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RAILROAD CROSSING SPECIFICATIONS

CONTENTS

Specification for Communication Lines
Crossing the Tracks of Railroads
(See page 1 of the Specification for Index)

1. GENERAL

1.1 This section is intended to provide REA borrowers, consulting engineers, contractors and other interested parties with technical information for use in the design and construction of REA-financed telephone systems. It provides information on specifications for communication lines crossing the tracks of railroads.

1.2 The following specification which is made a part of this section is reproduced by permission of the Association of American Railroads.

1.3 Some railroads may have their own specifications for the same purpose which may differ from the specifications contained in this section. Therefore consultation should be had with individual railroads in regard to their use of this specification before design or construction work is undertaken.

Adopted August, 1949

GENERAL PROCEDURE INFORMATION ON PERMIT APPLICATIONS FOR SUBMARINE OR OVERHEAD COMMUNICATION LINE CROSSINGS OF NAVIGABLE WATERS IN THE UNITED STATES

A—Purpose

A-1. The following is intended as a guide, with respect to Federal, State and Municipal regulations, in securing permits for communication line crossings of navigable waters (tidal or non-tidal) in the United States.

B—General

B-1. Federal. The Federal laws require a permit for such crossings, in all cases, and place the jurisdiction under the Secretary of War; also his Chief of Engineers represented locally by District Engineers in most of our principal cities.

B-2. State. Most states require special procedures in connection with such crossings and the body having jurisdiction should be consulted.

B-3. Municipal. In addition, some municipalities, such as New York, require municipal permit for locations within their corporate limits.

C—Procedure

C-1. Preliminary to preparing applications and plans, the local District Engineer should be consulted regarding the information required for Federal permit and the manner of its preparation.

C-2. An "Information Circular" entitled "Applications for Authority to Execute Work or Erect Structures in the Navigable Waters of the United States" can be furnished, by the District Engineer, or directions given for obtaining it from the Government Printing Office. It covers the requirements for applications, sample maps and plans, and addresses of the District Engineers.

C-3. The District Engineer is required to notify municipal authorities of any application for work lying within their corporate limits.

C-4. Preliminary to preparing applications and plans the appropriate State and Municipal authorities should be consulted regarding the information required for State and Municipal permits and the manner of their preparation.

Association of American Railroads
Telegraph and Telephone Section **1-B-1**

Parts I and II
Adopted September, 1922

Part III
Adopted November, 1925

First Revision
Adopted August, 1929

Second Revision
Adopted April, 1937

Third Revision
Adopted February, 1942

SPECIFICATION FOR COMMUNICATION LINES CROSSING THE TRACKS OF RAILROADS

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SPECIFICATION FOR COMMUNICATION LINES CROSSING THE TRACKS OF RAILROADS

A—Purpose

A-1. The purpose of this specification is to describe the general requirements of construction and maintenance of communication lines crossing the tracks and associated parallel communication lines of steam and electrified railroads, except street railways.

A-2. Where any requirements of this specification do not meet Municipal or State requirements, such Municipal or State requirements shall govern.

A-3. This specification prescribes the standard practice to be followed. In matters not specifically prescribed, or where local conditions make the prescribed practice impracticable, they shall be met by methods that will provide equivalent security and protection to life and property.

B—Definitions

B-1. Communication Lines. Communication lines as used in this specification mean telegraph, telephone and other communication wires and cables and their supporting or containing structures which are located outside of buildings and are used for public or private 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. For such communication wires, when operating at less than 150 volts between wires or to ground, no limit is placed on the capacity of the system.

B-2. Interlocking, automatic signal and other similar wires (not including electric light and supply wires), which operate at not exceeding the voltage and power requirements of communication wires, shall be classed as communication wires.

B-3. Communication circuits used exclusively in the operation of supply lines shall, in general, be considered as supply circuits of the highest voltage to which they are exposed, and shall be constructed in accordance with the Railroad Specifications for Electric Light, Power Supply and Trolley Lines Crossing Railways, S-1, but in no case need the communication conductors meet the requirements for supply conductors in excess of 8,700 volts between conductors.

B-4. Where, however, such communication circuits are below the supply conductors in the operation of which they are used, at all points throughout their length or throughout the section in which the railroad crossing occurs, provided such section of the communication circuits is isolated from the remainder of the system by transformers or other means, they may be considered as ordinary communication circuits and so constructed, if either of the following conditions obtain:

(a) Such communication circuits occupy a position below all other conductors or equipment or other lines at crossings, conflicts, or on commonly used poles throughout the section to which reference is made.

(b) Such 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.

B-5. Supply Lines. Electrical supply lines mean 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.

B-6. Except as specified in paragraphs B-4 and B-7, communication and railway signaling wires exceeding the voltage or power limitations specified in paragraph B-1, are supply lines within the meaning of this specification and shall be so constructed.

B-7. Circuits used for supplying power solely to apparatus forming part of a communication system may be run either in open wire or cable as follows:

(a) Where run in open wire, such circuits shall have the strength of construction, clearances, insulation, etc., prescribed for communication or supply circuits of the voltage concerned.

(b) Where run in effectively grounded continuous metal sheath cable or in cable which is attached to effectively grounded suspension strand by means of metal rings or spirally wound lashing wire, the strength of construction, clearances, locations, etc., prescribed in this specification for communication cables shall apply.

B-8. Voltage of a Circuit. Voltage of a circuit means the highest effective voltage between any two conductors of the circuit concerned, except that in a grounded multi-wire circuit of 750 volts or less between any two conductors, it means the highest effective voltage between any wire of the circuit and that point or conductor of the circuit that is grounded.

B-9. Minor Tracks. Minor tracks mean railroad tracks included in the following:

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

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

(c) Tracks used only temporarily for construction or similar purposes for a period not exceeding one year.

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

(e) By agreement between the parties at interest, other similar minor tracks than those listed under (a), (b), (c), and (d) above.

B-10. Major Tracks. Major tracks mean any tracks not included under the definition of minor tracks.

C—General

C-1. Permits and Notices. A party planning to erect wires across the tracks of a railroad shall give to the Superintendent of Communication or other designated officer of the railroad, written notice at least thirty days in advance of starting construction. Such notice shall include information regarding the location and general plan of the crossing, clearances and other data indicated on Typical Communication Line Crossing Data Sheet, Appendix L, and on Typical Drawings T & T 1029, 1383, 1384, and 1385, and any other pertinent information in sufficient detail so that it can be determined whether or not the proposed construction will conform to this specification.

C-2. In cases where thirty days' notice is impracticable because of service demands or emergency, the parties concerned shall cooperate to avoid unnecessary delay in the construction of the crossing.

C-3. **Marking Poles.** Crossing poles shall be plainly marked by means of stencils or metal characters showing the name, initials or trade mark of the owning company. Where lines are located on railroad right-of-way for at least three poles adjacent to the crossing and it is the standard practice of the owning company to so mark at least every fifth pole in the line, the above requirement shall be considered as having been met.

C-4. **Fire Hazard.** Crossing poles or other supporting structures shall be located as far distant as practicable from inflammable structures and the space around the poles or other supporting structures kept free from inflammable material.

C-5. **Protection from Moving Vehicles.** Supporting structures adjacent to traveled highways shall be located with a view to reducing, as far as practicable, the danger of being struck by moving vehicles. Structures which are exposed to abrasion by moving vehicles or to other damage which would affect their strength materially, shall be protected by guards.

C-6. **Inspection.** The construction shall be subject to the inspection of the railroad company and shall comply with the requirements of this specification. Defective material shall be rejected and replaced with acceptable material.

C-7. All parts of the supporting structures of overhead crossings shall be inspected at such intervals as are necessary to assure adequate maintenance. All defective parts shall be promptly restored to a safe condition and, with the exception of wood poles, shall be replaced when they have deteriorated to fifty per cent of their required initial strength. Wood poles shall be replaced when they have deteriorated to two-thirds their required initial strength. (The ground line circumference of various classes and species of poles whose strengths have deteriorated to two-thirds their strength when new is given in Appendix G.) In the replacement inspection of treated poles where decay is usually internal, the extent of the decay shall be determined and evaluated in terms of external decay so that the tables in Appendix G may be applied.

C-8. Underground crossings shall be properly maintained.

Part I—Overhead Crossings

D—General

D-1. **Relative Levels of Supply and Communication Wires.** Every reasonable effort shall be made in the construction or reconstruction of a crossing to arrange or rearrange the lines so that supply wires shall be at a higher level than the communication wires. This does not apply in the case of trolley contact wires or their associated feeders, which must, of necessity, occupy a position below all other wires at the crossing.

D-2. Where communication lines cross over tracks and a supply line in the same span, or where supply wires are carried in the lower position on the same crossing poles as the communication wires, the construction of the crossing shall be as follows, depending upon the voltage of the supply circuits:

(a) Where the supply line is open wire and the voltage does not exceed 750 volts a-c or d-c to ground, construction shall be in accordance with this specification.

(b) Where supply circuits of any voltage are carried in cable having effectively grounded continuous metal sheath or on effectively grounded suspension strand, the construction shall be in accordance with this specification.

(c) Where the supply line is open wire or is in cable not meeting the requirements of (b) above and the voltage exceeds 750 volts a-c to ground but does not exceed 5,000 volts between conductors (2,900 volts to neutral or ground), the construction shall be in accordance with this specification, except that the communication conductors shall be not smaller than No. 6 A.W.G. (0.162 in. diam.) copper or No. 6 Stl.W.G. (0.192 in. diam.) steel, or wires the equivalent thereof.

(d) Where the supply circuits involved are in excess of the a-c voltage limitations in (c) above, or in excess of 750 volts d-c to ground, the construction shall not be made except with the approval of all parties concerned.

D-3. Supply wires or cables carried on the poles supporting communication circuits crossing over railroad tracks shall be constructed in accordance with the Railroad Specifications for Electric Light, Power Supply and Trolley Lines Crossing Railroads, S-1. For construction of signal supply circuits not in excess of 550 volts and 3,200 watts, located below communication wires, see Specification for the Construction of Railroad Communication Pole Lines, 1-A-6.

D-4. **Protection of Metals Against Corrosion.** All pole line hardware shall be of material that will not corrode excessively under the prevailing conditions. Where galvanizing is used, it shall meet the requirements of the specifications for galvanizing of the American Society for Testing Materials.

D-5. **Vertical Pull.** The vertical distance from the top crossarm of a crossing pole to a straight line connecting the top crossarm of the next adjacent poles on either side of this crossing pole should not exceed the values given in Table D-1.

Table D-1

Vertical Pull

Average Length of Two Adjacent Spans in Feet	Allowable Vertical Distance in Feet
Less than 100	8
101 to 130	10
131 to 150	12
Over 150	14

D-6. Length of Crossing Span. The crossing span shall, where practicable, not exceed 100 feet in the heavy loading district, 125 feet in the medium loading district and 150 feet in the light loading district. Where practicable, the adjacent spans shall not exceed the length of the crossing span by more than fifty per cent.

D-7. Where practicable, the supports for the crossing and next adjoining spans shall be located in a straight line.

D-8. The crossing and each adjoining span shall be kept free from decayed trees and as far as practicable from overhanging trees, which might fall into the line.

E—Clearances

E-1. General. The conditions under which all clearances are specified are 60 F. and no wind. Clearances shall be measured between the nearest parts of the objects concerned. The clearances required by this section shall be maintained at not less than the specified values.

E-2. Side Clearances from Rails. Poles or towers supporting the crossing span shall, where practicable, be so located as to provide a minimum horizontal clearance of twelve feet from the nearest track rail and a minimum horizontal clearance of eight feet between the nearest track rail and any crossarm, guy or other attachment. Where it is impracticable or undesirable to provide these clearances, they may be reduced if the approval of the railroad concerned is obtained. Where necessary to provide safe operating conditions, which require uninterrupted view along the tracks for signals, signs, etc., the parties concerned shall cooperate to provide greater clearances than those specified above.

E-3. Vertical Clearance Above Rails for Fixed Supports. The vertical clearance between the lowest wire, guy, or cable and the top of rail shall be not less than given in Table E-1.

Table E-1

Vertical Clearance Above Rails

	Vertical Clearance in feet
For wires	27 (a) (b)
For guys, or cables carried on suspension strands	25 (b)

(a) Where the wires are paralleled on the same street or highway by a trolley contact conductor at a lower level, this clearance may be reduced to 25 feet.

(b) Where agreed to by the railroad concerned, in special situations, less clearance may be provided if safety will not be decreased thereby.

E-4. The clearances specified in paragraph E-3 are applicable for crossing span lengths up to 175 feet in the heavy loading district, 250 feet in the medium loading district, and 350 feet in the light loading district. Where crossing span lengths greater than these are involved, the clearances should be increased in accordance with paragraph E-6 (a).

E-5. Vertical Clearances Between Wires Not on the Same Supporting Structures. The vertical clearances between conductors of the crossing span and conductors of other lines shall be not less than the values shown in Table E-2. These clearances apply under the following conditions:

(a) Where the conductors at the upper level have fixed supports (pin or strain type insulators) or are supported on suspension type insulators in a suspended position at both supports, or are arranged so that they are restrained from displacement toward the crossing.

