445	1,440	1,440
	C	30	3,011	2,991	2,950	2,880	2,830	2,765	2,671
		60	2,537	2,520	2,472	2,437	2,400	2,332	2,280
		90	2,089	2,067	2,034	1,988	1,956	1,946	1,920
0000	A and B	30	3,601	3,552	3,544	3,470	3,460	3,329	3,252
		60	2,870	2,862	2,830	2,771	2,789	2,755	2,689
		90	2,158	2,165	2,165	2,173	2,232	2,232	2,300
	C	30	4,415	4,391	4,359	4,341	4,300	4,200	4,118
		60	3,693	3,651	3,651	3,635	3,585	3,542	3,452
		90	2,954	2,939	2,930	2,947	2,961	2,921	2,930

Table 60.—Stringing Tensions for Medium and Hard-Drawn T. B. W. P. Solid Copper Wire—Continued

LIGHT LOADING DISTRICT

[The tensions being such that when loaded at 30° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C]

Size A.W.G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—						
			100	125	150	175	200	250	300
		°F.							
8	B	30	378	359	336	--------	--------	--------	--------
		60	319	303	281	--------	--------	--------	--------
		90	261	248	230	--------	--------	--------	--------
	C	30	470	455	443	422	--------	--------	--------
		60	410	395	384	366	--------	--------	--------
		90	352	341	328	312	--------	--------	--------
6	A and B	30	634	584	562	539	512	--------	--------
		60	544	493	477	451	432	--------	--------
		90	449	405	387	373	352	--------	--------
	C	30	747	727	709	696	674	--------	--------
		60	649	633	618	605	584	--------	--------
		90	554	543	528	515	479	--------	--------
4	A and B	30	951	940	920	890	860	--------	--------
		60	799	790	776	757	722	--------	--------
		90	657	649	639	613	597	--------	--------
	C	30	1,157	1,144	1,133	1,122	1,091	--------	--------
		60	1,014	992	983	971	952	--------	--------
		90	864	847	839	831	805	--------	--------
2	A and B	30	1,476	1,460	1,435	1,425	1,383	1,331	1,284
		60	1,226	1,232	1,211	1,205	1,164	1,132	1,091
		90	1,007	1,001	987	982	966	929	924
	C	30	1,790	1,779	1,764	1,737	1,714	1,685	1,633
		60	1,545	1,534	1,529	1,513	1,495	1,466	1,424
		90	1,320	1,307	1,299	1,278	1,271	1,255	1,213
1	A and B	30	1,808	1,792	1,781	1,755	1,726	1,686	1,644
		60	1,513	1,500	1,496	1,473	1,441	1,434	1,382
		90	1,218	1,212	1,212	1,212	1,189	1,179	1,172
	C	30	2,188	2,170	2,145	2,038	2,118	2,070	2,040
		60	1,886	1,873	1,864	1,847	1,815	1,801	1,778
		90	1,592	1,585	1,572	1,562	1,559	1,526	1,526
0	A and B	30	2,230	2,198	2,185	2,163	2,152	2,098	2,052
		60	1,858	1,850	1,824	1,800	1,792	1,792	1,734
		90	1,497	1,485	1,476	1,485	1,494	1,476	1,468
	C	30	2,682	2,662	2,650	2,638	2,623	2,575	2,529
		60	2,297	2,297	2,280	2,277	2,269	2,230	2,198
		90	1,935	1,932	1,925	1,915	1,920	1,900	1,882
00	A and B	30	2,702	2,682	2,678	2,670	2,655	2,588	2,568
		60	2,229	2,219	2,211	2,208	2,232	2,180	2,165
		90	1,774	1,774	1,790	1,800	1,795	1,800	1,832
	C	30	3,271	3,267	3,232	3,232	3,209	3,171	3,140
		60	2,795	2,785	2,785	2,780	2,770	2,728	2,702
		90	2,335	2,331	2,314	2,336	2,310	2,310	2,314
0000	A and B	30	4,019	4,010	4,010	4,000	3,960	3,884	3,850
		60	3,288	3,270	3,295	3,303	3,260	3,245	3,303
		90	2,558	2,564	2,605	2,614	2,672	2,672	2,698
	C	30	4,830	4,708	4,708	4,780	4,798	4,740	4,690
		60	4,060	4,068	4,040	4,068	4,083	4,050	4,050
		90	3,343	3,320	3,338	3,370	3,402	3,387	3,379

Table 61.—Stringing Tensions for T. B. W. P. Solid Soft Copper Wire

HEAVY LOADING DISTRICT

[The tensions being such that when loaded at 0° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C].

Size A. W. G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—				
			100	125	150	175	200
		°F.					
6	C	30	58	54	49	--------	--------
		60	54	51	49	--------	--------
		90	49	47	48	--------	--------
4	A and B	30	109	98	91	--------	--------
		60	96	90	88	--------	--------
		90	88	85	81	--------	--------
	C	30	171	137	121	--------	--------
		60	138	121	112	--------	--------
		90	116	109	103	--------	--------
2	A and B	30	324	269	235	224	219
		60	248	224	209	209	206
		90	201	198	193	196	196
	C	30	543	433	349	308	287
		60	391	329	290	274	261
		90	276	266	253	248	248
1	A and B	30	491	416	367	334	324
		60	360	328	318	301	295
		90	278	282	285	278	275
	C	30	810	682	576	485	442
		60	580	507	449	416	393
		90	406	383	376	354	350
0	A and B	30	783	663	588	534	506
		60	551	497	485	456	456
		90	414	414	414	414	431
	C	30	1,156	1,024	892	787	713
		60	824	746	680	630	605
		90	592	568	551	538	526
00	A and B	30	1,080	991	898	798	757
		60	772	731	699	673	662
		90	548	574	584	579	584
	C	30	1,539	1,424	1,304	1,190	1,085
		60	1,120	1,043	976	944	887
		90	782	772	778	761	757
0000	A and B	30	2,001	1,876	1,768	1,634	1,618
		60	1,410	1,353	1,360	1,319	1,303
		90	1,020	1,020	1,062	1,070	1,136
	C	30	2,622	2,522	2,422	2,273	2,233
		60	1,942	1,868	1,817	1,776	1,726
		90	1,335	1,353	1,410	1,394	1,435

Table 61.—Stringing Tensions for T. B. W. P. Solid Soft Copper Wire—Continued

MEDIUM LOADING DISTRICT

[The tensions being such that when loaded at 15° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of— 100	125	150	175	200	250
		°F.						
6	C	30	190	134	111	--------	--------	--------
		60	137	111	100	--------	--------	--------
		90	106	96	91	--------	--------	--------
4	A and B	30	298	230	193	181	--------	--------
		60	212	183	168	161	--------	--------
		90	161	150	147	147	--------	--------
	C	30	461	388	309	267	--------	--------
		60	329	282	244	220	--------	--------
		90	235	218	196	196	--------	--------
2	A and B	30	663	590	519	449	423	--------
		60	483	438	407	375	360	--------
		90	336	334	329	318	318	--------
	C	30	906	820	756	689	611	--------
		60	678	618	572	530	496	--------
		90	491	462	446	433	417	--------
1	A and B	30	888	806	738	655	612	556
		60	632	579	570	537	518	488
		90	445	439	449	435	439	449
	C	30	1, 160	1, 107	1, 035	990	895	774
		60	885	838	803	753	702	662
		90	632	625	609	609	589	566
0	A and B	30	1, 172	1, 090	1, 031	954	912	804
		60	834	812	775	775	746	708
		90	601	596	613	613	618	622
	C	30	1, 508	1, 450	1, 384	1, 322	1, 251	1, 123
		60	1, 152	1, 110	1, 074	1, 040	995	958
		90	821	816	816	812	812	800
00	A and B	30	1, 518	1, 482	1, 393	1, 351	1, 278	1, 185
		60	1, 095	1, 080	1, 075	1, 033	1, 038	986
		90	772	804	819	850	845	871
	C	30	1, 930	1, 868	1, 836	1, 806	1, 696	1, 581
		60	1, 493	1, 461	1, 420	1, 403	1, 352	1, 320
		90	1, 069	1, 064	1, 085	1, 100	1, 080	1, 100
0000	A and B	30	2, 490	2, 458	2, 423	2, 315	2, 290	2, 165
		60	1, 826	1, 801	1, 801	1, 801	1, 809	1, 809
		90	1, 269	1, 320	1, 394	1, 403	1, 469	1, 527
	C	30	3, 112	3, 090	3, 030	2, 988	2, 988	2, 808
		60	2, 390	2, 408	2, 373	2, 341	2, 350	2, 291
		90	1, 717	1, 760	1, 777	1, 835	1, 892	1, 900

Table 61.—Stringing Tensions for T. B. W. P. Solid Soft Copper Wire—Continued

LIGHT LOADING DISTRICT

[The tensions being such that when loaded at 30° F. the wires will be stressed to 50 per cent of their ultimate strength for grades A and B and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—					
			100	125	150	175	200	250
		° F.						
6	A and B	30	279	239	206	--------	--------	--------
		60	202	181	167	--------	--------	--------
		90	148	142	135	--------	--------	--------
	C	30	384	342	314	--------	--------	--------
		60	303	262	239	--------	--------	--------
		90	224	199	190	--------	--------	--------
4	A and B	30	514	469	434	381	346	--------
		60	383	347	334	311	290	--------
		90	269	266	258	248	241	--------
	C	30	648	619	594	554	508	--------
		60	508	491	463	438	404	--------
		90	381	362	355	342	332	--------
2	A and B	30	882	846	809	772	731	658
		60	663	650	619	600	584	558
		90	480	475	475	485	485	480
	C	30	1,106	1,078	1,044	1,010	969	904
		60	880	848	833	802	783	736
		90	653	647	640	624	629	619
1	A and B	30	1,136	1,081	1,055	1,028	983	894
		60	852	826	822	800	780	750
		90	608	609	619	619	638	622
	C	30	1,375	1,362	1,340	1,304	1,267	1,199
		60	1,087	1,087	1,054	1,035	1,041	982
		90	813	819	816	816	813	813
0	A and B	30	1,450	1,409	1,367	1,359	1,310	1,214
		60	1,090	1,069	1,069	1,060	1,027	1,019
		90	783	787	808	812	842	871
	C	30	1,745	1,712	1,707	1,683	1,637	1,567
		60	1,396	1,360	1,360	1,355	1,360	1,277
		90	1,040	1,032	1,056	1,060	1,056	1,060
00	A and B	30	1,830	1,800	1,778	1,742	1,721	1,622
		60	1,387	1,366	1,382	1,387	1,387	1,345
		90	981	1,012	1,064	1,064	1,095	1,121
	C	30	2,211	2,207	2,180	2,140	2,150	2,070
		60	1,764	1,757	1,747	1,711	1,726	1,706
		90	1,315	1,330	1,352	1,357	1,394	1,394
0000	A and B	30	2,962	2,952	2,898	2,862	2,798	2,771
		60	2,281	2,273	2,232	2,250	2,265	2,258
		90	1,610	1,676	1,693	1,760	1,768	1,867
	C	30	3,538	3,543	3,520	3,494	3,452	3,403
		60	2,822	2,848	2,822	2,839	2,789	2,807
		90	2,090	2,159	2,159	2,190	2,232	2,282

Table 62.—Stringing Tensions for Ordinary Grade Steel Wire

HEAVY LOADING DISTRICT

[At 30, 60, and 90° F. without load, the tensions being such that when loaded at 0° F. the wire will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Steel wire gage No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of— 100	125	150	175	200	250	300	400	500
		°F.									
8	C	30	260	130	89	------	------	------	------	------	------
		60	165	99	79	------	------	------	------	------	------
		90	110	83	70	------	------	------	------	------	------
6	A and B	30	320	190	135	------	------	------	------	------	------
		60	200	140	120	------	------	------	------	------	------
		90	135	115	105	------	------	------	------	------	------
	C	30	580	450	300	210	170	140	125	115	110
		60	430	300	220	170	150	130	120	110	110
		90	280	210	160	145	130	125	115	110	110
4	A and B	30	640	480	360	280	240	200	185	175	165
		60	430	330	260	230	210	185	180	170	165
		90	270	230	210	195	185	175	170	165	165
	C	30	970	850	710	560	450	310	260	220	210
		60	740	630	510	410	340	270	240	220	210
		90	530	440	360	310	280	240	220	210	200

MEDIUM LOADING DISTRICT

[At 30, 60, and 90° F. without load, the tensions being such that when loaded at 15° F. the wire will be stressed to 50 per cent of ultimate strength for Grades A and B, and to 60 per cent for grade C]

8	C	30	580	520	450	------	------	------	------	------	------
		60	460	400	340	------	------	------	------	------	------
		90	340	300	240	------	------	------	------	------	------
6	A and B	30	670	610	530	------	------	------	------	------	------
		60	500	450	380	------	------	------	------	------	------
		90	360	310	270	------	------	------	------	------	------
	C	30	880	830	780	710	640	500	380	280	230
		60	710	660	610	550	490	390	320	260	220
		90	550	500	460	410	370	310	270	230	210
4	A and B	30	980	930	870	790	720	590	480	370	340
		60	760	710	650	600	540	460	400	340	320
		90	550	510	470	430	410	370	340	310	300
	C	30	1,250	1,220	1,170	1,110	1,050	920	780	550	480
		60	1,030	990	950	890	840	730	630	480	440
		90	800	770	730	680	640	570	510	420	400

Table 62.—Stringing Tensions for Ordinary Grade Steel Wire—Continued

LIGHT LOADING DISTRICT

[At 30, 60, and 90° F. without load, the tensions being such that when loaded at 30° F. the wire will be stressed to 50 per cent of ultimate strength for grades A and B and to 60 per cent for grade C]

Steel wire gage No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—								
			100	125	150	175	200	250	300	400	500
		°F.									
8	C	30	730	720	710						
		60	610	610	600						
		90	490	490	480						
6	A and B	30	850	840	830						
		60	680	670	660						
		90	520	520	510						
	C	30	1,030	1,030	1,020	1,010	1,000	970	940	870	800
		60	870	860	850	850	840	820	790	730	680
		90	700	690	690	680	680	660	640	610	580
4	A and B	30	1,180	1,170	1,160	1,150	1,140	1,110	1,070	970	860
		60	950	940	930	920	910	890	860	810	760
		90	720	720	720	720	710	700	690	680	660
	C	30	1,420	1,420	1,410	1,400	1,390	1,370	1,340	1,260	1,180
		60	1,190	1,190	1,180	1,170	1,170	1,150	1,120	1,060	1,010
		90	970	960	960	950	950	930	910	880	860

Table 63.—Stringing Tensions for Siemens-Martin Steel Wire

HEAVY LOADING DISTRICT

[At 30, 60, and 90° F., without load, the tensions being such that when loaded at 0 °F., the wire will be stressed to 50 per cent of ultimate strength for grades A and B and to 60 per cent for grade C]

Steel wire gage No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of— 200	250	300	400	500	600	700	1,000
		°F.								
6	C	30	440	260	200	160	150	145	140	------
		60	330	220	185	155	150	145	140	------
		90	250	190	170	150	145	140	140	------
4	A and B	30	530	350	280	240	220	210	210	------
		60	400	290	260	230	220	210	210	------
		90	310	260	240	220	210	210	200	------
	C	30	1,000	730	520	340	300	270	270	260
		60	780	570	420	320	290	270	260	260
		90	590	440	360	300	280	260	260	260

MEDIUM LOADING DISTRICT

[At 30, 60, and 90° F., without load, the tensions being such that when loaded at 15° F., the wire will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

6	C	30	1,010	890	760	520	390	330	300	270
		60	820	730	620	440	350	310	290	270
		90	690	580	490	380	320	300	280	260
4	A and B	30	1,130	1,020	860	640	520	450	430	390
		60	910	810	690	550	470	430	410	380
		90	700	640	560	470	430	400	390	370
	C	30	1,500	1,410	1,300	1,060	830	670	590	490
		60	1,280	1,180	1,090	880	720	610	550	480
		90	1,060	970	890	730	620	550	520	470

LIGHT LOADING DISTRICT

[At 30, 60, and 90° F., without load, the tensions being such that when loaded at 30° F., the wire will be stressed to 50 per cent of ultimate strength for grades A and B and to 60 per cent for grade C]

6	C	30	1,280	1,260	1,240	1,190	1,130	1,060	1,000	830
		60	1,110	1,090	1,080	1,030	980	920	880	760
		90	940	930	920	880	840	800	770	700
4	A and B	30	1,450	1,430	1,400	1,330	1,260	1,180	1,110	960
		60	1,230	1,210	1,180	1,130	1,080	1,020	980	890
		90	1,000	990	980	950	920	890	870	830
	C	30	1,770	1,750	1,730	1,680	1,620	1,540	1,480	1,280
		60	1,540	1,530	1,510	1,460	1,410	1,350	1,300	1,160
		90	1,310	1,300	1,290	1,260	1,220	1,170	1,140	1,060

Table 64.—Stringing Tensions for High-Tension Steel Wire

HEAVY LOADING DISTRICT

[At 30, 60, and 90° F., without load, the tensions being such that when loaded at 0° F., the wire will be stressed to 50 per cent of ultimate strength for grades A and B and to 60 per cent for grade C]

Steel wire gage No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—							
			200	250	300	400	500	600	700	1,000
		°F.								
6	C	30	1,730	1,590	1,420	960	560	400	330	250
		60	1,570	1,430	1,260	810	480	380	320	250
		90	1,400	1,260	1,100	680	420	350	300	250
4	A and B	30	1,970	1,800	1,590	1,110	710	540	470	390
		60	1,730	1,570	1,370	930	620	500	440	380
		90	1,500	1,340	1,160	770	550	460	420	370
	C	30	2,560	2,430	2,280	1,940	1,500	1,070	790	520
		60	2,330	2,190	2,050	1,720	1,290	930	710	500
		90	2,100	1,960	1,820	1,500	1,110	820	650	490

MEDIUM LOADING DISTRICT

[At 30, 60, and 90° F. without load, the tensions being such that when loaded at 15° F. the wire will be stressed to 50 pei cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

6	C	30	2,000	1,970	1,920	1,790	1,640	1,440	1,220	740
		60	1,820	1,800	1,750	1,620	1,480	1,290	1,090	690
		90	1,660	1,630	1,580	1,460	1,320	1,140	960	630
4	A and B	30	2,290	2,240	2,180	2,020	1,830	1,620	1,400	950
		60	2,060	2,010	1,950	1,800	1,620	1,430	1,230	880
		90	1,830	1,780	1,720	1,580	1,420	1,250	1,080	820
	C	30	2,810	2,770	2,730	2,620	2,480	2,320	2,140	1,540
		60	2,580	2,540	2,500	2,400	2,250	2,100	1,930	1,390
		90	2,350	2,310	2,270	2,170	2,030	1,880	1,730	1,260

LIGHT LOADING DISTRICT

[At 30, 60, and 90° F. without load, the tensions being such that when loaded at 30° F. the wire will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

6	C	30	2,160	2,150	2,140	2,120	2,100	2,080	2,060	1,910
		60	1,980	1,980	1,970	1,950	1,930	1,910	1,890	1,750
		90	1,820	1,820	1,810	1,800	1,770	1,750	1,720	1,610
4	A and B	30	2,470	2,470	2,450	2,430	2,400	2,350	2,310	2,130
		60	2,240	2,230	2,220	2,200	2,180	2,140	2,090	1,940
		90	2,020	2,010	1,990	1,970	1,950	1,910	1,870	1,770
	C	30	2,980	2,970	2,960	2,940	2,920	2,890	2,860	2,730
		60	2,750	2,740	2,730	2,710	2,690	2,660	2,640	2,520
		90	2,530	2,520	2,510	2,490	2,470	2,440	2,420	2,320

Table 65.—Stringing Tensions for Ordinary Grade Steel Cable

HEAVY LOADING DISTRICT

[At 30, 60, and 90° F. without load, the tensions being such that when loaded at 0° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—								
			100	125	150	175	200	250	300	400	500
		°F.									
¼	A and B	30	470	320	220	170	150	130	125	120	115
		60	340	230	175	150	140	125	125	115	115
		90	230	175	150	135	130	120	120	115	115
	C	30	770	630	480	350	260	195	170	150	145
		60	610	500	370	270	220	180	160	150	140
		90	470	360	270	220	190	165	155	145	135
5/16	A and B	30	1,140	1,010	880	740	610	450	390	340	330
		60	900	780	670	560	490	400	360	330	320
		90	670	580	500	450	410	360	340	320	320
	C	30	1,550	1,440	1,330	1,210	1,090	820	620	480	420
		60	1,290	1,190	1,100	990	880	680	550	450	410
		90	1,040	960	870	780	690	550	480	420	390
⅜	A and B	30	1,680	1,580	1,460	1,320	1,180	920	780	640	580
		60	1,350	1,260	1,150	1,040	930	770	690	600	560
		90	1,020	950	870	800	740	660	620	560	540
	C	30	2,200	2,130	2,030	1,920	1,800	1,530	1,280	940	800
		60	1,850	1,780	1,690	1,590	1,480	1,260	1,070	840	760
		90	1,510	1,460	1,370	1,280	1,170	1,020	910	770	710
7/16	A and B	30	2,570	2,480	2,370	2,260	2,140	1,870	1,630	1,320	1,180
		60	2,080	2,000	1,900	1,810	1,710	1,530	1,370	1,180	1,110
		90	1,600	1,540	1,480	1,420	1,360	1,250	1,170	1,080	1,050
	C	30	3,280	3,210	3,130	3,040	2,940	2,700	2,450	1,990	1,690
		60	2,780	2,710	2,640	2,560	2,470	2,250	2,060	1,730	1,520
		90	2,280	2,220	2,160	2,100	2,020	1,860	1,720	1,510	1,390
½	A and B	30	3,120	3,020	2,930	2,830	2,720	2,470	2,200	1,790	1,600
		60	2,520	2,460	2,380	2,290	2,180	1,980	1,840	1,590	1,480
		90	1,940	1,910	1,860	1,800	1,730	1,630	1,550	1,420	1,380
	C	30	3,970	3,900	3,830	3,740	3,640	3,420	3,180	2,720	2,320
		60	3,380	3,300	3,230	3,150	3,070	2,880	2,670	2,330	2,060
		90	2,780	2,720	2,660	2,590	2,520	2,380	2,240	2,030	1,860
9/16	A and B	30	4,210	4,150	4,070	3,960	3,840	3,600	3,380	2,930	2,620
		60	3,440	3,380	3,300	3,230	3,150	2,960	2,800	2,560	2,380
		90	2,670	2,630	2,580	2,530	2,480	2,410	2,350	2,260	2,180
	C	30	5,310	5,280	5,230	5,140	5,050	4,840	4,590	4,140	3,720
		60	4,500	4,470	4,420	4,350	4,280	4,100	3,900	3,560	3,290
		90	3,700	3,680	3,650	3,600	3,540	3,400	3,270	3,080	2,920
⅝	A and B	30	5,250	5,160	5,070	4,980	4,880	4,660	4,390	3,960	3,590
		60	4,280	4,190	4,140	4,060	3,990	3,830	3,680	3,440	3,240
		90	3,340	3,290	3,250	3,220	3,180	3,140	3,080	2,980	2,930
	C	30	6,550	6,500	6,440	6,370	6,280	6,100	5,860	5,410	4,970
		60	5,570	5,530	5,480	5,410	5,340	5,190	4,980	4,660	4,380
		90	4,560	4,540	4,500	4,470	4,430	4,310	4,210	4,030	3,880

Table 65.—Stringing Tensions for Ordinary Grade Steel Cable—Con.

