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APPENDIX - A

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Proposed Revisions to General Order 95 to Incorporate Load and Resistance Factor Design Methodology

Introduction

The proposed rule changes (PRCs) in this document were initially developed by the GO 95/128 Rules Committee and certain PRCs were revised during meet and confer sessions with the CPUC's Safety Enforcement Division/Electric Safety Reliability Branch engineers.

Purpose

The purpose of these PRCs is to modernize General Order 95 and align this vital General Order with an engineering methodology, Load and Resistance Factor Design, already adopted and applied throughout most of the United States and North America.

Rationale

The following PRCs, if adopted, would make some significant changes to Section IV while also seeking to incorporate most of the current requirements of GO 95, albeit with the modifications necessary for incorporating a load and resistance factor design (LRFD) method. These changes include migrating from the "Working Stress Design (WSD) method now in Section IV to an LRFD method that is consistent with the current structural design methodology embedded in the National Electrical Safety Code. Although these PRCs reflect the LRFD methodology incorporated in the NESC, this work product is not an attempt to transplant the NESC's strength and loading rules into GO 95. The initial goal is to provide a framework of rules in GO 95 that improves control of structural reliability and at some point in the future supports a transition to Reliability-Based Design (RBD). It is also important to note that as a starting point, the load and strength (aka resistance) factors in new Table 4-2 of Rule 44 (associated with Light Loading and Heavy Loading criteria) were selected to yield the same results as applying the current 'safety factors' via a WSD method in Rule 44.

In the Rule's Committee's view, there are several shortcomings to applying the existing safety factors requirements. Presently, the result of WSD is inconsistent reliability for different materials and components. This shortcoming has not been fully addressed in these proposals due to the initial challenges of replacing a long held, albeit outdated WSD methodology with a more modern and industry tested methodology (LRFD). Such challenges include but are not limited to – ensuring technical accuracy and completeness, agreeing on the correct verbiage and terms of art to replace the term 'safety factor', validating the strength criteria and sources referenced for information on materials, correcting existing verbiage conflicts or errors, while remaining mindful of editorial and ministerial changes. For example, Appendix F may need to be revised to include examples of how to apply the LRFD methodology. These examples would illustrate that the LRFD format yields essentially the same results as previously allowed by applying the WSD methodology.

A transition to an LRFD methodology would modernize GO 95. The WSD methodology (currently in GO 95) is basic, simple, and attempts to ensure that overhead line designs will provide adequate safety and reliability at reasonable costs through the selection of components so that the effects of the loads (e.g., bending stresses) to which the selected line elements (poles, crossarms, insulators, hardware, etc…) are subjected to will not exceed designated material/component/structure strength characteristics when divided by a prescribed factor of safety. While simple to use, this methodology has several limitations including (but not limited to):1) WSD does not directly or adequately account for variability in loads and strengths, which is evidenced by the current debate and misunderstanding regarding the safety and reliability provided by application of the minimum requirements set forth in Section IV of GO 95, and 2) the safety factors used in WSD are subjective and can be misleading as is evidenced by the disparity in structural reliability provided by wood and steel structures designed using the safety factors currently in Table 4 of Section IV.

Like WSD, LRFD is intended to ensure that selected materials and line elements will provide adequate safety and reliability at reasonable costs. However, LRFD accomplishes this in a different way than WSD. Rather than dividing material/component/structure strength by a safety factor, LRFD uses an approach in which load effects and strengths are segregated such that they can be treated separately. The desired level of safety and reliability is established by: 1) multiplying the loads by load factors (load factors are typically greater than 1.0) determined with consideration given to the characteristics of the load (e.g., the statistical variability of the loads as well as the quality and quantity of available loading data), and 2) multiplying the material/component/structure strengths by resistance factors (aka strength factors) (resistance/strength factors are typically less than 1.0) that are established based on consideration of the characteristics of the materials, components, and structures (e.g., the statistical variability of the strength properties as well as the quality and quantity of data available on the properties).

In day-to-day practice the application of LRFD requires little to no more effort than applying the WSD method. However, it is the underlying framework and principles upon which LRFD relies that provide a clear and traceable approach to account for variability, to base criteria selection on reliability theory, and to guide the designs of different grades of construction to rational and consistent reliability levels. LRFD also promotes awareness of the inescapable fact that there is a finite, but mostly controllable, probability of failure for every engineered facility and fosters an understanding that a structural failure, that is not attributable to errors in the design process, should be viewed as occasionally-expected events albeit with controllably low probabilities of occurrence rather than as events that can only be attributed to the consequences of poor designs, construction errors, or completely unexpected/unanticipated loadings.

Further, LRFD is information centric and provides a framework for adopting new and/or improved information on loads, load effects, strengths and structural behavior, and identifying the limitations and deficiencies of current data. LRFD also fosters a more complete understanding of material properties, actual loads, and the ways structures respond to loads, which should ultimately help California’s electric and communication companies produce improved designs that are safe and secondarily, cost effective.

Table of Contents

Revised PRC 1 Rule 44 – Safety Factors

Original

44 Safety Factors

The safety factors specified in these rules are the minimum allowable ratios of material and/or line element strengths to the effect of design loads as specified in Rule 43.

Note: Revised March 30, 1968 by Decision No. 73813, February 13, 1974 by Decision No. 82466 and February 5, 2014 by Decision No. 14-02-015.

Strikeout/underline

44 ~~Safety~~ Load and Strength Factors

~~The safety factors specified in these rules are the minimum allowable ratios of material and/or line element strengths to the effect of design loads as specified in Rule 43.~~

~~The ratios of the load factors in Table 4-1 to the strength factors in Table 4-2 are analogous to factors of safety (i.e., safety factors). These factors are applied to account for variabilities (e.g., deterioration, material properties, environmental loads, additional attachments, construction details and workmanship).~~

The effects of the loads in Rule 43, multiplied by the load factors in Table 4-1, shall be less than or equal to the strengths of materials and/or line elements multiplied by the applicable strength factors in Table 4-2.

> Note 1: Deformation, deflection, or displacement of the structure or parts of the structure may change the effects of the assumed loads. When calculating stresses and loads that account for deformation, deflection, or displacement of supporting structures and other line elements, calculations should be made using Rule 43 loads prior to application of the load factors.
>
> Note 2: The ratios of the load factors in Table 4-1 to the strength factors in Table 4-2 are analogous to factors of safety (i.e., safety factors). These factors are applied to account for variabilities (e.g., deterioration, material properties, environmental loads, additional attachments, construction details and workmanship). See Table F-1 in Appendix F for a summary of comparable factors of safety for various line components.

Note: Revised March 30, 1968 by Decision No. 73813, February 13, 1974 by Decision No. 82466 and February 5, 2014 by Decision No. 14-02-015.

44 Load and Strength Factors

The effects of the loads in Rule 43, multiplied by the load factors in Table 4-1, shall be less than or equal to the strengths of materials and/or line elements multiplied by the applicable strength factors in Table 4-2.

Note 1: Deformation, deflection, or displacement of the structure or parts of the structure may change the effects of the assumed loads. When calculating stresses and loads that account for deformation, deflection, or displacement of supporting structures and other line elements, calculations should be made using Rule 43 loads prior to application of the load factors.

Note 2: The ratios of the load factors in Table 4-1 to the strength factors in Table 4-2 are analogous to factors of safety (i.e., safety factors). These factors are applied to account for variabilities (e.g., deterioration, material properties, environmental loads, additional attachments, construction details and workmanship). See Table F-1 in Appendix F for a summary of comparable factors of safety for various line components.

Note: Revised March 30, 1968 by Decision No. 73813, February 13, 1974 by Decision No. 82466 and February 5, 2014 by Decision No. 14-02-015.

Revised PRC 2   Rule 44.1 – Installation and Reconstruction

__Original__

44.1 Installation and Reconstruction

Lines and elements of lines, upon installation or reconstruction, shall provide as a minimum the safety factors specified in Table 4. The design shall consider all supply and communication facilities planned to occupy the structure. For purposes of this rule, the term "planned" applies to the facilities intended to occupy the structure that are actually known to the constructing company at the time of design.

The entity responsible for performing the loading calculation(s) for an installation or reconstruction shall maintain records of these calculations for the service life of the pole or other structure for which a loading calculation was made and shall provide such information to authorized joint use occupants and the Commission upon request.

Note: Revised January 12, 2012 by Decision No. 1201032 and February 5, 2014 by Decision No. 14-02-015.

Table 4: Minimum Safety Factors

Line Element	Grades of Construction		
	Grade "A"	Grade "B	Grade "C"
Conductors, splices and conductor fastenings (other than tie wires)	2	2	2
Pins	2	2	2
Pole line hardware	2	2	2
Line Insulators (mechanical)	3	2	2
Guy insulators (mechanical)			
Interlocking	2	2	2
Noninterlocking glass fiber	3	2 (a)	2 (b)
Guys	2	2	2
Messengers and span wires	2	2	2
Foundations against uplift	1.5	1.5	1.5
Foundations against depression	3	2	2
Poles Towers and Structures			
Wood	4	3	2
Metal (including elements of foundations)	1.5 (c)	1.25 (c)	1.25 (c)
Reinforced concrete	4	3	3
Prestressed or post-tensioned concrete	1.8	1.5	1.5
Other engineered materials	1.5	1.25	1.25
Crossarms			
Wood	2	2	2
Metal	1.5(c)	1.25(c)	1.25(c)
Prestressed Concrete	1.8	1.5	1.5
Other engineered materials	1.5	1.25	1.25

a) Insulators are to be replaced before safety factors have been reduced (due to deterioration or changes in construction, arrangement, or other conditions subsequent to installation) to less than 95 percent of the safety factor specified in Rule 44.1.

b) Insulators are to be replaced before safety factors have been reduced (due to deterioration or changes in construction, arrangement, or other conditions subsequent to installation) to less than 75 percent of the safety factor specified in Rule 44.1.

c) For aluminum members subject to tension caused by one or more estimated loads and where the critical load combination for the tension member would not endanger adjacent compression members, the factor of safety on ultimate tension shall be 2 for Grade "A" construction and 1.67 for Grades "B" and "C" construction.

Note: Revised July 26, 1966 by Decision No. 71009; January 6, 1968 by Decision No. 73455; March 30, 1968 by Decision No. 73813; February 13, 1974 by Decision No. 82466; January 21, 1992 by Resolution SU–10, January 13, 2005 by Decision No. 0501030 and February 5, 2014 by Decision No. 14-02-015.

Strikeout/Underline

44.1 Installation and Reconstruction

~~Lines and elements of lines, upon installation or reconstruction, shall provide as a minimum the safety factors specified in Table 4.~~ The load and strength factors in Table 4-1 and Table 4-2 shall be used when designing lines and elements of lines for installation or reconstruction.

The design shall consider the structural loading and mechanical strength requirements of all supply and communication facilities planned to occupy the structure. For purposes of this rule, the term "planned" applies to the facilities intended to occupy the structure that are actually known to the constructing company at the time of design.

The entity responsible for performing the loading calculation(s) for an installation or reconstruction shall maintain records of these calculations for the service life of the pole or other structure for which a loading calculation was made and shall provide such information to authorized joint use occupants and the Commission upon request.

Note: Revised January 12, 2012 by Decision No. 1201032 and February 5, 2014 by Decision No. 14-02-015.