(b) Where the length of the span of the conductors in the upper position is not greater than 175 feet in the heavy loading district, 250 feet in the medium loading district, or 350 feet in the light loading district.

Table E-2

Minimum Vertical Clearance in Feet Between Wires Not on the Same Structures

(All voltages are between wires, except where otherwise stated, or for trolley contact wires where voltages are to ground.)

Nature of wires crossed Over (a)	Nature of Wires at Higher Level (a): Communication wires, cables and suspension strand	Open supply wires, 0–750 volts; supply cables, all voltages having effectively grounded metal sheath or suspension strand: Line wires and cables	Open supply wires, 0–750 volts; supply cables, all voltages having effectively grounded metal sheath or suspension strand: Service drops	Open supply wires and service drops (d): 750 to 8 700 Volts	Open supply wires and service drops (d): 8 700 to 50 000 Volts	Guys, span wires, lightning protection wires
Communication wires, cables and suspension strand	2 (g)	4 (b) (g)	2 (g)	4 (e)	6 (h)	2
Trolley contact conductors	4 (c)	—	—	—	—	4 (c)
Guys and span wires, lightning protection wires, supply service drops of 0 to 750 volts	2 (f)	2	2	4	4	2 (j)

(a) These clearances apply also to inverted levels.

(b) Except where neutral conductors of primary supply circuits are concerned, a clearance of two feet is permitted where the supply conductor is above the communication conductor, provided the crossing is not within six feet of any pole concerned in the crossing and the voltage to ground of the supply conductor does not exceed 300 volts.

(c) This clearance shall be increased to at least six feet above trolley contact conductors of more than 750 volts to ground. This increased clearance should also be provided over trolley contact conductors of lower voltage, 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.

(d) A conductor which is effectively grounded throughout its length, such as a multi-grounded neutral wire, and is associated with a circuit of 750 to

15,000 volts between conductors, may have the clearances specified for open supply wires of 0 to 750 volts between conductors.

(e) This clearance shall be increased to six feet where the supply wires cross over the communication line within six feet horizontally of a communication pole.

(f) This clearance shall be increased to four feet where communication cables cross over open supply service wires.

(g) Where the required clearance is two feet, and where conditions are such that the sag in the upper conductor would increase more than 1.5 feet at the crossing point, under full load conditions, the two foot clearance shall be increased by the amount of sag increase less 1.5 feet.

(h) Multi-grounded wye circuits not exceeding 8,700 volts to ground may have a four foot clearance if the lowest supply wire at the crossing is not lower than a straight line joining the points of support of the highest communication conductor, provided the crossing does not occur within six feet horizontally of a communication pole.

(j) Completely insulated sections of guys attached to supporting structures having no conductor of more than 8,700 volts may have less than this clearance from each other.

E-6. Increased Clearances. Conductors in the upper position at the crossing, except guys or cables supported by suspension strand, shall have greater clearances than given in paragraphs E-3 and E-5 under the following conditions. The increases in (a), (b), and (c) below are cumulative. An example illustrating the method of determining the clearance between power wires and communication wires where an open wire communication line crosses over railroad tracks and under an open wire power line in the same span is given in Appendix K.

(a) For crossing spans longer than specified in paragraphs E-4 and E-5 (b), clearances shall be increased as follows:

(1) The clearances given in Tables E-1 and E-2 shall be increased by the following amounts for each ten feet by which the crossing span length exceeds the limits specified in paragraphs E-4 and E-5 (b):

Table E-3

Clearance Increase Increments

Loading District	Amount of Increase per 10 feet: Large Conductors	Small Conductors *
Heavy and Medium	0.15 ft.	0.30 ft.
Light	0.10 ft.	0.15 ft.

* A small conductor is a conductor having an overall diameter of metallic material equal to or less than the following values:

Material	Outside Diameter of Conductor (Inch): Solid	Stranded
All copper	0.160	0.250
Other than all copper	0.250	0.275

(2) If the crossing point is located elsewhere than at mid-span of the conductors in the upper position, the required clearance may be obtained by multiplying the clearance determined in (1) above by the appropriate

reduction factors specified in Table E-4. The factors to be used in any case will depend upon the basic clearance required by Tables E-1 or E-2, and in no case shall the clearance, after the reduction factor has been applied, be less than such basic clearance. In applying these factors, the point of crossing in the case of a railroad crossing is the track rail which is farthest from the nearer support of the crossing span. In other situations, it is the location under the conductors of any topographical feature which is the determinant of the clearance.

Table E-4

Clearance Reduction Factors

Distance from Nearer Support of Crossing Span to Point of Crossing, in Per Cent of Crossing Span Length	Basic Clearance 4 Feet	6 Feet	27 Feet
	Reduction Factor		
5	0.35	0.47	0.85
10	0.47	0.58	0.88
15	0.60	0.68	0.91
20	0.71	0.78	0.94
25	0.82	0.85	0.96
30	0.90	0.92	0.98
35	0.96	0.98	0.99
40–50	1.00	1.00	1.00

Interpolate for intermediate values

(b) For voltages in excess of 50,000 volts between wires, the vertical clearances given in Table E-2 shall be increased at the rate of ½ inch for each 1,000 volts of excess.

(c) Where the conductors of the line in the upper position at a crossing over a communication line are supported by suspension type insulators, the clearances shall be increased by such an amount that the values specified in Table E-2 will be maintained in case of a broken conductor in either adjacent span, provided such conductor is supported as follows:

(1) 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).

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

E-7. Clearance of Conductors of a Communication Line From the Supports of Another Line. Where conductors of a communication line are carried near a supporting structure of any other line and not attached thereto, they shall have a clearance from any part of such structure not less than the larger value required by either (a) or (b) below:

(a) Three feet, if practicable.

(b) Six inches plus one inch for each two feet of the distance from the supporting structure of the line passed to the nearest supporting structure of the communication line.

F—Loading Assumptions

F-1. Three degrees of severity are recognized for the loading due to weather conditions and are designated, respectively, as heavy, medium, and light loading. The classification of the United States on the basis of the districts in which these loadings shall be considered to apply is shown on the loading map, Appendix A. Crossing wires and supporting structures shall be designed for heavy, medium, and light loading, dependent upon the district in which they are located.

F-2. In those states in which detailed local districting of loading areas has been prescribed by state administrative authority, this districting should be employed in lieu of that given in Appendix A. Where such districting has not been prescribed, detailed districting or different loading assumptions from those given in this specification may be employed where agreed to by all parties concerned, including such administrative authority as may have jurisdiction.

F-3. The specific transverse and longitudinal loadings which shall be assumed in determining the size of poles or the strength of guys in each of the loading districts are indicated below:

(a) **Transverse Loading (Poles and Side Guys).**

(1) **Heavy Loading.** A horizontal wind pressure at right angles to the direction of the line of four pounds per square foot upon the projected area of the cylindrical surfaces of all supported conductors and cables, together with their supporting suspension strand when covered with a layer of ice ½ inch in radial thickness and on surfaces of poles without ice covering.

For supporting structures, other than unguyed poles at crossings over major tracks, carrying more than ten wires, not including cables supported by suspension strand, the transverse load due to the open wires shall be calculated on two-thirds of the total number of such wires, with a minimum of ten wires.

(2) **Medium Loading.** A horizontal wind pressure at right angles to the direction of the line of four pounds per square foot of the projected area of cylindrical surfaces of all supported conductors and cables, together with their supporting suspension strand, when covered with a layer of ice ¼ inch in radial thickness and on the surfaces of the poles without ice covering.

For supporting structures, other than unguyed poles at crossings over major tracks, carrying more than ten wires, not including cables supported by suspension strand, the transverse load shall be calculated on two-thirds of the total number of such wires, with a minimum of ten wires.

(3) **Light Loading.** A horizontal wind pressure at right angles to the direction of the line of nine pounds per square foot upon the projected area of cylindrical surfaces of all supported conductors and cables, together with their supporting suspension strand, and poles, without ice covering.

(b) **Longitudinal Loading (Poles and Head Guys).** The longitudinal loading shall be assumed equal to a pull in the direction of the crossing of all open wire conductors supported, the pull of each conductor being taken as 50 per cent of its ultimate strength in the heavy loading district, 33⅓ per cent in the medium loading district, and 22¼ per cent in the light loading district.

G—Poles

G-1. Material. Wood poles shall be of suitable and selected timber free from observable defects that would decrease their strength or durability. Poles of Northern White Cedar, Western Red Cedar, Chestnut, Southern Pine, Lodgepole Pine and Douglas Fir shall meet the requirements of the American Standard Specifications for poles of these species. For convenience, tables giving the dimensions of various classes and lengths of these species of poles, as specified in the American Standard Specifications, are given in Appendix J. In the absence of specifications covering other species of poles, they shall be considered on the basis of the American Standard Specification for the species of pole having the nearest equivalent ultimate fiber stress. A table giving the ultimate fiber stresses of the species of poles in more common use in communication plant is included in Appendix H. The use of treated poles is recommended where practicable, but is not required, except in the case of timbers subject to rapid decay.

G-2. Sizes. Poles shall be of a size not less than the class specified in Table G-1 for the corresponding number of wires carried. If guys are omitted, poles must be of sufficient strength to meet the requirements specified in paragraph Q-9.

Table G-1

Minimum Class (A.S.A. Classification)

	10 wires or less	11 to 20 wires	21 to 40 wires	Over 40 wires
Heavy and Medium Loading Districts	7	6	5	4
Light Loading District	7	6	6	5

G-3. Gains. Gains shall not be cut to a depth of more than ½ in.

G-4. Setting. Table G-2 specifies the minimum depth of setting for unguyed poles in average soil and in rock.

Table G-2

Minimum Depth of Setting for Unguyed Poles

Length of Pole in Feet	Depth in Feet in Average Soil for Different Classes of Poles				Depth in Feet in Rock
	Class 1 and 2	Class 3 and 4	Class 5 and 6	Class 7	All Classes
16	......	......	4	3¾	3
18	......	......	4¼	4	3¼
20	4¾	4½	4¼	4	3¼
22	5	4¾	4½	4¼	3½
25	5½	5¼	4¾	4½	3¾
27	5¾	5½	5	4¾	4
30	6	5¾	5¼	5	4¼
35	6½	6	5½	5¼	4½
40	6¾	6¼	5¾	5½	4¾
45	7	6½	6	5¾	5
50	7¼	6¾	6¼	6	5¼
55	7½	7	6½	......	5½
60	7¾	7¼	6¾	......	5¾
65	8	7½	7	......	6
70	8½	8	7½	......	6
75	9	8½	8	......	6
80	9½	9	8½	......	....
85	10	9½	9	......	....
90	10½	10	9½	......	....

G-5. Where crossing poles are head and side guyed, the depth of setting of poles normally employed by a constructing company in the construction of its lines may, in general, be used. However, in no case shall the depth of setting of a pole at a crossing be more than one foot less than the depths given in Table G-2, where the pole is set in earth or more than ½ foot less when set in rock.

G-6. Where soil conditions are such that the above depths of setting will not develop the strength of the pole, the pole shall be set to an additional depth or other means used to properly secure the pole.

G-7. Pole Mounts. Where a crossing pole is to be set on surface rock, a concrete bridge abutment, or other masonry or stone structure, approved pole mounts may be used.

G-8. Spliced Poles. Spliced poles shall not be used to support the crossing span.

G-9. Stub Reinforced Poles. Stub reinforced poles shall not be used at crossings over major tracks. At crossings over minor tracks, the use of stub reinforcements is permitted, provided:

(a) The pole above the ground line is in good condition and is of sufficient size to develop its required strength.

(b) The stub shall have a ground line circumference at least as great as would be required for a new pole in the same location.

(c) The stub shall be set to a depth at least as great as that required for the pole being stubbed. (See paragraph G-4.)

(d) The stub shall be attached to the pole by a method which will develop at all times the required strength of the pole.

G-10. Stubs shall, in general, be set at the side of the pole in a plane perpendicular to the direction of the line. Where the direction of the line changes at the pole being stub reinforced, the stub shall be at the side of the pole in a plane bisecting the angle of the corner and in the direction of the corner pull. Where head guys are omitted, as permitted in paragraph Q-9, the stub shall be set on the track side of the pole in line with the crossing span.

H—Crossarms and Brackets

H-1. Wood crossarms supporting the crossing span shall be of fir, treated yellow pine or other suitable timber. They shall have a nominal cross-section of not less than the values given in Table H-1.

Table H-1

Dimensions of Wood Crossarms

Number of Wires	Nominal Length (Feet)	Nominal Length (Inches)	Nominal Cross-section (Inches)
2	1	4½	2⁵⁄₁₆ by 3⁵⁄₁₆
4	3	4½	2⁵⁄₁₆ by 3⁵⁄₁₆
6	6	0	2¾ by 3¾
10	8	6	2¾ by 3¾
10	10	0	3 by 4
12*	10	0	3¼ by 4¼
16**	10	0	3¼ by 4¼

* Where crossarms are bored for ½ inch steel pins, 3 inch by 4¼ inch crossarms may be used.