MEDIUM LOADING DISTRICT

[At 30, 60, and 90° F. without load, the tensions being such that when loaded at 15° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—								
			100	125	150	175	200	250	300	400	500
		°F.									
¼	A and B	30	770	710	640	570	500	370	300	250	230
		60	630	570	510	450	390	310	260	230	220
		90	480	440	390	350	310	270	240	220	210
	C	30	990	950	900	840	780	640	520	360	300
		60	850	800	760	700	650	530	440	330	280
		90	700	660	620	570	520	430	370	300	270
5/16	A and B	30	1,420	1,380	1,330	1,290	1,220	1,090	950	750	650
		60	1,180	1,140	1,100	1,040	990	880	800	670	600
		90	930	900	870	830	790	720	670	590	560
	C	30	1,790	1,760	1,730	1,690	1,640	1,520	1,390	1,150	950
		60	1,540	1,500	1,470	1,440	1,400	1,290	1,190	990	850
		90	1,320	1,270	1,230	1,190	1,150	1,070	990	850	770
⅜	A and B	30	2,000	1,960	1,910	1,860	1,810	1,690	1,550	1,320	1,150
		60	1,640	1,610	1,580	1,550	1,510	1,410	1,300	1,140	1,040
		90	1,310	1,290	1,260	1,230	1,200	1,140	1,080	1,010	950
	C	30	2,470	2,440	2,420	2,380	2,340	2,240	2,120	1,860	1,640
		60	2,120	2,100	2,070	2,040	2,000	1,910	1,810	1,610	1,460
		90	1,780	1,760	1,740	1,710	1,670	1,610	1,520	1,390	1,280
7/16	A and B	30	2,940	2,890	2,860	2,830	2,780	2,660	2,540	2,320	2,090
		60	2,430	2,400	2,370	2,330	2,300	2,220	2,140	1,990	1,840
		90	1,940	1,920	1,890	1,870	1,860	1,820	1,780	1,720	1,660
	C	30	3,600	3,580	3,560	3,530	3,490	3,400	3,310	3,080	2,830
		60	3,100	3,080	3,060	3,030	3,000	2,930	2,840	2,670	2,500
		90	2,600	2,580	2,560	2,540	2,520	2,470	2,410	2,310	2,190
½	A and B	30	3,520	3,500	3,460	3,420	3,380	3,260	3,140	2,900	2,660
		60	2,920	2,900	2,860	2,830	2,800	2,740	2,640	2,500	2,370
		90	2,330	2,320	2,300	2,290	2,270	2,230	2,200	2,160	2,110
	C	30	4,310	4,300	4,290	4,260	4,220	4,130	4,050	3,800	3,560
		60	3,720	3,710	3,700	3,670	3,630	3,560	3,480	3,300	3,120
		90	3,120	3,110	3,100	3,080	3,060	3,010	2,950	2,850	2,750
9/16	A and B	30	4,720	4,700	4,670	4,630	4,580	4,470	4,360	4,110	3,900
		60	3,940	3,920	3,880	3,850	3,820	3,760	3,690	3,540	3,440
		90	3,160	3,150	3,140	3,130	3,120	3,100	3,080	3,060	3,040
	C	30	5,800	5,770	5,740	5,710	5,690	5,610	5,510	5,310	5,110
		60	5,000	4,970	4,940	4,920	4,900	4,850	4,790	4,630	4,470
		90	4,190	4,180	4,160	4,150	4,140	4,100	4,060	3,980	3,920
⅝	A and B	30	5,800	5,770	5,740	5,710	5,670	5,560	5,440	5,220	4,970
		60	4,830	4,800	4,780	4,750	4,730	4,670	4,620	4,540	4,400
		90	3,880	3,860	3,860	3,870	3,880	3,880	3,880	3,890	3,890
	C	30	7,110	7,070	7,050	7,030	7,000	6,940	6,870	6,680	6,400
		60	6,110	6,100	6,090	6,080	6,060	6,000	5,940	5,790	5,600
		90	5,110	5,110	5,110	5,110	5,110	5,110	5,070	5,000	4,940

Table 65.—Stringing Tensions for Ordinary Grade Steel Cable—Con.

LIGHT LOADING DISTRICT

[At 30, 60, and 90° F. without load, the tensions being such that when loaded at 30° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—								
			100	125	150	175	200	250	300	400	500
		°F.									
1/4	A and B	30	930	920	900	890	870	820	770	690	610
		60	790	770	760	740	720	690	660	590	540
		90	640	620	620	600	590	570	540	510	480
	C	30	1,160	1,140	1,120	1,100	1,080	1,050	1,010	930	850
		60	970	960	950	940	930	900	870	800	740
		90	820	810	800	790	780	760	730	690	640
5/16	A and B	30	1,620	1,610	1,600	1,580	1,550	1,520	1,470	1,380	1,290
		60	1,370	1,360	1,340	1,330	1,310	1,280	1,260	1,200	1,140
		90	1,120	1,100	1,100	1,090	1,080	1,070	1,060	1,030	1,010
	C	30	1,960	1,950	1,940	1,930	1,920	1,880	1,850	1,760	1,670
		60	1,710	1,700	1,690	1,680	1,670	1,640	1,610	1,540	1,470
		90	1,460	1,450	1,440	1,430	1,420	1,400	1,380	1,330	1,270
3/8	A and B	30	2,220	2,210	2,200	2,180	2,160	2,130	2,080	1,980	1,870
		60	1,870	1,860	1,850	1,840	1,830	1,810	1,770	1,710	1,650
		90	1,530	1,530	1,520	1,520	1,510	1,500	1,480	1,470	1,450
	C	30	2,680	2,670	2,660	2,650	2,640	2,600	2,580	2,490	2,380
		60	2,340	2,330	2,320	2,310	2,300	2,280	2,260	2,180	2,100
		90	1,990	1,980	1,970	1,960	1,950	1,940	1,930	1,890	1,850
7/16	A and B	30	3,230	3,220	3,200	3,190	3,180	3,140	3,100	3,000	2,880
		60	2,730	2,720	2,710	2,700	2,680	2,660	2,640	2,600	2,530
		90	2,230	2,230	2,220	2,220	2,220	2,220	2,220	2,230	2,230
	C	30	3,890	3,880	3,870	3,860	3,850	3,820	3,780	3,710	3,620
		60	3,390	3,380	3,370	3,360	3,360	3,340	3,320	3,260	3,220
		90	2,890	2,880	2,880	2,880	2,870	2,860	2,830	2,840	2,820
1/2	A and B	30	3,880	3,860	3,850	3,840	3,820	3,770	3,720	3,620	3,500
		60	3,270	3,260	3,260	3,250	3,240	3,220	3,180	3,120	3,060
		90	2,680	2,680	2,680	2,680	2,680	2,680	2,680	2,690	2,700
	C	30	4,660	4,660	4,650	4,640	4,630	4,600	4,550	4,450	4,360
		60	4,050	4,050	4,050	4,040	4,030	4,000	3,970	3,920	3,870
		90	3,460	3,460	3,460	3,460	3,460	3,450	3,440	3,420	3,390
9/16	A and B	30	5,160	5,150	5,140	5,120	5,100	5,070	5,040	4,920	4,800
		60	4,370	4,360	4,350	4,340	4,330	4,300	4,290	4,250	4,210
		90	3,580	3,580	3,580	3,580	3,590	3,600	3,620	3,670	3,710
	C	30	6,210	6,200	6,190	6,180	6,170	6,150	6,110	6,030	5,940
		60	5,410	5,400	5,390	5,380	5,370	5,360	5,350	5,320	5,260
		90	4,610	4,610	4,600	4,600	4,600	4,610	4,620	4,630	4,640
5/8	A and B	30	6,330	6,310	6,300	6,290	6,280	6,240	6,200	6,080	5,980
		60	5,360	5,350	5,340	5,320	5,310	5,300	5,270	5,250	5,230
		90	4,390	4,390	4,390	4,400	4,400	4,420	4,450	4,520	4,590
	C	30	7,620	7,610	7,600	7,590	7,580	7,560	7,510	7,410	7,330
		60	6,620	6,610	6,610	6,610	6,610	6,600	6,590	6,550	6,500
		90	5,650	5,640	5,640	5,640	5,650	5,680	5,690	5,700	5,720

Table 66.—Stringing Tensions for Siemens-Martin Steel Cable

HEAVY LOADING DISTRICT

[At 30, 60, and 90° F. without load, the sags being such that when loaded at 0° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—							
			200	250	300	400	500	600	700	1,000
		°F.								
5/16	A and B	30	1,210	930	720	520	450	420	410	410
		60	990	770	620	480	440	410	400	400
		90	780	620	530	450	430	400	390	390
	C	30	1,790	1,520	1,270	870	650	570	530	480
		60	1,530	1,290	1,080	760	610	550	520	470
		90	1,300	1,070	980	680	570	520	500	460
3/8	A and B	30	1,940	1,700	1,450	1,070	870	770	730	680
		60	1,620	1,420	1,210	950	820	740	720	670
		90	1,310	1,150	1,020	860	770	710	700	660
	C	30	2,690	2,480	2,250	1,750	1,360	1,110	1,010	870
		60	2,360	2,140	1,920	1,520	1,230	1,040	960	850
		90	2,030	1,830	1,630	1,310	1,100	970	910	830
7/16	A and B	30	3,140	2,910	2,660	2,220	1,840	1,600	1,470	1,340
		60	2,650	2,440	2,250	1,910	1,660	1,490	1,420	1,300
		90	2,190	2,050	1,890	1,650	1,500	1,400	1,350	1,270
	C	30	4,090	3,920	3,740	3,260	2,790	2,400	2,120	1,730
		60	3,600	3,440	3,270	2,860	2,460	2,160	1,980	1,670
		90	3,110	2,960	2,810	2,470	2,160	1,950	1,830	1,610
1/2	A and B	30	3,910	3,660	3,390	2,930	2,540	2,240	2,040	1,790
		60	3,340	3,120	2,900	2,550	2,250	2,040	1,910	1,740
		90	2,780	2,580	2,410	2,180	2,020	1,900	1,810	1,690
	C	30	4,950	4,800	4,600	4,150	3,660	3,260	2,890	2,370
		60	4,360	4,220	4,040	3,650	3,250	2,930	2,660	2,280
		90	3,770	3,650	3,500	3,160	2,840	2,620	2,440	2,180
9/16	A and B	30	5,320	5,120	4,920	4,470	4,040	3,630	3,320	2,920
		60	4,550	4,360	4,180	3,840	3,550	3,270	3,070	2,810
		90	3,780	3,650	3,520	3,330	3,150	2,980	2,860	2,700
	C	30	6,750	6,600	6,410	6,010	5,590	5,100	4,670	3,880
		60	5,940	5,830	5,680	5,340	4,950	4,570	4,260	3,650
		90	5,130	5,050	4,960	4,680	4,320	4,070	3,850	3,470
5/8	A and B	30	6,630	6,460	6,230	5,770	5,340	4,940	4,570	4,030
		60	5,700	5,550	5,360	5,030	4,700	4,420	4,180	3,840
		90	4,770	4,630	4,500	4,300	4,140	4,000	3,870	3,660
	C	30	8,340	8,190	8,030	7,660	7,250	6,800	6,320	5,330
		60	7,370	7,250	7,110	6,790	6,450	6,080	5,670	5,000
		90	6,410	6,310	6,200	5,950	5,670	5,420	5,150	4,670

Table 66.—Stringing Tensions for Siemens-Martin Steel Cable—Con.

MEDIUM LOADING DISTRICT

[At 30, 60, and 90° F., without load, the tensions being such that when loaded at 15° F., the cable will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of— 200	250	300	400	500	600	700	1,000
		° F.								
5/16	A and B	30	1,730	1,610	1,500	1,260	1,030	900	820	710
		60	1,480	1,380	1,290	1,090	920	830	770	690
		90	1,240	1,150	1,080	950	830	770	730	680
	C	30	2,190	2,120	2,020	1,830	1,590	1,350	1,190	940
		60	1,940	1,880	1,800	1,610	1,400	1,220	1,090	900
		90	1,690	1,630	1,560	1,400	1,230	1,100	1,020	870
3/8	A and B	30	2,460	2,370	2,260	2,020	1,770	1,560	1,440	1,220
		60	2,120	2,040	1,930	1,760	1,570	1,410	1,330	1,180
		90	1,780	1,710	1,630	1,500	1,390	1,290	1,230	1,140
	C	30	3,070	3,010	2,940	2,750	2,520	2,280	2,060	1,660
		60	2,720	2,670	2,590	2,440	2,240	2,030	1,870	1,560
		90	2,380	2,330	2,260	2,130	1,960	1,800	1,680	1,490
7/16	A and B	30	3,670	3,600	3,490	3,290	3,070	2,860	2,660	2,280
		60	3,180	3,120	3,040	2,880	2,720	2,540	2,410	2,160
		90	2,700	2,650	2,590	2,470	2,370	2,290	2,210	2,060
	C	30	4,530	4,480	4,410	4,240	4,050	3,830	3,600	3,060
		60	4,030	3,990	3,940	3,790	3,620	3,440	3,260	2,860
		90	3,540	3,500	3,460	3,340	3,200	3,050	2,920	2,660
1/2	A and B	30	4,380	4,330	4,260	4,050	3,810	3,580	3,390	2,940
		60	3,800	3,760	3,700	3,540	3,360	3,200	3,070	2,770
		90	3,230	3,200	3,150	3,040	2,940	2,860	2,800	2,630
	C	30	5,440	5,400	5,340	5,180	4,990	4,760	4,530	3,910
		60	4,840	4,800	4,750	4,620	4,450	4,270	4,090	3,640
		90	4,250	4,200	4,160	4,060	3,950	3,820	3,680	3,390
9/16	A and B	30	5,960	5,880	5,800	5,610	5,380	5,150	4,940	4,460
		60	5,180	5,130	5,060	4,920	4,760	4,590	4,470	4,170
		90	4,400	4,360	4,320	4,230	4,150	4,090	4,030	3,920
	C	30	7,300	7,240	7,180	7,030	6,860	6,650	6,410	5,900
		60	6,470	6,430	6,390	6,280	6,140	5,980	5,800	5,440
		90	5,650	5,630	5,610	5,540	5,450	5,340	5,220	5,030
5/8	A and B	30	7,340	7,260	7,160	6,990	6,800	6,580	6,340	5,750
		60	6,380	6,330	6,270	6,160	6,030	5,880	5,710	5,370
		90	5,420	5,400	5,380	5,330	5,260	5,220	5,160	5,030
	C	30	8,990	8,930	8,860	8,710	8,520	8,320	8,120	7,450
		60	8,010	7,960	7,900	7,790	7,660	7,520	7,370	6,880
		90	7,030	6,990	6,950	6,880	6,800	6,720	6,630	6,360

Table 66.—Stringing Tensions for Siemens-Martin Steel Cable—Con.

LIGHT LOADING DISTRICT

[At 30, 60, and 90° F. without load, the tensions being such that when loaded at 30° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—							
			200	250	300	400	500	600	700	1,000
		°F.								
5/16	A and B	30	2,000	1,970	1,940	1,860	1,780	1,690	1,610	1,410
		60	1,750	1,720	1,700	1,640	1,570	1,510	1,460	1,320
		90	1,510	1,480	1,460	1,420	1,370	1,340	1,310	1,230
	C	30	2,420	2,400	2,380	2,330	2,270	2,190	2,100	1,870
		60	2,170	2,150	2,140	2,090	2,040	1,980	1,910	1,730
		90	1,920	1,910	1,890	1,850	1,820	1,770	1,710	1,590
3/8	A and B	30	2,760	2,750	2,710	2,620	2,510	2,430	2,350	2,090
		60	2,420	2,410	2,380	2,320	2,240	2,180	2,130	1,960
		90	2,080	2,070	2,060	2,020	1,960	1,930	1,910	1,820
	C	30	3,350	3,330	3,300	3,240	3,160	3,080	2,990	2,710
		60	3,010	2,990	2,960	2,910	2,850	2,790	2,710	2,510
		90	2,670	2,650	2,620	2,580	2,540	2,490	2,440	2,310
7/16	A and B	30	4,030	4,000	3,970	3,900	3,810	3,710	3,620	3,370
		60	3,540	3,520	3,500	3,450	3,390	3,330	3,270	3,110
		90	3,050	3,040	3,030	3,000	2,980	2,950	2,930	2,900
	C	30	4,850	4,840	4,820	4,770	4,700	4,620	4,540	4,250
		60	4,340	4,330	4,320	4,290	4,240	4,180	4,130	3,940
		90	3,840	3,830	3,820	3,800	3,780	3,750	3,730	3,630
1/2	A and B	30	4,840	4,810	4,770	4,680	4,560	4,450	4,330	4,090
		60	4,250	4,230	4,200	4,140	4,070	4,000	3,930	3,800
		90	3,670	3,660	3,640	3,610	3,580	3,560	3,560	3,510
	C	30	5,830	5,810	5,780	5,720	5,640	5,550	5,480	5,350
		60	5,220	5,210	5,190	5,150	5,090	5,030	4,960	4,850
		90	4,620	4,610	4,600	4,580	4,550	4,510	4,450	4,360
9/16	A and B	30	6,440	6,420	6,390	6,300	6,180	6,080	6,000	5,880
		60	5,660	5,650	5,640	5,600	5,540	5,470	5,430	5,380
		90	4,870	4,870	4,870	4,870	4,870	4,870	4,870	4,870
	C	30	7,760	7,740	7,700	7,650	7,580	7,500	7,400	7,110
		60	6,930	6,920	6,900	6,860	6,820	6,780	6,730	6,550
		90	6,100	6,100	6,090	6,080	6,070	6,070	6,050	5,980
5/8	A and B	30	7,900	7,880	7,850	7,780	7,680	7,570	7,470	7,140
		60	6,940	6,930	6,920	6,890	6,840	6,800	6,750	6,620
		90	5,990	5,990	5,990	6,000	6,010	6,030	6,050	6,100
	C	30	9,510	9,490	9,460	9,410	9,350	9,250	9,160	8,890
		60	8,500	8,480	8,460	8,430	8,400	8,370	8,330	8,190
		90	7,490	7,480	7,460	7,460	7,480	7,480	7,480	7,490