~~**Table 4: Minimum Safety Factors**~~ *(Strike existing Table 4 and replace with new Table 4-1 and new Table 4-2)*

Table 4-1: Minimum Load Factors

Load Condition	Load Factors		
	"Grade A"	"Grade B"	"Grade C"
Vertical Loads	1.500	1.250	1.250
Wind Loads	1.500	1.250	1.250
Wire Tension Loads	1.500	1.250	1.250

Table 4-2: Maximum Strength Factors

Line Element	Strength Factors		
	"Grade A"	"Grade B"	"Grade C"
Conductors, splices and conductor fastenings (other than tie wires)	0.750	0.625	0.625
Pins	0.750	0.625	0.625
Pole line hardware	0.750	0.625	0.625
Line Insulators (mechanical)	0.500	0.625	0.625
Guy insulators (mechanical)			
Interlocking	0.750	0.625	0.625
Noninterlocking glass fiber	0.500	0.625(a)	0.625(b)
Guys	0.750	0.625	0.625
Messengers and span wires	0.750	0.625	0.625
Foundations against uplift	1.000	0.833	0.833
Foundations against depression	0.500	0.625	0.625
Poles, Towers and Structures			
Wood	0.375	0.415	0.625
Metal (including elements of foundations)	1.000(c)	1.000(c)	1.000(c)
Reinforced concrete	0.375	0.415	0.415
Prestressed or post-tensioned concrete	0.830	0.830	0.830
Other engineered materials	1.000	1.000	1.000
Crossarms			
Wood	0.750	0.625	0.625
Metal	1.000(c)	1.000(c)	1.000(c)
Prestressed Concrete	0.830	0.830	0.830
Other engineered materials	1.000	1.000	1.000

(a) Insulators are to be replaced before their mechanical strengths safety factors have been reduced (due to deterioration or changes in construction, arrangement, or other conditions subsequent to installation) to less than 95 percent of the strength required at installation. safety factor specified in Rule 44.1.

(b) Insulators are to be replaced before their mechanical strengths safety factors have been reduced (due to deterioration or changes in construction, arrangement, or other conditions subsequent to installation) to less than 75 percent of the strength required at installation. safety factor specified in Rule 44.1.

(c) For aluminum members subject to tension caused by one or more estimated loads and where the critical load combination for the tension member would not endanger adjacent compression members, the strength factor of safety on ultimate tension shall be .75 2 for Grades "A", "B" and "C" construction. and 1.67 for Grades "B" and "C" construction.

Proposed Final

44.1 Installation and Reconstruction

The load and strength factors in Table 4-1 and Table 4-2 shall be used when designing lines and elements of lines for installation or reconstruction.

The design shall consider the structural loading and mechanical strength requirements of all supply and communication facilities planned to occupy the structure. For purposes of this rule, the term "planned" applies to the facilities intended to occupy the structure that are actually known to the constructing company at the time of design.

The entity responsible for performing the loading calculation(s) for an installation or reconstruction shall maintain records of these calculations for the service life of the pole or other structure for which the loading calculation was made and shall provide such information to authorized joint use occupants and the Commission upon request.

Note: Revised January 12, 2012 by Decision No. 1201032 and February 5, 2014 by Decision No. 14-02-015.

Table 4-1: Minimum Load Factors

Load Condition	Load Factors		
	"Grade A"	"Grade B"	"Grade C"
Vertical Loads	1.500	1.250	1.250
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	"Grade A"	"Grade B"	"Grade C"
Conductors, splices and conductor fastenings (other than tie wires)	0.750	0.625	0.625
Pins	0.750	0.625	0.625
Pole line hardware	0.750	0.625	0.625
Line Insulators (mechanical)	0.500	0.625	0.625
Guy insulators (mechanical)			
Interlocking	0.750	0.625	0.625
Noninterlocking glass fiber	0.500	0.625(a)	0.625(b)
Guys	0.750	0.625	0.625
Messengers and span wires	0.750	0.625	0.625
Foundations against uplift	1.000	0.833	0.833
Foundations against depression	0.500	0.625	0.625
Poles, Towers and Structures			
Wood	0.375	0.415	0.625
Metal (including elements of foundations)	1.000(c)	1.000(c)	1.000(c)
Reinforced concrete	0.375	0.415	0.415
Prestressed or post-tensioned concrete	0.830	0.830	0.830
Other engineered materials	1.000	1.000	1.000
Crossarms			
Wood	0.750	0.625	0.625
Metal	1.000(c)	1.000(c)	1.000(c)
Prestressed Concrete	0.830	0.830	0.830
Other engineered materials	1.000	1.000	1.000

(a) Insulators are to be replaced before their mechanical strengths have been reduced (due to deterioration or changes in construction, arrangement, or other conditions subsequent to installation) to less than 95 percent of the strength required at installation.

(b) Insulators are to be replaced before their mechanical strengths have been reduced (due to deterioration or changes in construction, arrangement, or other conditions subsequent to installation) to less than 75 percent of the strength required at installation.

(c) For aluminum members subject to tension caused by one or more estimated loads and where the critical load combination for the tension member would not endanger adjacent compression members, the strength factor on ultimate tension shall be .75 for Grades "A", "B" and "C" construction.

Revised PRC 3 Rule 44.2 – Additional Construction

Original

44.2 Additional Construction

Any entity planning the addition of facilities shall ensure that the addition of the facilities will not reduce the safety factors below the values specified by Rule 44.3.

If performed, the entity responsible for performing loading calculations for additional construction shall maintain these loading calculations for the service life of the pole or other structure for which a loading calculation was made and shall provide such information to authorized joint use occupants and the Commission upon request.

Any loading calculations performed for wood structures more than 15 years old shall incorporate the results of intrusive inspections performed within the previous five years.

Note: Added August 20, 2009 by Decision No. 09-08-029. Revised January 12, 2012 by Decision No. 1201032, and February 5, 2014 by Decision No. 14-02-015.

Strikeout/underline

44.2 Additional Construction

Any entity planning the addition of facilities shall ensure that, following the addition~~, of the facilities~~ supporting structures, including their members and connections, will ~~not reduce the safety factors below the values~~ meet the strength requirements specified by Rule 44.3.

If performed, the entity responsible for performing loading calculations for additional construction shall maintain these loading calculations for the service life of the pole or other structure for which a loading calculation was made and shall provide such information to authorized joint use occupants and the Commission upon request.

Any loading calculations performed for wood structures more than 15 years old shall incorporate the results of intrusive inspections performed within the previous five years.

The previous working stress design methodology may still be used to show compliance with Rule 44.2 for lines or portions of lines designed, constructed, added, or reconstructed prior to the adoption of the load factor and strength factor requirements under R.24-10-005 in this general order.

Note: Added August 20, 2009 by Decision No. 09-08-029. Revised January 12, 2012 by Decision No. 1201032, and February 5, 2014 by Decision No. 14-02-015.

Proposed Final

44.2 Additional Construction

Any entity planning the addition of facilities shall ensure that, following the addition, supporting structures, including their members and connections, will meet the strength requirements specified by Rule 44.3.

If performed, the entity responsible for performing loading calculations for additional construction shall maintain these loading calculations for the service life of the pole or other structure for which a loading calculation was made and shall provide such information to authorized joint use occupants and the Commission upon request.

Any loading calculations performed for wood structures more than 15 years old shall incorporate the results of intrusive inspections performed within the previous five years.

The previous working stress design methodology may still be used to show compliance with Rule 44.2 for lines or portions of lines designed, constructed, added, or reconstructed prior to the adoption of the load factor and strength factor requirements under R.24-10-005 in this general order.

Note: Added August 20, 2009 by Decision No. 09-08-029. Revised January 12, 2012 by Decision No. 1201032, and February 5, 014 by Decision No. 14-02-015.

Revised PRC 4 Rule 44.3 – Replacement

Original

44.3 Replacement

Lines or parts thereof shall be replaced or reinforced before safety factors have been reduced (due to factors such as deterioration and/or installation of additional facilities) in Grades "A" and "B" construction to less than two-thirds of the safety factors specified in Rule 44.1 and in Grade "C" construction to less than one-half of the safety factors specified in Rule 44.1. Poles in Grade "C" construction that only support communication lines shall also conform to the requirements of Rule 81.3–A. In no case shall the application of this rule be held to permit the use of structures or any member of any structure with a safety factor less than one.

Note: Allowed reductions specified in this rule are modified by Table 4, Footnotes.
Note: Revised January 13, 2005 by Decision No. 0501030, January 12, 2012 by Decision No. 1201032 and February 5, 2014 by Decision No. 14-02-015

Strikeout/underline

44.3 Replacement

~~Lines or parts thereof shall be replaced or reinforced before safety factors have been reduced (due to factors such as deterioration and/or installation of additional facilities) in Grades "A" and "B" construction to less than two-thirds of the safety factors specified in Rule 44.1 and in Grade "C" construction to less than one-half of the safety factors specified in Rule 44.1.~~
Lines or parts thereof shall be replaced or reinforced before their ability to withstand the loads specified in Rule 43 is reduced (due to changes such as the addition of facilities and/or deterioration) to less than two-thirds of that required at installation by Rule 44 for Grades "A" and "B" construction, and to less than one-half of that required for Grade "C" construction.

Poles in Grade "C" construction that only support communication lines shall also conform to the requirements of Rule 81.3-A.

In no case shall the application of this rule be held to permit the use of ~~structures or any member of any structure with a safety factor less than one.~~ lines or parts thereof with strengths less than the effects of the loads specified in Rule 43.

Note: Allowed reductions specified in this rule are modified by Table 4~~,~~-2 Footnotes.

Note: Revised January 13, 2005 by Decision No. 0501030, January 12, 2012 by Decision No. 1201032, and February 5, 2014 by Decision No. 14-02-015.

Proposed Final

44.3 Replacement

Lines or parts thereof shall be replaced or reinforced before their ability to withstand the loads specified in Rule 43 is reduced (due to changes such as the addition of facilities and/or deterioration) to less than two-thirds of that required at installation by Rule 44 for Grades "A" and "B" construction, and to less than one-half of that required for Grade "C" construction.

Poles in Grade "C" construction that only support communication lines shall also conform to the requirements of Rule 81.3-A.

In no case shall the application of this rule be held to permit the use of lines or parts thereof with strengths less than the effects of the loads specified in Rule 43.

Note: Allowed reductions specified in this rule are modified by Table 4-2 Footnotes.

Note: Revised January 13, 2005 by Decision No. 0501030, January 12, 2012 by Decision No. 1201032, and February 5, 2014 by Decision No. 14-02-015.

PRC 5 Rule 45 – Transverse Strength Requirements

Original

45 Transverse Strength Requirements

In computing the transverse strength requirements of Lines (See Rule 22.1) under the conditions specified in Rule 43, safety factors at least equal to those of Rule 44 shall be used. In heavy loading areas, for supporting structures carrying more than 10 wires (not including cables and supporting messengers) where the pin spacing does not exceed 15 inches, the transverse wind load shall be calculated on two–thirds of the total number of such wires with a minimum of ten. Where there is a change in direction of conductors and messengers, an additional transverse load shall be the resultant of all tensions under the assumed loading conditions.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

45.1 Special Provisions

Where it is impossible to obtain the required transverse strength except by the use of side guys or special structures and it is physically impossible to install them at the location of the transversely weak support, the strength may be supplied by side guying the support at each side of, and as near as practicable to, such weak support with a distance not in excess of 800 feet between the supports so guyed; provided that the section of line between the transversely strong structures is weak in regard to transverse loads only, that is in a straight line and that the strength of the side guyed supports is calculated on the transverse loading of the entire section of line between them.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

Strikeout/Underline

45 Transverse Strength Requirements

In computing the transverse strength requirements of Lines (See Rule 22.1) under the conditions specified in Rule 43, ~~safety~~ load and strength factors ~~at least equal to those~~ meeting the requirements of Rule 44 shall be used. In heavy loading areas, for supporting structures carrying more than 10 wires (not including cables and supporting messengers) where the pin spacing does not exceed 15 inches, the transverse wind load shall be calculated on two–thirds of the total number of such wires with a minimum of ten. Where there is a change in direction of conductors and messengers, an additional transverse load shall be the resultant of all tensions under the assumed loading conditions.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

45.1 Special Provisions

Where it is impossible to obtain the required transverse strength except by the use of side guys or special structures and it is physically impossible to install them at the location of the transversely weak support, the strength may be supplied by side guying the support at each side of, and as near as practicable to, such weak support with a distance not in excess of 800 feet between the supports so guyed; provided that the section of line between the transversely strong structures is weak in regard to transverse loads only, that is in a straight line and that the strength of the side guyed supports is calculated on the transverse loading of the entire section of line between them.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

Proposed Final

45 Transverse Strength Requirements

In computing the transverse strength requirements of Lines (See Rule 22.1) under the conditions specified in Rule 43, load and strength factors meeting the requirements of Rule 44 shall be used. In heavy loading areas, for supporting structures carrying more than 10 wires (not including cables and supporting messengers) where the pin spacing does not exceed 15 inches, the transverse wind load shall be calculated on two–thirds of the total number of such wires with a minimum of ten. Where there is a change in direction of conductors and messengers, an additional transverse load shall be the resultant of all tensions under the assumed loading conditions.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

45.1 Special Provisions

Where it is impossible to obtain the required transverse strength except by the use of side guys or special structures and it is physically impossible to install them at the location of the transversely weak support, the strength may be supplied by side guying the support at each side of, and as near as practicable to, such weak support with a distance not in excess of 800 feet between the supports so guyed; provided that the section of line between the transversely strong structures is weak in regard to transverse loads only, that is in a straight line and that the strength of the side guyed supports is calculated on the transverse loading of the entire section of line between them.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

PRC 6 Rule 46 – Vertical Strength Requirements

Original

46 Vertical Strength Requirements

In computing vertical strength requirements, the loads upon Lines (See Rule 22.1) shall be their own weight plus the vertical loads which they support under the conditions of Rule 43, together with the effect of any difference in elevation of supports.