** Permitted in medium and light loading districts only.

H-2. Galvanized or painted iron or steel crossarms of strengths equal to those of the wood crossarms specified in Table H-1 may be used.

H-3. Double crossarms shall be provided on crossing poles and shall be attached to the pole by means of a ⅝ inch crossarm bolt. Double crossarms longer than two-pin shall be equipped with double arming bolts, or spacing blocks and crossarm bolts, at a point near each end of the crossarms.

H-4. Wood pole brackets may only be used at crossings over minor tracks and shall be in duplicate so as to afford two points of support for each conductor.

H-5. Single metal brackets, drive hooks or fixtures may be used to support distributing wire at railroad crossings provided such bracket, drive hook or fixture and the attachment of the wire thereto is such as to withstand the ultimate breaking strength of the wire.

J—Crossarm Braces

J-1. Crossarms and buckarms, except two-pin crossarms, shall be so braced as to safely support the loads to which they may be subjected in use, including lineman working on them. This strength may be obtained by the use of one pair of crossarm braces. Steel crossarm braces shall have a cross section of not less than ⅛ inch by 1⅛ inches and a length not less than 20 inches.

J-2. The braces shall be attached to the pole by a drive screw not less than ½ inch by 4½ inches and to the crossarm by drive screws not less than ⅜ inch by 2¼ inches or by bolts ⅜ inch in diameter.

K—Pins

K-1. Insulator pins shall have strength sufficient to withstand the loads to which they may be subjected. Steel or iron pins shall have a diameter of shank not less than ½ inch. Wood pins shall be sound and straight grained with a diameter of shank not less than 1¼ inches.

L—Insulators

L-1. Each insulator shall be of such pattern, design and material that, when mounted on its pin, it will withstand, without injury and without being pulled off the pin, the ultimate strength of the conductor which it supports.

L-2. Each conductor (not including paired wire) unless dead-ended, shall be tied to two supporting insulators in such a manner that they will securely hold the conductor to its supporting insulators at each crossing pole.

M—Tie Wires

M-1. A type of tie shall be used which will develop the greatest practicable holding power without injury to the line conductors.

N—Conductors

N-1. Conductors shall be of material or combinations of materials which will not corrode excessively under the prevailing conditions.

N-2. Conductors of material other than those specified in Table N-1 shall be of such size and so erected as to have a mechanical strength not less than that of the sizes of copper conductors specified in Table N-1.

N-3. The minimum allowable sizes of conductors in a span crossing over a railroad which does not in the same span also cross over supply conductors in excess of 750 volts to ground, shall be as given in Table N-1.

Table N-1

Minimum Wire Sizes

Conductor	Spans 125 Feet or Less		Spans Exceeding 125 Feet up to 150 Feet (Note)	
	Gage	Diameter Inches	Gage	Diameter Inches
Copper, hard-drawn	10 A.W.G.	0.102	9 A.W.G.	0.114
Steel, galvanized:				
In general	10 B.W.G.	0.134	8 B.W.G.	0.165
In rural districts of arid regions	12 B.W.G.	0.109	10 B.W.G.	0.134

NOTE.—If spans in excess of 150 ft. are necessary, the size of conductors specified above, or the sags of the conductors, shall be correspondingly increased.

N-4. Paired or single distributing wires without a suspension strand shall in no case be used for spans longer than 100 feet in the heavy loading district, 125 feet in the medium loading district, and 150 feet in the light loading district. Each wire of a pair not supported by a suspension strand shall have an ultimate strength of not less than 170 pounds. Single distributing wires not supported by suspension strand shall have an ultimate strength of not less than 340 pounds.

N-5. Splices shall, so far as practicable, be avoided in the crossing and adjacent spans, unless they are of such a type and so made as to have a strength substantially equal to that of the conductors in which they are placed. Taps shall be avoided in the crossing span where practicable, but if required, they shall be of a type which will not impair the strength of the conductors to which they are attached.

P—Sags

P-1. Table P-1 specifies recommended sags for wires shown in Table N-1. Where, however, the wires in the communication line are strung in accordance with recognized practices, the stringing tensions employed in the line, generally will be satisfactory in the crossing span.

Table P-1

Wire Stringing Sags

Heavy and Medium Loading Districts

Span Length in Feet	Temperature—Deg. F. 100	80	60	40	20	0	−20
	Sag in Inches						
70	5½	4½	3½	2¾	2¼	1¾	1½
80	7½	6	4½	3½	2¾	2½	2
90	9½	7½	5½	4½	3½	3	2½
100	11½	9	7	5½	4½	3¾	3¼
110	14	11	8½	6½	5½	4½	4
120	17	13	10	8	6½	5½	4½
130	20	15	12	9½	7½	6½	5½
140	23	18	14	11	8½	7½	6½
150	26	20	16	13	10	8½	7

Light Loading District

Span Length in Feet	120	100	80	60	40	20	0
			Temperature—Deg. F.				
			Sag in Inches				
90	7½	6½	5½	4½	3½	3	2½
100	9½	8	6½	5½	4½	3¾	3¼
110	11½	9½	8	6½	5½	4½	4
120	14	11½	9	7½	6½	5½	4½
130	16	13	11	9	7½	6½	5½
140	18	15	13	10½	8½	7½	6½
150	21	18	15	12	10	8½	7

Q—Guys

Q-1. **Material.** Guys shall be of galvanized steel or other material that will not corrode excessively under the prevailing conditions.

Q-2. **Side Guys.** Poles supporting the crossing span shall be side-guyed with guys having strengths specified in Appendix B, except as provided in paragraphs Q-9 and Q-10. The strength specified in this appendix may be obtained by using various combinations of standard guys, which, when taken together, will give strength at least as great as that specified.

Q-3. For the purpose of side-guying, aerial cables and their suspension strands shall have the wire equivalents given in Table Q-1.

Table Q-1

Wire Equivalents

Diameter of Cable	Equivalent Number of Open Wires: Heavy Loading District	Medium Loading District	Light Loading District
Less than 1¼ in.	3	4	10
1¼ to 2¼ in.	4	5	15
Over 2¼ in.	5	6	20

Q-4. **Head Guys.** Poles supporting the crossing span shall be head-guyed away from the crossing span with guys having strengths specified in Appendix C, except as provided in paragraph Q-9. The strength specified in this appendix may be obtained by using various combinations of standard guys, which, when taken together, will give strength at least as great as that specified. No head guys are required for lines carrying only aerial cable. For lines carrying both open wire and aerial cable, head guying need be provided only for the number of wires in excess of ten if the cable is supported by a 6,000-pound suspension strand or for the number of wires in excess of 20 if the suspension strand is 10,000 pounds or stronger.

Q-5. Head guys shall be installed so as not to increase tension in the crossing span. In order to facilitate the installation of the head guys, a section of 6,000 pound strand may be placed between the crossing poles so as to provide an additional support for pulling up the head guys.

Q-6. **Guying at Corners and Terminals.** Where the line terminates or changes direction or has substantially unbalanced tension at any crossing support, such additional guying as may be necessary shall be provided to take care of the additional load.

Q-7. Where a line crossing a railroad changes direction more than ten degrees at either crossing support, the side guy within the angle may be omitted and the head guy, if required, shall be placed in the direction of the adjacent span unless the angle of turn is greater than 60 degrees. Where the angle is greater than 60 degrees, the head guy shall be placed in a direction away from the crossing span.

Q-8. Corner guys shall conform to standard corner guying requirements unless the guying prescribed in Appendix B is greater, in which case the latter guying shall be provided.

Q-9. **Omission of Guys.** Guys may be omitted in the following cases:

(a) Side guys may be omitted where the poles when new will not be stressed to more than 25 per cent of their ultimate strengths, when subjected to the transverse load specified in paragraph F-3 (a), except as otherwise permitted in paragraph Q-10. The maximum number of wires which can be carried by poles of various classes to meet this requirement is given in Appendix D.

(b) Head guys may be omitted where the poles when new will not be stressed to more than 66⅔ per cent of their ultimate strengths when subjected to the longitudinal load specified in paragraph F-3 (b). The maximum number of wires of various sizes which can be carried by poles of various classes to meet this requirement is given in Appendix F.

Q-10. Where a communication line paralleling a railroad track on the right-of-way of the railroad crosses any of the minor tracks listed under subparagraphs (a), (c), (d), and (e) of paragraph B-9, the side guys may be omitted, provided the crossing poles when new will not be stressed to more than 33⅓ per cent of their ultimate strengths when subjected to the transverse load specified in paragraph F-3 (a). The maximum number of wires which can be carried by poles of various classes to meet this requirement is given in Appendix E.

Q-11. If, however, under the conditions stated in paragraph Q-10, there is an angle in the line at either crossing pole, corner guys sufficient to withstand the unbalanced load on such poles shall be installed. Head guys may be omitted unless conductor tensions are not balanced at one or both poles due to the dead-ending of any of the wires. Where conductors are dead-ended, guys of strengths specified in Appendix C shall be provided.

Q-12. **Guying in Special Cases.** Where, on account of physical conditions, it is impracticable to side guy the crossing poles, as specified in paragraph Q-2, or to provide the strength of an unguyed pole specified in paragraphs Q-9 and Q-10, the requirements may be met by head-guying and side-guying the line as near as practicable to the crossing, provided the line is approximately straight and the intermediate poles are not of a class lower than those specified in paragraph G-2 and that a strand of strength equivalent to the load in pounds for which head-guying is required, is run between the two guyed poles. Where such guying is employed, it shall meet the requirements of paragraphs Q-2 to Q-5, inclusive, and shall be applied at a distance not exceeding 500 feet from the nearest crossing pole. The strand shall be attached to the guyed poles close to the point at which the head guys are attached, and shall be securely attached to every pole between the guyed poles.

Q-13. Guy Leads. Guy anchors shall, where practicable, 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. The guys shall be attached as near to the center of the load as practicable. (See Drawing T & T 1246 for method of measuring guy lead and height.)

Q-14. Methods of Anchoring Guys. The anchorage for guys shall in all cases be adequate to develop the required strength of the guys attached to them. Guys should preferably be attached to anchors set in earth or secured in rock. Where this is impracticable, guys may be attached to stubs or poles which are properly anchor guyed, or to buildings or other secure structures. Guys should not be attached to trees.

Q-15. Guy Rods. Guy rods not smaller than those specified in Table Q-2 should be employed. The length of guy rods shall be sufficient so that where the anchor is set to adequate depth, the eye of the rod will not be below the surface of the ground.

Table Q-2

Minimum Size of Guy Rods

Size of Guy (pounds)	Diameter of Guy Rod (inches)
2 200	1/2
4 000	1/2
6 000	5/8
10 000	3/4
16 000	7/8

Q-16. Anchors. Where wood logs are employed as anchors, such logs (preferably treated) should be not less than the size specified in Table Q-3 and set as specified in paragraph Q-19.

Table Q-3

Size of Anchor Logs

Number and Size of Guys (pounds)	Minimum Size of Logs for Good S Round Logs	Split Log
1— 2 200	3 ft. by 6 in.	3 ft. by 8 in.
1— 4 000	3 ft. by 6 in.	3 ft. by 8 in.
1— 6 000	3 ft. by 7 in.	3 ft. by 9 in.
1—10 000	4 ft. by 8 in.	4 ft. by 10 in.
1—16 000	6 ft. by 9 in.	6 ft. by 12 in.
2— 6 000	4 ft. by 8 in.	4 ft. by 10 in.
2—10 000	7 ft. by 9 in.	7 ft. by 12 in.
2—16 000	10 ft. by 9 in.	10 ft. by 12 in.

Q-17. In wet or loose soil, logs having a length and diameter twenty-five to fifty per cent greater than specified in Table Q-3 should be used, or cross logs or planks providing an equivalent increase in cross-section should be installed on top of the logs.

Q-18. When anchor logs somewhat smaller than indicated in paragraphs Q-16 and Q-17 are used, they will be considered as satisfactory if set to a sufficiently increased depth to develop equivalent holding power.

Q-19. **Setting Anchors.** Holes for anchor logs shall be dug vertically downward to such a depth that the guy rod when in line with the guy will be buried in the earth at least to the extent specified in Table Q-4.

Table Q-4

Depth of Setting for Anchors

Number and Size of Guys (pounds)	Length of Rod Below Ground (feet)
1— 2 200	4
1— 4 000	4
1— 6 000	4½
1—10 000	5½
1—16 000	6
2— 6 000	5½
2—10 000	6
2—16 000	6

Q-20. **Method of Securing Guy Strand.** In securing guys, clamps of suitable strength shall be employed. A guy strand may be attached to the pole either by the wrapping method or by attachment to suitable eye bolts extending through the pole. The size of the eye bolt shall be sufficient to develop the required strength of the guy.

Q-21. **Guards for Guys.** When anchor guys are located so that persons or livestock may come into accidental contact with them, they shall be equipped with suitable guards.