Table 67.—Stringing Tensions for High-Tension Steel Cable

HEAVY LOADING DISTRICT

[At 30, 60, and 90° F. without load, the tensions being such that when loaded at 0° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—							
			200	250	300	400	500	600	700	1,000
		°F.								
5/16	A and B	30	2,990	2,840	2,660	2,250	1,850	1,420	1,130	800
		60	2,700	2,570	2,420	2,040	1,650	1,270	1,040	770
		90	2,420	2,310	2,180	1,830	1,450	1,140	960	740
	C	30	3,670	3,590	3,500	3,240	2,860	2,430	2,060	1,230
		60	3,410	3,340	3,240	2,990	2,640	2,220	1,860	1,160
		90	3,160	3,080	2,990	2,750	2,420	2,000	1,670	1,090
3/8	A and B	30	4,160	4,050	3,920	3,590	3,210	2,760	2,340	1,560
		60	3,810	3,690	3,560	3,260	2,890	2,480	2,110	1,490
		90	3,460	3,340	3,210	2,920	2,580	2,220	1,900	1,420
	C	30	5,150	5,060	4,970	4,740	4,460	4,110	3,640	2,630
		60	4,800	4,710	4,620	4,400	4,120	3,790	3,330	2,500
		90	4,440	4,350	4,270	4,050	3,780	3,460	3,030	2,360
7/16	A and B	30	6,130	6,020	5,910	5,640	5,320	4,960	4,550	3,400
		60	5,630	5,530	5,420	5,170	4,870	4,510	4,140	3,140
		90	5,120	5,030	4,940	4,680	4,390	4,060	3,730	2,930
	C	30	7,500	7,450	7,380	7,200	6,950	6,670	6,350	5,260
		60	7,000	6,950	6,880	6,700	6,470	6,210	5,890	4,850
		90	6,490	6,450	6,380	6,200	5,980	5,710	5,430	4,440
1/2	A and B	30	7,380	7,300	7,200	6,920	6,600	6,230	5,860	4,620
		60	6,770	6,700	6,600	6,350	6,040	5,700	5,350	4,270
		90	6,160	6,100	6,000	5,750	5,460	5,150	4,850	3,940
	C	30	9,050	8,990	8,920	8,750	8,490	8,210	7,910	6,840
		60	8,440	8,380	8,320	8,150	7,900	7,630	7,330	6,340
		90	7,840	7,780	7,710	7,550	7,310	7,050	6,750	5,850
9/16	A and B	30	9,900	9,830	9,750	9,510	9,200	8,850	8,500	7,310
		60	9,100	9,030	8,940	8,710	8,440	8,120	7,790	6,750
		90	8,300	8,240	8,150	7,930	7,670	7,370	7,080	6,210
	C	30	12,080	12,020	11,960	11,800	11,600	11,310	11,020	10,110
		60	11,280	11,210	11,150	10,990	10,800	10,520	10,250	9,420
		90	10,440	10,390	10,330	10,180	10,000	9,750	9,500	8,710
5/8	A and B	30	12,150	12,070	11,980	11,780	11,520	11,150	10,780	9,700
		60	11,160	11,090	11,010	10,820	10,580	10,240	9,890	8,950
		90	10,200	10,140	10,060	9,880	9,640	9,350	9,060	8,240
	C	30	14,800	14,750	14,700	14,570	14,380	14,100	13,820	13,000
		60	13,820	13,780	13,720	13,580	13,380	13,140	12,890	12,100
		90	12,850	12,800	12,730	12,600	12,420	12,180	11,940	11,280

Table 67.—Stringing Tensions for High-Tension Steel Cable—Contd.

MEDIUM LOADING DISTRICT

[At 30, 60, and 90°F. without load, the tensions being such that when loaded at 15°F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B, and 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of — 200	250	300	400	500	600	700	1,000
		°F.								
5/16	A and B	30	3,200	3,170	3,120	3,000	2,850	2,680	2,490	1,860
		60	2,960	2,920	2,870	2,760	2,610	2,450	2,280	1,720
		90	2,720	2,670	2,630	2,520	2,370	2,220	2,060	1,590
	C	30	3,920	3,890	3,850	3,770	3,650	3,520	3,370	2,870
		60	3,670	3,630	3,590	3,510	3,400	3,270	3,130	2,650
		90	3,410	3,380	3,340	3,250	3,150	3,030	2,900	2,440
3/8	A and B	30	4,450	4,420	4,370	4,260	4,140	3,980	3,790	3,120
		60	4,100	4,060	4,030	3,930	3,810	3,660	3,490	2,920
		90	3,760	3,730	3,690	3,600	3,480	3,340	3,180	2,720
	C	30	5,400	5,380	5,350	5,270	5,190	5,060	4,900	4,230
		60	5,050	5,030	5,000	4,930	4,850	4,720	4,560	3,920
		90	4,690	4,680	4,660	4,580	4,500	4,380	4,220	3,640
7/16	A and B	30	6,470	6,440	6,400	6,310	6,200	6,060	5,870	5,340
		60	5,980	5,940	5,900	5,820	5,710	5,590	5,430	4,940
		90	5,490	5,450	5,420	5,330	5,230	5,120	4,940	4,540
	C	30	7,840	7,820	7,800	7,740	7,650	7,550	7,450	7,000
		60	7,320	7,310	7,290	7,240	7,150	7,060	6,960	6,560
		90	6,810	6,800	6,780	6,730	6,650	6,570	6,470	6,120
1/2	A and B	30	7,770	7,740	7,700	7,610	7,500	7,330	7,170	6,690
		60	7,180	7,150	7,120	7,030	6,900	6,760	6,620	6,190
		90	6,580	6,540	6,500	6,430	6,320	6,190	6,070	5,700
	C	30	9,410	9,390	9,360	9,290	9,200	9,090	8,960	8,550
		60	8,800	8,780	8,750	8,690	8,610	8,520	8,380	8,000
		90	8,190	8,180	8,150	8,100	8,010	7,920	7,810	7,460
9/16	A and B	30	10,370	10,340	10,310	10,230	10,120	9,980	9,820	9,370
		60	9,590	9,550	9,520	9,450	9,350	9,220	9,080	8,690
		90	8,780	8,740	8,710	8,650	8,550	8,460	8,350	8,030
	C	30	12,530	12,510	12,500	12,440	12,370	12,270	12,140	11,780
		60	11,700	11,680	11,660	11,620	11,570	11,490	11,360	11,000
		90	10,910	10,880	10,860	10,810	10,770	10,700	10,580	10,260
5/8	A and B	30	12,700	12,680	12,650	12,560	12,440	12,320	12,190	11,720
		60	11,710	11,700	11,690	11,600	11,500	11,390	11,260	10,890
		90	10,740	10,720	10,700	10,640	10,540	10,440	10,330	10,060
	C	30	15,380	15,350	15,320	15,250	15,200	15,100	15,000	14,550
		60	14,380	14,350	14,330	14,280	14,200	14,130	14,040	13,660
		90	13,380	13,370	13,350	13,320	13,250	13,170	13,100	12,780

Table 67.—Stringing Tensions for High-Tension Steel Cable—Contd.

LIGHT LOADING DISTRICT

[At 30, 60, and 90° without load the tensions being such that when loaded at 30° F. the cable will be stressed to 50 per cent of ultimate strength for grades A and B, and to 60 per cent for grade C]

Cable diameter (inches)	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—							
			200	250	300	400	500	600	700	1,000
		° *F.*								
5/16	A and B	30	3,390	3,380	3,370	3,340	3,300	3,260	3,200	3,030
		60	3,140	3,130	3,120	3,090	3,050	3,020	2,960	2,810
		90	2,880	2,870	2,860	2,840	2,810	2,780	2,740	2,590
	C	30	4,080	4,070	4,060	4,040	4,020	3,980	3,950	3,800
		60	3,820	3,810	3,800	3,790	3,760	3,730	3,700	3,560
		90	3,560	3,560	3,550	3,540	3,510	3,480	3,450	3,330
3/8	A and B	30	4,660	4,650	4,650	4,620	4,580	4,540	4,470	4,280
		60	4,310	4,310	4,300	4,280	4,240	4,210	4,150	3,990
		90	3,970	3,960	3,960	3,940	3,910	3,880	3,840	3,710
	C	30	5,610	5,600	5,600	5,570	5,550	5,510	5,470	5,320
		60	5,250	5,250	5,240	5,220	5,200	5,170	5,140	4,990
		90	4,900	4,900	4,890	4,880	4,860	4,840	4,820	4,670
7/16	A and B	30	6,770	6,760	6,730	6,710	6,670	6,610	6,550	6,380
		60	6,260	6,250	6,230	6,220	6,180	6,130	6,100	5,960
		90	5,760	5,750	5,740	5,730	5,700	5,660	5,630	5,540
	C	30	8,130	8,120	8,100	8,080	8,050	8,020	7,980	7,840
		60	7,620	7,600	7,590	7,580	7,560	7,530	7,490	7,360
		90	7,100	7,090	7,080	7,080	7,060	7,040	7,000	6,870
1/2	A and B	30	8,110	8,100	8,090	8,060	8,010	7,960	7,900	7,650
		60	7,510	7,500	7,490	7,470	7,430	7,380	7,330	7,160
		90	6,910	6,900	6,890	6,870	6,840	6,810	6,770	6,650
	C	30	9,740	9,730	9,720	9,690	9,670	9,650	9,590	9,420
		60	9,130	9,120	9,110	9,090	9,080	9,060	9,000	8,850
		90	8,510	8,500	8,490	8,480	8,470	8,460	8,410	8,280
9/16	A and B	30	10,790	10,780	10,770	10,750	10,710	10,650	10,600	10,300
		60	10,010	9,990	9,980	9,950	9,920	9,860	9,800	9,630
		90	9,190	9,180	9,170	9,150	9,140	9,100	9,050	8,940
	C	30	12,970	12,960	12,940	12,930	12,900	12,880	12,850	12,670
		60	12,150	12,140	12,130	12,110	12,090	12,080	12,060	11,900
		90	11,320	11,320	11,310	11,300	11,300	11,290	11,280	11,160
5/8	A and B	30	13,230	13,220	13,210	13,200	13,150	13,100	13,020	12,800
		60	12,280	12,280	12,280	12,250	12,210	12,180	12,120	11,960
		90	11,280	11,280	11,280	11,260	11,240	11,220	11,200	11,130
	C	30	15,890	15,880	15,870	15,840	15,830	15,800	15,770	15,600
		60	14,890	14,880	14,870	14,850	14,830	14,810	14,780	14,670
		90	13,890	13,880	13,880	13,860	13,850	13,840	13,820	13,730

Table 68.—Stringing Tensions for Bare Copper-Covered Steel Wire (Ordinary Grade)

HEAVY LOADING DISTRICT

[The tensions being such that when loaded at 0° F. the wires will be stressed to 50 per cent of their ultimate strength]

Size A.W.G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—						
			100	125	150	175	200	250	300
		° F.							
6	A and B	30	637	530	424	310			
		60	548	441	341	246			
		90	460	352	264	197			
4	A and B	30	1,037	964	863	752	635	400	274
		60	901	822	729	620	507	314	244
		90	764	685	594	495	400	275	222

MEDIUM LOADING DISTRICT

[The tensions being such that when loaded at 15° F. the wires will be stressed to 50 per cent of their ultimate strength]

Size A.W.G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—							
			100	125	150	175	200	250	300	400
		° F.								
8	B	30	511	479	437					
		60	455	423	384					
		90	400	368	327					
6	A and B	30	807	780	747	706				
		60	719	691	660	619				
		90	629	602	570	532				
4	A and B	30	1,210	1,190	1,160	1,130	1,087	998	894	670
		60	1,070	1,050	1,020	988	949	860	767	572
		90	933	910	881	850	826	734	648	484

Table 68.—Stringing Tensions for Bare Copper-Covered Steel Wire (Ordinary Grade)—Continued

LIGHT LOADING DISTRICT

[The tensions being such that when loaded at 30° F. the wires will be stressed to 50 per cent of their ultimate strength]

Size A. W. G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—					
			100	150	200	300	400	500
		° F.						
8	B	30	595	590				
		60	540	534				
		90	484	478				
6	A and B	30	893	886	877			
		60	805	799	790			
		90	718	711	702			
4	A and B	30	1,323	1,302	1,300	1,287	1,225	1,176
		60	1,180	1,162	1,160	1,152	1,093	1,052
		90	1,038	1,024	1,022	996	967	931

Table 69.—Stringing Tensions for Bare Copper-Covered Steel Cable

HEAVY LOADING DISTRICT

[The tensions being such that when loaded at 0° F. the cable will be stressed to 50 per cent of its ultimate strength]

Size (inch)	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—							
			200	250	300	400	500	600	800	1,000
		° F.								
5/16	A and B	30	2,260	2,105	1,885	1,455	1,065			
		60	2,020	1,870	1,660	1,260	940			
		90	1,790	1,605	1,440	1,105	840			
3/8	A and B	30	3,600	3,435	3,285	2,920	2,505	2,100	1,586	
		60	3,240	3,080	2,940	2,600	2,220	1,887	1,490	
		90	2,885	2,740	2,595	2,290	1,970	1,700	1,405	
7/16	A and B	30	4,309	4,280	4,110	3,760	3,350	2,930	2,320	1,995
		60	3,960	3,850	3,700	3,360	2,990	2,640	2,160	1,910
		90	3,530	3,425	3,285	2,985	2,665	2,380	2,010	1,835
1/2	A and B	30	5,585	5,480	5,330	5,015	4,625	4,230	3,485	2,985
		60	5,060	4,960	4,820	4,520	4,180	3,830	3,210	2,830
		90	4,560	4,465	4,325	4,055	3,745	3,460	2,960	2,685
9/16	A and B	30	6,845	6,790	6,660	6,380	6,020	5,635	4,875	4,260
		60	6,280	6,180	6,050	5,800	5,470	5,130	4,480	4,010
		90	5,650	5,570	5,460	5,220	4,940	4,660	4,140	3,810

Table 69.—Stringing Tensions for Bare Copper-Covered Steel Cable—Continued

MEDIUM LOADING DISTRICT

[The tensions being such that when loaded at 15° F. the cable will be stressed to 50 per cent of its ultimate strength]

Size (inch)	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—					
			100	250	400	600	800	1,000
		° F.						
5/16	A and B	30	2,660	2,540	2,330	1,940	--------	--------
		60	2,420	2,300	2,100	1,750	--------	--------
		90	2,180	2,070	1,880	1,570	--------	--------
3/8	A and B	30	4,000	3,890	3,710	3,330	2,940	--------
		60	3,630	3,540	3,370	3,040	2,710	--------
		90	3,270	3,180	3,020	2,730	2,470	--------
7/16	A and B	30	4,830	4,750	4,560	4,230	3,850	3,490
		60	4,400	4,320	4,150	3,850	3,530	3,250
		90	3,960	3,890	3,760	3,490	3,240	3,030
1/2	A and B	30	6,030	5,930	5,760	5,450	5,080	4,710
		60	5,500	5,410	5,260	4,990	4,690	4,390
		90	4,970	4,900	4,770	4,530	4,320	4,090
9/16	A and B	30	7,370	7,280	7,150	6,820	6,470	6,110
		60	6,740	6,660	6,520	6,270	5,980	5,690
		90	6,120	6,050	5,930	5,740	5,520	5,310

LIGHT LOADING DISTRICT

[The tensions being such that when loaded at 30° F. the cable will be stressed to 50 per cent of its ultimate strength]

5/16	A and B	30	2,800	2,760	2,710	2,610	2,460	--------
		60	2,560	2,530	2,480	2,390	2,260	--------
		90	2,320	2,290	2,220	2,180	2,070	--------
3/8	A and B	30	4,190	4,170	4,105	4,000	3,900	3,720
		60	3,830	3,810	3,755	3,670	3,570	3,490
		90	3,470	3,440	3,400	3,350	3,270	3,190
7/16	A and B	30	5,030	5,020	4,970	4,880	4,740	4,590
		60	4,640	4,610	4,570	4,480	4,380	4,270
		90	4,200	4,180	4,150	4,090	4,020	3,960
1/2	A and B	30	6,300	6,270	6,200	6,100	5,960	5,810
		60	5,780	5,750	5,700	5,620	5,520	5,420
		90	5,260	5,230	5,210	5,160	5,100	5,040
9/16	A and B	30	7,700	7,660	7,660	7,490	7,360	7,210
		60	7,070	7,040	7,000	6,920	6,830	6,730
		90	6,450	6,430	6,410	6,370	6,320	6,280

Table 70.—Stringing Tensions for Bare Stranded Aluminum

HEAVY LOADING DISTRICT

[The tensions being such that when loaded at 0° F. the conductor will be stressed to 50 per cent of the ultimate strength for grades A and B and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of — 100	125	150	200	250	300	400	600
		°F.								
1	A and B	30	96	73	66	------	------	------	------	------
		60	66	59	53	------	------	------	------	------
		90	53	50	50	------	------	------	------	------
	C	30	267	149	99	------	------	------	------	------
		60	125	89	79	------	------	------	------	------
		90	73	69	66	------	------	------	------	------
0	A and B	30	199	125	108	95	87	87	83	------
		60	108	91	91	87	83	83	79	------
		90	79	75	75	75	75	75	75	------
	C	30	527	315	216	133	112	108	104	------
		60	273	162	133	112	104	104	100	------
		90	116	104	104	100	100	95	91	------
00	A and B	30	378	263	200	152	147	137	131	------
		60	173	152	142	131	131	131	126	------
		90	121	116	116	121	121	126	126	------
	C	30	709	593	420	252	194	179	168	152
		60	378	305	231	189	173	163	158	147
		90	173	168	158	158	152	152	147	147
000	A and B	30	640	488	370	251	218	211	198	185
		60	304	251	231	205	198	191	191	185
		90	165	165	172	172	178	185	185	185
	C	30	1,030	871	759	455	330	290	264	231
		60	601	482	409	304	264	251	244	224
		90	277	244	251	231	224	224	224	224
0000	A and B	30	938	747	623	398	349	324	291	282
		60	448	415	349	299	291	291	274	266
		90	232	232	241	249	257	266	266	266
	C	30	1,370	1,295	1,104	780	589	452	365	349
		60	772	722	631	465	415	365	349	340
		90	374	374	340	332	332	332	324	324

Table 70.—Stringing Tensions for Bare Stranded Aluminum—Contd.

MEDIUM LOADING DISTRICT

[The tensions being such that when loaded at 15° F. the conductor will be stressed to 50 per cent of the ultimate strength for grades A and B and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—								
			100	125	150	200	250	300	400	500	600
		°F.									
1	A and B	30	426	337	254	------	------	------	------	------	------
		60	224	172	137	------	------	------	------	------	------
		90	102	99	96	------	------	------	------	------	------
	C	30	620	535	472	------	------	------	------	------	------
		60	399	317	277	------	------	------	------	------	------
		90	198	162	152	------	------	------	------	------	------
0	A and B	30	598	523	427	261	199	174	154	145	141
		60	336	274	237	174	162	154	145	141	133
		90	149	145	145	137	137	137	137	137	137
	C	30	822	768	697	552	374	274	208	191	183
		60	531	498	427	315	249	216	187	178	174
		90	282	253	237	203	187	183	174	170	170
00	A and B	30	830	746	672	467	347	284	247	226	221
		60	473	425	373	289	252	236	226	215	210
		90	221	210	210	205	205	205	205	205	205
	C	30	1,087	1,040	982	824	641	494	352	305	278
		60	735	683	646	625	410	347	299	278	263
		90	399	382	352	310	278	273	263	257	252
000	A and B	30	1,089	1,010	937	746	581	455	442	343	323
		60	640	587	548	442	396	350	337	317	310
		90	304	297	297	297	297	297	297	297	297
	C	30	1,412	1,360	1,294	1,142	990	812	568	469	429
		60	964	911	865	746	647	542	455	416	396
		90	528	502	482	442	422	403	383	376	370
0000	A and B	30	1,411	1,328	1,262	1,038	896	706	589	515	490
		60	855	789	747	614	581	523	490	465	457
		90	407	407	407	407	415	415	432	432	432
	C	30	1,785	1,743	1,594	1,552	1,378	1,187	921	739	656
		60	1,220	1,179	1,162	1,038	896	797	689	614	589
		90	681	664	647	614	581	573	564	540	540

Table 70.—Stringing Tensions for Bare Stranded Aluminum—Contd.