On structures with crossarms or guard arms, the vertical loads on the structure shall include a load of 300 lbs. at one end of one of the arms.

Safety factors shall apply as specified in Rule 44.

Strikeout/underline

46 Vertical Strength Requirements

In computing vertical strength requirements, the loads upon Lines (See Rule 22.1) shall be their own weight plus the vertical loads which they support under the conditions of Rule 43, together with the effect of any difference in elevation of supports.

On structures with crossarms or guard arms, the vertical loads on the structure shall include a load of 300 lbs. at one end of one of the arms.

~~Safety~~ Load and strength factors shall apply as specified in Rule 44.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

Proposed Final

46 Vertical Strength Requirements

In computing vertical strength requirements, the loads upon Lines (See Rule 22.1) shall be their own weight plus the vertical loads which they support under the conditions of Rule 43, together with the effect of any difference in elevation of supports.

On structures with crossarms or guard arms, the vertical loads on the structure shall include a load of 300 lbs. at one end of one of the arms.

Load and strength factors shall apply as specified in Rule 44.

PRC 7 Rule 47 – Longitudinal Strength Requirements

Original

47 Longitudinal Strength Requirements

In computing the longitudinal strength requirements of Lines (See Rule 22.1), the longitudinal load shall be considered as that due to the maximum working tension under the conditions specified in Rule 43.

Safety factors shall apply as specified in Rule 44.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

47.1 Use of Guys and Braces

The longitudinal strength requirements for poles, towers and other supporting structures shall be met either by the structure alone or with the aid of guys and/or braces. Deflection shall be limited by guys and/or braces where such structures alone, although providing the strength and safety factors required, would deflect sufficiently under the prescribed loadings to reduce clearances below the required values.

47.2 Change in Grade of Construction

Where sections of higher grade construction are located in lines of lower grade construction the longitudinal load on each end support of such sections at the level involved shall be taken as an unbalanced load in the direction of the higher grade section equal to the total pull of all conductors in that direction. For spans not exceeding 500 feet in length, where the pull in the direction of the higher grade section exceeds 30,000 lbs., the loading requirements may be modified to consider 30,000 lbs. plus one–fourth the excess above 30,000 lbs., to a maximum of 50,000 lbs. The construction of the end supports (including poles, structures, towers, crossarms, pins, insulators, conductor fastenings and guys) of such sections shall be such as to withstand at all times the load specified with a safety factor at least equal to unity.

In lieu of meeting the requirements of this rule on single poles or structures at ends of higher grade sections, the longitudinal load may be distributed over two poles or structures provided that the two poles or structures are suitably side guyed or are in a straight line with the direction of the longitudinal load of the higher grade section and that the two poles or structures comply with the requirements for the higher grade as to transverse strength and conductors between the two poles comply with the requirements for the higher grade.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

47.3 End Supports in Grades "A" or "B" Construction

In Grades "A" or "B" construction the longitudinal load on each end support of crossings, conflicts or joint use, where located in lines of the same grade of construction, shall be taken as the unbalanced load equal to the tension of one–third of the total number of conductors (not including overhead ground wires), such one–third of the conductors being so selected as to produce the maximum stress in the supports. If the application of the above results in the fractional part of a conductor, the nearest whole number of conductors shall be used. The construction of the supports (including poles, structures, towers, crossarms, pins, insulators, conductor fastenings and guys) shall be such as to withstand at all times the load specified with a safety factor at least equal to unity. Excluded from the requirements of this rule, where Grade "B" construction is required, are Class L lines crossing minor railways and conductor fastenings of Class C circuits crossing major railways.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

Strikeout/underline

47 Longitudinal Strength Requirements

In computing the longitudinal strength requirements of Lines (See Rule 22.1), the longitudinal load shall be considered as that due to the maximum working tension under the conditions specified in Rule 43.

~~Safety~~ Load and strength factors shall apply as specified in Rule 44.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

47.1 Use of Guys and Braces

The longitudinal strength requirements for poles, towers and other supporting structures shall be met either by the structure alone or with the aid of guys and/or braces. Deflection shall be limited by guys and/or braces where such structures alone, although providing the ~~and safety~~ load and strength factors required would deflect sufficiently under the prescribed loadings to reduce clearances below the required values.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

47.2 Change in Grade of Construction

Where sections of higher grade construction are located in lines of lower grade construction the longitudinal load on each end support of such sections at the level involved shall be taken as an unbalanced load in the direction of the higher grade section equal to the total pull of all conductors in that direction. For spans not exceeding 500 feet in length, where the pull in the direction of the higher grade section exceeds 30,000 lbs., the loading requirements may be modified to consider 30,000 lbs. plus one–fourth the excess above 30,000 lbs., to a maximum of 50,000 lbs. ~~The construction of the end supports (including poles, structures, towers, crossarms, pins, insulators, conductor fastenings and guys) of such sections shall be such as to withstand at all times the load specified with a safety factor at least equal to unity.~~ In no case shall the application of this rule be held to permit the design of the end supports (including poles, structures, towers, crossarms, pins, insulators, conductor fastenings and guys) with strengths less than the effects of the loads.

In lieu of meeting the requirements of this rule on single poles or structures at ends of higher grade sections, the longitudinal load may be distributed over two poles or structures provided that the two poles or structures are suitably side guyed or are in a straight line with the direction of the longitudinal load of the higher grade section and that the two poles or structures comply with the requirements for the higher grade as to transverse strength and conductors between the two poles comply with the requirements for the higher grade.

47.3 End Supports in Grades "A" or "B" Construction

In Grades "A" or "B" construction the longitudinal load on each end support of crossings, conflicts or joint use, where located in lines of the same grade of construction, shall be taken as the unbalanced load equal to the tension of one–third of the total number of conductors (not including overhead ground wires), such one–third of the conductors being so selected as to produce the maximum stress in the supports. If the application of the above results in the fractional part of a conductor, the nearest whole number of conductors shall be used. ~~The construction of the supports (including poles, structures, towers, crossarms, pins, insulators, conductor fastenings and guys) shall be such as to withstand at all times the load specified with a safety factor at least equal to unity.~~ In no case shall the application of this rule be held to permit the design of the end supports (including poles, structures, towers, crossarms, pins, insulators, conductor fastenings and guys) with strengths less than the effects of the loads.

Excluded from the requirements of this rule, where Grade "B" construction is required, are Class L lines crossing minor railways and conductor fastenings of Class C circuits crossing major railways.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

Proposed Final

47 Longitudinal Strength Requirements

In computing the longitudinal strength requirements of Lines (See Rule 22.1), the longitudinal load shall be considered as that due to the maximum working tension under the conditions specified in Rule 43.

Load and strength factors shall apply as specified in Rule 44.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

47.1 Use of Guys and Braces

The longitudinal strength requirements for poles, towers and other supporting structures shall be met either by the structure alone or with the aid of guys and/or braces. Deflection shall be limited by guys and/or braces where such structures alone, although providing the load and strength factors required would deflect sufficiently under the prescribed loadings to reduce clearances below the required values.

47.2 Change in Grade of Construction

Where sections of higher grade construction are located in lines of lower grade construction the longitudinal load on each end support of such sections at the level involved shall be taken as an unbalanced load in the direction of the higher grade section equal to the total pull of all conductors in that direction. For spans not exceeding 500 feet in length, where the pull in the direction of the higher grade section exceeds 30,000 lbs., the loading requirements may be modified to consider 30,000 lbs. plus one–fourth the excess above 30,000 lbs., to a maximum of 50,000 lbs. In no case shall the application of this rule be held to permit the design of the end supports (including poles, structures, towers, crossarms, pins, insulators, conductor fastenings and guys) with strengths less than the effects of the loads.

In lieu of meeting the requirements of this rule on single poles or structures at ends of higher grade sections, the longitudinal load may be distributed over two poles or structures provided that the two poles or structures are suitably side guyed or are in a straight line with the direction of the longitudinal load of the higher grade section and that the two poles or structures comply with the requirements for the higher grade as to transverse strength and conductors between the two poles comply with the requirements for the higher grade.

47.3 End Supports in Grades "A" or "B" Construction

In Grades "A" or "B" construction the longitudinal load on each end support of crossings, conflicts or joint use, where located in lines of the same grade of construction, shall be taken as the unbalanced load equal to the tension of one–third of the total number of conductors (not including overhead ground wires), such one–third of the conductors being so selected as to produce the maximum stress in the supports. If the application of the above results in the fractional part of a conductor, the nearest whole number of conductors shall be used. In no case shall the application of this rule be held to permit the design of the end supports (including poles, structures, towers, crossarms, pins, insulators, conductor fastenings and guys) with strengths less than the effects of the loads.

Excluded from the requirements of this rule, where Grade "B" construction is required, are Class L lines crossing minor railways and conductor fastenings of Class C circuits crossing major railways.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

Revised PRC 8 - Rule 48 – Strength of Materials

<u>Original</u>

48 Strength of Materials

Structural members and their connection shall be designed and constructed so that the structures and parts thereof will not fail or be seriously distorted at any load less than their maximum working loads (developed under the current construction arrangements with loadings as specified in Rule 43) multiplied by the safety factors in Rule 44.

Values used for the strength of material shall comply with the safety factors specified in Rule 44.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

<u>Proposed Strikeout/Underline</u>

48 Strength of Materials

~~tructural members and their connection shall be designed and constructed so that the structures and parts thereof will not fail or be seriously distorted at any load less than their maximum working loads (developed under the current construction arrangements with loadings as specified in Rule 43) multiplied by the safety factors in Rule 44.~~

~~Values used for the strength of material shall comply with the safety factors specified in Rule 44.~~

<u>Structures, including their members and connections, shall be designed and constructed to withstand the loads in Rule 43 multiplied by the appropriate load factors in Table 4-1. The effects of these loads shall not exceed the strengths of the structures, including their members and connections, multiplied by the strength factors in Table 4-2.</u>

<u>Structures, structure members, and their connections shall not fail or be seriously distorted at any load less than their maximum loads (developed under the current construction arrangements with loadings as specified in Rule 43) multiplied by the load factors in Table 4-1 and divided by the strength factors in Table 4-2, reduced by the allowances at replacement as specified in Rule 44.3.</u>

48 Strength of Materials

Structures, including their members and connections, shall be designed and constructed to withstand the loads in Rule 43 multiplied by the appropriate load factors in Table 4-1. The effects of these loads shall not exceed the strengths of the structures, including their members and connections, multiplied by the strength factors in Table 4-2.