Q-22. **Pole Braces.** Pole braces may be used in the place of guys called for in paragraphs Q-2 to Q-8, inclusive, to provide equivalent strength.

R—Suspension Strand

R-1. **Material.** Suspension strands shall be of galvanized steel or other material that will not corrode excessively under the prevailing conditions.

R-2. **Sizes.** For spans of 150 feet or less, Table R-1 gives the minimum sizes of suspension strand to be used for supporting different sizes of aerial cable.

Table R-1

Minimum Sizes of Suspension Strand

Weights of Cable in Pounds per Foot	Suspension Strand (Nominal Ultimate Strength in Pounds)
Less than 2.25	6 000
2.25 to 5	10 000
Exceeding 5 and less than 8.5	16 000

R-3. For spans exceeding 150 feet or for heavier cables, a proportionately larger suspension strand or other proportionately stronger means of support shall be used.

R-4. Attachment to Poles. The suspension strand shall be attached to the pole by means of standard cable suspension clamp secured by a bolt not less than ⅝ inches in diameter extending through the pole. Three-bolt suspension clamps should be used with 10,000 and 16,000 pound suspension strand; single-bolt suspension clamps may be used for 6,000 pound suspension strand.

R-5. Where one or both of the crossing poles is a corner pole and the corner pull is in excess of five feet, suspension clamps with flared grooves or other means that will prevent sharp bends in the suspension strand shall be employed. Where the cable is carried on the inside of the corner, reinforcing links or other equivalent means shall also be used where the corner pull exceeds the values given in Table R-2.

Table R-2

Size of Suspension Strand	Pull on Corner
6M	15 ft. or over
10M	15 ft. or over
16M	10 ft. or over

R-6. Safety straps, grade clamps, reinforcing bands or other equivalent devices which will prevent progressive stripping of cable from entering the crossing span shall be placed at each crossing pole for cables 1½ inches in diameter or larger.

R-7. Where the suspension strand is dead-ended on a crossing pole, it may be attached by the wrapping method or by attaching it to a suitable eye bolt extending through the pole. The size of the eye bolt shall be sufficient to develop the required strength of the suspension strand.

R-8. Sags. Suspension strands for aerial cables shall be strung so that when the cables are in place the sags will be not less than given in Table R-3.

Table R-3

Minimum Sags in Aerial Cables

(No Ice or Wind Loading)

Average Weight of Cables in Pounds per Foot	Fahr. Temp.	Size of Strand	Sags in Inches for Spans of						
			90′	100′	110′	120′	130′	140′	150
Up to .6	20		5	6	7	8	10	11	13
	60	6 000	5	7	8	10	11	13	15
	100		6	8	10	12	14	16	18
Exceeding .6 but not exceeding .8	20		6	7	9	10	12	14	16
	60	6 000	6	8	10	12	14	16	18
	100		8	9	11	13	16	18	21
Exceeding .8 but not exceeding 1.1	20		7	9	11	13	15	17	20
	60	6 000	8	10	12	14	17	19	22
	100		9	11	13	15	18	21	24
Exceeding 1.1 but not exceeding 1.4	20		9	11	13	16	19	22	25
	60	6 000	10	12	15	17	20	24	27
	100		10	13	16	19	22	25	29
Exceeding 1.4 but not exceeding 1.8	20		10	13	16	19	22	25	29
	60	6 000	11	14	17	20	23	27	31
	100		12	15	18	21	25	29	33
Exceeding 1.8 but not exceeding 2.25	20		12	14	17	20	24	28	32
	60	6 000	12	15	18	22	26	30	34
	100		13	16	20	24	28	32	37
Exceeding 2.25 but not exceeding 2.8	20		8	10	12	15	17	20	23
	60	10 000	9	11	13	16	19	22	25
	100		10	12	15	17	20	24	27
Exceeding 2.8 but not exceeding 3.9	20		10	13	16	19	22	25	29
	60	10 000	11	14	17	20	23	27	31
	100		12	15	18	21	25	29	33
Exceeding 3.9 but not exceeding 4.4	20		12	14	17	20	24	28	32
	60	10 000	12	15	18	22	26	30	34
	100		13	16	19	23	27	31	36
Exceeding 4.4 but not exceeding 5.0	20		13	16	19	23	27	31	36
	60	10 000	14	17	20	24	29	33	38
	100		14	18	22	26	30	35	40
Exceeding 5.0 but not exceeding 6.3	20		11	13	16	19	23	26	30
	60	16 000	12	14	17	20	24	28	32
	100		12	15	18	22	26	30	34
Exceeding 6.3 but not exceeding 7.2	20		12	14	17	20	24	28	32
	60	16 000	12	15	18	22	26	30	34
	100		13	16	20	24	28	32	37
Exceeding 7.2 but not exceeding 8.1	20		13	16	19	22	26	31	35
	60	16 000	13	16	19	23	27	31	36
	100		14	17	20	24	29	33	38
Exceeding 8.1 but not exceeding 8.6	20		13	16	20	24	28	32	37
	60	16 000	14	17	20	24	29	33	38
	100		14	18	22	26	30	35	40

S—Cable Attachments to Suspension Strands

S-1. Cables shall be attached to the suspension strand in the crossing span by means of suitable metal rings or spirally-wound lashing wire which will resist corrosion. The spacing of rings shall not be greater than indicated in Table S-1. The spirals of lashing wire shall be so spaced that they will safely support the cable and prevent appreciable sagging between points of support. The metal rings or lashing wire shall be so installed that the protective coating will not be damaged.

Table S-1

Spacing of Cable Rings

Weight of Cable in Pounds per Foot	Spacing of Cable Rings in Inches
Less than 5	20
5 to 8.5	15

Part II—Underbridge Crossings

T—General

T-1. Avoidance of Attachments. The line preferably should be so graded that it will be unnecessary to make attachment to the bridge structure. If, for any reason, it is impracticable to grade a cable line to pass under a bridge and it is undesirable to attach to the bridge, vertical runs may be made on poles adjacent to the bridge.

T-2. Attachments. Unless approved by the railroad company, attachments to railroad steel bridges shall not be made by devices that require the drilling or cutting of the bridge structure or the removal of rivets, and the attachments shall be so made that wires, cables and suspension strand will not be in metallic contact with the bridge structure.

T-3. Clearance from Abutments. The clearance of any conductor from the face of the abutment, when not attached thereto, should be not less than three feet for steel bridges. Cables or paired wires and their suspension strand may be attached directly to the face of the abutment if located not less than 24 inches below the elevation of the bridge seat, and they shall provide suitable clearance for pedestrians, vehicles, etc., as may be necessary.

T-4. Clearance from Bridge Structure. The clearance between any conductor attached to the bridge in open construction, and any portion of the bridge structure should preferably be not less than six inches, but in no case less than three inches. The clearance between any conductor not attached to the bridge and any portion of the bridge structure should preferably be not less than one foot, but in no case less than six inches.

Part III—Underground Crossings

U—General

U-1. Arrangement for Work. The work shall be done at such time and in such a manner as not to interfere with the proper and safe use or operation of the property and tracks of the railroad company, previous arrangements having been made with the duly authorized representative of the railroad company for date and time of commencement. Where iron or mild steel pipes are used, as permitted in paragraph U-7 (d), consideration should be given to forcing or driving them under the roadbed instead of laying in an open trench.

U-2. Location. The underground system on the railroad property shall be so located as to be subject to the least practicable disturbance. Railway tracks and underground structures, including catch basins, gas pipes, etc., should be avoided where practicable. The manholes, pull boxes, and terminals should, where practicable, be located away from the roadbed.

U-3. Side Clearance from Rail. Where underground conduit construction terminates at terminal poles, the side clearance of such poles from the nearest track rail shall be as provided in paragraph E-2. Where manholes, handholes, etc., are employed, which project above the surface of the ground, the side clearance, unless physical conditions prevent, shall be not less than twelve feet from the nearest track rail, except that at sidings, a clearance of seven feet may be allowed. At loading sidings, sufficient space shall be left for a driveway.

U-4. Clearance Below Base of Rail. The top of all conduit protection, except as specified in paragraph U-8 shall generally be located at a depth of not less than 3 feet 6 inches below the base of rail. Where this is impracticable, or for other reasons, this clearance may be reduced by agreement between the parties concerned. In no case, however, shall the top of the conduit protection extend higher than the bottom of the ballast section which is subject to working or cleaning.

U-5. Where unusual conditions exist or where proposed construction would interfere with existing construction, a greater depth than specified above may be required.

U-6. Arrangement of Conduit System. The arrangement of ducts in the conduit system contemplated under this specification shall consist of not more than four ducts of vitrified clay, four impregnated fiber ducts or three creosoted wood ducts in width. Where other arrangements are contemplated, additional strength of construction and protection may be required.

U-7. Protection of Ducts. Ducts extending under the roadbed section of the right-of-way shall be protected under the roadbed section as specified below and for a distance of at least six feet beyond each outside rail. In other sections of the right-of-way, concrete, creosoted plank or other forms of protection should be provided where necessary to prevent injury to the conduit system.

(a) **Vitrified Clay Ducts.** The ducts shall be laid on at least four inches of concrete with at least three inches of concrete on the top and sides.

(b) **Impregnated Fiber and Other Tubular Composition Ducts.** The ducts shall be completely encased in concrete. The encasement shall be at least four inches thick on bottom and at least three inches thick on top and sides.

(c) **Creosoted Wood Ducts.** The ducts shall be protected on the top and bottom by means of creosoted wood plank not less than 1½ inches in thickness or by three inches of concrete.

(d) **Iron or Mild Steel Pipes.** Such pipes shall normally be encased in concrete as provided in (b) above. However, where physical or chemical conditions will permit, a conduit system consisting of a group of not more than four iron or mild steel pipes not more than 4 inches in diameter may be laid beneath the roadbed without any form of protection.

U-8. Where physical and chemical conditions will permit, a conduit consisting of not more than two iron pipes, not exceeding four inches in diameter, or two creosoted wood ducts not exceeding six inches square, or one or more cables of a type designed for burying directly in the earth may be laid in the ground beneath railroad tracks without any form of protection at a minimum depth of eighteen inches below the base of the rail, unless the worked ballast section of the roadbed exceeds eighteen inches, in which case the conduit shall be laid below the ballast section. Cables under main line tracks shall preferably be installed in conduit to prevent disturbance to the roadbed at times of replacement.

U-9. Excavation. The excavated material shall be so placed as not to interfere with traffic. Ballast material excavated shall be kept separate and free from earth.

U-10. Shoring. Where necessary to prevent caving, the sides of trench shall be supported with suitable planks and bracing. No bracing shall extend above the base of the rail or be attached in any way to the rails or ties.

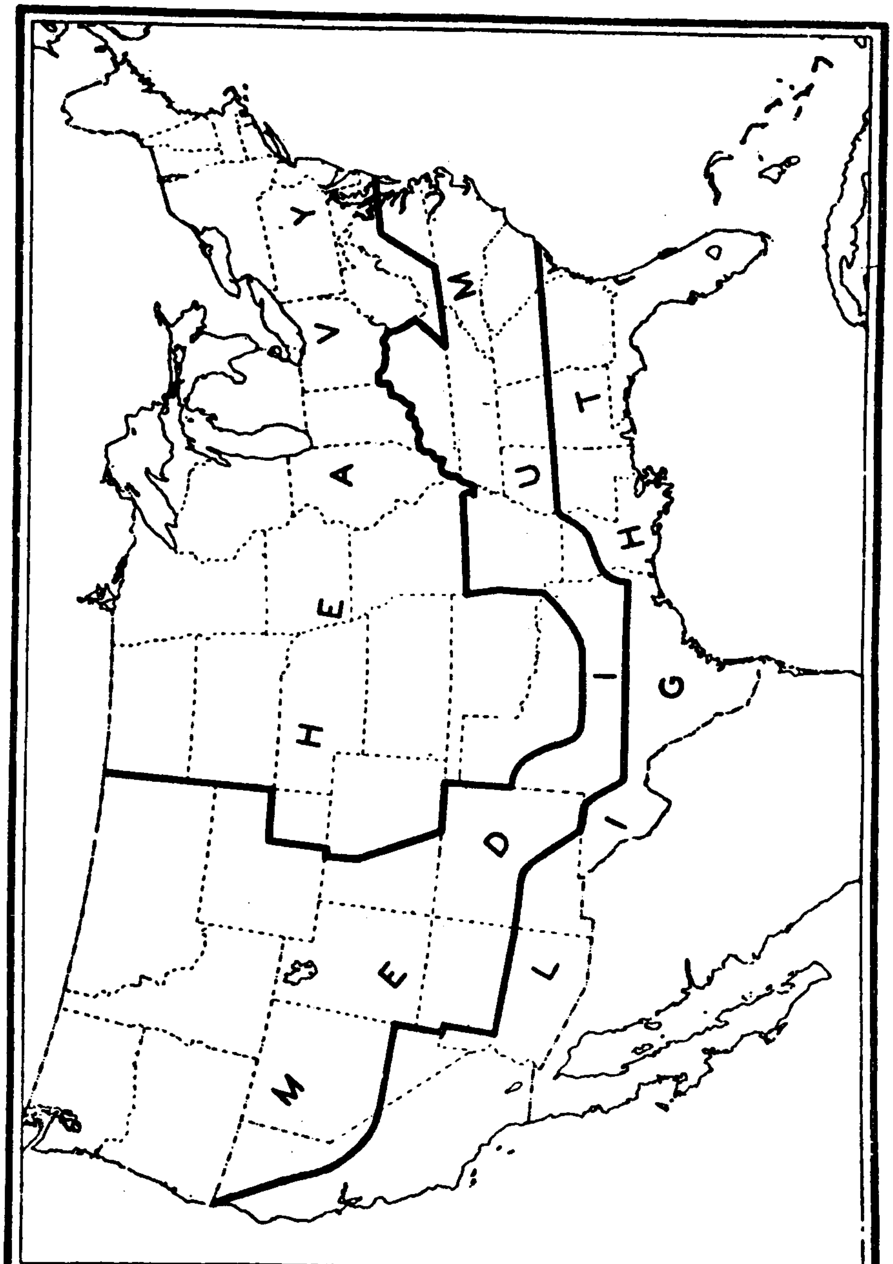
U-11. Grading and Drainage. The trench shall be so graded that it will have a fall of at least three inches in 100 feet toward the lower manhole or terminal, or from an intermediate point toward both manholes or terminals, and the bottom of the trench shall be graded evenly. Where conditions require, a sump or other suitable drainage should be provided for manholes.