LIGHT LOADING DISTRICT

[The tensions being such that when loaded at 30° F., the conductor will be stressed to 50 per cent of the ultimate strength for grades A and B and 60 per cent for grade C]

Size A.W.G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—								
			100	125	150	200	250	300	400	500	600
		°F.									
1	A and B	30	660	634	597	------	------	------	------	------	------
		60	436	409	383	------	------	------	------	------	------
		90	228	218	208	------	------	------	------	------	------
	C	30	828	812	776	------	------	------	------	------	------
		60	597	574	551	------	------	------	------	------	------
		90	380	353	340	------	------	------	------	------	------
0	A and B	30	838	813	780	714	606	506	361	303	274
		60	564	535	510	465	423	340	286	270	253
		90	303	291	278	278	257	253	241	232	232
	C	30	1,042	1,021	988	934	855	784	593	452	378
		60	751	739	668	660	598	549	427	361	332
		90	477	465	440	411	390	361	328	307	295
00	A and B	30	1,087	1,055	1,024	935	845	719	536	452	404
		60	730	698	677	614	557	478	415	378	368
		90	399	383	378	373	362	347	336	336	336
	C	30	1,323	1,302	1,292	1,218	1,145	1,045	840	683	572
		60	966	940	914	872	809	730	609	525	483
		90	614	599	578	557	536	494	452	431	425
000	A and B	30	1,366	1,360	1,313	1,214	1,129	1,010	818	640	581
		60	917	904	878	865	746	680	601	535	515
		90	502	502	502	482	482	469	469	455	455
	C	30	1,663	1,650	1,630	1,577	1,511	1,406	1,214	997	858
		60	1,214	1,201	1,175	1,135	1,089	1,003	878	759	700
		90	772	766	752	733	713	680	634	601	594
0000	A and B	30	1,735	1,693	1,668	1,594	1,486	1,370	1,137	930	830
		60	1,170	1,145	1,121	1,071	996	930	822	755	706
		90	639	639	639	639	639	639	631	631	631
	C	30	2,108	2,075	2,067	2,017	1,934	1,834	1,627	1,411	1,204
		60	1,544	1,519	1,511	1,461	1,403	1,320	1,204	1,054	963
		90	988	963	963	955	930	905	863	830	797

Table 71.—Stringing Tensions for Bare Stranded Aluminum, Steel-Reinforced

HEAVY LOADING DISTRICT

[The tensions being such that when loaded at 0° F. the cable will be stressed to 50 per cent of the ultimate strength for grades A and B and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of— 100	150	200	300	400	500	700	1,000
		°F.								
4	A and B	30	282	80	57	49	46	45	-------	------
		60	155	64	53	47	46	45	-------	------
		90	81	55	49	46	45	45	-------	------
	C	30	528	258	98	64	58	56	-------	------
		60	385	153	81	61	57	55	-------	------
		90	246	98	70	59	56	55	-------	------
2	A and B	30	732	454	219	132	117	112	-------	------
		60	507	274	163	122	113	109	-------	------
		90	296	170	133	115	109	107	-------	------
	C	30	1,043	840	570	212	158	143	127	------
		60	815	618	380	180	149	139	126	------
		90	588	407	248	159	141	134	124	------
1	A and B	30	1,005	756	462	226	188	182	165	161
		60	720	494	303	199	178	169	163	160
		90	446	293	220	180	169	165	161	159
	C	30	1,365	1,188	946	435	273	233	207	197
		60	1,077	904	678	329	246	221	203	194
		90	792	629	447	267	225	211	199	194
0	A and B	30	1,345	1,127	841	411	307	276	255	245
		60	984	781	554	334	282	264	249	243
		90	633	479	365	284	262	252	245	241
	C	30	1,777	1,610	1,408	865	499	387	326	302
		60	1,414	1,251	1,059	619	418	355	315	297
		90	1,052	898	734	457	364	330	305	294
00	A and B	30	1,768	1,575	1,316	768	521	445	393	372
		60	1,310	1,134	911	567	454	411	384	369
		90	865	722	588	451	405	387	372	366
	C	30	2,290	2,155	1,968	1,466	948	677	523	468
		60	1,832	1,712	1,522	1,079	734	588	496	458
		90	1,376	1,253	1,093	772	596	523	473	449
000	A and B	30	2,275	2,106	1,875	1,299	884	715	607	561
		60	1,698	1,545	1,337	930	722	638	576	553
		90	1,137	1,007	876	692	615	584	553	538
	C	30	2,916	2,793	2,624	2,162	1,616	1,173	834	714
		60	2,335	2,218	2,058	1,642	1,220	960	772	692
		90	1,762	1,652	1,510	1,187	942	814	718	672
0000	A and B	30	2,938	2,782	2,569	2,026	1,493	1,192	950	863
		60	2,210	2,065	1,881	1,464	1,154	1,008	892	834
		90	1,483	1,386	1,270	1,057	940	882	834	805
	C	30	3,740	3,632	3,482	3,068	2,539	2,007	1,379	1,118
		60	3,010	2,909	2,767	2,384	1,950	1,589	1,228	1,068
		90	2,283	2,190	2,069	1,762	1,480	1,287	1,110	1,023

Table 71.—Stringing Tensions for Bare Stranded Aluminum, Steel-Reinforced—Continued

MEDIUM LOADING DISTRICT

[The tensions being such that when loaded at 15° F. the cable will be stressed to 50 per cent of the ultimate strength for grades A and B and 60 per cent for grade C]

Size A. W. G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—							
			100	150	200	300	400	500	700	1,000
		°F.								
4	A and B	30	579	457	301	126	99	91	------	------
		60	435	320	195	109	93	88	------	------
		90	294	198	132	97	88	85	------	------
	C	30	759	673	555	272	150	123	------	------
		60	614	530	417	197	133	116	------	------
		90	471	390	288	153	120	110	------	------
2	A and B	30	1,079	913	786	477	295	240	------	------
		60	851	688	571	344	251	220	------	------
		90	624	472	381	261	220	205	------	------
	C	30	1,268	1,203	1,112	862	573	385	------	------
		60	1,039	975	887	655	435	327	------	------
		90	810	749	667	474	342	286	------	------
1	A and B	30	1,290	1,203	1,088	788	519	396	321	292
		60	999	919	812	569	413	349	305	286
		90	715	643	558	411	343	314	291	280
	C	30	1,617	1,549	1,467	1,240	953	687	453	375
		60	1,328	1,262	1,183	970	728	552	414	362
		90	1,040	977	903	720	554	458	383	351
0	A and B	30	1,646	1,570	1,466	1,187	879	665	504	444
		60	1,283	1,211	1,115	878	670	555	468	430
		90	923	861	783	629	529	480	439	418
	C	30	2,042	1,990	1,916	1,711	1,441	1,149	754	583
		60	1,678	1,626	1,556	1,363	1,127	904	663	555
		90	1,314	1,267	1,202	1,035	857	721	595	530
00	A and B	30	2,099	2,031	1,937	1,680	1,370	1,086	797	674
		60	1,641	1,577	1,491	1,267	1,039	872	718	646
		90	1,187	1,134	1,065	915	795	723	655	620
	C	30	2,593	2,545	2,478	2,292	2,043	1,755	1,232	914
		60	2,133	2,088	2,024	1,850	1,627	1,393	1,042	850
		90	1,675	1,633	1,576	1,426	1,253	1,097	901	797
000	A and B	30	2,657	2,594	2,507	2,270	1,969	1,660	1,237	1,014
		60	2,079	2,021	1,943	1,738	1,508	1,310	1,080	957
		90	1,507	1,462	1,403	1,268	1,142	1,056	962	907
	C	30	3,271	3,227	3,165	2,994	2,763	2,487	1,920	1,413
		60	2,691	2,650	2,591	2,433	2,227	1,998	1,591	1,283
		90	2,113	2,076	2,026	1,893	1,734	1,575	1,340	1,178
0000	A and B	30	3,382	3,324	3,244	3,023	2,740	2,429	1,904	1,537
		60	2,653	2,601	2,530	2,344	2,125	1,915	1,615	1,420
		90	1,929	1,892	1,844	1,728	1,611	1,517	1,401	1,325
	C	30	4,154	4,114	4,057	3,899	3,685	3,426	3,025	2,177
		60	3,424	3,385	3,334	3,190	3,002	2,784	2,501	1,931
		90	2,694	2,662	2,620	2,503	2,361	2,210	2,069	1,737

Table 71.—Stringing Tensions for Bare Stranded Aluminum, Steel-Reinforced—Continued

LIGHT LOADING DISTRICT

[The tensions being such that when loaded at 30° F. the cable will be stressed to 50 per cent of the ultimate strength for grades A and B and 60 per cent for grade C]

Size A.W.G. No.	Grade of construction	Temperature	Tensions (in pounds) for span lengths (in feet) of—							
			100	150	200	300	400	500	700	1,000
		°F.								
4	A and B	30	729	702	666	565	442	331	-------	------
		60	585	559	525	434	336	260	-------	------
		90	441	418	388	316	256	222	-------	------
	C	30	885	870	842	769	673	560	-------	------
		60	741	723	698	629	540	445	-------	------
		90	597	579	556	493	419	350	-------	------
2	A and B	30	1,176	1,150	1,114	1,012	882	739	-------	------
		60	947	922	888	796	686	581	-------	------
		90	719	697	668	595	521	463	-------	------
	C	30	1,422	1,403	1,377	1,306	1,208	1,090	-------	------
		60	1,192	1,174	1,150	1,082	992	887	-------	------
		90	963	947	924	863	787	705	-------	------
1	A and B	30	1,479	1,452	1,415	1,313	1,179	1,027	766	592
		60	1,190	1,165	1,131	1,039	919	812	648	550
		90	903	882	854	783	707	642	562	514
	C	30	1,785	1,766	1,741	1,668	1,570	1,449	1,174	853
		60	1,496	1,478	1,454	1,386	1,296	1,189	970	758
		90	1,208	1,192	1,170	1,110	1,034	951	804	683
0	A and B	30	1,869	1,842	1,805	1,703	1,568	1,410	1,107	856
		60	1,505	1,480	1,447	1,356	1,242	1,121	923	781
		90	1,142	1,122	1,097	1,028	953	883	786	720
	C	30	2,253	2,235	2,209	2,136	2,037	1,916	1,628	1,241
		60	1,888	1,871	1,847	1,779	1,689	1,582	1,350	1,085
		90	1,524	1,509	1,488	1,430	1,356	1,274	1,116	962
00	A and B	30	2,364	2,337	2,301	2,198	2,061	1,901	1,568	1,232
		60	1,904	1,880	1,848	1,758	1,646	1,521	1,297	1,106
		90	1,448	1,429	1,404	1,341	1,269	1,198	1,091	1,007
	C	30	2,847	2,829	2,803	2,731	2,631	2,509	2,214	1,774
		60	2,387	2,370	2,347	2,280	2,191	2,084	1,844	1,535
		90	1,928	1,913	1,893	1,838	1,768	1,687	1,524	1,345
000	A and B	30	2,977	2,949	2,913	2,810	2,673	2,510	2,152	1,742
		60	2,398	2,375	2,342	2,256	2,144	2,018	1,779	1,542
		90	1,821	1,804	1,783	1,725	1,660	1,591	1,479	1,385
	C	30	3,583	3,564	3,537	3,465	3,366	3,242	2,942	2,461
		60	3,003	2,985	2,962	2,896	2,810	2,705	2,461	2,120
		90	2,424	2,409	2,390	2,339	2,272	2,196	2,035	1,841
0000	A and B	30	3,774	3,747	3,710	3,608	3,471	3,306	2,934	2,453
		60	3,043	3,021	2,990	2,906	2,796	2,674	2,424	2,147
		90	2,316	2,303	2,283	2,234	2,176	2,116	2,012	1,908
	C	30	4,540	4,521	4,495	4,423	4,323	4,200	3,897	3,387
		60	3,807	3,791	3,768	3,705	3,620	3,517	3,275	2,912
		90	3,077	3,065	3,047	3,001	2,939	2,870	2,715	2,517

Appendix C.—SAGS FOR LINE CONDUCTORS STRUNG TO THE 2,000-POUND LIMITATION

By stringing conductors so that, under the worst assumed condition of loading, the tension in the conductor does not exceed 2,000 pounds, the required strength of cross arms and pins is similarly limited. (See rules 261, D, 3, and 261, E, 1.) Values of sag at a stringing temperature of 60° F. which will keep the tension when loaded within this limit are given for conductor sizes having an ultimate strength in excess of 4,000 pounds. Figures 2 to 13 give the sag values for copper, and Figures 14, 15, and 16 for aluminum cable with steel core.

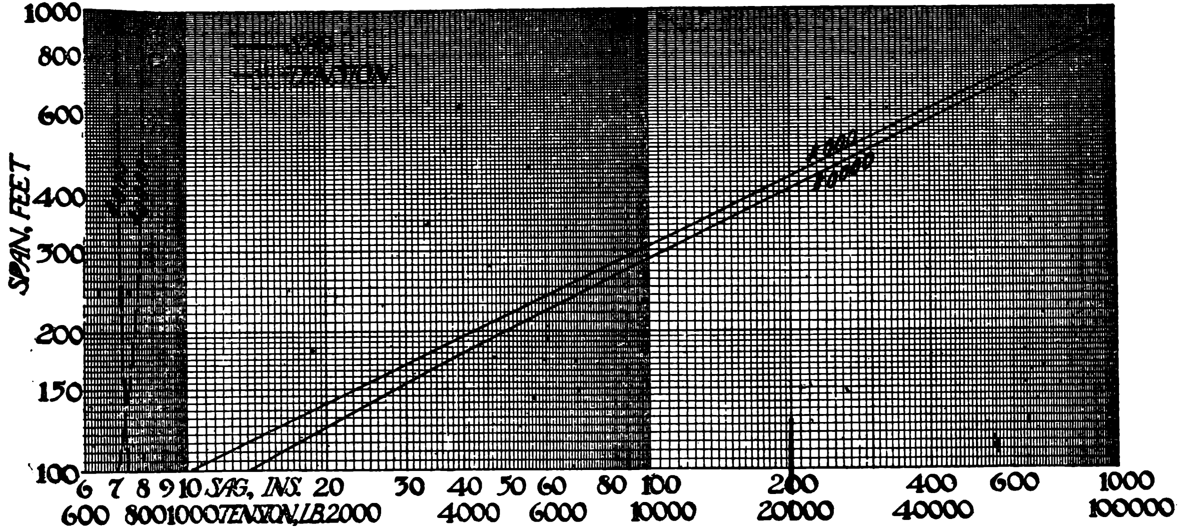

FIG. 2.—*Sags and tensions at 60° F., heavy loading district. Bare, solid, soft or hard-drawn copper wire, Nos. 3/0 and 4/0*

Tension when loaded at 0° F. is 2,000 pounds

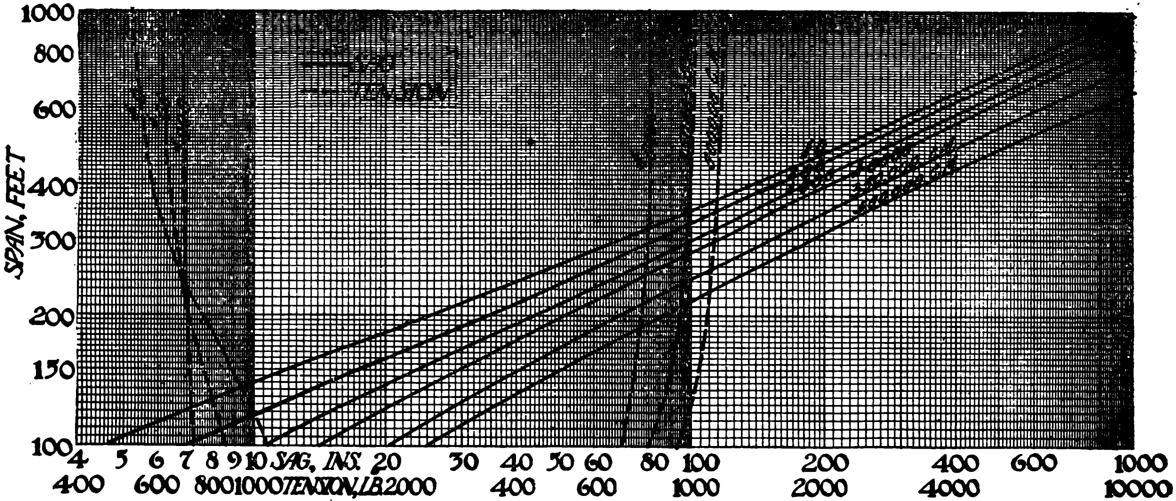

FIG. 3.—*Sags and tensions at 60° F., heavy loading district. Bare, stranded, hard-drawn copper conductors, Nos. 1/0, 2/0, 3/0, and 4/0, 350,000 c. m., and 500,000 c. m.; soft copper Nos. 3/0 and 4/0, 350,000 c. m., and 500,000 c. m.*

Tension when loaded at 0° F. is 2,000 pounds

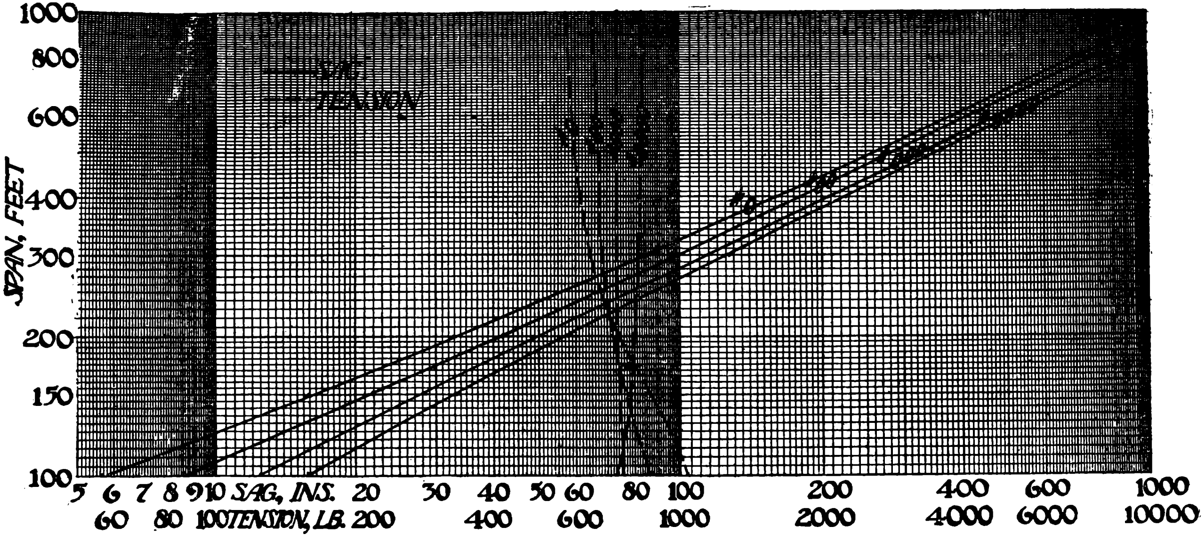

Fig. 4.—*Sags and tensions at 60° F., heavy loading district. Triple-braid weatherproof, solid, hard-drawn copper wire, Nos. 1/0, 2/0, 3/0, and 4/0; soft copper Nos. 3/0 and 4/0*

Tension when loaded at 0° F. is 2,000 pounds

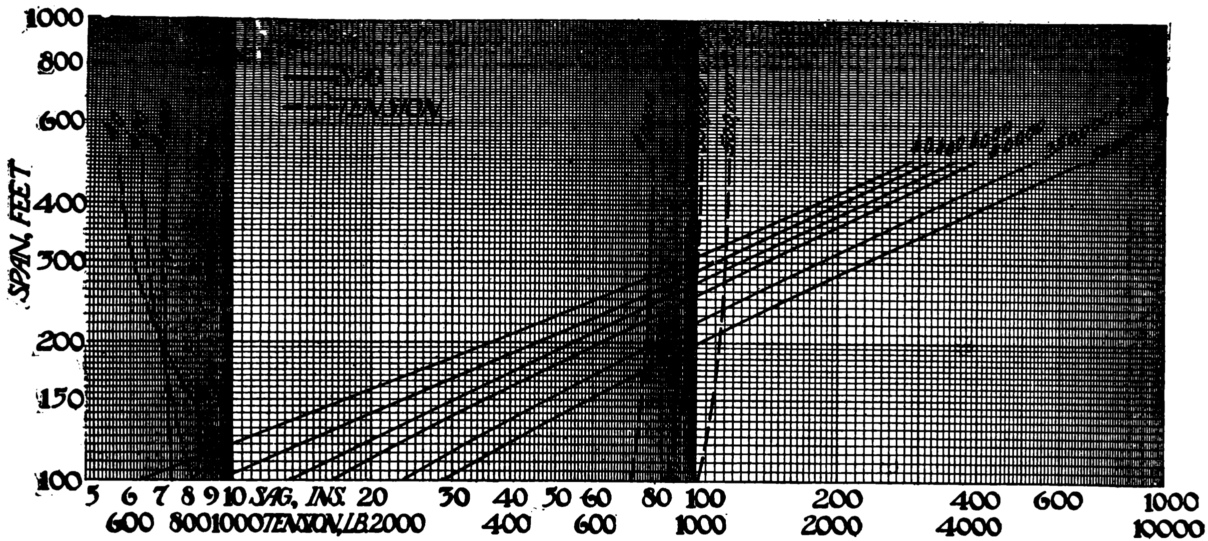

FIG. 5.—*Sags and tensions at 60° F., heavy loading district. Triple-braid weatherproof, stranded, hard-drawn copper conductors, Nos. 1/0, 2/0, 3/0, and 4/0, 350,000 c. m., and 500,000 c. m.; soft copper Nos. 3/0 and 4/0, 350,000 c. m., and 500,000 c. m.*