Structures, structure members, and their connections shall not fail or be seriously distorted at any load less than their maximum loads (developed under the current construction arrangements with loadings as specified in Rule 43) multiplied by the load factors in Table 4-1 and divided by the strength factors in Table 4-2, reduced by the allowances at replacement as specified in Rule 44.3.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

Revised PRC 9 Rule 48.1 – Wood

Original

48.1 Wood

A. Natural Wood (Non Laminate)

(1) Poles

The required strength for natural wood poles of various species meeting the requirements of ANSI O5.1 2008 shall be derived in conjunction with the safety factors in Rule 44 and the designated fiber strength specified in ANSI 05.1 2008. Table 5 lists some of the values of fiber strength specified in ANSI 05.1 2008.

(2) Sawn Wood Structural Members

The required strength for sawn wood structural members, such as crossarms and braces, meeting the requirements of ANSI O5.3 2008 shall be derived in conjunction with the safety factors in Rule 44 and the designated fiber strength specified in ANSI O5.3 2008.

Multiply the given allowable stress values by 0.55 for sawn wood where the loading being considered is a long-time loading (i.e., continuous load for one year or more).

B. Laminated Wood

The required strength for laminated wood poles and other structural members, such as crossarms, meeting the requirements of ANSI O5.2 2006 shall be derived in conjunction with the safety factors in Rule 44 and the designated strength specified in ANSI O5.2 2006.

Table 5: Sample Wood Strengths
Specified in ANSI O5.1-2008

Species	Designated Fiber Strength
Cedar, western red	6,000 lbs per square inch
Douglas fir	8,000 lbs per square inch
Fir, white or red, local	6,600 lbs per square inch
Pine, southern	8,000 lbs per square inch

Note: Revised April 26, 1965 by Decision No. 68835; March 9, 1988 by Resolution E–3076, October 9, 1996 by Resolution SU–40 and February 5, 2014 by Decision No. 14-02-015.

Strikeout/underline

48.1 Wood

A. Natural Wood (Non Laminate)

(1) Poles

The ~~required~~ strength for natural wood poles of various species meeting the requirements of ANSI O5.1 2008 shall be ~~derived in conjunction with the safety factors in Rule 44 and~~ the designated fiber strength specified in ANSI ~~0~~<u>O</u>5.1 2008. Table 5 lists some of the values of <u>designated</u> fiber strength specified in ANSI ~~0~~<u>O</u> 5.1 2008.

(2) Sawn Wood Structural Members

The ~~required~~ strength for sawn wood structural members, such as crossarms and braces, meeting the requirements of ANSI O5.3 2008 shall be ~~derived in conjunction with the safety factors in Rule 44 and~~ the designated fiber strength specified in ANSI O5.3 2008.

Multiply the given ~~allowable stress~~ <u>designated fiber strength values by an additional factor</u> ~~values by~~ <u>of</u> 0.55 for sawn wood where the loading being considered is a long-time loading (i.e., continuous load for one year or more).

B. Laminated Wood

The ~~required~~ strength for laminated wood poles and other structural members, such as crossarms, meeting the requirements of ANSI O5.2 2006 shall be ~~derived in conjunction with the safety factors in Rule 44 and~~ the designated <u>fiber</u> strength specified in ANSI O5.2 2006.

Table 5: Sample Wood Strengths
Specified in ANSI O5.1-2008

Species	Designated Fiber Strength
Cedar, western red	6,000 lbs per square inch
Douglas fir	8,000 lbs per square inch
Fir, white or red, local	6,600 lbs per square inch
Pine, southern	8,000 lbs per square inch

Note: Revised April 26, 1965 by Decision No. 68835; March 9, 1988 by Resolution E–3076, October 9, 1996 by Resolution SU–40 and February 5, 2014 by Decision No. 14-02-015.

Proposed Final

48.1 Wood

A. Natural Wood (Non Laminate)

(1) Poles

The strength for natural wood poles of various species meeting the requirements of ANSI O5.1 2008 shall be the designated fiber strength specified in ANSI O5.1 2008. Table 5 lists some of the values of designated fiber strength specified in ANSI O5.1 2008.

(2) Sawn Wood Structural Members

The strength for sawn wood structural members, such as crossarms and braces, meeting the requirements of ANSI O5.3 2008 shall be the designated fiber strength specified in ANSI O5.3 2008.

Multiply the given designated fiber strength values by an additional factor of 0.55 for sawn wood where the loading being considered is a long-time loading (i.e., continuous load for one year or more).

B. Laminated Wood

The strength for laminated wood poles and other structural members, such as crossarms, meeting the requirements of ANSI O5.2 2006 shall be the designated fiber strength specified in ANSI O5.2 2006.

Table 5: Sample Wood Strengths
Specified in ANSI O5.1-2008

Species	Designated Fiber Strength
Cedar, western red	6,000 lbs per square inch
Douglas fir	8,000 lbs per square inch
Fir, white or red, local	6,600 lbs per square inch
Pine, southern	8,000 lbs per square inch

Note: Revised April 26, 1965 by Decision No. 68835; March 9, 1988 by Resolution E–3076, October 9, 1996 by Resolution SU–40 and February 5, 2014 by Decision No. 14-02-015.

PRC 10 Rule 48.2 – Steel

Original

48.2 Steel

The required strength of steel structures and components shall be designed using ASCE 10 97 for latticed steel structures and ASCE 48 11 for tubular steel pole structures, as applicable.

Allowable stresses for steel members and their connections shall be derived in conjunction with the safety factors in Rule 44 and the permitted stresses specified in the applicable standard.

Steel members not covered by either of these standards shall be designed using allowable stresses as defined below:

Tension: The maximum allowable tensile stress shall be calculated using the following formula:

$$F_t = \frac{1}{SF}(F_y)$$

Compression: The maximum allowable compressive stress shall be calculated using the following formula:

$$F_a = \frac{1}{SF}\left[F_y - \left(\frac{F_y - 12{,}000}{200}\right)\frac{l}{r}\right]$$

Shear: The maximum allowable shear stress shall be calculated using the following formula:

$$F_v = \frac{1}{SF}\,0.66(F_t)$$

Bending: The maximum allowable bending stress for a compact section shall be calculated using the following equation:

$$F_b = \frac{1}{SF}\,(F_y)$$

The maximum allowable bending stress for a non-compact section shall be determined according to the provisions of Chapter E of the AISC Manual of Steel Construction, Allowable Stress Design, 9th Edition.

Combined Stresses: The strength of members subjected to combined stresses shall be determined according to the provisions of Chapter H of the AISC Manual of Steel Construction, Allowable Stress Design, 9th Edition.

Where,
Fa = maximum allowable axial stress, psi

Fb = maximum allowable bending stress, psi

Ft = maximum allowable tensile stress, psi

Fv = maximum allowable shear stress, psi

Fy = specified minimum yield stress, psi

Fu = specified minimum tensile stress, psi

SF = safety factor specified in Rule 44

l = unsupported length of member, inches

r = radius of gyration of member, inches

The values used for yield stress, Fy, and tensile stress, Fu, shall be the specified minimum values as listed in the appropriate ASTM specification. If the material specification for the steel is unknown and cannot be determined, the values for its yield stress and tensile stress shall be assumed to be 33,000 psi and 60,000 psi, respectively. The modulus of elasticity, E, is defined to be 29,000 ksi.

Note: Revised March 30, 1968 by Decision No. 73813, January 13, 2005 by Decision No. 0501030, and February 5, 2014 by Decision No. 14-02-015.

<u>Strikeout/underline</u>

48.2 Steel

~~The required strength of steel structures and components shall be designed using ASCE 10 97 for latticed steel structures and ASCE 48 11 for tubular steel pole structures, as applicable.~~

<u>As applicable, steel members and their connections shall be designed in accordance with the following standards:</u>

<u>Latticed Steel Structures: ASCE 10-97, and</u>

<u>Tubular Steel Pole Structures: ASCE 48-11</u>

Allowable stresses for steel members and their connections shall be derived ~~in conjunction with the safety factors in Rule 44 and the permitted stresses specified in the applicable standard.~~ <u>by multiplying the values specified in the applicable standard by the appropriate strength factors specified in Table 4-2.</u>

Steel members not covered by either of these standards shall be designed using allowable stresses as defined below, consistent with Rule 48:

Tension: The maximum allowable tensile stress shall be calculated using the following formula:

$$F_t = \frac{1}{SF} SF\ (F_y)$$

Compression: The maximum allowable compressive stress shall be calculated using the following formula:

$$F_a = \frac{1}{SF} SF \left[F_y - \left(\frac{F_y - 12{,}000}{200}\right)\frac{l}{r}\right]$$

Shear: The maximum allowable shear stress shall be calculated using the following formula:

$$F_v = \frac{1}{SF} SF 0.66(F_{ut})$$

Bending: The maximum allowable bending stress for a compact section shall be calculated using the following equation:

$$F_b = \frac{1}{SF} SF\ (F_y)$$

The maximum allowable bending stress for a non-compact section shall be determined according to the provisions of Chapter E of the AISC Manual of Steel Construction, Allowable Stress Design, 9th Edition.

Combined Stresses: The strength of members subjected to combined stresses shall be determined according to the provisions of Chapter H of the AISC Manual of Steel Construction, Allowable Stress Design, 9th Edition.

Where,
Fa = maximum allowable axial stress, psi

Fb = maximum allowable bending stress, psi

Ft = maximum allowable tensile stress, psi

Fv = maximum allowable shear stress, psi

Fy = specified minimum yield stress, psi

Fu = specified minimum tensile stress, psi

SF = ~~safety~~ strength factor specified in Rule 44

l = unsupported length of member, inches

r = radius of gyration of member, inches

The values used for yield stress, Fy, and tensile stress, Fu, shall be the specified minimum values as listed in the appropriate ASTM specification. If the material specification for the steel is unknown and cannot be determined, the values for its yield stress and tensile stress shall be assumed to be 33,000 psi and 60,000 psi, respectively. The modulus of elasticity, E, is defined to be 29,000 ksi.

Note: Revised March 30, 1968 by Decision No. 73813, January 13, 2005 by Decision No. 0501030, and February 5, 2014 by Decision No. 14-02-015.

Proposed Final

48.2 Steel

As applicable, steel members and their connections shall be designed in accordance with the following standards:

Latticed Steel Structures: ASCE 10-97, and

Tubular Steel Pole Structures: ASCE 48-11

Allowable stresses for steel members and their connections shall be derived by multiplying the values specified in the applicable standard by the appropriate strength factors specified in Table 4-2.

Steel members not covered by either of these standards shall be designed using allowable stresses as defined below, consistent with Rule 48:

Tension: The maximum allowable tensile stress shall be calculated using the following formula:

$$F_t = SF\left(F_y\right)$$

Compression: The maximum allowable compressive stress shall be calculated using the following formula:

$$F_a = SF\left[F_y - \left(\frac{F_y - 12{,}000}{200}\right)\frac{l}{r}\right]$$

Shear: The maximum allowable shear stress shall be calculated using the following formula:

$$F_v = SF\ 0.66\ (F_u)$$

Bending: The maximum allowable bending stress for a compact section shall be calculated using the following equation:

$$F_b = SF\ (F_y)$$

The maximum allowable bending stress for a non-compact section shall be determined according to the provisions of Chapter E of the AISC Manual of Steel Construction, Allowable Stress Design, 9th Edition.

Combined Stresses: The strength of members subjected to combined stresses shall be determined according to the provisions of Chapter H of the AISC Manual of Steel Construction, Allowable Stress Design, 9th Edition.

Where,
Fa = maximum allowable axial stress, psi

Fb = maximum allowable bending stress, psi

Ft = maximum allowable tensile stress, psi

Fu = specified minimum tensile stress, psi

Fv = maximum allowable shear stress, psi

Fy = specified minimum yield stress, psi

SF = strength factor specified in Rule 44

l = unsupported length of member, inches

r = radius of gyration of member, inches

The values used for yield stress, Fy, and tensile stress, Fu, shall be the specified minimum values as listed in the appropriate ASTM specification. If the material specification for the steel is unknown and cannot be determined, the values for its yield stress and tensile stress shall be assumed to be 33,000 psi and 60,000 psi, respectively. The modulus of elasticity, E, is defined to be 29,000 ksi.