U-12. Backfilling. The trench shall be backfilled with earth to the subgrade line and tamped. Track ballast shall be replaced under railroad supervision.

U-13. Removing Surplus Material. All surplus material remaining after the work has been finished shall be removed, and if disposed of upon railroad property, it shall be under railroad supervision.

U-14. Concrete. All concrete employed shall be such that when tested in 6 by 12 inch cylinders after 28 days, it shall withstand a compressive test of not less than 2,000 pounds per square inch without rupture. Concrete shall be thoroughly tamped.

Appendix A



District Loading Map

Appendix B

STRENGTH OF SIDE GUYS REQUIRED, IN POUNDS
(Combinations of Standard Size Guys May Be Used)

Number of Wires	Average of Crossing and Adjacent Span 100 Feet or Less — Ratio of Guy Lead to Height Not Less Than				Average of Crossing and Adjacent Span 100 to 125 Feet — Ratio of Guy Lead to Height Not Less Than				Average of Crossing and Adjacent Span 125 to 150 Feet — Ratio of Guy Lead to Height Not Less Than			
	1	3/4	1/2	1/3	1	3/4	1/2	1/3	1	3/4	1/2	1/3
Heavy Loading												
2	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
4	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	4 000
6	2 200	2 200	2 200	4 000	2 200	2 200	2 200	4 000	2 200	2 200	4 000	4 000
10	2 200	2 200	4 000	4 000	2 200	4 000	4 000	6 000	4 000	4 000	4 000	6 000
20	4 000	4 000	4 000	6 000	4 000	4 000	4 000	6 000	4 000	4 000	6 000	10 000
30	4 000	4 000	6 000	10 000	4 000	6 000	6 000	10 000	6 000	6 000	10 000	10 000
40	4 000	6 000	10 000	10 000	6 000	10 000	10 000	12 000	6 000	10 000	10 000	16 000
50	6 000	10 000	10 000	12 000	6 000	10 000	10 000	16 000	10 000	10 000	12 000	16 000
60	6 000	10 000	10 000	16 000	10 000	10 000	12 000	16 000	10 000	12 000	16 000	20 000
70	10 000	10 000	12 000	16 000	10 000	12 000	16 000	20 000	10 000	16 000	16 000	26 000
80	10 000	10 000	16 000	20 000	10 000	16 000	16 000	26 000	12 000	16 000	20 000	26 000
Medium Loading												
2	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
4	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
6	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
10	2 200	2 200	2 200	2 200	2 200	2 200	2 200	4 000	2 200	2 200	2 200	4 000
20	4 000	4 000	4 000	4 000	4 000	4 000	4 000	4 000	4 000	4 000	4 000	4 000
30	4 000	4 000	4 000	6 000	4 000	4 000	4 000	6 000	4 000	4 000	6 000	6 000
40	4 000	4 000	4 000	6 000	4 000	4 000	6 000	10 000	4 000	6 000	6 000	10 000
50	4 000	4 000	6 000	10 000	4 000	6 000	6 000	10 000	6 000	6 000	10 000	10 000
60	4 000	6 000	6 000	10 000	6 000	6 000	10 000	10 000	6 000	10 000	10 000	12 000
70	4 000	6 000	10 000	10 000	6 000	10 000	10 000	12 000	6 000	10 000	10 000	16 000
80	6 000	6 000	10 000	10 000	6 000	10 000	10 000	16 000	10 000	10 000	12 000	16 000
Light Loading												
2	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
4	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
6	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
10	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
20	4 000	4 000	4 000	4 000	4 000	4 000	4 000	4 000	4 000	4 000	4 000	4 000
30	4 000	4 000	4 000	6 000	4 000	4 000	4 000	6 000	4 000	4 000	4 000	6 000
40	4 000	4 000	4 000	6 000	4 000	4 000	6 000	6 000	4 000	4 000	6 000	10 000
50	4 000	4 000	6 000	6 000	4 000	6 000	6 000	10 000	4 000	6 000	6 000	10 000
60	4 000	4 000	6 000	10 000	4 000	6 000	6 000	10 000	6 000	6 000	10 000	10 000
70	4 000	6 000	6 000	10 000	6 000	6 000	10 000	10 000	6 000	10 000	10 000	12 000
80	4 000	6 000	10 000	10 000	6 000	6 000	10 000	12 000	6 000	10 000	10 000	16 000

Appendix B (Continued)

Number of Wires	Average of Crossing and Adjacent Span 150 to 175 Feet — Ratio of Guy Lead to Height Not Less Than				Average of Crossing and Adjacent Span 175 to 200 Feet — Ratio of Guy Lead to Height Not Less Than			
	1	2/3	1/2	1/3	1	2/3	1/2	1/3
Heavy Loading								
2	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
4	2 200	2 200	2 200	4 000	2 200	2 200	2 200	4 000
6	2 200	2 200	4 000	4 000	2 200	4 000	4 000	6 000
10	4 000	4 000	6 000	6 000	4 000	4 000	6 000	10 000
20	4 000	6 000	6 000	10 000	4 000	6 000	10 000	10 000
30	6 000	10 000	10 000	12 000	6 000	10 000	10 000	16 000
40	10 000	10 000	12 000	16 000	10 000	10 000	16 000	20 000
50	10 000	12 000	16 000	20 000	10 000	16 000	16 000	26 000
60	10 000	16 000	16 000	26 000	12 000	16 000	20 000	26 000
70	12 000	16 000	20 000	30 000	16 000	20 000	26 000	30 000
80	16 000	20 000	26 000	30 000	16 000	20 000	26 000	40 000
Medium Loading								
2	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
4	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
6	2 200	2 200	2 200	4 000	2 200	2 200	2 200	4 000
10	2 200	2 200	4 000	4 000	2 200	2 200	4 000	4 000
20	4 000	4 000	4 000	6 000	4 000	4 000	4 000	6 000
30	4 000	4 000	6 000	10 000	4 000	6 000	6 000	10 000
40	4 000	6 000	10 000	10 000	6 000	6 000	10 000	10 000
50	6 000	10 000	10 000	12 000	6 000	10 000	10 000	16 000
60	6 000	10 000	10 000	16 000	10 000	10 000	12 000	16 000
70	10 000	10 000	12 000	16 000	10 000	10 000	16 000	20 000
80	10 000	10 000	16 000	20 000	10 000	12 000	16 000	20 000
Light Loading								
2	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
4	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
6	2 200	2 200	2 200	2 200	2 200	2 200	2 200	2 200
10	2 200	2 200	2 200	4 000	2 200	2 200	2 200	4 000
20	4 000	4 000	4 000	4 000	4 000	4 000	4 000	6 000
30	4 000	4 000	6 000	6 000	4 000	4 000	6 000	10 000
40	4 000	6 000	6 000	10 000	4 000	6 000	6 000	10 000
50	6 000	6 000	10 000	10 000	6 000	6 000	10 000	12 000
60	6 000	10 000	10 000	12 000	6 000	10 000	10 000	16 000
70	6 000	10 000	10 000	16 000	10 000	10 000	10 000	16 000
80	10 000	10 000	10 000	16 000	10 000	10 000	12 000	16 000

Appendix C

STRENGTH OF HEAD GUYS REQUIRED, IN POUNDS
(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
			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
			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	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
			Light Loading		
2	4 000	4 000	4 000	4 000	4 000
	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

Appendix D

MAXIMUM NUMBER OF WIRES WHICH CAN BE SUPPORTED BY POLES OF VARIOUS CLASSES WITHOUT SIDE GUYS AT CROSSINGS OVER RAILROAD TRACKS

(For the Special Case Covered By Paragraph Q-10, See Appendix E)

Class of Pole	Average of Crossing and Adjacent Spans—Feet				
	100	125	150	175	200
		Heavy Loading District			
1	28	22	18	15	13
2	22	18	14	12	11
3	17	14	11	10	8
4	13	11	9	8	7
5	10	8	7	6	5
6	8	6	5	4	4
7	6	5	4	3	3
		Medium Loading District			
1	53	41	33	28	24
2	41	32	26	22	19
3	32	25	21	17	15
4	24	19	16	14	12
5	18	15	12	10	9
6	14	11	9	8	7
7	10	8	7	6	5
		Light Loading District			
1	....	82	65	54	46
2	81	61	49	41	35
3	58	45	37	31	27
4	42	33	27	23	20
5	29	23	19	15	14
6	19	15	13	11	9
7	10	10	8	7	6

Appendix E

MAXIMUM NUMBER OF WIRES WHICH CAN BE SUPPORTED BY POLES OF VARIOUS CLASSES WITHOUT SIDE GUYS AT CROSSINGS OVER MINOR TRACKS UNDER THE CONDITIONS SPECIFIED IN PARAGRAPH Q-10

Class of Pole	Average of Crossing and Adjacent Span—Feet				
	100	125	150	175	200
			Heavy Loading District		
1	62	48	39	33	28
2	48	38	31	26	23
3	38	29	24	20	18
4	29	23	19	16	9
5	22	17	9	8	7
6	16	9	8	7	6
7	8	7	6	5	4
			Medium Loading District		
1	....	90	76	63	54
2	....	74	59	50	42
3	75	56	45	39	33
4	55	42	35	29	25
5	40	32	26	22	19
6	20	20	20	17	9
7	10	10	10	8	7
			Light Loading District		
1	....	....	....	81	68
2	....	....	75	61	52
3	....	70	55	46	39
4	65	50	40	34	30
5	45	35	29	24	21
6	31	25	20	17	15
7	10	10	10	10	10

Appendix F

MAXIMUM NUMBER OF WIRES WHICH CAN BE SUPPORTED BY POLES OF VARIOUS CLASSES WITHOUT HEAD GUYS

Wire Gage and Material	Diameter (Inches)	Ultimate Strength (Pounds)	Class of Pole 1	2	3	4	5	6	7
			Heavy Loading District						
10 A.W.G. Copper	0.102	530	11	9	7	6	4	3	2
9 A.W.G. Copper	0.114	660	8	7	6	4	3	3	2
8 A.W.G. Copper	0.128	826	7	5	4	4	3	2	1
8 B.W.G. Copper	0.165	1 325	4	3	3	2	2	1	1
10 B.W.G. Steel	0.134	1 200	4	4	3	2	2	1	1
8 B.W.G. Steel	0.165	1 710	3	2	2	2	1	1	0
			Medium Loading District						
10 A.W.G. Copper	0.102	530	16	13	11	8	6	5	4
9 A.W.G. Copper	0.114	660	13	11	9	6	5	4	3
8 A.W.G. Copper	0.128	826	10	8	7	5	4	3	2
8 B.W.G. Copper	0.165	1 325	5	5	4	3	3	2	1
10 B.W.G. Steel	0.134	1 200	7	6	5	4	4	2	2
8 B.W.G. Steel	0.165	1 710	5	4	3	2	2	2	1
			Light Loading District						
10 A.W.G. Copper	0.102	530	24	21	16	13	10	8	6
9 A.W.G. Copper	0.114	660	20	16	13	10	8	7	5
8 A.W.G. Copper	0.128	826	16	13	10	8	6	5	4
8 B.W.G. Copper	0.165	1 325	10	8	6	5	4	3	2
10 B.W.G. Steel	0.134	1 200	10	8	7	5	4	3	2
8 B.W.G. Steel	0.165	1 710	7	6	5	4	3	2	2

Where wires of other sizes or having other ultimate strengths, as in the case of various grades of steel, are used, the number of wires can be determined by selecting the wire in the table which has the nearest to the same ultimate strength as the wire under consideration.