Tension when loaded at 0° F. is 2,000 pounds

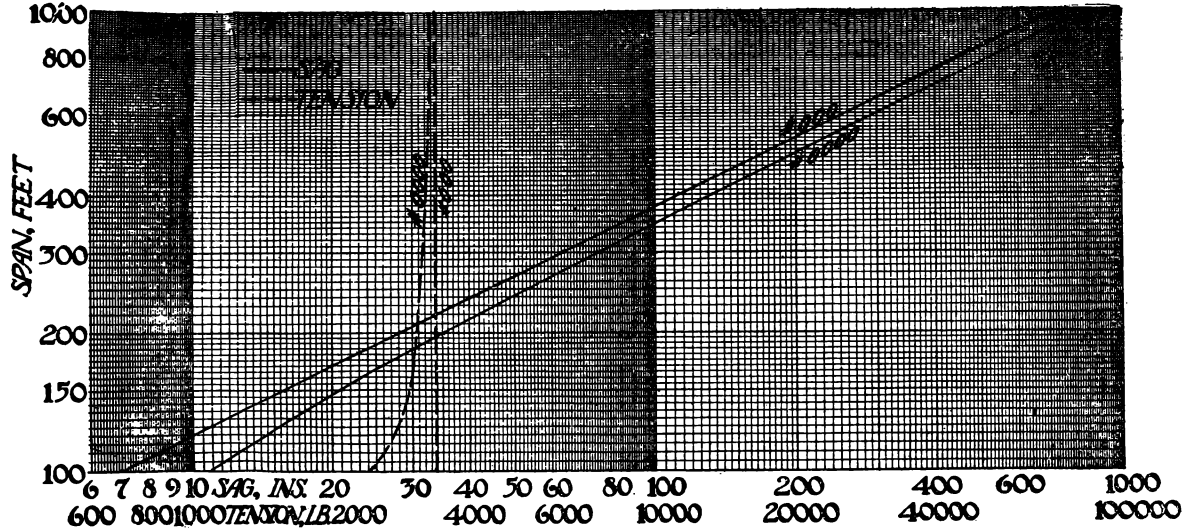

Fig. 6.—*Sags and tensions at 60° F., medium loading district. Bare, solid, soft or hard-drawn copper wire, Nos. 3/0 and 4/0*

Tension when loaded at 15° F. is 2,000 pounds

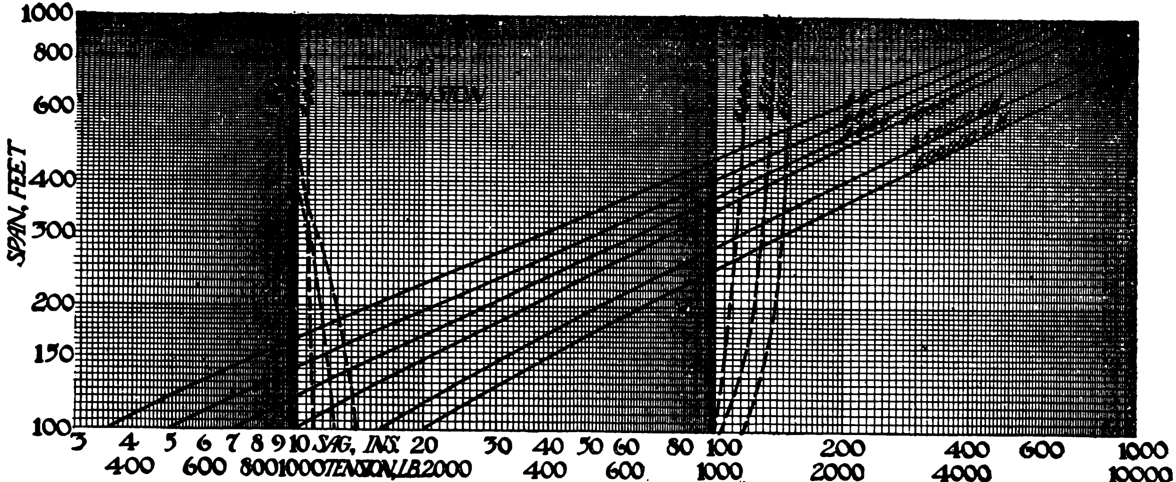

FIG. 7.—*Sags and tensions at 60° F., medium loading district. Bare, stranded, hard-drawn copper conductors, Nos. 1/0, 2/0, 3/0, and 4/0, 350,000 c. m., and 500,000 c. m.; soft copper Nos. 3/0 and 4/0, 350,000 c. m., and 500,000 c. m.*

Tension when loaded at 15° F. is 2,000 pounds

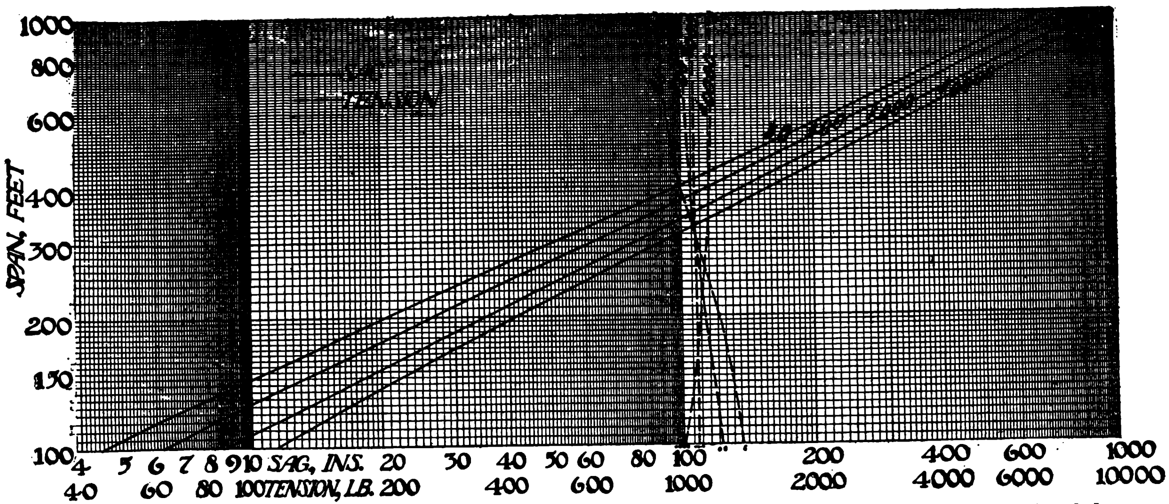

FIG. 8.—*Sags and tensions at 60° F., medium loading district. Triple-braid weatherproof, solid, hard-drawn copper wire, Nos. 1/0, 2/0, 3/0, and 4/0; soft copper Nos. 3/0 and 4/0*

Tension when loaded at 15° F. is 2,000 pounds

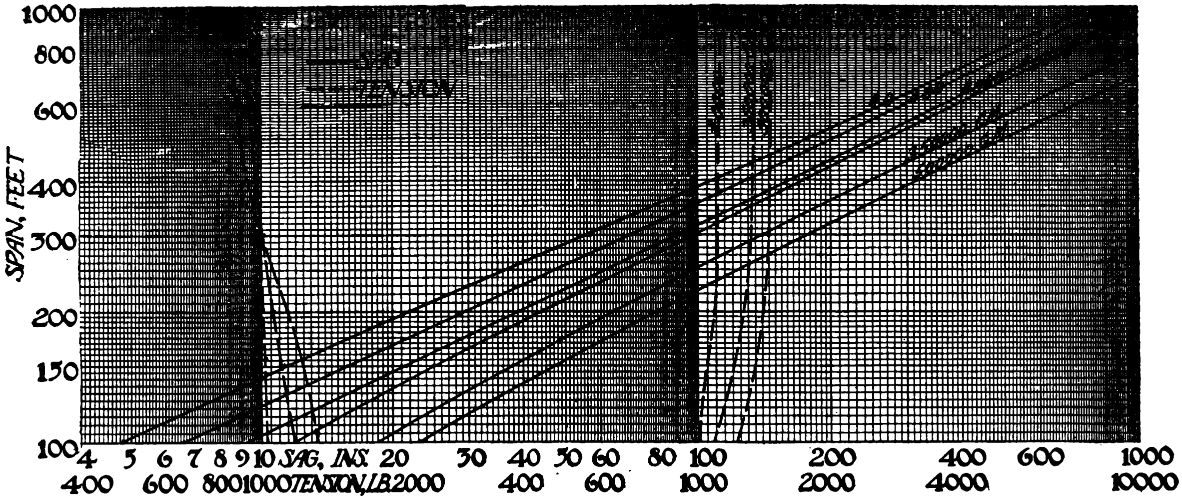

FIG. 9.—*Sags and tensions at 60° F., medium loading district. Triple-braid weatherproof, stranded, hard-drawn copper wire, Nos. 1/0, 2/0, 3/0, and 4/0, 350,000 c. m., and 500,000 c. m.; soft copper Nos. 3/0 and 4/0, 350,000 c. m., and 500,000 c. m.*

Tension when loaded at 15° F. is 2,000 pounds

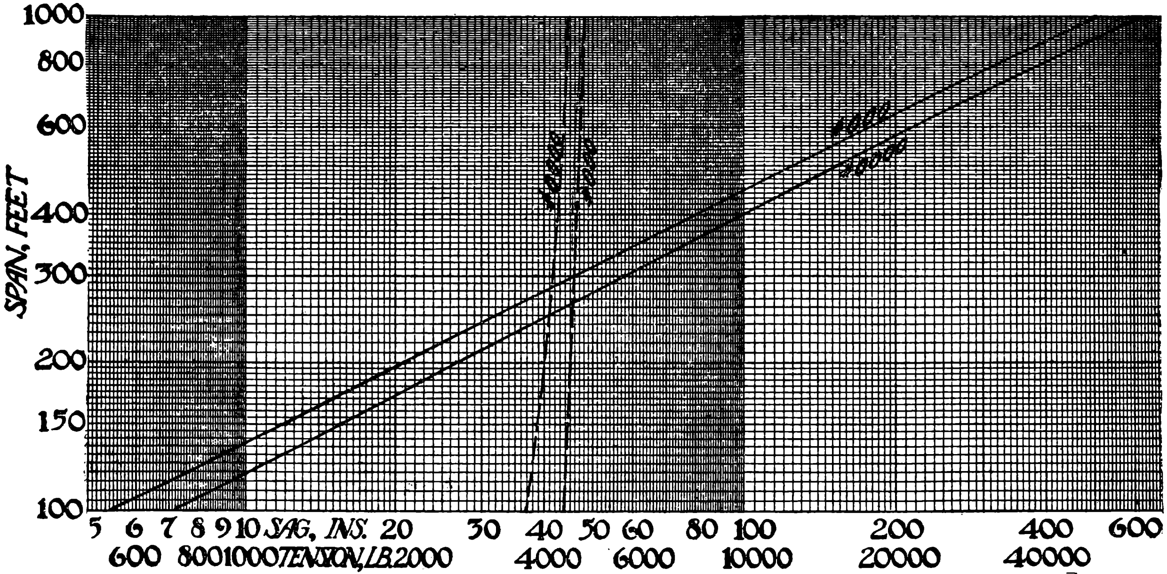

Fig. 10.—*Sags and tensions at 60° F., light loading district. Bare, solid, soft or hard-drawn copper wire, Nos. 3/0 and 4/0*

Tension when loaded at 30° F. is 2,000 pounds

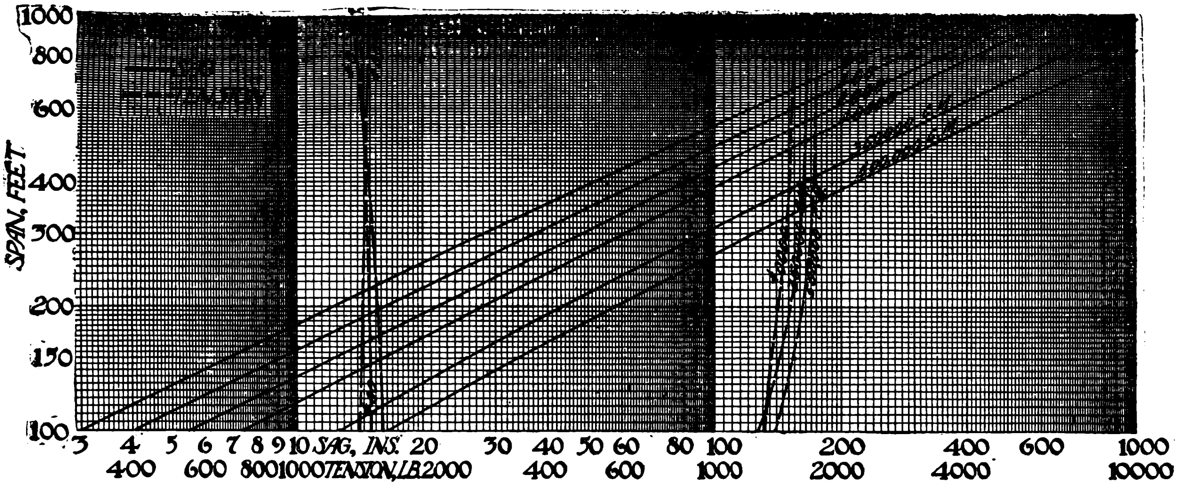

Fig. 11.—*Sags and tensions at 60° F., light loading district. Bare, stranded, hard-drawn copper conductors, Nos. 1/0, 2/0, 3/0, and 4/0, 350,000 c. m., and 500,000 c. m.; soft copper Nos. 3/0 and 4/0, 350,000 c. m., and 500,000 c. m.*

Tension when loaded at 30° F. is 2,000 pounds

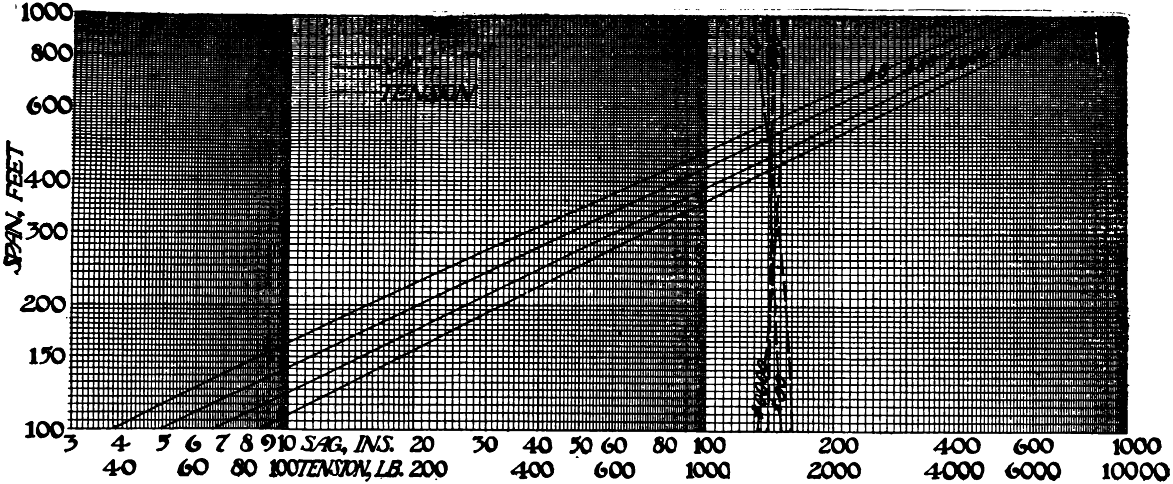

FIG. 12.—*Sags and tensions at 60° F., light loading district. Triple-braid weatherproof, solid, hard-drawn copper wire, Nos. 1/0, 2/0, 3/0, and 4/0; soft copper Nos. 3/0 and 4/0*

Tension when loaded at 30° F. is 2,000 pounds

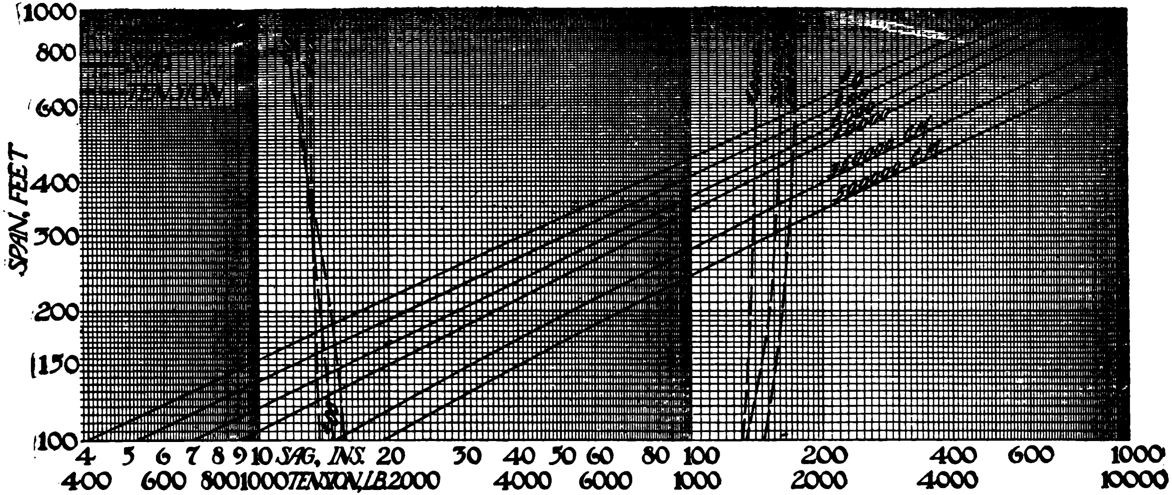

FIG. 13.—*Sags and tensions at 60° F., light loading district. Triple-braid weatherproof, stranded, hard-drawn copper wire, Nos. 1/0, 2/0, 3/0, and 4/0, 350,000 c. m., and 500,000 c. m.; soft copper Nos. 3/0 and 4/0, 350,000 c. m., and 500,000 c. m.*

Tension when loaded at 30° F. is 2,000 pounds

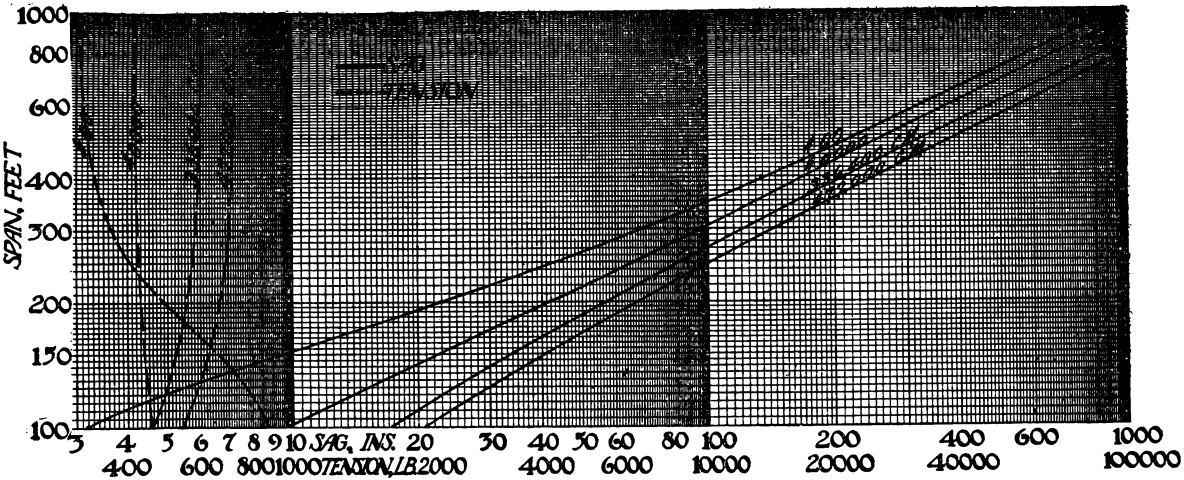

Fig. 14.—*Sags and tensions at 60° F., heavy loading district. Bare, stranded, aluminum conductors, steel-reinforced, Nos. 2/0 and 4/0, 336,400 c. m., and 477,000 c. m.*