Note: Revised March 30, 1968 by Decision No. 73813, January 13, 2005 by Decision No. 0501030, and February 5, 2014 by Decision No. 14-02-015.

PRC 11 Rule 48.3 – Concrete

Original

48.3 Concrete

A. Reinforced Concrete

Values used for ultimate strengths of reinforced concrete, in conjunction with safety factors given in Rule 44, shall not exceed the following:

Reinforcing steel, tensile or compressive strength, pounds per square inch: 55,000

Concrete, 1:2:4 mixture		Age	Compressive Strength
		7 days	900 lbs per sq. in.
		30 days	2,400 lbs per sq. in.
		90 days	3,100 lbs per sq. in.
		6 months	4,400 lbs per sq. in.

If reinforced concrete is designed for higher strength values which are proven by test, such values may be used in lieu of the figures given.

B. Prestressed Concrete

The minimum strength of the materials used in prestressed concrete structures used in conjunction with the safety factors given in Table 4 shall be as follows:

Reinforcing Steel - yield strength (F_y) 40,000 psi
Prestressing Steel - yield strength (F_y) 188,000 psi
Concrete - compressive strength (F'_c)at 28 days 4,000 psi

Other strength values may be used provided the strength values used for design are proven by tests.

Note: Rule 48.3–B added on February 13, 1974 by Decision No. 82466.

Strikeout/underline

48.3 Concrete

A. Reinforced Concrete

Values used for ultimate strengths of reinforced concrete, in conjunction with safety strength factors given in Rule 44, shall not exceed the following:

Reinforcing steel, tensile or compressive strength, pounds per square inch: 55,000

Concrete, 1:2:4 mixture		Age	Compressive Strength
		7 days	900 lbs per sq. in.
		30 days	2,400 lbs per sq. in.
		90 days	3,100 lbs per sq. in.
		6 months	4,400 lbs per sq. in.

If reinforced concrete is designed for higher strength values which are proven by test, such values may be used in lieu of the figures given.

B. Prestressed Concrete

The minimum strength of the materials used in prestressed concrete structures used in conjunction with the safety strength factors given in Table 4-2 shall be as follows:

Reinforcing Steel - yield strength (F_y) 40,000 psi
Prestressing Steel - yield strength (F_y) 188,000 psi
Concrete - compressive strength (F'_c) at 28 days 4,000 psi

Other strength values may be used provided the strength values used for design are proven by tests.

Note: Rule 48.3–B added on February 13, 1974 by Decision No. 82466.

Proposed Final

48.3 Concrete

A. Reinforced Concrete

Values used for ultimate strengths of reinforced concrete shall not exceed the following:

Reinforcing steel, tensile or compressive strength, pounds per square inch: 55,000

Concrete, 1:2:4 mixture		Age	Compressive Strength
		7 days	900 lbs per sq. in.
		30 days	2,400 lbs per sq. in.
		90 days	3,100 lbs per sq. in.
		6 months	4,400 lbs per sq. in.

If reinforced concrete is designed for higher strength values which are proven by test, such values may be used in lieu of the figures given.

B. Prestressed Concrete

The minimum strength of the materials used in prestressed concrete structures shall be as follows:

Reinforcing Steel - yield strength (F_y) 40,000 psi
Prestressing Steel - yield strength (F_y) 188,000 psi
Concrete - compressive strength (F'_c)at 28 days 4,000 psi

Other strength values may be used provided the strength values used for design are proven by tests.

Note: Rule 48.3–B added on February 13, 1974 by Decision No. 82466.

PRC 12 Rule 48.4 – Fiber-Reinforced Polymer

Original

48.4 Fiber-Reinforced Polymer

The required strength of overhead line structures and subcomponents made with fiber-reinforced polymer shall be derived in conjunction with the safety factors in Rule 44 and other permitted stresses specified in the applicable standard. This requirement applies to tension and bending, compression and bending, and shear.

The compressive strength of the material shall be determined by suitable formula for the material or structure, considering the strength of the material, modulus of elasticity, geometry, slenderness ratio and eccentricity of connection.

Note: The strength may be determined per Section 2.6.2 of ASCE 111-2006.

Note: Added February 5, 2014 by Decision No. 14-02-015.

Strikeout/underline

48.4 Fiber-Reinforced Polymer

The ~~required~~ strength of overhead line structures and subcomponents made with fiber-reinforced polymer shall be ~~derived in conjunction with the safety factors in Rule 44 and other permitted stresses specified in the applicable standard.~~ ~~by multiplying~~ the lower 5th percentile strengths determined in accordance with ASCE 111-2006 ~~by the strength factors in Table 4-2~~. This requirement applies to tension and bending, compression and bending, and shear.

The compressive strength shall be determined by a suitable formula for the material or structure, considering the strength of the material, modulus of elasticity, geometry, slenderness ratio and eccentricity of connection.

~~Note: The strength may be determined per Section 2.6.2 of ASCE 111-2006.~~

Note: Added February 5, 2014 by Decision No. 14-02-015.

Proposed Final

48.4 Fiber-Reinforced Polymer

The strength of overhead line structures and subcomponents made with fiber-reinforced polymer shall be the lower 5th percentile strength determined in accordance with ASCE 111-2006. This requirement applies to tension and bending, compression and bending, and shear.

The compressive strength shall be determined by a suitable formula for the material or structure, considering the strength of the material, modulus of elasticity, geometry, slenderness ratio and eccentricity of connection.

Note: Added February 5, 2014 by Decision No. 14-02-015.

PRC 13 Rule 48.5 – Other Engineered Materials

Original

48.5 Other Engineered Materials

The required strength of overhead line structures and subcomponents made with other engineered materials shall be derived in conjunction with the safety factors in Rule 44 and other permitted stresses specified in the applicable standard. This requirement applies to tension, compression and shear.

Tension: If the material has a published yield strength value, that value shall be used in lieu of the tensile strength value.

Compression: The compressive strength shall be determined by suitable formula for the material used and member geometry, considering yield and /or tensile strength of the material, modulus of elasticity, slenderness ratio and eccentricity of connection. In no case shall the compressive stress be greater than the yield strength of the material.

Note: The strength may be determined per Section 2.6.2 of ASCE 111-2006.

Note: Added February 5, 2014 by Decision No. 14-02-015.

Strikeout/underline

48.5 Other Engineered Materials

The ~~required~~ strength of overhead line structures and subcomponents made with other engineered materials shall be ~~derived in conjunction with the safety factors in Rule 44 and other permitted stresses specified in the applicable standard.~~ by multiplying the lower 5th percentile strengths determined in accordance with ASCE 111-2006 ~~by the strength factors in Table 4-2~~. This requirement applies to tension, compression and shear.

Tension: If the material has a published yield strength value, that value shall be used in lieu of the tensile strength value.

Compression: The compressive strength shall be determined by suitable formula for the material used and member geometry, considering yield and /or tensile strength of the material, modulus of elasticity, slenderness ratio and eccentricity of connection. In no case shall the compressive stress be greater than the yield strength of the material.

~~Note: The strength may be determined per Section 2.6.2 of ASCE 111-2006.~~

Note: Added February 5, 2014 by Decision No. 14-02-015.

Proposed Final

48.5 Other Engineered Materials

The strength of overhead line structures and subcomponents made with other engineered materials shall be the lower 5th percentile strength determined in accordance with ASCE 111-2006. This requirement applies to tension, compression and shear.

Tension: If the material has a published yield strength value, that value shall be used in lieu of the tensile strength value.

Compression: The compressive strength shall be determined by suitable formula for the material used and member geometry, considering yield and /or tensile strength of the material, modulus of elasticity, slenderness ratio and eccentricity of connection. In no case shall the compressive stress be greater than the yield strength of the material.

Note: Added February 5, 2014 by Decision No. 14-02-015.

PRC 14 Rule 48.7 – Tower or Pole Foundations and Footings

Original

48.7 Tower or Pole Foundations and Footings

The resistance of soil to foundation or footing bearing and uplift shall be calculated from the best available data or determined by test(s).

Foundation or footing resistance shall be designed with safety factors applied as specified in Rule 44.

Strikeout/underline

48.7 Tower or Pole Foundations and Footings

The resistance of soil to foundation or footing bearing and uplift shall be calculated from the best available data or determined by test(s).

Foundations ~~or~~ and footings ~~resistance~~ shall be designed consistent with Rule 48 ~~with safety factors applied as specified in Rule 44~~.

Proposed Final

48.7 Tower or Pole Foundations and Footings

The resistance of soil to foundation or footing bearing and uplift shall be calculated from the best available data or determined by test(s).

Foundations and footings shall be designed consistent with Rule 48.

Revised PRC 15 Rule 49.2-C – Crossarms (Strength)

Original

C. Strength

Crossarms shall be securely supported by bracing, where necessary, to withstand unbalanced vertical loads and to prevent tipping of any arm sufficiently to decrease clearances below the values specified in Section III. Such bracing shall be securely attached to poles and crossarms. Supports in lieu of crossarms shall have means of resisting rotation in a vertical plane about their attachment to poles or shall be supported by braces as required for crossarms. Metal braces or attachments shall meet the requirements of Rules 48.2 and 49.8.

In addition to the above, a vertical load of 300 lbs. at the outer pin position shall be included in computing the vertical loads on all crossarms.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

(1) Longitudinal Loads Normally Balanced:

(a) Supply Lines: Where longitudinal loads are normally balanced, crossarms supporting supply conductors shall have sufficient strength to withstand a load, applied in the direction of the conductors at the outer pin position, of 700 pounds with a safety factor of not less than unity.

(b) Communication Lines, Class C: Where longitudinal loads are normally balanced, crossarms supporting Class C conductors shall have sufficient strength to withstand a load, applied in the direction of the conductors at the outer pin position, of 400 pounds with a safety factor of not less than unity.

(2) **Longitudinal Loads Normally Unbalanced:** Crossarms subjected to unbalanced longitudinal loads shall have sufficient strength to meet the strength requirements with safety factors at least equal to those in Rule 44.

At unbalanced corners and dead ends in Grades "A", "B" or "C" construction, where conductor tension is held by cantilever strength of pin–type insulators and pins, double crossarms shall be used to permit conductor fastenings at two insulators to prevent slipping. In lieu of double crossarms and double insulators, single crossarms may be used with single insulators and steel pins and prefabricated conductor ties.

For conductor tensions up to 2,000 pounds per conductor, double wood crossarms fitted with spacing devices at each end will be considered as meeting the strength requirements of Rules 47.2 and 47.3.

Note: Revised March 9, 1988 by Resolution E–3076, and February 5, 2014 by Decision No. 14-02-015.

Strikeout/underline

C. Strength

Crossarms shall be securely supported by bracing, where necessary, to withstand unbalanced vertical loads and to prevent tipping of any arm sufficiently to decrease clearances below the values specified in Section III. Such bracing shall be securely attached to poles and crossarms. Supports in lieu of crossarms shall have means of resisting rotation in a vertical plane about their attachment to poles or shall be supported by braces as required for crossarms. Metal braces or attachments shall meet the requirements of Rules 48.2 and 49.8.

In addition to the above, a vertical load of 300 lbs. at the outer pin position shall be included in computing the vertical loads on all crossarms.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

(1) **Longitudinal Loads Normally Balanced:**

(a) Supply Lines: Where longitudinal loads are normally balanced, crossarms supporting supply conductors shall be designed to withstand a load, applied in the direction of the conductors at the outer pin position, of 700 pounds. ~~with a safety factor of not less than unity.~~ In no case shall the application of this rule be held to permit the design of crossarms with strengths less than the effects of the loads.