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Appendix G

GROUND LINE CIRCUMFERENCE OF POLES OF VARIOUS CLASSES AND SPECIES WHICH HAVE DETERIORATED TO TWO-THIRDS THEIR STRENGTH WHEN NEW

Northern White Cedar and Other Species of Poles Having a Fiber Strength of 3,600 Pounds per Square Inch. (See Group No. 1 in Appendix H)

Length of Pole Feet	Class of Pole 1	2	3	4	5	6	7
	Ground Line Circumference—Inches						
20	34½	32½	30½	28½	26½	24½	22½
25	38	35½	33½	30½	29	27	25
30	41½	38½	36	33½	31	28½	27
35	44	41	38½	35½	33	30	28
40	46½	43½	40½	37½	35	32½	....
45	48½	45½	42½	39½	36½	....	....
50	50½	47½	44½	41	38	....	....
55	52½	49	46	42½	39½	....	....
60	54	51	47½	44	40½	....	....

Western Red Cedar and Other Species of Poles Having a Fiber Strength of 5,600 Pounds per Square Inch. (See Group No. 2 in Appendix H)

Length of Pole Feet	Class of Pole 1	2	3	4	5	6	7
	Ground Line Circumference—Inches						
20	30	28	26½	24½	22½	21	19½
25	32½	31	29	26½	25	23	21½
30	35½	33½	31	28½	26½	25	23½
35	37½	35½	33½	30½	28½	26½	24½
40	40	37½	35	32½	30½	27½	....
45	42	39	37	34	31½	....	....
50	43½	41	38½	35	32½	....	....
55	45½	42½	39½	37	34	....	....
60	46½	43½	41	38	....	....	....
65	48½	45	42	39½	....	....	....
70	50	46½	43½	40½	....	....	....
75	50½	47½	44½	41½	....	....	....
80	52	48½	45½	42	....	....	....
85	53	49½	46½	....	....	....	....
90	56	52½	47½	....	....	....	....

Chestnut Poles—Fiber Strength, 6,000 Pounds per Square Inch

Length of Pole Feet	Class of Pole 1	2	3	4	5	6	7
	Ground Line Circumference—Inches						
20	29	27½	25½	24	22	20½	19½
25	32½	30½	28½	26	24½	22½	21
30	34½	32½	30½	28½	26	24	22½
35	37	34½	32½	30½	28	25½	24½
40	39	36½	34½	31½	29½	27	25½
45	41	38½	36	33½	31	28½	26½
50	42½	40	37½	34½	32½	30	27½
55	44	41½	38½	36	33½	30½	....
60	45½	43	40	37	....	....	....
65	47	44	41	38½	....	....	....
70	48	45½	....	....	....	....	....

Appendix G (Continued)

Lodgepole Pine—Fiber Strength 6,600 Pounds per Square Inch

Length of Pole Feet	Class of Pole 1	2	3	4	5	6	7
	Ground Line Circumference—Inches						
20	28½	26½	25	23	21½	20	19
25	31½	29½	27½	25	24	21½	20½
30	33½	31½	29½	27½	25½	23½	22
35	35½	33½	31½	29½	27	24½	23½
40	38	35½	33½	30½	28½	26½	24½
45	39½	37	35	32½	30	27½	25½
50	41½	38½	36½	33½	31½	29	27
55	42½	40	37½	35	32½	30	....
60	44	41½	39	36	33	30½	....
65	45½	42½	40	37	34½	....	....
70	47	43½	41	38	35½	....	....
75	48	45	42	39	....	....	....
80	49	46	43	40	....	....	....
85	50½	47	44	....	....	....	....
90	53	49½	45	....	....	....	....

Southern Pine, Douglas Fir and Other Species of Poles Having a Fiber Strength of 7,400 Pounds per Square Inch. (See Group 5 of Appendix H)

Length of Pole Feet	Class of Pole 1	2	3	4	5	6	7
	Ground Line Circumference—Inches						
20	27½	25½	24	22½	20½	19	18
25	30	28	26½	24	23	21	19½
30	32½	30½	28½	26½	24½	22½	21
35	34½	32	30½	28½	26	24½	22½
40	36½	34	32	29½	27½	25½	24
45	38½	35½	33½	31	29	26½	25
50	40	37	35	32½	30	28	26
55	41½	39	36	33½	31	29	....
60	42½	40	37½	35	32	29½	....
65	44	41	38½	35½	....	....	....
70	45	42	39½	36½	....	....	....
75	46½	43	40½	....	....	....	....
80	47	44	41½	....	....	....	....
85	48	45	....	....	....	....	....
90	51	48	....	....	....	....	....

Appendix H

ULTIMATE FIBER STRESS (Modulus of Rupture) OF VARIOUS SPECIES OF WOOD POLES

	(Pounds per Square Inch)
Group No. 1	
*Northern White Cedar	3 600
Eastern White Cedar	3 600
Red Wood	3 600
Group No. 2	
*Western Red Cedar	5 600
Southern Red Cedar	5 600
Washington Cedar	5 600
Idaho Cedar	5 600
Port Orford Cedar	5 600
Cypress	5 000
Group No. 3	
*Chestnut	6 000
Group No. 4	
*Lodgepole Pine	6 600
Group No. 5	
*Douglas Fir	7 400
*Southern Pine, creosoted	7 400

* A.S.A. Standard.

Appendix J

DIMENSIONS FOR NEW POLES OF VARIOUS SPECIES AS SPECIFIED IN AMERICAN STANDARD SPECIFICATIONS 05.1 TO 05.6, INCLUSIVE, OF THE AMERICAN STANDARDS ASSOCIATION

Northern White Cedar

Fiber Strength, 3,600 Pounds per Square Inch.
From A.S.A. Standard 05.1.

Class of Pole		1	2	3	4	5	6	7
Minimum Top Circumference (Inches)		27	25	23	21	19	17	15
Length of Pole Feet	Ground Line Distance from Butt Feet	Minimum Circumference at Six Feet from Butt (Inches)						
16	3½	....	....	....	....	26.0	24.0	22.0
18	3½	....	....	32.5	30.0	28.0	25.5	23.5
20	4	39.5	37.0	34.0	31.5	29.0	27.0	25.0
22	4	41.0	38.5	36.0	33.0	30.5	28.0	26.0
25	5	43.5	41.0	38.0	35.5	32.5	30.0	28.0
30	5½	47.5	44.5	41.5	38.5	35.5	33.0	30.5
35	6	50.5	47.5	44.0	41.0	38.0	35.0	32.5
40	6	53.5	50.0	46.5	43.5	40.0	37.0	....
45	6½	56.0	52.5	49.0	45.5	42.0	....	....
50	7	58.5	55.0	51.5	47.5	44.0	....	....
55	7½	61.0	57.5	53.5	49.5	46.0	....	....
60	8	63.5	59.5	55.5	51.5	....	....	....

Western Red Cedar

Fiber Strength, 5,600 Pounds per Square Inch.
From A.S.A. Standard 05.2.

Class of Pole		1	2	3	4	5	6	7
Minimum Top Circumference (Inches)		27	25	23	21	19	17	15
Length of Pole Feet	Ground Line Distance from Butt Feet	Minimum Circumference at Six Feet from Butt (Inches)						
16	3½	....	....	....	....	23.0	21.5	19.5
18	3½	....	....	28.5	26.5	24.5	22.5	21.0
20	4	34.5	32.0	30.0	28.0	25.5	23.5	22.0
22	4	36.0	33.5	31.5	29.0	27.0	25.0	23.0
25	5	38.0	35.5	33.0	30.5	28.5	26.0	24.5
30	5½	41.0	38.5	35.5	33.0	30.5	28.5	26.5
35	6	43.5	41.0	38.0	35.5	32.5	30.5	28.0
40	6	46.0	43.5	40.5	37.5	34.5	32.0	....
45	6½	48.5	45.5	42.5	39.5	36.5	....	....
50	7	50.5	47.5	44.5	41.0	38.0	....	....
55	7½	52.5	49.5	46.0	42.5	39.5	....	....
60	8	54.5	51.0	47.5	44.0	....	....	....
65	8½	56.0	52.5	49.0	45.5	....	....	....
70	9	57.5	54.0	50.5	47.0	....	....	....
75	9½	59.5	55.5	52.0	48.5	....	....	....
80	10	61.0	57.0	53.5	49.5	....	....	....
85	10½	62.5	58.5	54.5	....	....	....	....
90	11	63.5	60.0	56.0	....	....	....	....

Appendix J (Continued)

Chestnut

Fiber Strength, 6,000 Pounds per Square Inch.
From A.S.A. Standard 05.3.

Class of Pole		1	2	3	4	5	6	7
Minimum Top Circumference (Inches)		27	25	23	21	19	17	15
Length of Pole Feet	Ground Line Distance from Butt Feet	Minimum Circumference at Six Feet from Butt (Inches)						
16	3½	-------	-------	-------	-------	22.5	21.0	19.5
18	3½	-------	-------	28.0	26	24.0	22.0	20.5
20	4	33.5	31.5	29.5	27.0	25.0	23.0	21.5
22	4	35.0	33.0	30.5	28.5	26.5	24.5	22.5
25	5	37.0	34.5	32.5	30.0	28.0	25.5	24.0
30	5½	40.0	37.5	35.0	32.5	30.0	28.0	26.0
35	6	42.5	40.0	37.5	34.5	32.0	30.0	27.5
40	6	45.0	42.5	39.5	36.5	34.0	31.5	29.5
45	6½	47.5	44.5	41.5	38.5	36.0	33.0	31.0
50	7	49.5	46.5	43.5	40.0	37.5	34.5	32.0
55	7½	51.5	48.5	45.0	42.0	39.0	36.0	-------
60	8	53.5	50.0	46.5	43.5	-------	-------	-------
65	8½	55.0	51.5	48.0	45.0	-------	-------	-------
70	9	56.5	53.0	-------	-------	-------	-------	-------

Lodgepole Pine

Fiber Strength, 6,600 Pounds per Square Inch.
From A.S.A. Standard 05.5.

Class of Pole		1	2	3	4	5	6	7
Minimum Top Circumference (Inches)		27	25	23	21	19	17	15
Length of Pole Feet	Ground Line Distance from Butt Feet	Minimum Circumference at Six Feet from Butt (Inches)						
16	3½	-------	-------	-------	-------	22.0	20.5	19.0
18	3½	-------	-------	27.5	25.5	23.5	21.5	20.0
20	4	32.5	30.5	28.5	26.5	24.5	22.5	21.0
22	4	34.0	32.0	30.0	27.5	25.5	23.5	22.0
25	5	36.0	33.5	31.0	29.0	27.0	25.0	23.0
30	5½	39.0	36.5	34.0	31.5	29.0	27.0	25.0
35	6	41.5	38.5	36.0	33.5	31.0	28.5	26.5
40	6	44.0	41.0	38.0	35.5	33.0	30.5	28.0
45	6½	46.0	43.0	40.0	37.0	34.5	32.0	29.5
50	7	48.0	45.0	42.0	39.0	36.0	33.5	31.0
55	7½	49.5	46.5	43.5	40.5	37.5	34.5	-------
60	8	51.5	48.0	45.0	42.0	38.5	-------	-------
65	8½	53.0	49.5	46.0	43.0	-------	-------	-------
70	9	54.5	51.0	47.5	-------	-------	-------	-------
75	9½	56.0	52.5	-------	-------	-------	-------	-------

Appendix J (Continued)

Southern Pine (Creosoted) and Douglas Fir (Creosoted)

Fiber Strength, 7,400 Pounds per Square Inch.
From A.S.A. Standards 05.4 and 05.6.

Class of Pole		1	2	3	4	5	6	7
Minimum Top Circumference (Inches)		27	25	23	21	19	17	15
Length of Pole Feet	Ground Line Distance from Butt Feet	Minimum Circumference at Six Feet from Butt (Inches)						
16	3½	....	....	....	....	21.5	19.5	18.0
18	3½	....	....	26.5	24.5	22.5	21.0	19.0
20	4	31.5	29.5	27.5	25.5	23.5	22.0	20.0
22	4	33.0	31.0	29.0	26.5	24.5	23.0	21.0
25	5	34.5	32.5	30.0	28.0	26.0	24.0	22.0
30	5½	37.5	35.0	32.5	30.0	28.0	26.0	24.0
35	6	40.0	37.5	35.0	32.0	30.0	27.5	25.5
40	6	42.0	39.5	37.0	34.0	31.5	29.0	27.0
45	6½	44.0	41.5	38.5	36.0	33.0	30.5	28.5
50	7	46.0	43.0	40.0	37.5	34.5	32.0	29.5
55	7½	47.5	44.5	41.5	39.0	36.0	33.5	....
60	8	49.5	46.0	43.0	40.0	37.0	34.5	....
65	8½	51.0	47.5	44.5	41.5	38.5	....	....
70	9	52.5	49.0	46.0	42.5	39.5	....	....
75	9½	54.0	50.5	47.0	44.0	....	....	....
80	10	55.0	51.5	48.5	45.0	....	....	....
85	10½	56.5	53.0	49.5	....	....	....	....
90	11	57.5	54.0	50.5	....	....	....	....