Tension when loaded at 0° F. is 2,000 pounds

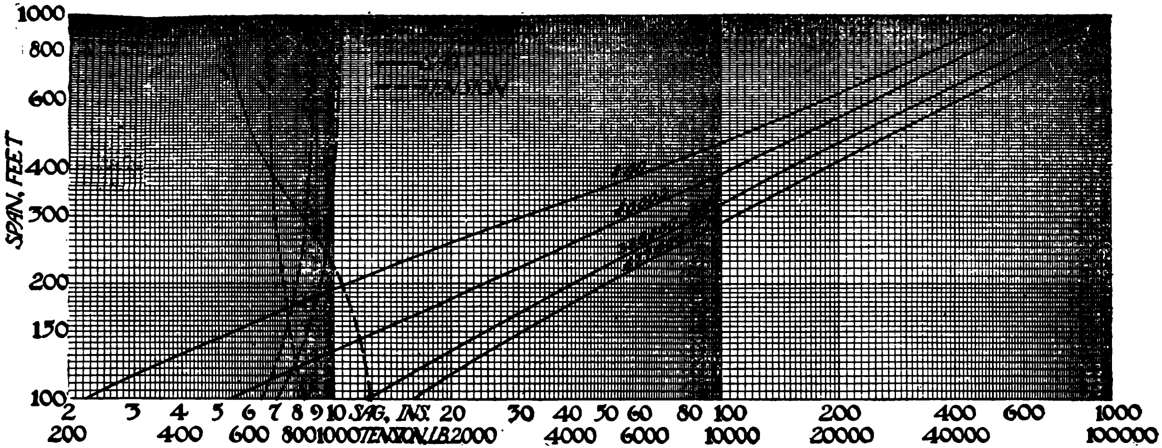

FIG. 15.—*Sags and tensions at 60° F., medium loading district. Bare, stranded, aluminum conductors, steel-reinforced, Nos. 2/0 and 4/0, 336,400 c. m., and 477,000 c. m.*

Tension when loaded at 15° F. is 2,000 pounds

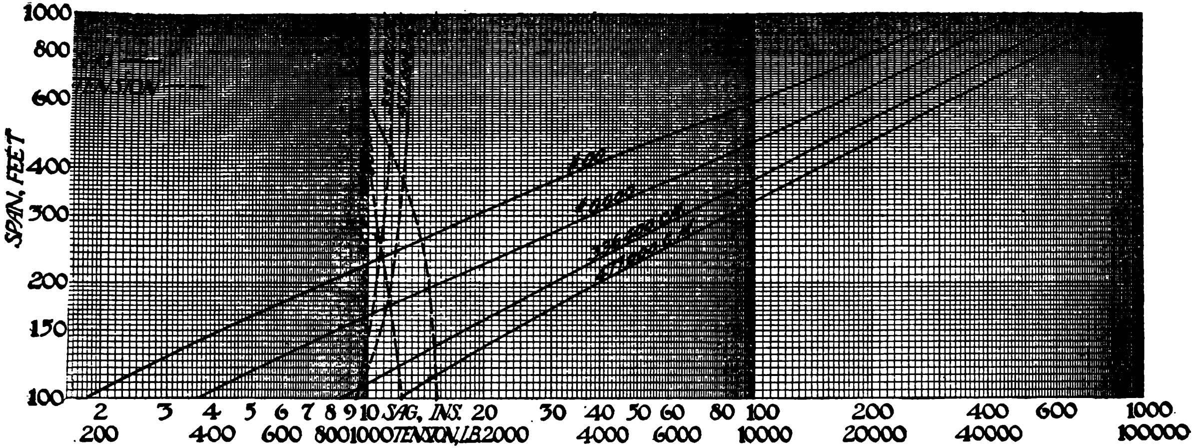

Fig. 16.—*Sags and tensions at 60° F., light loading district. Bare, stranded, aluminum conductors, steel-reinforced, Nos. 2/0 and 4/0, 336,400 c. m., and 477,000 c. m.*

Tension when loaded at 30° F. is 2,000 pounds

Appendix D.—MECHANICAL DATA FOR WIRES AND CABLES

Copper.

The following tables give the mechanical characteristics of copper wire and cable and are based on the standard specifications of the American Society for Testing Materials.

Hard-drawn copper manufactured in accordance with these specifications has an elastic limit of approximately 55 per cent of the ultimate strength given. Soft copper has no definite elastic limit, but it is below 5,000 pounds per square inch. It is not customarily stressed in excess of half its ultimate stress.

For purposes of calculation of sags and stresses, medium hard-drawn wire conforming with the A. S. T. M. specifications is considered as hard-drawn. The breaking load of stranded cable has been taken as 90 per cent of the sum of the breaking loads of the individual strands.

The modulus of elasticity has been taken at 16,000,000 pounds per square inch for all grades of copper. The coefficient of linear thermal expansion per degree Fahrenheit has been taken as 9.6×10^{-6}. The weight of bare solid copper conductors has been taken as 3.854 pounds per square inch of cross section per foot of length; and of stranded conductors as 3.931 pounds. The weights of covered conductors are given in Table 81.

Table 72.—Solid Copper Wire

Size A. W. G. No.	Diameter	Area of conductor	Hard-drawn wire: Ultimate stress	Hard-drawn wire: Breaking load	Soft wire: Ultimate stress	Soft wire: Breaking load
	Inch	*Sq. in.*	*Lbs./in.²*	*Pounds*	*Lbs./in.²*	*Pounds*
0000	0.460	0.166	49,000	8,100	36,000	6,000
000	.410	.132	51,000	6,700	36,000	4,700
00	.365	.104	52,800	5,500	36,000	3,800
0	.325	.083	54,500	4,500	36,000	3,000
1	.289	.066	56,100	3,700	37,000	2,400
2	.258	.052	57,600	3,000	37,000	1,900
3	.229	.041	59,000	2,400	37,000	1,500
4	.204	.033	60,100	2,000	37,000	1,200
6	.162	.021	62,100	1,300	37,000	760
8	.128	.013	63,700	830	37,000	480
9	.114	.010	64,300	660	37,000	370
10	.102	.0082	64,900	530	38,500	310
12	.081	.0051	65,700	340	----------	----------
14	.064	.0032	66,200	210	----------	----------

Table 73.—Stranded Copper Conductors

Size	External diameter	Stranding	Area of conductors	Breaking load: Hard-drawn	Breaking load: Soft
Circular mills:	*Inches*		*Sq. in.*	*Pounds*	*Pounds*
1,000,000	1.15	61×0.128	0.785	45,000	----------
500,000	.813	37× .116	.392	22,700	13,000
450,000	.772	37× .110	.353	20,500	11,700
400,000	.728	37× .104	.314	18,300	10,500
350,000	.681	37× .097	.275	16,100	9,500
350,000	.678	19× .136	.275	15,700	9,100
300,000	.630	37× .090	.236	13,900	8,200
300,000	.628	19× .126	.236	13,500	7,800
250,000	.575	37× .082	.196	11,600	6,800
250,000	.573	19× .115	.196	11,300	6,500
A. W. G. No.:					
0000	.528	19× .106	.166	9,700	5,500
0000	.522	7× .174	.166	9,200	5,500
000	.470	19× .094	.132	7,700	4,600
000	.464	7× .155	.132	7,400	4,400
00	.418	19× .084	.104	6,100	3,600
00	.414	7× .138	.104	5,900	3,500
0	.373	19× .075	.083	4,900	2,850
0	.368	7× .123	.083	4,800	2,750
1	.332	19× .066	.066	3,900	2,300
1	.328	7× .109	.066	3,800	2,200
2	.292	7× .097	.052	3,050	1,800
3	.260	7× .087	.041	2,450	1,430
4	.232	7× .077	.033	1,950	1,130
5	.207	7× .069	.026	1,550	900
6	.184	7× .061	.021	1,230	710
7	.165	7× .055	.016	980	550
8	.146	7× .049	.013	780	450

Steel.

Tables 74 and 75 give the mechanical characteristics of steel wire and cable of three grades, ordinary, Siemens-Martin, and high-tension. The ultimate stresses of the three are taken as 60,000, 75,000, and 125,000 pounds per square inch, respectively. The breaking load of stranded cable has in all cases been taken as 90 per cent of the sum of the breaking loads of the individual strands.

The coefficient of linear thermal expansion for steel has been taken as 6.7×10^{-6} per ° F. The modulus of elasticity has been taken as 29,000,000 pounds per square inch for solid wires and 21,000,000 pounds per square inch for cables. The weight of conductor per square inch of cross section is taken as 3.39 pounds per foot of length.

Steel from different sources may differ in physical properties, and when materials are used having properties different from those assumed, loads and sags should be computed from the actual values.

Table 74.—Bare Solid Steel Wires

Size Stl. W. G. No.	Diameter	Area	Breaking load		
			Ordinary	Siemens-Martin	High-tension steel
	Inch	*Sq. in.*	*Pounds*	*Pounds*	*Pounds*
4	0.225	0.0400	2,400	3,000	5,000
6	.192	.0290	1,740	2,170	3,620
8	.162	.0206	1,240	1,560	2,570

Table 75.—Stranded Bare Steel Conductors

Nominal size (inches)	Diameter	Area	Breaking load		
			Ordinary	Siemens-Martin	High-tension steel
	Inch	*Sq. in.*	*Pounds*	*Pounds*	*Pounds*
5/8	0.625	0.2356	12,720	15,900	26,500
9/16	.562	.1922	10,380	13,000	21,620
1/2	.500	.1443	7,790	9,740	16,230
7/16	.437	.1204	6,500	8,130	13,540
3/8	.375	.0832	4,490	5,620	9,360
5/16	.312	.0606	3,270	4,090	6,820
1/4	.250	.0352	1,900	2,380	3,960

Copper-Covered Steel.

Tables 76, 77, and 78 give the mechanical characteristics of copper-covered steel conductors of standard tensile grade and extra-high-tensile grade. The tables were submitted by the Copperweld Steel Co. for copperweld wire, with supporting data. The breaking load of stranded conductors has been taken as 90 per cent of the sum of the breaking loads of the individual strands.

Sags have been computed for standard tensile grade only. The coefficient of linear thermal expansion for these conductors has been taken as 7.2×10^{-6} per ° F. The modulus of elasticity for solid wires has been taken as 20,000,000 pounds per square inch. For stranded cables, the value of the modulus varies with size as follows:

5/8 inch diameter, 15,600,000 pounds per square inch.
9/16 inch diameter, 16,100,000 pounds per square inch.
1/2 inch diameter, 17,000,000 pounds per square inch.
7/16 inch diameter, 17,800,000 pounds per square inch.
3/8 inch diameter, 18,600,000 pounds per square inch.
5/16 inch diameter, 19,500,000 pounds per square inch.

The weight of conductor per square inch of cross section is taken as 3.53 pounds per foot of length.

Table 76.—Solid Bare Copper-Covered Steel Conductors

Size A. W. G. No.	Diameter	Area	Breaking load	
			Standard	Extra-high tensile
	Inch	*Square inch*	*Pounds*	*Pounds*
0000	0.460	0.166	9,850	----------
000	.410	.132	8,280	----------
00	.365	.104	6,850	----------
0	.325	.083	5,700	----------
1	.289	.066	4,800	----------
2	.258	.052	4,000	7,300
3	.229	.041	3,200	5,780
4	.204	.033	2,650	4,600
5	.182	.026	2,200	3,640
6	.162	.021	1,800	2,880
7	.144	.016	1,450	2,290
8	.128	.013	1,200	1,820
9	.114	.0103	970	----------
10	.102	.0082	800	----------

Table 77.—Stranded Bare Copper-Covered Steel Conductors—Standard Tensile Grade

Size A. W. G. No.	Nominal diameter	Stranding	Area	Breaking load
	Inch		*Square inch*	*Pounds*
	5/8	7 No. 4	0.229	18,550
	9/16	7 No. 5	.182	15,400
0000		7^x	.166	14,300
	1/2	7 No. 6	.144	12,600
000		7^x	.132	11,640
	7/16	7 No. 7	.114	10,160
00		7^x	.105	9,460
	3/8	7 No. 8	.091	8,400
0		7^x	.0829	7,780
	11/32	7 No. 9	.0719	6,790
	5/16	7 No. 10	.0571	5,600

^{x} Means special size wire, not an A.W.G. size.

Table 78.—Stranded Bare Copper-Covered Steel Conductors—Extra-High Tensile Grade

Size A. W. G. No.	Nominal diameter	Stranding	Area	Breaking load
	Inch		*Square inch*	*Pounds*
	7/8	19 No. 5	0.495	62,240
	13/16	19 No. 6	.392	49,250
	3/4	19^x	.354	44,600
	23/32	19 No. 7	.311	39,160
	11/16	19^x	.275	34,800
	5/8	19 No. 8	.246	31,120
	5/8	7 No. 4	.229	28,980
	9/16	7 No. 5	.182	22,930
0000		7^x	.166	20,940
	1/2	7 No. 6	.144	18,200
000		7^x	.132	16,600
	7/16	7 No. 7	.114	14,420
00		7^x	.105	13,160
	3/8	7 No. 8	.091	11,460

^{x} Means special size wire, not an A.W.G. size.

Aluminum.

Table 79 gives the mechanical characteristics of stranded aluminum conductors. The coefficient of linear thermal expansion for aluminum has been taken as 12.8×10^{-6} per degree Fahrenheit, and the modulus of elasticity as 9,000,000 pounds per square inch. The weight of conductor is 1.194 pounds per square inch of cross section for a length of 1 foot.

Table 80 gives the mechanical characteristics of aluminum cable having a steel core. The virtual coefficient of expansion, the modulus of elasticity, and the weight per unit length vary with the size of cable. For cables of sizes 4/0 to 6, A. W. G., the coefficient of thermal expansion has been taken as 10.5×10^{-6} per degree Fahrenheit; the modulus of elasticity as 12,000,000 pounds per square inch; and the weight per unit cross section as 1.52 pounds per foot of length.

Table 79.—Stranded Aluminum Conductors

Size	Diameter	Area	Usual stranding	Copper equivalent	Elastic limit	Breaking load
Circular mils:	*Inches*	*Square inch*		*c. m.*	*Pounds*	*Pounds*
87[illegible]500	1.077	0.687	37×0.154	550,000	9,600	14,800
7[illegible],000	1.026	.624	37× .146	500,000	8,750	13,500
750,000	.994	.589	37× .142	472,000	8,250	12,700
715,500	.974	.562	37× .139	450,000	7,870	12,100
636,000	.918	.500	37× .131	400,000	7,000	10,800
556,500	.856	.437	19× .171	350,000	6,120	9,450
500,000	.810	.393	19× .162	314,500	5,500	8,500
477,000	.793	.375	19× .158	300,000	5,240	8,100
397,500	.724	.312	19× .145	250,000	4,370	6,750
300,000	.621	.236	19× .126	188,800	3,300	5,100
				A. W. G. No.		
336,400	.657	.264	19× .133	4/0	3,700	5,700
266,800	.586	.209	7× .195	3/0	2,940	4,550
A. W. G. No.:						
4/0	.522	.166	7× .174	2/0	2,330	3,570
3/0	.464	.132	7× .155	0	1,845	2,860
2/0	.414	.104	7× .138	1	1,465	2,270
0	.368	.083	7× .123	2	1,160	1,790
1	.328	.066	7× .109	3	920	1,420

Table 80.—Aluminum Cables, Steel-Reinforced

Size	Equivalent copper	Diameter	Stranding		Total area	Breaking load
			Aluminum	Steel		
Circular mils:	*c. m.*	*Inches*			*Square inch*	*Pounds*
795,000	500,000	1.093	54×0.1214	7×0.1214	0.7060	25,150
715,500	450,000	1.036	54× .1151	7× .1151	.6350	22,680
636,000	400,000	.977	54× .1085	7× .1085	.5640	20,060
477,000	300,000	.883	30× .1261	7× .1261	.4620	20,700
397,500	250,000	.806	30× .1151	7× .1151	.3850	17,250
	A. W. G. No.					
336,400	0000	.741	30× .1059	7× .1059	.3260	14,580
266,800	000	.633	6× .2108	7× .0705	.2370	8,450
A. W. G. No.:						
0000	00	.564	6× .1880	1× .1880	.1939	7,590
000	0	.501	6× .1670	1× .1670	.1537	5,995
00	1	.447	6× .1490	1× .1490	.1219	4,770
0	2	.398	6× .1327	1× .1327	.0967	3,780
1	3	.355	6× .1182	1× .1182	.0766	3,000
2	4	.316	6× .1052	1× .1052	.0608	2,394
3	5	.281	6× .0938	1× .0938	.0482	1,890
4	6	.250	6× .0834	1× .0834	.0383	1,500
5	7	.223	6× .0743	1× .0743	.0303	1,183
6	8	.198	6× .0661	1× .0661	.0240	940

The values given in these tables were submitted by the Aluminum Co. of America with supporting data. The breaking load of stranded conductors has been taken as 90 per cent of the sum of the breaking loads of the individual strands, including the steel core where used.

Appendix E.—LOADS UPON CONDUCTORS AND SUPPORTS

Table 81 gives the weights of conductors of various sizes and materials, with and without ice loading. Table 82 gives the transverse and resultant loads of the same conductors based on the assumed loadings of section 25. The over-all diameters of covered wires supplied by different manufacturers are not the same and hence average values have been chosen. This is also true of the sizes of strands which make up steel cables.

Table 81.—Vertical Loads on Conductor Supports

Size of conductor	Diameter over all	Weight of—		
		Conductor +0.5 inch of ice= heavy	Conductor +0.25 inch of ice= medium	Conductor only= light
Bare solid copper:				
A. W. G. No.—	*Inch*	*Lbs./ft.*	*Lbs./ft.*	*Lbs./ft.*
12	0.081	0.381	0.122	0.020
10	.102	.406	.141	.031
8	.128	.440	.168	.050
6	.162	.491	.207	.079
4	.204	.564	.268	.126
3	.229	.612	.308	.159
2	.258	.672	.359	.201
1	.289	.744	.421	.253
0	.325	.832	.498	.319
00	.365	.943	.596	.405
000	.410	1.075	.714	.509
0000	.460	1.237	.861	.640
Bare stranded copper:				
A. W. G. No.—				
6	.18	.505	.216	.083
4	.23	.580	.275	.126
3	.26	.634	.320	.161
2	.29	.696	.372	.204
1	.33	.775	.440	.259
0	.37	.867	.519	.326
00	.41	.979	.618	.413
000	.46	1.116	.740	.519
0000	.52	1.287	.892	.652

Table 81.—Vertical Loads on Conductor Supports—Continued

Size of conductor	Diameter over all	Weight of— Conductor +0.5 inch of ice= heavy	Conductor +0.25 inch of ice= medium	Conductor only= light
Bare stranded copper—Continued.				
Cir. mils—	*Inch*	*Lbs./ft.*	*Lbs./ft.*	*Lbs./ft.*
250,000	0.57	1.436	1.025	0.770
300,000	.63	1.630	1.201	.928
350,000	.68	1.815	1.370	1.081
400,000	.73	1.992	1.539	1.234
450,000	.77	2.177	1.705	1.388
500,000	.81	2.355	1.870	1.541
1,000,000	1.15	4.112	3.521	3.086
T. B. W. P. solid copper:				
A. W. G. No.—				
12	.21	.476	.178	.035
10	.25	.519	.208	.053
8	.26	.547	.234	.075
6	.32	.622	.289	.112
4	.38	.711	.370	.164
3	.41	.760	.405	.200
2	.44	.840	.474	.260
1	.47	.919	.540	.316
0	.50	1.029	.640	.407
00	.53	1.143	.745	.502
000	.62	1.326	.900	.630
0000	.66	1.482	1.047	.767
T. B. W. P. stranded copper:				
A. W. G. No.—				
2	.444	.857	.486	.270
1	.518	.961	.567	.328
0	.620	1.120	.694	.424
00	.662	1.245	.806	.522
000	.734	1.421	.960	.654
0000	.785	1.599	1.122	.800
Cir. mils—				
250,000	.862	1.832	1.331	.985
350,000	.978	2.264	1.727	1.345
500,000	1.108	2.894	2.316	1.894
750,000	1.343	3.968	3.317	2.822
1,000,000	1.531	4.937	4.228	3.674
Bare solid steel:				
Stl. W. G. No.—				
8	.162	.482	.198	.070
6	.192	.528	.235	.098
4	.225	.586	.283	.135
Bare stranded steel:				
¼-inch	.250	.586	.275	.119
5/16-inch	.312	.711	.380	.205
⅜-inch	.375	.826	.476	.282
7/16-inch	.437	.991	.622	.408
½-inch	.500	1.111	.722	.489
9/16-inch	.562	1.312	.904	.652
⅝-inch	.625	1.498	1.071	.799