(b) Communication Lines, Class C: Where longitudinal loads are normally balanced, crossarms supporting Class C conductors shall have sufficient strength to withstand a load, applied in the direction of the conductors at the outer pin position, of 400 pounds. ~~with a safety factor of not less than unity.~~ In no case shall the application of this rule be held to permit the design of crossarms with strengths less than the effects of the loads.

(2) **Longitudinal Loads Normally Unbalanced:** Crossarms subjected to unbalanced longitudinal loads shall have sufficient strength to meet the ~~strength~~ requirements with ~~safety factors at least equal to those~~ the load and strength factors specified in Rule 44.

At unbalanced corners and dead ends in Grades "A", "B" or "C" construction, where conductor tension is held by cantilever strength of pin–type insulators and pins, double crossarms shall be used to permit conductor fastenings at two insulators to prevent slipping. In lieu of double crossarms and double insulators, single crossarms may be used with single insulators and steel pins and prefabricated conductor ties.

For conductor tensions up to 2,000 pounds per conductor, double wood crossarms fitted with spacing devices at each end will be considered as meeting the strength requirements of Rules 47.2 and 47.3.

Note: Revised March 9, 1988 by Resolution E–3076, and February 5, 2014 by Decision No. 14-02-015.

Proposed Final

C. Strength

Crossarms shall be securely supported by bracing, where necessary, to withstand unbalanced vertical loads and to prevent tipping of any arm sufficiently to decrease clearances below the values specified in Section III. Such bracing shall be securely attached to poles and crossarms. Supports in lieu of crossarms shall have means of resisting rotation in a vertical plane about their attachment to poles or shall be supported by braces as required for crossarms. Metal braces or attachments shall meet the requirements of Rules 48.2 and 49.8.

In addition to the above, a vertical load of 300 lbs. at the outer pin position shall be included in computing the vertical loads on all crossarms.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

(1) Longitudinal Loads Normally Balanced:

(a) Supply Lines: Where longitudinal loads are normally balanced, crossarms supporting supply conductors shall be designed to withstand a load, applied in the direction of the conductors at the outer pin position, of 700 pounds. In no case shall the application of this rule be held to permit the design crossarms with strengths less than the effects of the loads.

(b) Communication Lines, Class C: Where longitudinal loads are normally balanced, crossarms supporting Class C conductors shall have sufficient strength to withstand a load, applied in the direction of the conductors at the outer pin position, of 400 pounds. In no case shall the application of this rule be held to permit the design of crossarms with strengths less than the effects of the loads.

(2) **Longitudinal Loads Normally Unbalanced:** Crossarms subjected to unbalanced longitudinal loads shall have sufficient strength to meet the requirements with the load and strength factors specified in Rule 44.

At unbalanced corners and dead ends in Grades "A", "B" or "C" construction, where conductor tension is held by cantilever strength of pin–type insulators and pins, double crossarms shall be used to permit conductor fastenings at two insulators to prevent slipping. In lieu of double crossarms and double insulators, single crossarms may be used with single insulators and steel pins and prefabricated conductor ties.

For conductor tensions up to 2,000 pounds per conductor, double wood crossarms fitted with spacing devices at each end will be considered as meeting the strength requirements of Rules 47.2 and 47.3.

Note: Revised March 9, 1988 by Resolution E–3076, and February 5, 2014 by Decision No. 14-02-015

PRC 16 Rule 49.3-C – Pins and Conductor Fastenings (Strength)

Original

C. Strength

Insulator pins and conductor fastenings shall be able to withstand the loads to which they may be subjected with safety factors at least equal to those in Rule 44.

Note: A 1–1/2 inch by 9 inch locust pin will usually provide cantilever strength up to 1,000 pounds tension in the conductor with the conductor 3–1/2 inches above the crossarm and a load factor of unity.

(1) Longitudinal Loads Normally Balanced:

(a) Insulator Pins: Where longitudinal loads are normally balanced, insulator pins which support conductors shall have sufficient strength to withstand, with a load factor of not less than unity, a load at the conductor position as follows:

Pins supporting supply conductors 700 pounds
Pins supporting Class C conductors 400 pounds

(b) Conductor Fastenings: Where longitudinal loads are normally balanced, tie wires or other conductor fastenings shall be installed in such a manner that they will securely hold the line conductor to the supporting insulators and will withstand without slipping of the conductor unbalanced pulls as follows:

Supply conductor fastening	40% of the maximum working tensions but not more than 500 pounds.
Class C conductor fastenings	15% of the maximum working tensions but not more than 300 pounds.

Tie wires are not required on Class C conductors at point– type transpositions in Grade F construction.

(2) Longitudinal Loads Normally Unbalanced: At unbalanced corners and dead ends in Grades "A", "B" or "C" construction, where conductor tension is held by cantilever strength of pin–type insulators and pins, double insulators and wood pins or single insulators and steel pins shall be used. Each line conductor shall be tied or fastened to both insulators, or the single insulator, to prevent slipping of the conductor under maximum working tension with ~~a~~ safety factor of 2 for the temperature and loading conditions specified in Rule 43.

At changes in grade of construction and at end supports in Grades "A" or "B" construction where the conductors are not dead–ended and are supported on pin–type insulators, double insulators and pins with tie wires, or equivalent fastenings, will be considered as meeting the strength requirements of Rules 47.2 and 47.3 for conductor tensions up to 2,000 pounds per conductor.

Note: Revised March 9, 1988 by Resolution E–3076, and February 5, 2014 by Decision No. 14-02-015.

Strikeout/Underline

C. Strength

Insulator pins and conductor fastenings shall be able to withstand the loads to which they may be subjected with ~~safety factors at least equal to those~~ the load and strength factors specified in Rule 44 applied.

Note: A 1–1/2 inch by 9 inch locust pin will usually provide cantilever strength up to 1,000 pounds tension in the conductor with the conductor 3–1/2 inches above the crossarm and a load factor of unity.

(1) Longitudinal Loads Normally Balanced:

(a) Insulator Pins: Where longitudinal loads are normally balanced, insulator pins which support conductors shall have sufficient strength to withstand~~, with a safety factor of not less than unity,~~ a load at the conductor position as follows:

Pins supporting supply conductors 700 pounds
Pins supporting Class C conductors 400 pounds

In no case shall the application of this rule be held to permit the design of insulator pins and conductor fastenings with strengths less than the effects of the loads.

(b) Conductor Fastenings: Where longitudinal loads are normally balanced, tie wires or other conductor fastenings shall be installed in such a manner that they will securely hold the line conductor to the supporting insulators and will withstand without slipping of the conductor unbalanced pulls as follows:

Supply conductor fastening	40% of the maximum working tensions but not more than 500 pounds.

Class C conductor fastenings	15% of the maximum working tensions but not more than 300 pounds.

~~Tie wires are required on Class C conductors at point– type transpositions not in Grade F construction.~~

(2) Longitudinal Loads Normally Unbalanced: At unbalanced corners and dead ends in Grades "A", "B" or "C" construction, where conductor tension is held by cantilever strength of pin–type insulators and pins, double insulators and wood pins or single insulators and steel pins shall be used. Each line conductor shall be tied or fastened to both insulators, or the single insulator, to prevent slipping of the conductor under maximum working tension with a ~~safety~~ load factor of 2 for the temperature and loading conditions specified in Rule 43.

At changes in grade of construction and at end supports in Grades "A" or "B" construction where the conductors are not dead–ended and are supported on pin–type insulators, double insulators and pins with tie wires, or equivalent fastenings, will be considered as meeting the strength requirements of Rules 47.2 and 47.3 for conductor tensions up to 2,000 pounds per conductor.

Note: Revised March 9, 1988 by Resolution E–3076, and February 5, 2014 by Decision No. 14-02-015.

Proposed Final

C. Strength

Insulator pins and conductor fastenings shall be able to withstand the loads to which they may be subjected with the load and strength factors specified in Rule 44 applied.

Note: A 1–1/2 inch by 9 inch locust pin will usually provide cantilever strength up to 1,000 pounds tension in the conductor with the conductor 3–1/2 inches above the crossarm and a load factor of unity.

(1) Longitudinal Loads Normally Balanced:

(a) Insulator Pins: Where longitudinal loads are normally balanced, insulator pins which support conductors shall have sufficient strength to withstand a load at the conductor position as follows:

Pins supporting supply conductors 700 pounds
Pins supporting Class C conductors 400 pounds

In no case shall the application of this rule be held to permit the design of insulator pins and conductor fastenings with strengths less than the effects of the loads.

(b) Conductor Fastenings: Where longitudinal loads are normally balanced, tie wires or other conductor fastenings shall be installed in such a manner that they will securely hold the line conductor to the supporting insulators and will withstand without slipping of the conductor unbalanced pulls as follows:

Supply conductor fastening	40% of the maximum working tensions but not more than 500 pounds.
Class C conductor fastenings	15% of the maximum working tensions but not more than 300 pounds.

(2) Longitudinal Loads Normally Unbalanced: At unbalanced corners and dead ends in Grades "A", "B" or "C" construction, where conductor tension is held by cantilever strength of pin–type insulators and pins, double insulators and wood pins or single insulators and steel pins shall be used. Each line conductor shall be tied or fastened to both insulators, or the single insulator, to prevent slipping of the conductor under maximum working tension with a load factor of 2 for the temperature and loading conditions specified in Rule 43.

At changes in grade of construction and at end supports in Grades "A" or "B" construction where the conductors are not dead–ended and are supported on pin–type insulators, double insulators and pins with tie wires, or equivalent fastenings, will be considered as meeting the strength requirements of Rules 47.2 and 47.3 for conductor tensions up to 2,000 pounds per conductor.

Note: Revised March 9, 1988 by Resolution E–3076, and February 5, 2014 by Decision No. 14-02-015.

Revised PRC 17 Rule 49.4-B – Conductors (Size)

Original

B. Size

The minimum sizes of conductors which shall be used in spans of 150 feet or less under the several classes of construction and loadings in both urban and rural districts are specified in Table 8. Larger conductors than those specified in the table will often be necessary to maintain reasonable sag and at the same time provide the required safety factors of Rule 44, ground clearances of Table 1, and wire clearances of Table 2.

Conductors of the sizes specified in Table 8 may be used in spans longer than 150 feet, except when specifically prevented by Rule 49.4–C, provided the sags and conductor positions are so adjusted that the allowable working tensions and clearances of this Order are not violated.

The common neutral conductor in common neutral systems shall conform to the requirements of Rule 59.3–B in addition to the above requirements.

Note: Revised February 5, 2014 by Decision No. 1402015.

Strikeout/Underline

B. Size

The minimum sizes of conductors which shall be used in spans of 150 feet or less under the several classes of construction and loadings in both urban and rural districts are specified in Table 8. Larger conductors than those specified in the table will often be necessary to maintain reasonable sag and at the same time ~~provide the required safety~~ to meet the load and strength factor~~s~~ requirements of Rule 44, ground clearances of Table 1, and wire clearances of Table 2.

Conductors of the sizes specified in Table 8 may be used in spans longer than 150 feet, except when specifically prevented by Rule 49.4–C, provided the sags and conductor positions are so adjusted that the allowable working tensions and clearances of this Order are not violated.

The common neutral conductor in common neutral systems shall conform to the requirements of Rule 59.3–B in addition to the above requirements.

Note: Revised February 5, 2014 by Decision No. 1402015.

Proposed Final

B. Size

The minimum sizes of conductors which shall be used in spans of 150 feet or less under the several classes of construction and loadings in both urban and rural districts are specified in Table 8. Larger conductors than those specified in the table will often be necessary to maintain reasonable sag and at the same time to meet the load and strength factor requirements of Rule 44, ground clearances of Table 1, and wire clearances of Table 2.

Conductors of the sizes specified in Table 8 may be used in spans longer than 150 feet, except when specifically prevented by Rule 49.4–C, provided the sags and conductor positions are so adjusted that the allowable working tensions and clearances of this Order are not violated.