Appendix K

Example of computation of clearance between power wires and communication wires where an open-wire communication line crosses over the tracks of a railroad and under an open-wire power line in the same span.

Assume the case in which the power line carries a single-phase two-wire circuit of 6,900 volts between wires, the wires attached to pin-type insulators on wood crossarms and that each wire consists of two strands of solid copper and one strand of copper-covered steel, the overall diameter of which is 0.230 inch. Assume also that the crossing is located in the heavy loading district and that the length of the power line span concerned is 255 feet. The method of determining the required clearance between the lowest power wire and the highest communication wire consists of the following steps:

(a) Referring to Table E-2; the power line takes the classification of open supply wires, 750 to 8,700 volts and the basic clearance is, therefore, four feet.

(b) Referring to paragraph E-6 (a); since the crossing is located in the heavy loading district, and the power line span exceeds 175 feet in length, an increase in clearance is required. Referring to the second table in subparagraph (1) of paragraph E-6 (a), the wire used in this example takes the classification of a "small conductor" since it is stranded, is other than all-copper and has an overall diameter less than 0.275 inch. Referring now to the first table in this same subparagraph, it will be seen that the amount of clearance increase for a "small conductor" in the heavy loading district is 0.30 feet for each ten feet by which the span length exceeds 175 feet. The span length of 255 feet exceeds 175 feet by 80 feet, so that the clearance increase is 8 multiplied by 0.30 feet, or 2.4 feet. The total clearance is, therefore, the sum of 4 and 2.4, or 6.4 feet.

(c) This clearance is applicable if the communication line crosses under the power line at or near the middle of the power line span where the sags of the power wires will be greatest when they are loaded with ice. Since the increased sag of the power wires caused by ice loading is less near the power poles than at mid-span, the clearance need not be as great as 6.4 feet if the point where the communication line crosses under the power line (crossing point) is other than at the middle of the power line span. To take account of this permissible decrease, another step is necessary.

(d) Referring to Table E-4; assume that the distance from the nearest power pole to the center line of the communication line is 51 feet or 20 per cent of the length of the power line span. The corresponding reduction factor given in the table for a basic clearance of 4 feet is 0.71. Multiplying this by 6.4 gives a net clearance of 4.5 feet which is the clearance that should be provided under the conditions assumed. If this clearance had been less than 4 feet, the basic clearance of 4 feet should have been provided in accordance with the requirements of subparagraph (2) of paragraph E-6 (a).

(e) The above assumes that the supply wires cross over the communication wires at a distance of more than 6 feet horizontally from the nearest communication line pole. In accordance with note (e) of Table E-2, if this horizontal distance is less than 6 feet, the basic clearance used in the above computations should be 6 feet and the clearance under the conditions assumed above would be 8.4 feet at mid-span or 6.6 feet at the 20 per cent point.

(f) The above takes care of the clearance increase required by paragraph E-6 (a). The next step is to determine the further increase required by the voltage of the power circuit as given in paragraph E-6 (b). In the case assumed, since the voltage is less than 50,000 volts, no increase is required and the clearance as determined in step (d) or (e) above would meet the combined requirements of paragraphs E-6 (a) and E-6 (b). Had the voltage been 69,000 instead of 6,900 volts, the basic clearance from Table E-2 would have been 6 feet, the clearance due to span length would have been that determined in step (e) above to which would be added ½ inch for each 1,000 volts that the voltage exceeds 50,000 volts. This increase would amount to 9½ inches, or 0.8 feet, and the total clearance would have been 9.2 feet at mid-span, or 7.4 feet at the 20 per cent point.

(g) The final factor which enters into the determination of the clearance is the method of support of the power conductors as given in paragraph E-6 (c). The object of this clearance increase is to insure that a total clearance is provided such that at least the basic clearance called for in Table E-2 will be maintained in the event that the power conductor is broken in the span adjacent to the crossing in those situations where the conductor is more or less rigidly supported at one crossing structure and at the other crossing structure is supported by suspension or other type insulators which are free to swing and thereby permit a large increase in the sag of the power wire in the crossing span. Where the power conductor is supported by pin-type insulators at both crossing structures, as assumed in the example in this appendix, this effect is not present and no increase in clearance is required for this item. The same result would have obtained had the power conductor been supported by suspension-type insulators at both crossing structures. This effect is important only where the method of supporting the power conductor is such as not to permit the same freedom of movement of the conductor at one crossing structure as at the other. The determination of the increase in sag which would result from such dissimilar supporting arrangements is complicated and since it is a type of construction which will rarely be encountered where this specification is involved, it will generally be found preferable to obtain the information from the engineers of the company owning the power line rather than attempt to compute it.

Appendix L

TYPICAL COMMUNICATION LINE CROSSING DATA SHEET

(A data sheet of the type illustrated below shall be filled out by the party planning to erect wires across the railroad and forwarded to the Superintendent of Communication or other designated officer, together with the plan and other pertinent information, as a part of the notice required by paragraph C-1.)

Name of party desiring crossing..
Location of proposed crossing..

1. Poles—Kind of timber—Treated or untreated........................
2. Poles—Class and length........................
3. Poles—Depth of setting........................
4. Poles—Setting—Kind of earth, i.e., rock, firm earth or swampy ground....
5. Guys, Side—Number, kind and size........................
6. Guys, Side—Nominal breaking strength........................
7. Guys, Head—Number, kind and size........................
8. Guys, Head—Nominal breaking strength........................
9. Guy Clamps—Kind and size........................
10. Guy Clamps—Number at pole end........................
11. Guy Clamps—Number at guy rod end........................
12. Guy Rods—Kind and size........................
13. Anchors—Kind and size........................
14. Anchors—Depth of setting........................
15. Crossarms—Number, immediate construction........................
16. Crossarms—Number, future construction........................
17. Crossarms—Material........................
18. Crossarms—Size........................
19. Crossarms—Number of pins per arm........................
20. Pins—Material........................
21. Pins—Type........................
22. Pins—Size........................
23. Pins—If metal, state if galvanized........................
24. Insulators—Material........................
25. Insulators—Type........................
26. Wires—Material and number........................
27. Wires—Size and gage........................
28. Wires, supply, involved in crossing—Voltage........................
29. Suspension Strand—Kind and size........................
30. Suspension Strand—Nominal breaking strength........................
31. Suspension Strand Attachment—Kind and size of through bolt..........
32. Suspension Strand Attachment—Type of suspension clamp..........
33. Suspension Strand Attachment—Type of safety strap..........
34. Suspension Strand Attachment—Kind and size of safety strap bolt......
35. Suspension Strand Attachment—Type of reinforcing links..........
36. Suspension Strand Attachment—Kind and size of reinforcing link bolts
37. Cable, if any, diameter, inches........................
38. Cable, if any, weight, pounds, per foot........................
39. Cable Rings—Material........................
40. Cable Rings—Type........................
41. Cable Rings—Spacing........................

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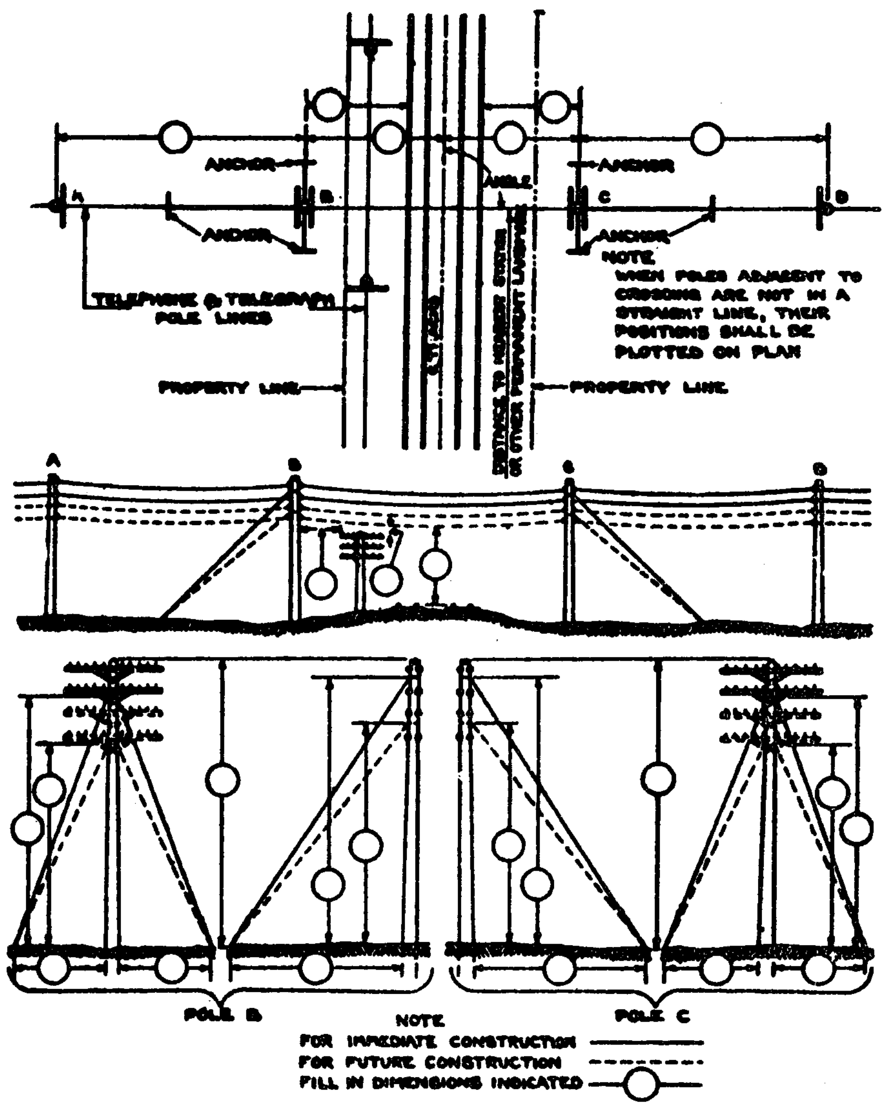
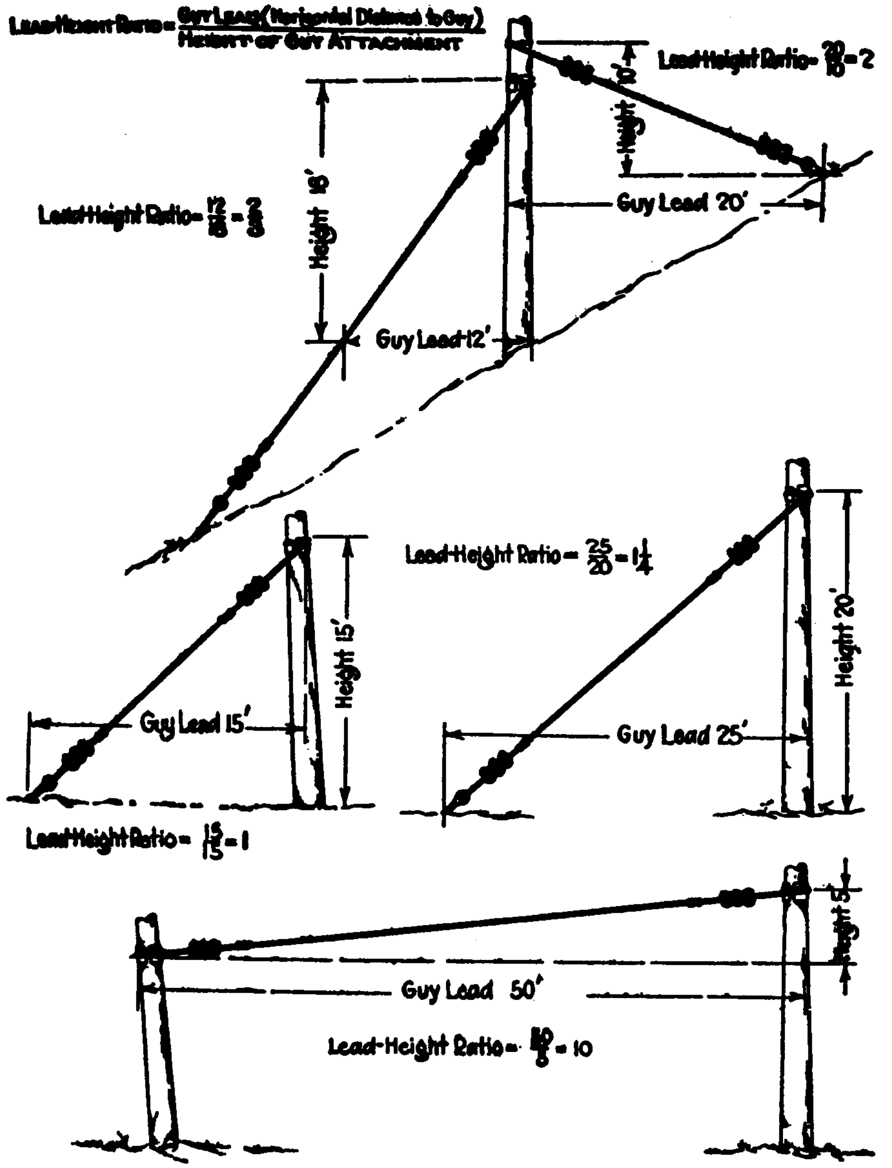