Table 81.—Vertical Loads on Conductor Supports—Continued

Size of conductor	Diameter over all	Weight of— Conductor +0.5 inch of ice=heavy	Conductor +0.25 inch of ice=medium	Conductor only=light
Solid bare copper-covered steel:				
A. W. G. No.—	*Inch*	*Lbs./ft.*	*Lbs./ft.*	*Lbs./ft.*
10	0.102	0.402	0.138	0.029
8	.128	.437	.163	.046
6	.162	.485	.201	.073
4	.204	.554	.257	.116
Stranded bare copper-covered steel:				
5/16-inch	.306	.710	.382	.209
3/8-inch	.384	.882	.529	.332
7/16-inch	.432	.998	.630	.418
1/2-inch	.486	1.139	.755	.526
9/16-inch	.546	1.313	.910	.663
Stranded aluminum, bare:				
A. W. G. No.—				
2	.293	.554	.230	.062
1	.328	.592	.258	.079
0	.368	.637	.290	.099
00	.414	.692	.331	.125
000	.464	.756	.379	.158
0000	.522	.832	.437	.198
Bare stranded aluminum, steel-reinforced:				
A. W. G. No.—				
4	.250	.523	.213	.058
2	.316	.598	.268	.092
1	.355	.647	.305	.117
0	.398	.704	.348	.147
00	.447	.772	.401	.185
000	.501	.853	.465	.232
0000	.564	.954	.547	.294
Cir. mils—				
336,400	.741	1.297	.834	.527
477,000	.883	1.605	1.098	.747

Table 82.—Transverse and Resultant Loads on Conductors and Supports in Three Loading Districts

[Pounds per conductor per linear foot]

Size of conductor	Transverse force on conductor with ice covering (if any)			Resultant force on conductor due to weight and wind		
	Heavy	Medium	Light	Heavy	Medium	Light
Bare solid copper:						
A. W. G. No.—						
12	0.721	0.387	0.081	0.815	0.406	0.084
10	.735	.401	.102	.840	.425	.107
8	.752	.419	.128	.872	.451	.137
6	.775	.442	.162	.918	.467	.180

Table 82.—Transverse and Resultant Loads on Conductors and Supports in Three Loading Districts—Continued

[Pounds per conductor per linear foot]

Size of conductor	Transverse force on conductor with ice covering (if any)			Resultant force on conductor due to weight and wind		
	Heavy	Medium	Light	Heavy	Medium	Light
Bare solid copper—Contd.						
A. W. G. No.—						
4	0.803	0.470	0.204	0.986	0.540	0.240
3	.820	.486	.229	1.023	.576	.279
2	.839	.506	.258	1.075	.620	.327
1	.860	.526	.289	1.137	.674	.384
0	.884	.550	.325	1.214	.742	.456
00	.910	.577	.365	1.310	.829	.545
000	.940	.607	.410	1.428	.937	.653
0000	.974	.640	.460	1.574	1.073	.788
Bare stranded copper:						
A. W. G. No.—						
6	.787	.454	.180	.935	.503	.198
4	.820	.487	.230	1.005	.559	.262
3	.840	.507	.260	1.053	.599	.306
2	.860	.527	.290	1.106	.645	.355
1	.887	.554	.330	1.178	.707	.420
0	.914	.580	.370	1.260	.779	.493
00	.940	.607	.410	1.357	.866	.582
000	.974	.640	.460	1.481	.978	.693
0000	1.014	.680	.520	1.638	1.122	.834
Cir. mils—						
250,000	1.047	.714	.570	1.777	1.294	.958
300,000	1.087	.754	.630	1.960	1.418	1.121
350,000	1.121	.787	.680	2.133	1.580	1.277
400,000	1.154	.820	.730	2.308	1.744	1.434
450,000	1.181	.847	.770	2.477	1.904	1.587
500,000	1.207	.874	.810	2.646	2.064	1.741
1,000,000	1.434	1.100	1.150	4.355	3.822	3.293
T. B. W. P. solid copper:						
A. W. G. No.—						
12	.807	.474	.210	.937	.506	.213
10	.834	.500	.250	.987	.542	.255
8	.840	.507	.260	1.003	.558	.270
6	.880	.547	.320	1.078	.619	.339
4	.920	.587	.380	1.163	.694	.414
3	.940	.607	.410	1.213	.730	.456
2	.960	.627	.440	1.276	.768	.511
1	.980	.647	.470	1.344	.843	.566
0	1.000	.667	.500	1.435	.924	.645
00	1.020	.687	.530	1.532	1.013	.730
000	1.080	.747	.620	1.711	1.170	.872
0000	1.100	.767	.650	1.846	1.286	1.005
T. B. W. P. stranded copper:						
A. W. G. No.—						
2	.961	.630	.444	1.289	.796	.520
1	1.012	.679	.518	1.396	.884	.613
0	1.080	.747	.620	1.557	1.020	.751
00	1.109	.775	.662	1.667	1.118	.843
000	1.157	.823	.734	1.832	1.331	.983
0000	1.191	.857	.785	1.994	1.412	1.121

Table 82.—Transverse and Resultant Loads on Conductors and Supports in Three Loading Districts—Continued

[Pounds per conductor per linear foot]

Size of conductor	Transverse force on conductor with ice covering (if any)			Resultant force on conductor due to weight and wind		
	Heavy	Medium	Light	Heavy	Medium	Light
T. B. W. P. stranded copper—Continued.						
Cir. mils—						
250,000	1.241	0.908	0.862	2.213	1.611	1.309
350,000	1.319	.986	.978	2.620	1.988	1.663
500,000	1.406	1.072	1.108	3.217	2.552	2.194
750,000	1.563	1.229	1.343	4.265	3.538	3.125
1,000,000	1.688	1.355	1.531	5.218	4.439	3.980
Bare solid steel:						
Stl. W. G. No.—						
8	.775	.442	.162	.912	.484	.176
6	.795	.462	.192	.955	.518	.216
4	.817	.484	.225	1.006	.560	.263
Bare stranded steel:						
¼-inch	.833	.500	.250	1.018	.570	.277
5/16-inch	.875	.542	.312	1.126	.661	.374
⅜-inch	.917	.583	.375	1.234	.753	.469
7/16-inch	.958	.625	.437	1.379	.882	.598
½-inch	1.000	.667	.500	1.495	.983	.699
9/16-inch	1.042	.708	.562	1.675	1.149	.861
⅝-inch	1.083	.750	.625	1.849	1.307	1.014
Solid bare copper-covered steel:						
A. W. G. No.—						
10	.735	.401	.102	.838	.425	.106
8	.752	.419	.128	.870	.450	.136
6	.775	.442	.162	.914	.485	.178
4	.803	.470	.204	.975	.535	.235
Stranded bare copper-covered steel:						
5/16-inch	.871	.538	.306	1.124	.659	.370
⅜-inch	.923	.590	.384	1.276	.792	.508
7/16-inch	.955	.622	.432	1.381	.885	.601
½-inch	.991	.658	.486	1.510	1.001	.716
9/16-inch	1.031	.698	.546	1.670	1.147	.859
Bare stranded aluminum:						
A. W. G. No.—						
2	.862	.529	.293	1.020	.577	.300
1	.886	.552	.328	1.065	.609	.337
0	.912	.579	.368	1.113	.647	.380
00	.943	.610	.414	1.170	.693	.432
000	.976	.643	.464	1.234	.746	.489
0000	1.015	.682	.522	1.312	.810	.557
Bare stranded aluminum steel-reinforced:						
A. W. G. No.—						
4	.834	.500	.250	.984	.544	.257
2	.878	.544	.316	1.062	.607	.329
1	.904	.570	.355	1.112	.646	.374
0	.932	.599	.398	1.168	.693	.424
00	.965	.632	.447	1.236	.748	.484
000	1.001	.668	.501	1.315	.814	.552
0000	1.043	.710	.564	1.414	.896	.636
Cir. mils—						
336,400	1.161	.828	.741	1.741	1.175	.909
477,000	1.256	.922	.883	2.038	1.434	1.157

Appendix F.—WOOD POLES

Moments of Resistance of Poles.

The resisting moments of wood poles of various ground-line circumferences are given in the accompanying tables for each value of allowable fiber stress recognized in Table 21 (rule 261A, 4) for poles when installed. Table 83 gives the values for dense southern yellow pine; Table 84 for other pine, chestnut, western cedar, cypress, etc., having a recognized ultimate fiber stress of 5,000 pounds per square inch; and Table 85 for woods having an ultimate fiber stress of 3,600 pounds per square inch, such as redwood and eastern cedar (northern white cedar).

Southern yellow pine should not be used for supporting structures unless first given a preservative treatment, as otherwise the rapid deterioration will require early replacement.

The following formula has been used in calculating the moments:

$M = 0.0002638\, f\, C^3$ = moment in pound-feet; where

f = allowable fiber stress in pounds per square inch, and

C = circumference of the pole at ground line in inches.

While the ground-line section may not be the most stressed section in poles with considerable taper, it is so regarded here. Since the wood usually deteriorates most rapidly at this point, it is here that sufficient strength must be provided.

Table 83.—Resisting Moments for Poles of Woods Having Ultimate Fiber Stress of 6,500 Pounds per Square Inch (Dense Southern Yellow Pine)

Circumference at ground line (inches)	Resisting moments for fiber stress of (pounds per square inch)					
	2,170	2,600	3,250	3,900	4,870	6,500
	Lb.-ft.	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*
24	7,900	9,500	11,850	14,200	17,750	23,700
25	8,950	10,700	13,400	16,100	20,050	26,800
26	10,050	12,050	15,050	18,100	22,600	30,150
27	11,250	13,500	16,900	20,250	25,300	33,750
28	12,550	15,050	18,800	22,600	28,200	37,650
29	13,950	16,750	20,900	25,100	31,350	41,800
30	15,450	18,500	23,150	27,800	34,700	46,300
31	17,050	20,450	25,550	30,650	38,250	51,100
32	18,750	22,500	28,100	33,700	42,100	56,200
33	20,550	24,650	30,800	36,950	46,150	61,600
34	22,500	26,950	33,700	40,450	50,500	67,400
35	24,550	29,400	36,750	44,100	55,100	73,500
36	26,700	32,000	40,000	48,000	59,950	80,000
37	29,000	34,750	43,400	52,100	65,050	86,850
38	31,400	37,650	47,050	56,450	70,500	94,100
39	33,950	40,700	50,850	61,050	76,200	101,700
40	36,650	43,900	54,850	65,850	82,200	109,750
41	39,450	47,250	59,100	70,900	88,550	118,200
42	42,400	50,800	63,500	76,200	95,200	127,050
43	45,500	54,550	68,150	81,800	102,150	136,350
44	48,750	58,450	73,050	87,650	109,450	146,050
45	52,150	62,500	78,150	93,750	117,050	156,250
46	55,700	66,750	83,450	100,150	125,050	166,900
47	59,450	71,200	89,000	106,800	133,400	178,000
48	63,300	75,850	94,800	113,800	142,100	189,650
49	67,350	80,700	100,850	121,050	151,150	201,750
50	71,550	85,750	107,150	128,600	160,600	214,350
51	75,950	91,000	113,750	136,450	170,400	227,450
52	80,500	96,450	120,550	144,650	180,650	241,100
53	85,200	102,100	127,650	153,150	191,250	255,300
54	90,150	108,000	135,000	162,000	202,300	270,000
55	95,250	114,100	142,650	171,150	213,750	285,300
56	100,550	120,450	150,550	180,700	225,600	301,150
57	106,000	127,000	158,800	190,550	237,900	317,550
58	111,700	133,800	167,300	200,750	250,650	334,550
59	117,550	140,850	176,100	211,300	263,850	352,150
60	123,650	148,150	185,200	222,200	277,500	370,400
61	129,950	155,700	194,600	233,500	291,600	389,200
62	136,450	163,450	204,350	245,200	306,200	408,650
63	143,150	171,500	214,400	257,250	321,250	428,750

Table 83.—Resisting Moments for Poles of Woods Having Ultimate Fiber Stress of 6,500 Pounds per Square Inch (Dense Southern Yellow Pine—Continued)

Circumference at ground line (inches)	Resisting moments for fiber stress of (pounds per square inch)					
	2,170	2,600	3,250	3,900	4,870	6,500
	Lb.-ft.	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*
64	150,050	179,800	224,750	269,700	336,800	449,500
65	157,200	188,350	235,450	282,550	352,800	470,900
66	164,600	197,200	246,500	295,800	369,350	492,950
67	172,150	206,300	257,850	309,450	386,400	515,700
68	180,000	215,050	269,600	323,500	403,950	539,150
69	188,050	225,300	281,650	338,000	422,050	563,300
70	196,350	235,250	294,050	352,900	440,650	588,150
71	204,900	245,500	306,850	368,250	459,800	613,700
72	213,650	256,000	320,000	384,000	479,500	640,000
73	222,700	266,800	335,500	400,250	499,750	667,050
74	231,950	277,950	347,400	416,900	520,600	694,850
75	241,500	289,350	361,700	434,050	542,000	723,400

Table 84.—Resisting Moments for Poles of Woods with Ultimate Fiber Stress of 5,000 Pounds per Square Inch (Pine, Chestnut, Western Cedar, Cypress, etc.)

Circumference at ground line (inches)	Resisting moments for fiber stress of (pounds per square inch)—						
	1,250	1,670	2,000	2,500	3,000	3,750	5,000
	Lb.-ft.	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*
24	4,550	6,100	7,300	9,100	10,950	13,700	18,250
25	5,150	6,900	8,250	10,300	12,350	15,450	20,600
26	5,800	7,750	9,250	11,600	13,900	17,400	23,200
27	6,500	8,650	10,400	13,000	15,600	19,450	25,950
28	7,250	9,650	11,600	14,500	17,350	21,700	28,950
29	8,050	10,750	12,850	16,100	19,300	24,150	32,150
30	8,900	11,900	14,250	17,800	21,350	26,700	35,600
31	9,800	13,100	15,700	19,650	23,600	29,450	39,300
32	10,800	14,450	17,300	21,600	25,950	32,400	43,200
33	11,850	15,850	18,950	23,700	28,450	35,550	47,400
34	12,950	17,300	20,750	25,900	31,100	38,900	51,850
35	14,150	18,900	22,600	28,300	33,950	42,400	56,550
36	15,400	20,550	24,600	30,750	36,900	46,150	61,550
37	16,700	22,300	26,700	33,400	40,100	50,100	66,800
38	18,100	24,150	28,950	36,200	43,450	54,300	72,400
39	19,550	26,150	31,300	39,100	46,950	58,700	78,250

Table 84.—Resisting Moments for Poles of Woods with Ultimate Fiber Stress of 5,000 Pounds per Square Inch (Pine, Chestnut, Western Cedar, Cypress, etc.)—Continued

Circumference at ground line (inches)	Resisting moments for fiber stress of (pounds per square inch)—						
	1,250	1,670	2,000	2,500	3,000	3,750	5,000
	Lb.-ft.	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*
40	21, 100	28, 200	33, 750	42, 200	50, 650	63, 300	84, 400
41	22, 750	30, 350	36, 350	45, 450	54, 550	68, 200	90, 900
42	24, 450	32, 650	39, 100	48, 850	58, 650	73, 300	97, 700
43	26, 200	35, 050	41, 950	52, 450	62, 900	78, 650	104, 850
44	28, 100	37, 550	44, 950	56, 200	67, 400	84, 250	112, 350
45	30, 050	40, 150	48, 100	60, 100	72, 100	90, 150	120, 200
46	32, 100	42, 900	51, 350	64, 200	77, 050	96, 300	128, 400
47	34, 250	45, 750	54, 800	68, 500	82, 150	102, 700	136, 950
48	36, 450	48, 700	58, 350	72, 950	87, 500	109, 400	145, 850
49	38, 800	51, 850	62, 050	77, 600	93, 100	116, 400	155, 200
50	41, 200	55, 050	65, 950	82, 450	98, 900	123, 650	164, 900
51	43, 750	58, 450	70, 000	87, 500	105, 000	132, 200	174, 950
52	46, 350	61, 950	74, 200	92, 750	111, 300	139, 100	185, 450
53	49, 100	65, 600	78, 550	98, 200	117, 800	147, 300	196, 350
54	51, 900	69, 350	83, 100	103, 850	124, 600	155, 750	207, 700
55	54, 850	73, 300	87, 800	109, 700	131, 650	164, 600	219, 450
56	57, 900	77, 350	92, 650	115, 800	139, 000	173, 750	231, 650
57	61, 050	81, 600	97, 700	122, 150	146, 550	183, 200	244, 250
58	64, 350	85, 950	102, 950	128, 700	154, 400	193, 000	257, 350
59	67, 700	90, 500	108, 350	135, 450	162, 550	203, 150	270, 900
60	71, 250	95, 150	113, 900	142, 450	170, 950	213, 700	284, 900
61	74, 850	100, 000	119, 750	149, 700	179, 650	224, 550	299, 400
62	78, 600	104, 500	125, 750	157, 200	188, 600	235, 750	314, 350
63	82, 450	110, 150	131, 900	164, 900	197, 900	247, 350	329, 800
64	86, 450	115, 500	138, 300	172, 900	207, 450	259, 350	345, 750
65	90, 550	121, 000	144, 900	181, 100	217, 350	271, 650	362, 250
66	94, 800	126, 650	151, 700	189, 600	227, 500	284, 400	379, 200
67	99, 200	132, 500	158, 700	198, 350	238, 000	297, 550	396, 700
68	103, 700	138, 500	165, 900	207, 350	248, 850	311, 050	414, 750
69	108, 350	144, 700	173, 300	216, 650	260, 000	325, 000	433, 300
70	113, 100	151, 100	180, 950	226, 200	271, 450	339, 300	452, 400
71	118, 000	157, 700	188, 850	236, 050	283, 250	354, 050	472, 100
72	123, 100	164, 450	196, 950	246, 150	295, 400	369, 250	492, 300
73	128, 250	171, 400	205, 250	256, 550	307, 850	384, 850	513, 100
74	133, 600	178, 500	213, 800	267, 250	320, 700	400, 850	534, 500
75	139, 100	185, 850	222, 600	278, 250	333, 850	417, 300	556, 450

Table 85.—Resisting Moments for Poles of Woods Having Ultimate Fiber Stress of 3,600 Pounds per Square Inch (Eastern Cedar, Redwood, etc.)

Circumference at ground line (inches)	Resisting moment for fiber stress of (pounds per square inch)—						
	900	1,200	1,440	1,800	2,160	2,700	3,600
	Lb-ft.	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*
24	3,300	4,400	5,250	6,550	7,900	9,850	13,150
25	3,700	4,950	5,950	7,400	8,900	11,150	14,850
26	4,150	5,550	6,700	8,350	10,000	12,500	16,700
[illegible]	4,650	6,250	7,500	9,350	11,200	14,000	18,700
[illegible]	5,200	6,950	8,350	10,400	12,500	15,650	20,850
29	5,800	7,700	9,250	11,600	13,900	17,350	23,150
30	6,400	8,550	10,250	12,800	15,400	19,250	25,650
31	7,050	9,450	11,300	14,150	17,000	21,200	28,300
32	7,800	10,350	12,450	15,550	18,650	23,350	31,100
33	8,550	11,400	13,650	17,050	20,500	25,600	34,150
34	9,350	12,450	14,950	18,650	22,400	28,000	37,350
35	10,200	13,550	16,300	20,350	24,450	30,550	40,700
36	11,100	14,750	17,700	22,150	26,600	33,250	44,300
37	12,050	16,050	19,250	24,050	28,850	36,100	48,100
38	13,050	17,350	20,850	26,050	31,250	39,100	52,100
39	14,100	18,800	22,550	28,150	33,800	42,250	56,350
40	15,200	20,250	24,300	30,400	36,450	45,600	60,800
41	16,350	21,800	26,200	32,750	39,250	49,100	65,450
42	17,600	23,450	28,150	35,200	42,200	52,750	70,350
43	18,900	25,150	30,200	37,750	45,300	56,650	75,500
44	20,200	26,950	32,350	40,450	48,550	60,650	80,900
45	21,650	28,850	34,600	43,250	51,900	64,900	86,550
46	23,100	30,800	37,000	46,200	55,450	69,350	92,450
47	24,650	32,850	39,450	49,300	59,150	73,950	98,600
48	26,250	35,000	42,000	52,500	63,000	78,750	105,050
49	27,950	37,250	44,700	55,850	67,050	83,800	111,750
50	29,700	39,550	47,500	59,350	71,250	89,050	118,700
51	31,500	42,000	50,400	63,000	75,600	94,500	126,000
52	33,400	44,500	53,400	66,750	80,100	100,150	133,550
53	35,350	47,150	56,550	70,700	84,850	106,050	141,400
54	37,400	49,850	59,800	74,750	89,700	112,150	149,550
55	39,500	52,650	63,200	79,000	94,800	118,500	158,000
56	41,700	55,600	66,700	83,400	100,050	125,100	166,800
57	43,950	58,600	70,350	87,950	105,500	131,900	175,850
58	46,300	61,750	74,100	92,650	111,200	138,950	185,300
59	48,750	65,000	78,000	97,500	117,500	146,300	195,050
60	51,300	68,400	82,050	102,550	123,100	153,850	205,150
61	53,900	71,850	86,200	107,800	129,350	161,650	215,550
62	56,600	75,450	90,550	113,150	135,800	169,750	226,350
63	59,350	79,150	95,000	118,750	142,500	178,100	237,450
64	62,250	83,000	99,600	124,500	149,350	186,700	248,950
65	65,200	86,950	104,300	130,400	156,900	195,600	260,800
66	68,250	91,000	109,200	136,500	163,800	204,750	273,050
67	71,400	95,200	114,250	142,800	171,400	214,200	285,650

Table 85.—Resisting Moments for Poles of Woods Having Ultimate Fiber Stress of 3,600 Pounds per Square Inch (Eastern Cedar, Redwood, etc.)—Continued

Circumference at ground line (inches)	Resisting moment for fiber stress of (pounds per square inch)—						
	900	1,200	1,440	1,800	2,160	2,700	3,600
	Lb.-ft.	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*	*Lb.-ft.*
68	74, 650	99, 550	119, 450	149, 300	179, 150	223, 950	298, 600
69	78, 000	104, 000	124, 800	156, 000	187, 200	234, 000	312, 000
70	81, 450	108, 600	130, 300	162, 850	195, 450	244, 300	325, 7[illegible]
71	85, 000	113, 300	135, 950	169, 950	203, 950	255, 000	339[illegible]
72	88, 600	118, 150	141, 800	177, 250	212, 700	265, 850	354, [illegible]
73	92, 350	123, 150	147, 800	184, 700	221, 650	277, 100	369, 450
74	96, 200	128, 300	153, 950	192, 400	230, 900	288, 600	384, 850
75	100, 150	133, 550	160, 250	200, 300	240, 400	300, 500	400, 650

Depreciation of Wood Poles.