The common neutral conductor in common neutral systems shall conform to the requirements of Rule 59.3–B in addition to the above requirements.

Note: Revised February 5, 2014 by Decision No. 1402015.

PRC 18 Rule 49.5 – Insulators

Original

49.5 Insulators

A. Line

Insulators, supports, clamps and other miscellaneous attachments shall be designed to withstand, with at least the safety factors specified in Rule 44, the mechanical stress to which they are subjected by conductors, wires or structures, under the loading conditions as specified in Rule 43. Pin insulators shall effectively engage the thread of the pin for at least two and one–half turns.

B. Guy

Guy insulators, including insulators in messengers, shall have mechanical strength at least equal to that required of the guys in which they are installed.

C. Replacements (See Rule 44.3)

D. Post

Post insulator units including insulator supports, clamps, and other miscellaneous attachments shall have a cantilever strength determined in accordance with paragraph 5.1.3 of the American Standard Insulator Tests, Publication No. C29.1–1961, or the latest revision thereof, equal to or greater than the product of the safety factors specified in Rule 44 and the mechanical load to which they are subjected by conductors, wires, or structures under the loading conditions as specified in Rule 43.

Note: Added January 6, 1968 by Decision No. 73455.

Strikeout/underline

49.5 Insulators

A. Line

Insulators, supports, clamps and other miscellaneous attachments shall be designed to withstand~~, with at least the safety factors specified in Rule 44,~~ the mechanical ~~stress~~ <u>load</u> to which they are subjected by conductors, wires or structures, under the loading conditions as specified in Rule 43<u>, with the load and strength factors of Rule 44 applied.</u>

Pin insulators shall effectively engage the thread of the pin for at least two and one–half turns.

B. Guy

Guy insulators, including insulators in messengers, shall have mechanical strength at least equal to that required of the guys or messengers in which they are installed.

C. Replacements (See Rule 44.3)

D. Post

Post insulator units including insulator supports, clamps, and other miscellaneous attachments shall have a cantilever strength determined in accordance with paragraph 5.1.3 of the American Standard Insulator Tests, Publication No. C29.1–1961, or the latest revision thereof, equal to or greater than ~~the product of the safety factors specified in Rule 44 and~~ the mechanical load to which they are subjected by conductors, wires, or structures under the loading conditions as specified in Rule 43 with the load and strength factors of Rule 44 applied.

Note: Added January 6, 1968 by Decision No. 73455.

Proposed Final

49.5 Insulators

A. Line

Insulators, supports, clamps and other miscellaneous attachments shall be designed to withstand the mechanical load to which they are subjected by conductors, wires or structures, under the loading conditions as specified in Rule 43, with the load and strength factors of Rule 44 applied.

Pin insulators shall effectively engage the thread of the pin for at least two and one–half turns.

B. Guy

Guy insulators, including insulators in messengers, shall have mechanical strength at least equal to that required of the guys or messengers in which they are installed.

C. **Replacements** (See Rule 44.3)

D. Post

Post insulator units including insulator supports, clamps, and other miscellaneous attachments shall have a cantilever strength determined in accordance with paragraph 5.1.3 of the American Standard Insulator Tests, Publication No. C29.1–1961, or the latest revision thereof, equal to or greater than the mechanical load to which they are subjected by conductors, wires, or structures under the loading conditions as specified in Rule 43 with the load and strength factors of Rule 44 applied.

Note: Added January 6, 1968 by Decision No. 73455

Revised PRC 19 Rule 49.6-B – Guys and Anchors (Size)

Original

B. Size

The size and ultimate strength of guys crossing in spans over Class H, L, T or C circuits shall be not less than as specified in Table 9 and shall also be such as to provide safety factors not less than those specified in Rule 44 for the loads imposed by the construction involved under the loading conditions specified in Rule 43.

Strikeout/underline

B. Size

The size and ultimate strength of guys crossing in spans over Class H, L, T or C circuits shall be not less than as specified in Table 9 and shall also ~~be such as to~~ ~~provide~~ meet the load and strength ~~safety~~ factor requirements ~~not less than those~~ specified in Rule 44 for the loads imposed by the construction involved under the loading conditions specified in Rule 43.

Proposed Final

B. Size

The size and ultimate strength of guys crossing in spans over Class H, L, T or C circuits shall be not less than as specified in Table 9 and shall also meet the load and strength factor requirements specified in Rule 44 for the loads imposed by the construction involved under the loading conditions specified in Rule 43.

PRC 20 Rule 49.7 – Messengers and Span Wires

<u>Original</u>

49.7 Messengers and Span Wires

A. Material

Messengers and span wires shall be stranded and of galvanized steel, copper–covered steel or other corrosion–resisting material not subject to rapid deterioration.

B. Strength

Messengers and span wires shall be capable of withstanding, with safety as specified in Rule 44, the tension developed because of the load they support combined with the loading conditions specified in Rule 43. An allowance of 300 lbs. of vertical load for a worker and cable chair shall be made in computing tensions in messengers and span wires which support cables except in the case of short spans which are not required to support workers or where the ice loading specified in Rule 43.1–B would exceed the allowance for the worker and cable chair.

Guys supporting messenger loads shall comply with the safety factors specified in Rule 44.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

C. Supports

Messengers supporting cables shall be attached to poles or crossarms with hardware that complies with the safety factors specified in Rule 44, based on the weight of the messenger wire, cable, line-mounted equipment plus an allowance of 300 lbs. for a worker and cable chair. If in heavy loading areas the specified ice load exceeds in weight the 300 lbs. allowance, such ice load shall be used in making the calculations in preference to the weight of the worker and cable chair.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

D. Replacements (See Rule 44.3)

Strikeout/underline

49.7 Messengers and Span Wires

A. Material

Messengers and span wires shall be stranded and of galvanized steel, copper–covered steel or other corrosion–resisting material not subject to rapid deterioration.

B. Strength

Messengers and span wires with the load and strength factor requirements ~~as~~ specified in Rule 44 applied shall be capable of withstanding ~~with safety factors as specified in Rule 44,~~ the tension developed because of the load they support combined with the loading conditions specified in Rule 43. An allowance of 300 lbs. of vertical load for a worker and cable chair shall be made in computing tensions in messengers and span wires which support cables except in the case of short spans which are not required to support workers or where the ice loading specified in Rule 43.1–B would exceed the allowance for the worker and cable chair.

Guys supporting messenger loads shall comply with the load and strength ~~safety~~ factor~~s~~ requirements specified in Rule 44.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

C. Supports

Messengers supporting cables shall be attached to poles or crossarms with hardware that complies with the ~~safety~~ load and strength factor~~s~~ requirements specified in Rule 44, based on the weight of the messenger wire, cable, line-mounted equipment plus an allowance of 300 lbs. for a worker and cable chair. If in heavy loading areas the specified ice load exceeds in weight the 300 lbs. allowance, such ice load shall be used in making the calculations in preference to the weight of the worker and cable chair.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

D. Replacements (See Rule 44.3)

Proposed Final

49.7 Messengers and Span Wires

A. Material

Messengers and span wires shall be stranded and of galvanized steel, copper–covered steel or other corrosion–resisting material not subject to rapid deterioration.

B. Strength

Messengers and span wires with the load and strength factor requirements specified in Rule 44 applied shall be capable of withstanding the tension developed because of the load they support combined with the loading conditions specified in Rule 43. An allowance of 300 lbs. of vertical load for a worker and cable chair shall be made in computing tensions in messengers and span wires which support cables except in the case of short spans which are not required to support workers or where the ice loading specified in Rule 43.1–B would exceed the allowance for the worker and cable chair.

Guys supporting messenger loads shall comply with the load and strength factor requirements specified in Rule 44.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

C. Supports

Messengers supporting cables shall be attached to poles or crossarms with hardware that complies with the load and strength factor requirements specified in Rule 44, based on the weight of the messenger wire, cable, line-mounted equipment plus an allowance of 300 lbs. for a worker and cable chair. If in heavy loading areas the specified ice load exceeds in weight the 300 lbs. allowance, such ice load shall be used in making the calculations in preference to the weight of the worker and cable chair.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

D. **Replacements** (See Rule 44.3)

PRC 21 Rule 81.3 – Material Strength

Original

81.3 Material and Strength

Communication poles shall meet the material and strength requirements specified in Section IV.

A. Replacement of Wood Poles in Grade C Construction

Wood poles in Grade C construction shall be replaced or reinforced before the safety factor has been reduced to less than one, except that the circumference of sound solid wood within 18 inches above and below the ground line on such poles before replacement or reinforcement shall not be less than as follows:

Poles supporting 10 or less open wire Conductors	9 inches
Poles supporting cable, or more than 10 open wires conductors	12 inches

Note: Revised November 21, 1990 by Resolution SU–6, January 13, 2005 by Decision No. 0501030, and February 5, 2014 by Decision No. 1402015.

Strikeout/underline

81.3 Material and Strength

Communication poles shall meet the material and strength requirements specified in Section IV.

A. Replacement of Wood Poles in Grade C Construction

Wood poles in Grade C construction shall be replaced or reinforced ~~before the safety factor has been reduced to less than one~~ in accordance with the requirements of Rule 44.3, except that the circumference of sound solid wood within 18 inches above and below the ground line on such poles before replacement or reinforcement shall not be less than as follows:

Poles supporting 10 or less open wire Conductors	9 inches
Poles supporting cable, or more than 10 open wires conductors	12 inches

Note: Revised November 21, 1990 by Resolution SU–6, January 13, 2005 by Decision No. 0501030, and February 5, 2014 by Decision No. 1402015.

81.3 Material and Strength

Communication poles shall meet the material and strength requirements specified in Section IV.

A. Replacement of Wood Poles in Grade C Construction

Wood poles in Grade C construction shall be replaced or reinforced in accordance with the requirements of Rule 44.3, except that the circumference of sound solid wood within 18 inches above and below the ground line on such poles before replacement or reinforcement shall not be less than as follows:

Poles supporting 10 or less open wire Conductors	9 inches
Poles supporting cable, or more than 10 open wires conductors	12 inches

Note: Revised November 21, 1990 by Resolution SU–6, January 13, 2005 by Decision No. 0501030, and February 5, 2014 by Decision No. 1402015.

Associated Rule Change A   Rule 43.1-C - Temperature

Original

C.   Temperature

Conductor temperature shall be assumed to be 0°F at the time of maximum loading. A conductor temperature of at least 130°F shall also be assumed for computing sag and its effect on structural loads due to weight span.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

Strikeout/Underline

C.   Temperature

Conductor or messenger temperature shall be assumed to be 0°F at the time of maximum loading. A conductor or messenger temperature of at least 130°F shall also be assumed for computing sag and its effect on structural loads due to weight span.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

Proposed Final

C.   Temperature

Conductor or messenger temperature shall be assumed to be 0°F at the time of maximum loading. A conductor or messenger temperature of at least 130°F shall also be assumed for computing sag and its effect on structural loads due to weight span.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

Associated Rule Change B   Rule 43.2-C - Temperature

Original

C. Temperature

Conductor temperature shall be assumed to be 25°F at the time of maximum loading. A conductor temperature of at least 130°F shall also be assumed for computing sag and its effect on structural loads due to weight span.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

Strikeout/Underline

C. Temperature

Conductor or messenger temperature shall be assumed to be 25°F at the time of maximum loading. A conductor or messenger temperature of at least 130°F shall also be assumed for computing sag and its effect on structural loads due to weight span.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

Proposed Final

C. Temperature

Conductor or messenger temperature shall be assumed to be 25°F at the time of maximum loading. A conductor or messenger temperature of at least 130°F shall also be assumed for computing sag and its effect on structural loads due to weight span.

Note: Revised February 5, 2014 by Decision No. 14-02-015.

Associated Rule Change C Rule 48.6 – Conductors, Span Wires, Guys and Messengers

Original

48.6 Conductors, Span Wires, Guys and Messengers

Values used for ultimate strengths of wires and cable shall not exceed those given in Appendix B. The ultimate strengths given in Table 17 to 24 of Appendix B, except for medium–hard drawn copper, are based on the minimum ultimate strengths given in the standard specifications of the American Society for Testing Material.