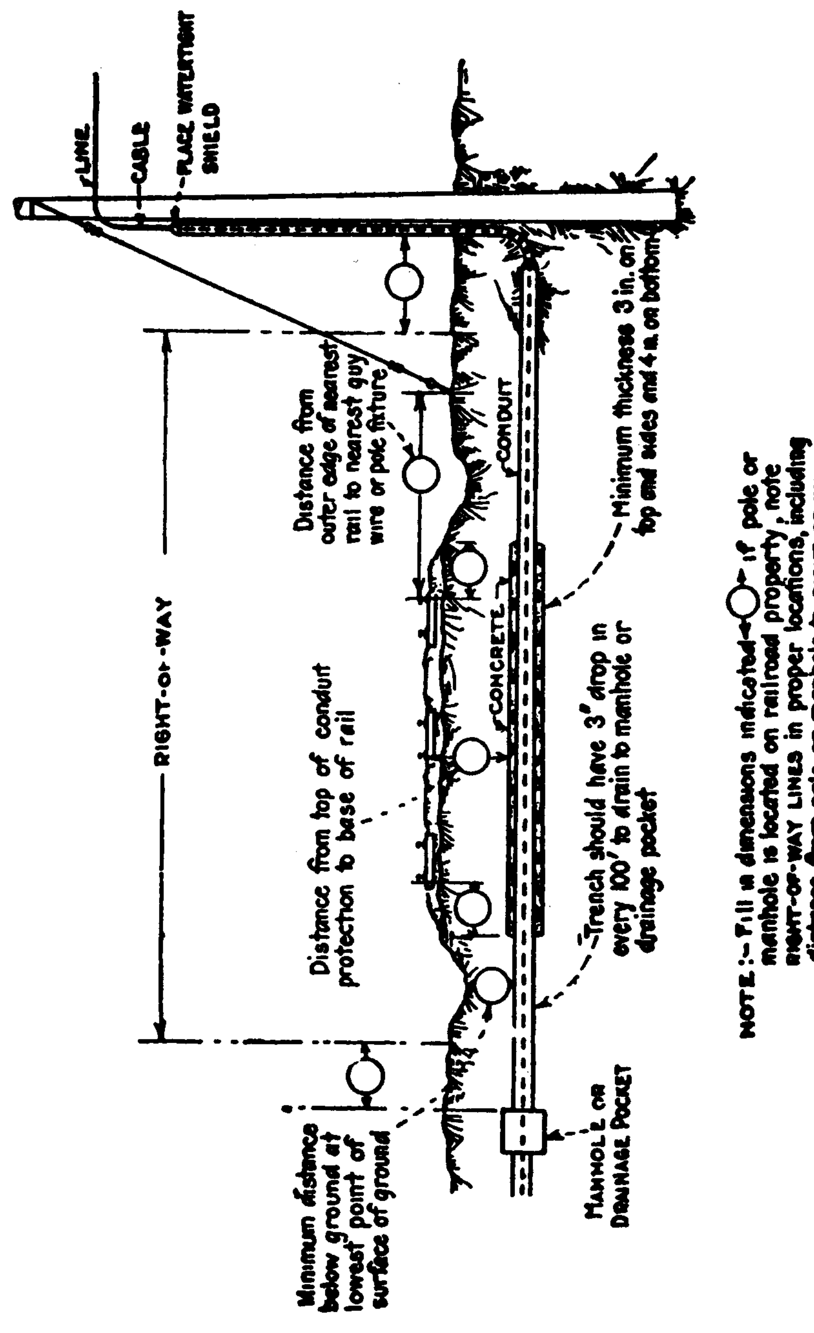
Typical Drawing for Communication Lines Crossing over Railroads

T & T 1029

June, 1928; August, 1922



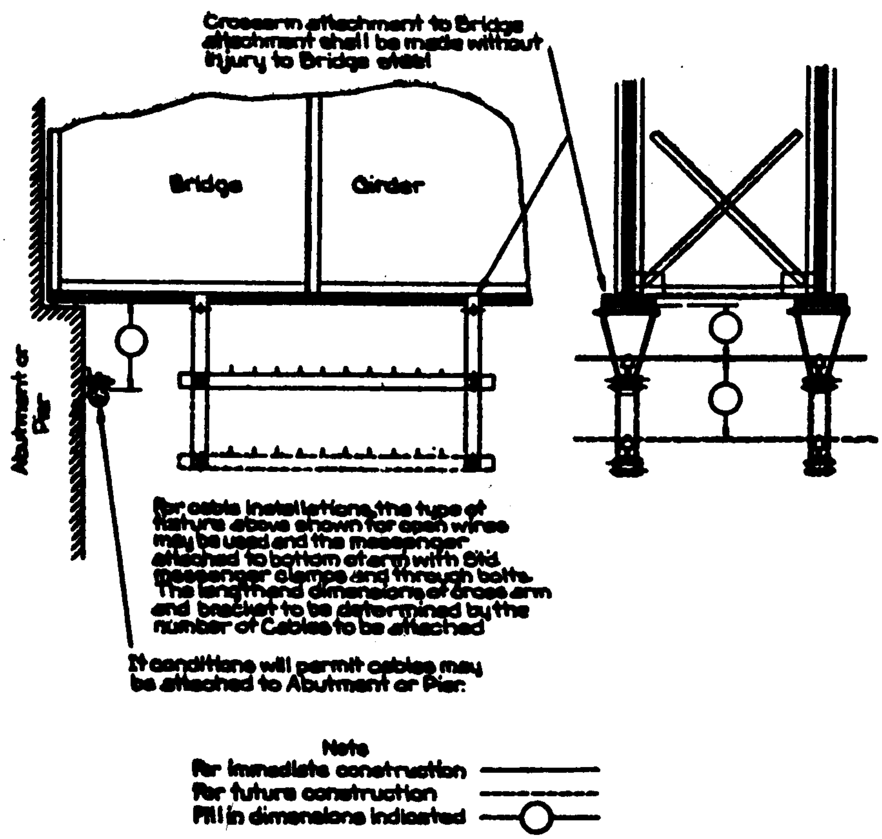
Guy Lead and Height and Their Ratio
T & T 1246
June, 1928; June, 1923; January, 1922



Typical Arrangement of Underground Crossing

T & T 1888

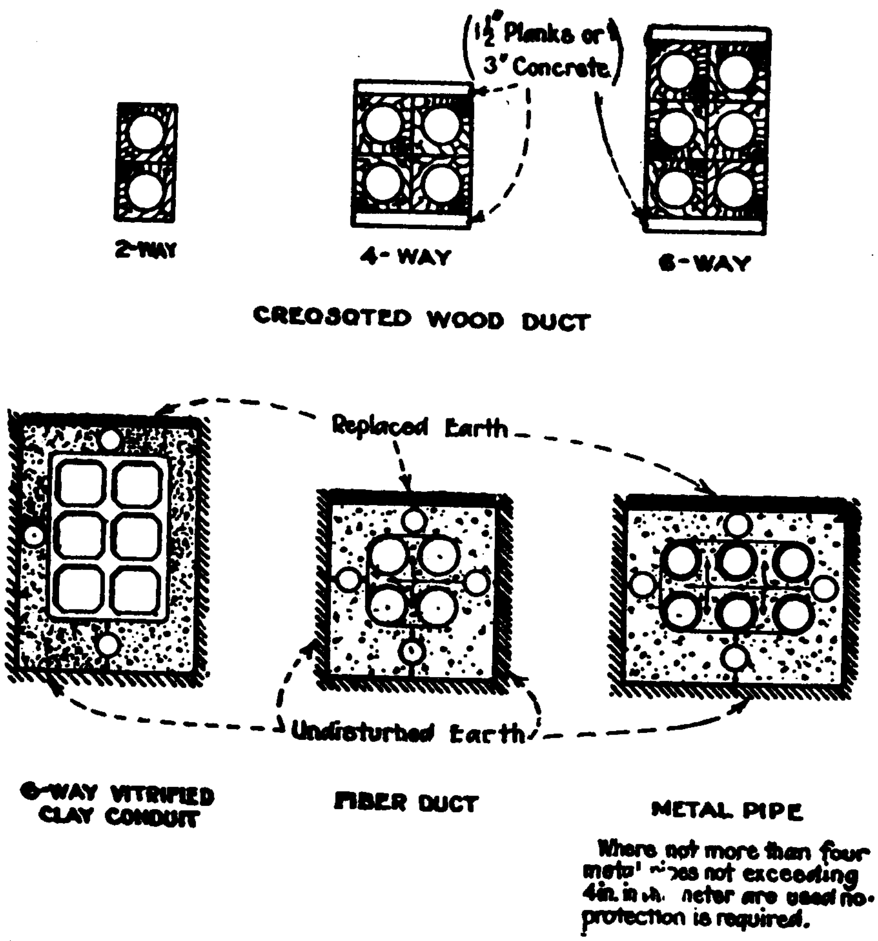
June, 1923



Typical Drawing for Communication Lines Crossing Under Bridges

T & T 1384

June, 1928



Typical Arrangement of Conduits for Underground Crossing

T & T 1385

June, 1923

Association of American Railroads
Communications Section

(Adopted June 1946)

FORM TO ACCOMPANY COMMUNICATION CROSSING APPLICATION

LOCATION

SPACE FOR APPLICANT'S USE

SPACE FOR RAILROAD CO. USE

OVERHEAD CROSSING

POLES	POLE NO.	POLE NO.	POLE NO.	POLE NO.
SPECIES				
TREATMENT				
CLASS				
LENGTH				
DEPTH OF SETTING				
EARTH OR ROCK				

CROSSARMS	MATERIAL	SIZE
	NO. NOW	NO. ULTIMATELY
CABLE - PRS.	DIA.	WT. LBS. PER FT.
CABLE RINGS - MATERIAL		SPACING
SUSPN. STRAND - MATERIAL		STRENGTH
CABLE - PRS.	DIA.	WT. LBS. PER FT.
CABLE RINGS - MATERIAL		SPACING
SUSPN. STRAND - MATERIAL		STRENGTH
WIRE LASHING - SPACING OF SPIRALS		

UNDERGROUND CROSSING

CABLE	PAIRS	CABLE	PAIRS
CABLE	PAIRS	CABLE	PAIRS

DATA TO BE SHOWN ON DRAWING

1 North and south direction.
2 Boundaries of railroad right-of-way, locations of rails, streets and highways.

Overhead Crossing

3 Locations of crossing and adjacent poles with regard to rails and railroad right-of-way.
4 Locations of poles and wires of other lines crossed over or under in the crossing span.
5 Lengths of crossing and adjacent spans and distance along the line from nearest crossing pole to nearest rail. Where the line crosses at an angle to the center line of the rails, show the horizontal distance from each crossing pole to the nearest rail.
6 Vertical clearance at 60°F. of lowest crossing wires above rails.
7 Vertical clearance at 60°F. of lowest crossing wires above the structures or wires of other lines crossed over in the crossing span.
8 Vertical clearance at 60°F. of highest crossing wires below the wires or structures of other lines crossed under in the crossing span.
9 Where the structures of other lines are located near the crossing line in the crossing span, show the clearance of the nearest crossing wires from each such structure.
10 Head and side guys on each crossing pole indicating height, lead and strength of each guy. If head or side guys are omitted, so indicate. Show special cases of guying in detail.
11 Pole head diagram of crossing line.
12 Kinds and sizes of wires and stringing sag at 60°F.
13 Kind and strength of drop wires and methods of attachments.

Underground Crossing

14 Material, size and number of conduits and protection provided under the roadbed.
15 Vertical clearance of conduit or buried cables below base of rails.
16 Vertical and horizontal clearances from other adjacent underground structures within confines of railroad right-of-way.
17 Location of manholes, handholes or risers on railroad right-of-way.

Underbridge Crossing

18 Location and arrangement of conductors or cables in regard to bridge structure showing vertical and horizontal clearance of nearest wires or suspension strand from bridge.
19 If open wire or cable is to be supported by cross arms or other arrangements attached to bridge structure, show method of attachment to bridge structure. Where cable is attached to a steel bridge, show method employed to prevent metallic contact between bridge structure and cable or suspension strand.

For general guide in making drawings, see Typical Drawings T&T 1029, 1383 and 1384 in Specification 1-B-1. Where space on this form is insufficient, supplemental drawings or data should be included.

....
RAILROAD

APP'D (1)________ TITLE: (2)________ TITLE:
(3)________ TITLE: (4)________ TITLE:

....
APPLICANT

APPROVED________ TITLE:
ADDRESS

....
RAILROAD

....
APPLICANT

FILE REF. ....

DR.	CHECKED	DATE	DWG.
TRACED	APPROVED	....	NO.