Rule 261, A, 4 stipulates that wood poles shall be of such material and dimensions that the loading specified in section 25 will not cause the fiber stresses given in Table 20 to be exceeded. The allowable fiber stresses vary with the grade of construction, and even with a stated grade of construction vary according to the situation and according to whether the pole has had previous preservative treatment. When the pole has deteriorated to such an extent that the fiber stress reaches another specified value, the pole must be replaced. The percentage of depreciation varies with the conditions. Table 86 gives the minimum permissible depreciated ground-line circumference for poles which have just met the requirements when installed. Table 88 gives the same information in terms of the permissible reduction in the radius of the cross section of the pole taken at the ground line. Table 87 shows the situations to which the various values in Tables 86 and 88 apply.

Table 86.—Minimum Depreciated Ground-Line Circumference of Wood Poles

Ground-line circumference when installed (inches)	Minimum allowable depreciated ground-line circumference for ratio of fiber stress when installed to fiber stress when depreciated of—					
	2/3	3/5	5/9	1/2	4/9	2/5
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
24	21.0	20.2	19.7	19.0	18.3	17.7
25	21.8	21.1	20.6	19.8	19.1	18.4
26	22.7	21.9	21.5	20.6	19.8	19.2
27	23.6	22.8	22.2	21.4	20.6	19.9
28	24.5	23.6	23.0	22.2	21.4	20.6
29	25.3	24.5	23.8	23.0	22.1	21.4
30	26.2	25.3	24.7	23.8	22.9	22.1
31	27.1	26.1	25.5	24.6	23.7	22.8
32	28.0	27.0	26.3	25.4	24.4	23.6
33	28.8	28.0	27.1	26.2	25.2	24.3
34	29.7	28.7	28.0	27.0	25.9	25.0
35	30.6	29.5	28.8	27.8	26.7	25.8
36	31.4	30.4	29.6	28.6	27.5	26.5
37	32.3	31.2	30.4	29.4	28.2	27.3
38	33.2	32.0	31.2	30.2	29.0	28.0
39	34.1	32.9	32.1	30.9	29.8	28.7
40	34.9	33.7	32.9	31.7	30.5	29.5
41	35.8	34.6	33.7	32.5	31.3	30.2
42	36.7	35.4	34.5	33.3	32.1	31.0
43	37.6	36.3	35.4	34.1	32.8	31.7
44	38.4	37.1	36.2	34.9	33.6	32.4
45	39.3	38.0	37.0	35.7	34.3	33.2
46	40.2	38.8	37.8	36.5	35.1	33.9
47	41.1	39.6	38.6	37.3	35.9	34.6
48	41.9	40.5	39.5	38.1	36.6	35.4
49	42.8	41.3	40.3	38.9	37.4	36.1
50	43.7	42.4	41.1	39.7	38.2	36.8
51	44.5	43.0	41.9	40.5	38.9	37.6
52	45.4	43.7	42.7	41.3	39.7	38.3
53	46.3	44.7	43.6	42.1	40.4	39.0
54	47.2	45.5	44.4	42.9	41.2	39.8
55	48.0	46.4	45.2	43.7	42.0	40.5
56	48.9	47.2	46.0	44.4	42.7	41.3
57	49.8	48.1	46.9	45.2	43.5	42.0
58	50.7	48.9	47.7	46.0	44.3	42.7
59	51.5	49.8	48.5	46.8	45.0	43.5
60	52.4	50.6	49.3	47.6	45.8	44.2
61	53.3	51.4	50.2	48.4	46.5	44.9
62	54.2	52.3	51.0	49.2	47.3	45.7
63	55.0	53.1	51.8	50.0	48.1	46.4
64	55.9	54.0	52.6	50.8	48.8	47.2
65	56.8	54.8	53.4	51.6	49.6	47.9
66	57.7	55.7	54.3	52.4	50.4	48.6
67	58.5	56.5	55.1	53.2	51.1	49.4

Table 86.—Minimum Depreciated Ground-Line Circumference of Wood Poles—Continued

Ground-line circumference when installed (inches)	Minimum allowable depreciated ground-line circumference for ratio of fiber stress when installed to fiber stress when depreciated of—					
	2/3	3/5	5/9	1/2	4/9	2/5
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
68	59.4	57.4	55.9	54.0	51.9	50.1
69	60.3	58.2	56.7	54.8	52.6	50.8
70	61.2	59.0	57.5	55.6	53.4	51.6
71	62.0	59.9	58.4	56.4	54.2	52.3
72	62.9	60.7	59.2	57.1	54.9	53.0
73	63.8	61.6	60.0	57.9	55.7	53.8
74	64.6	62.4	60.8	58.7	56.5	54.5
75	65.5	63.2	61.7	59.5	57.2	55.3

Table 87.—Allowable Depreciation of Wood Poles Under Vertical and Transverse Loading for Various Situations

[This table locates the situations to which the columns of Tables 86 and 88 apply]

	Ratio of maximum fiber stress when installed to maximum fiber stress when depreciated for—	
	Treated poles	Untreated poles
At crossings:		
In lines of one grade of construction throughout—		
Grade A	2/3	2/3
Grade B	2/3	2/3
Grade C	1/2	1/2
In isolated sections of higher grade of construction in lines of a lower grade of construction—		
Grade A	2/3	1/2
Grade B	2/3	4/9
Grade C	1/2	2/5
Elsewhere than at crossings:		
Grade A	2/3	5/9
Grade B	3/5	1/2
Grade C	2/3	1/2

Table 88.—Maximum Radial Depreciation of Wood Poles

Ground-line circumference when installed (inches)	Maximum allowable radial depreciation for ratio of fiber stress when installed to fiber stress when depreciated of—					
	2/3	3/5	5/9	1/2	4/9	2/5
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
24	0.48	0.60	0.68	0.79	0.90	1.01
25	.50	.62	.71	.82	.94	1.05
26	.52	.66	.72	.85	.98	1.09
27	.54	.67	.76	.89	1.02	1.13
28	.56	.70	.79	.92	1.06	1.17
29	.58	.72	.82	.95	1.09	1.21
30	.60	.75	.85	.99	1.13	1.26
31	.62	.77	.88	1.02	1.17	1.30
32	.64	.80	.91	1.05	1.21	1.34
33	.66	.82	.93	1.08	1.24	1.38
34	.68	.85	.96	1.12	1.28	1.42
35	.70	.87	.99	1.15	1.32	1.47
36	.72	.90	1.02	1.18	1.36	1.51
37	.75	.92	1.05	1.22	1.40	1.55
38	.76	.95	1.07	1.25	1.43	1.59
39	.78	.97	1.10	1.28	1.47	1.63
40	.80	1.00	1.13	1.31	1.51	1.68
41	.82	1.02	1.16	1.35	1.55	1.72
42	.85	1.05	1.19	1.38	1.58	1.76
43	.86	1.07	1.22	1.41	1.62	1.80
44	.88	1.10	1.25	1.44	1.66	1.84
45	.90	1.12	1.27	1.48	1.70	1.88
46	.93	1.15	1.30	1.51	1.74	1.93
47	.95	1.17	1.33	1.54	1.77	1.97
48	.97	1.20	1.36	1.58	1.81	2.01
49	.99	1.22	1.39	1.61	1.85	2.05
50	1.01	1.25	1.42	1.64	1.89	2.09
51	1.03	1.27	1.44	1.67	1.92	2.14
52	1.05	1.30	1.47	1.71	1.96	2.18
53	1.07	1.32	1.50	1.74	2.00	2.22
54	1.09	1.35	1.53	1.77	2.03	2.26
55	1.11	1.37	1.56	1.81	2.07	2.30
56	1.13	1.40	1.59	1.84	2.11	2.35
57	1.15	1.42	1.61	1.87	2.15	2.39
58	1.17	1.45	1.64	1.90	2.19	2.43
59	1.19	1.47	1.67	1.94	2.23	2.47
60	1.21	1.50	1.70	1.96	2.26	2.51
61	1.23	1.52	1.73	2.00	2.30	2.55
62	1.25	1.55	1.76	2.03	2.34	2.60
63	1.28	1.57	1.78	2.07	2.37	2.64

Table 88.—Maximum Radial Depreciation of Wood Poles—Continued

Ground-line circumference when installed (inches)	Maximum allowable radial depreciation for ratio of fiber stress when installed to fiber stress when depreciated of—					
	2/3	3/5	5/9	1/2	4/9	2/5
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
64	1.29	1.60	1.81	2.10	2.41	2.68
65	1.31	1.62	1.84	2.14	2.45	2.72
66	1.33	1.65	1.87	2.17	2.49	2.76
67	1.35	1.67	1.90	2.20	2.53	2.81
68	1.37	1.70	1.93	2.23	2.56	2.85
69	1.39	1.72	1.95	2.26	2.60	2.89
70	1.41	1.74	1.98	2.30	2.64	2.93
71	1.43	1.77	2.01	2.33	2.68	2.97
72	1.45	1.79	2.04	2.36	2.71	3.02
73	1.47	1.82	2.07	2.40	2.75	3.06
74	1.49	1.84	2.09	2.43	2.79	3.10
75	1.51	1.87	2.12	2.46	2.83	3.14

Allowable Number of Wires on a Given Pole With and Without Side Guys.

Table 89 gives the allowable number of No. 4 covered, solid, copper wires to be carried by a 35-foot pole of any wood having an ultimate fiber stress of 5,000 pounds per square inch. This number varies with the grade of construction and with the loading district. In this table it is assumed (1) that poles are set 6 feet in the ground; (2) that the cross arms are 2 feet apart; (3) that 6-pin cross arms are used up to 30 wires, and 8-pin arms for 31 or more wires; (4) that the placing of wires is begun at the top arm (wires 6 inches below the top of poles) and continues to lower cross arms after all wire positions are filled; (5) that the clearance of wires above ground is never less than 18 feet; (6) that the taper of poles amounts to 2 inches of circumference per 5 feet of length. Strengths are computed at the ground line. The values given apply to untreated poles in situations of conflict or joint use, or to poles either treated or untreated at crossings in a line of uniform construction. The values also hold for treated poles used at crossings where the construction differs from the remainder of the line.

Tables 90 and 91 are based upon the assumption (1) that the guys carry their loads with a factor of safety of 2; (2) that they are installed with a lead of 1 to 3; (3) that they are attached at the center of the load, thus making it unnecessary to take into account the height of the pole. The wind pressure on the pole itself has not been taken into account in these tables. This addition to the load is equivalent to that due to one or more wires, depending upon the size and height of the pole and length of span and deduction should be made in each case.

Table 89.—Allowable Number of No. 4 Solid Copper T. B. W. P. Wires to be Carried by Untreated 35-Foot Poles of Woods Classed as of 5,000 Pounds per Square Inch Ultimate Fiber Stress (Pine, Chestnut, Western Cedar, Cypress, etc.)

[For grades A, B, and C (except at crossings in isolated sections of higher grade) in heavy, medium, and light loading districts]

Grade and loading	Maximum stress in pole	Span	Allowable number of wires for ground-line circumference of—								
			32 in.	34 in.	36 in.	38 in.	40 in.	42 in.	44 in.	46 in.	48 in.
	Lbs./in.²	*Feet*									
A. H	1,670	100	[a] 4	5	6	8	9	11	14	16	18
		125	[a] 3	4	5	6	7	9	10	12	14
		150	[a] 3	3	4	5	6	7	9	10	11
		200	[a] 2	2	3	4	4	5	6	7	8
B. H	2,500	100	7	9	11	13	16	18	22	26	31
		125	6	7	8	10	12	14	17	20	23
		150	5	6	7	8	10	12	14	16	19
		200	3	4	5	6	7	9	10	12	14
C. H	3,750	100	11	14	17	21	26	30	35	[b] 40	[b] 40
		125	9	11	13	16	20	23	28	32	37
		150	7	9	11	13	16	19	22	27	29
		200	5	7	8	10	11	14	16	19	23
A. M	1,670	100	[a] 7	9	11	14	16	19	23	27	30
		125	[a] 5	7	9	10	12	15	17	20	24
		150	[a] 4	5	7	8	10	12	14	16	19
		200	[a] 3	4	5	6	7	9	10	12	14
B. M	2,500	100	12	14	18	22	26	30	36	[b] 40	[b] 40
		125	9	11	14	17	20	24	30	32	38
		150	7	9	11	14	16	19	23	27	30
		200	5	7	8	10	12	14	16	19	23
C. M	3,750	100	19	24	30	34	[b] 40	[b] 40	[b] 40	[b] 40	[b] 40
		125	15	18	23	28	32	38	[b] 40	[b] 40	[b] 40
		150	12	15	18	22	27	31	37	[b] 40	[b] 40
		200	9	11	13	16	19	23	27	30	36
A. L	1,670	100	11	14	17	21	26	30	36	[b] 40	[b] 40
		125	9	11	13	17	20	24	29	32	38
		150	7	9	11	14	16	19	23	27	30
		200	5	8	8	10	12	14	16	19	22
B. L	2,500	100	19	24	30	34	[b] 40	[b] 40	[b] 40	[b] 40	[b] 40
		125	15	18	23	28	32	39	[b] 40	[b] 40	[b] 40
		150	12	15	18	22	27	31	37	[b] 40	[b] 40
		200	9	11	13	16	19	23	27	31	36
C. L	3,750	100	30	38	[b] 40	[b] 40	[b] 40	[b] 40	[b] 40	[b] 40	[b] 40
		125	25	30	36	[b] 40	[b] 40	[b] 40	[b] 40	[b] 40	[b] 40
		150	20	25	30	36	[b] 40	[b] 40	[b] 40	[b] 40	[b] 40
		200	14	18	21	26	30	37	[b] 40	[b] 40	[b] 40

[a] For grade A in heavy and medium loading districts, 35-foot poles can not be used with so small a ground-line circumference, since pole top would be less than 7 inches. (See rule 261, A, 4, (*g*).)

[b] These numbers of wires will fill all available pole space when carried on 8-pin cross arms, but will not use up the available strength of the pole.

Table 90.—Allowable Number of No. 4 Solid Copper T. B. W. P. Wires to be Carried on Poles Supported by Side Guys of Various Strengths under Various Grades of Construction (A, B, or C) and Loadings (Heavy, Medium, Light)

Grade and loading	Span	Number of wires to be carried by poles supported by the following numbers and strengths of guys						
		One 4,000-pound	One 6,000-pound	One 10,000-pound	One 16,000-pound	Two 10,000-pound	One 10,000-pound, one 16,000-pound	Two 16,000-pound
	Feet							
A. H. and B. H.	75	9	13	22	36	45	59	73
	100	6	10	17	27	34	44	55
	125	5	8	13	22	27	35	44
	150	4	6	11	18	22	29	36
	200	3	5	8	13	17	22	27
C. H.	75	13	20	34	55	68	89	110
	100	10	15	25	41	51	67	82
	125	8	12	20	33	41	53	66
	150	6	10	17	27	34	44	55
	200	5	7	12	20	25	33	41
A. M. and B. M.	75	14	21	35	57	71	93	115
	100	10	16	26	43	53	70	86
	125	8	12	21	34	43	56	68
	150	7	10	18	28	35	46	57
	200	5	8	13	21	26	35	43
C. M.	75	21	32	53	86	107	140	172
	100	16	24	40	64	80	105	129
	125	12	19	32	51	64	84	103
	150	10	16	27	43	53	70	86
	200	8	12	20	32	40	52	64
A. L and B. L.	75	22	33	55	88	111	144	177
	100	16	25	41	66	83	108	133
	125	13	20	33	53	66	86	106
	150	11	16	27	44	55	72	88
	200	8	12	20	33	41	54	66
C. L.	75	33	49	83	133	166	216	266
	100	25	37	62	99	124	162	199
	125	20	30	49	79	99	129	159
	150	16	25	41	66	83	108	133
	200	12	18	31	49	62	82	99

Table 91.—Allowable Number of No. 8 B. W. G. Bare Iron Wires to be Carried on Poles Supported by Side Guys of Various Strengths under Various Grades of Construction (D or E) and Loading (Heavy, Medium, or Light)

Grade and loading	Span	One 4,000-pound	One 6,000-pound	One 10,000-pound	One 16,000-pound	Two 10,000-pound	One 10,000-pound, one 16,000-pound	Two 16,000-pound
D. H	75	10	16	27	43	54	70	86
	100	8	12	20	32	40	53	65
	125	6	9	17	26	32	42	52
	150	5	8	13	21	29	35	43
E. H	75	16	24	40	65	81	--------	--------
	100	12	18	30	48	61	79	97
	125	9	14	24	39	48	63	78
	150	8	12	20	32	40	53	65
D. M	75	19	28	47	76	95	--------	--------
	100	14	21	35	57	71	92	--------
	125	11	17	28	45	57	74	91
	150	9	14	23	38	47	61	76
E. M	75	28	42	71	--------	--------	--------	--------
	100	21	32	53	85	--------	--------	--------
	125	17	25	42	68	85	--------	--------
	150	14	21	35	57	71	92	--------
D. L	75	51	76	--------	--------	--------	--------	--------
	100	38	57	96	--------	--------	--------	--------
	125	30	46	76	--------	--------	--------	--------
	150	25	38	63	--------	--------	--------	--------
E. L	75	76	--------	--------	--------	--------	--------	--------
	100	57	86	--------	--------	--------	--------	--------
	125	46	69	--------	--------	--------	--------	--------
	150	38	57	95	--------	--------	--------	--------

NOTE.—The blank spaces in the above tables indicate that more than 100 wires can be carried by the size and number of guys in question under the indicated conditions of hazard, loading, and span length without exceeding one-half of the ultimate strength of the guys. Where the number of wires carried by a pole exceeds 80 it is good practice to install some of them in cable.

Depth of Setting of Poles.

The values given in Table 92 are those recommended as the depth to which poles should be set under ordinary straight-line conditions in firm soil or rock. On corners or angles, or heavy dead-ends, these values should be increased by at least 6 inches. (See rule 262, B.)

Table 92.—Recommended Depth of Setting of Poles—Rule 262, B

Length of pole in feet	Setting in soil	Setting in rock
	Feet	*Feet*
20	5.0	3.0
25	5.0	3.5
30	5.5	3.5
35	6.0	4.0
40	6.0	4.0
45	6.5	4.5
50	7.0	4.5
55	7.0	5.0
60	7.5	5.0
65	8.0	6.0
70	8.0	6.0
75	8.5	6.0
80	9.0	6.5

Appendix G.—DEFINITION OF AMERICAN SOCIETY FOR TESTING MATERIALS OF DENSE SOUTHERN YELLOW PINE

This term includes the species of yellow pine growing in the Southern States from Virginia to Texas; that is, the pines hitherto known as long-leaf pine (*Pinus palustris*), short-leaf pine (*Pinus echinata*), loblolly pine (*Pinus taeda*), Cuban pine (*Pinus heterophylla*), and pond pine (*Pinus serotina*).

Under this heading two classes of timber are designated: (*a*) Dense southern yellow pine and (*b*) sound southern yellow pine. It is understood that these two terms are descriptive of quality rather than of botanical species.

(*a*) Dense southern yellow pine shall show on either end an average of at least six annual rings per inch and at least one-third summer wood, or else the greater number of the rings shall show at least one-third summer wood, all as measured over the third, fourth, and fifth inches on a radial line from the pith. Wide-ringed material excluded by this rule will be acceptable, provided that the amount of summer wood as above measured shall be at least one-half.

The contrast in color between summer wood and spring wood shall be sharp and the summer wood shall be dark in color, except in pieces having considerably above the minimum requirement for summer wood.

(*b*) Sound southern yellow pine shall include pieces of southern pine without any ring or summer-wood requirement.

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