The ultimate strengths given in Appendix B for medium–hard drawn copper are based on the standard specifications of the ASTM and provide an allowance above the minimum values of one–quarter of the range between minimum and maximum values.

For use of types of wires and cables of other material not included in Appendix B, values for ultimate strengths similarly derived from specifications of the ASTM shall be used except that, if such specifications are nonexistent, maker's specifications may be used provided that tests have been made which shall justify the maker's rating for ultimate strength.

<u>Strikeout/underline</u>

48.6 Conductors, Span Wires, Guys and Messengers

Values used for ultimate strengths of wires and cable shall not exceed those given in Appendix B. The ultimate strengths given in Table 17 to 24 of Appendix B, except for medium–hard drawn copper, are based on the minimum ultimate strengths given in the standard specifications of ~~the American Society for Testing Material~~ <u>ASTM International.</u>

The ultimate strengths given in Appendix B for medium–hard drawn copper are based on the <u>referenced ASTM</u> standard specifications ~~of the ASTM~~ and provide an allowance above the minimum values of one–quarter of the ~~range~~ <u>difference</u> between minimum and maximum values.

For use of types of wires and cables of other material not included in Appendix B, values for ultimate strengths similarly derived from <u>ASTM standard</u> specifications ~~of the ASTM~~ shall be used except that, if such specifications are nonexistent, ~~maker's~~ <u>manufacturer's</u> specifications may be used provided that tests have been made which shall justify the ~~maker's~~ <u>manufacturer's</u> specifications rating for ultimate strength.

48.6 Conductors, Span Wires, Guys and Messengers

Values used for ultimate strengths of wires and cable shall not exceed those given in Appendix B. The ultimate strengths given in Table 17 to 24 of Appendix B, except for medium–hard drawn copper, are based on the minimum ultimate strengths given in the standard specifications of ASTM International.

The ultimate strengths given in Appendix B for medium–hard drawn copper are based on the referenced ASTM standard specifications and provide an allowance above the minimum values of one–quarter of the difference between minimum and maximum values.

For use of types of wires and cables of other material not included in Appendix B, values for ultimate strengths similarly derived from ASTM standard specifications shall be used except that, if such specifications are nonexistent, manufacturer's specifications may be used provided that tests have been made which shall justify the manufacturer's specifications rating for ultimate strength.

Revised Associated Rule Change D Rule 49 – Table 8 (Minimum Conductor Sizes)

Original

Table 8: Minimum Conductor Sizes (150–Foot Spans or Less)						
Loading Conditions and Grade of Construction	**Material or Type of Conductor**					
	Soft or Annealed Copper	**Hard–Drawn or Medium Hard–Drawn Copper**	**Stranded Aluminum**	**Aluminum Conductor Steel Reinforced**	**Copper Covered Steel, Bronze or Composites**	**Galvanized Iron or Galvanized Steel**
	AWG	AWG	AWG	AWG	AWG	
Heavy Loading						
Grade "A"	4	6	1	4	6	¼ inch Diameter Strand
Grade "B" (a) (h)	4	6	1	6	8	9 BWG
Grade "C" (h)	4	6	1	6	8	9 BWG
Light Loading						
Grade "A"	4	6	1	4	8	¼ inch Diameter Strand (b)
Grade "B" (a) (c) (h)	6	6	1	6	8	9 BWG
Grade "C" (c) (h)	6	8	1	6	10	9 BWG
Heavy and Light Loading						
Supply Service Drops Crossing Trolley Wires	8	10	-	-	12	-
Other Supply Service Drops	10	10	-	-	12	-
Grade "F", Single Conductors (d)	-	(e)	-	-	(e)	14 BWG
Grade "F", Paired Conductors (d)	-	14(f)			17 (g)	-

No changes to Footnotes a - h.

Strikeout/underline

Table 8: Minimum Conductor Sizes (150–Foot Spans or Less)						
Loading Conditions and Grade of Construction	Material or Type of Conductor					
	Soft or Annealed Copper	Hard–Drawn or Medium Hard–Drawn Copper	Stranded Aluminum	Aluminum Conductor Steel Reinforced	Copper Covered Steel, Bronze or Composites	Galvanized Iron or Galvanized Steel
	AWG	AWG	AWG	AWG	AWG	
Heavy Loading						
Grade "A"	4	6	1	4	6	~~¼~~ .25 ~~inch~~ Dia~~.meter~~ In. ~~Strand~~
Grade "B" (a) (h)	4	6	1	6	8	~~9 BWG~~ .148 Dia. in.
Grade "C" (h)	4	6	1	6	8	~~9 BWG~~ .148 Dia. in.
Light Loading						
Grade "A"	4	6	1	4	8	~~¼~~.25 Dia. In. ~~Inch Diameter Strand~~ (b)
Grade "B" (a) (c) (h)	6	6	1	6	8	~~9 BWG~~ .148 Dia. In.
Grade "C" (c) (h)	6	8	1	6	10	~~9 BWG~~ .148 Dia. In.
Heavy and Light Loading						
Supply Service Drops Crossing Trolley Wires	8	10	-	-	12	-
Other Supply Service Drops	10	10	-	-	12	-
Grade ~~"F"~~ "C", Single Conductors (d)	-	(e)	-	-	(e)	~~14 BWG~~ .083 Dia. In.
Grade ~~"F"~~ "C", Paired Conductors (d)	-	14(f)			17 (g)	-

No changes to Footnotes a - h.

Table 8: Minimum Conductor Sizes (150–Foot Spans or Less)						
Loading Conditions and Grade of Construction	**Material or Type of Conductor**					
	Soft or Annealed Copper	**Hard–Drawn or Medium Hard–Drawn Copper**	**Stranded Aluminum**	**Aluminum Conductor Steel Reinforced**	**Copper Covered Steel, Bronze or Composites**	**Galvanized Iron or Galvanized Steel**
	AWG	AWG	AWG	AWG	AWG	
Heavy Loading						
Grade "A"	4	6	1	4	6	.25 Dia. in.
Grade "B" (a) (h)	4	6	1	6	8	.148 Dia. in.
Grade "C" (h)	4	6	1	6	8	.148 Dia. in.
Light Loading						
Grade "A"	4	6	1	4	8	.25 Dia. in. (b)
Grade "B" (a) (c) (h)	6	6	1	6	8	.148 Dia. in.
Grade "C" (c) (h)	6	8	1	6	10	.148 Dia. in.
Heavy and Light Loading						
Supply Service Drops Crossing Trolley Wires	8	10	-	-	12	-
Other Supply Service Drops	10	10	-	-	12	-
Grade "C", Single Conductors (d)	-	(e)	-	-	(e)	.083 Dia. in.
Grade "C", Paired Conductors (d)	-	14(f)			17 (g)	-

Associated Rule Change E Appendix B – Mechanical/Loading Data for Conductors

Original

The tables included in Appendix B contain mechanical data for conductors commonly used in supply and communication lines. The ultimate strengths and other data for copper, steel and iron wires are those contained in specifications of the American Society for Testing Materials or are ultimate strengths based upon such specifications. For other types and kinds of conductors the ultimate strengths and other data used have been taken from manufacturers' specifications.

The requirements of Rule 43 were used to calculate the loaded conductor conditions.

Table No.	
17	Copper Wire–Bare–Solid–Characteristics and Loading
18	Copper Wire–Bare–Stranded and Solid–Characteristics and Loading
19	Copper Wire–Stranded and Solid–Double Braid Weather–proof–Characteristics and Loading
20	Copper Wire–Stranded and Solid–Triple Braid Weather–proof–Characteristics and Loading
21	Galvanized Steel and Iron Wire–Bare–Solid - Characteristics and Loading
22	Copper Covered Steel–Strand, Solid and Composite - Characteristics and Loading
23	Aluminum Cable Steel Reinforced–Bare–Characteristics and Loading
24	Mechanical Characteristics of Galvanized Steel Strand

Strikeout/Underline

The tables included in Appendix B contain mechanical data for conductors commonly used in supply and communication lines. The ultimate strengths and other data for copper, steel and iron wires are those contained in specifications of ASTM International (formerly - the American Society for Testing Materials) ~~or~~ are ultimate strengths based upon such specifications. For other types and kinds of conductors the ultimate strengths and other data used have been taken from manufacturers' specifications.

The requirements of Rule 43 were used to calculate the loaded conductor conditions.

Table No.	
17	Copper Wire–Bare–Solid–Characteristics and Loading
18	Copper Wire–Bare–Stranded and Solid–Characteristics and Loading
19	Copper Wire–Stranded and Solid–Double Braid Weather–proof–Characteristics and Loading
20	Copper Wire–Stranded and Solid–Triple Braid Weather–proof–Characteristics and Loading
21	Galvanized Steel and Iron Wire–Bare–Solid - Characteristics and Loading
22	Copper Covered Steel–Strand, Solid and Composite - Characteristics and Loading

23 Aluminum Cable Steel Reinforced–Bare–Characteristics and Loading
24 Mechanical Characteristics of Galvanized Steel Strand

__Proposed Final__

The tables included in Appendix B contain mechanical data for conductors commonly used in supply and communication lines. The ultimate strengths and other data for copper, steel and iron wires are those contained in specifications of ASTM International (formerly - the American Society for Testing Materials) are ultimate strengths based upon such specifications. For other types and kinds of conductors the ultimate strengths and other data used have been taken from manufacturers' specifications.

The requirements of Rule 43 were used to calculate the loaded conductor conditions.

Table No.

17 Copper Wire–Bare–Solid–Characteristics and Loading
18 Copper Wire–Bare–Stranded and Solid–Characteristics and Loading
19 Copper Wire–Stranded and Solid–Double Braid Weather–proof–Characteristics and Loading
20 Copper Wire–Stranded and Solid–Triple Braid Weather–proof–Characteristics and Loading
21 Galvanized Steel and Iron Wire–Bare–Solid - Characteristics and Loading
22 Copper Covered Steel–Strand, Solid and Composite - Characteristics and Loading
23 Aluminum Cable Steel Reinforced–Bare–Characteristics and Loading
24 Mechanical Characteristics of Galvanized Steel Strand

__Original Appendix B Table Footnotes__

Tables 17-20

- **ASTM B1-39** Standard Specification for Hard-Drawn Copper Wire <u>Current version B2-13(2018)</u>

Tables 17-10

- **ASTM B2 - 39** Standard Specification for Medium-Hard-Drawn Copper Wire <u>Current version B2 - 13(2018)</u>

Table 21

- **ASTM A111 – 33** Standard Specification for Zinc-Coated (Galvanized) "Iron" Telephone and Telegraph Line Wire Current version A111 - 99a(2014)

Table 24

- **ASTM A123 -33** Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products Current version ASTM A123 / A123M – 17

Strikeout/underline

Tables 17-20

- **ASTM B1-~~39~~ 13(2018)** Standard Specification for Hard-Drawn Copper Wire

Tables 17-10

- **ASTM B2 - ~~39~~ 13(2018)** Standard Specification for Medium-Hard-Drawn Copper Wire

Table 21

- **ASTM A111 – ~~33~~ 99a(2014)** Standard Specification for Zinc-Coated (Galvanized) "Iron" Telephone and Telegraph Line Wire

Table 24

- **ASTM A123 -~~33~~ /A123M-17** Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

Proposed Final

Tables 17-20

- **ASTM B1-13(2018)** Standard Specification for Hard-Drawn Copper Wire

Tables 17-10

- **ASTM B2 - 13(2018)** Standard Specification for Medium-Hard-Drawn Copper Wire

Table 21

- **ASTM A111– 99a(2014)** Standard Specification for Zinc-Coated (Galvanized) "Iron" Telephone and Telegraph Line Wire

Table 24

- **ASTM A123 /A123M-17** Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

END APPENDIX A