

235. Clearance for wires, conductors, or cables carried on the same supporting structure

A. Application of rule

1. Multiconductor wires or cables

Cables, and duplex, triple, or paired conductors supported on insulators or messengers meeting Rule 230C or 230D, whether single or grouped, for the purposes of this rule are considered single conductors even though they may contain individual conductors not of the same phase or polarity.

2. Conductors supported by messengers or span wires

Clearances between individual wires, conductors, or cables supported by the same messenger, or between any group and its supporting messenger, or between a trolley feeder, supply conductor, or communication conductor, and their respective supporting span wires, are not subject to the provisions of this rule.

3. Line conductors of different circuits

a. Unless otherwise stated, the voltage between line conductors of different circuits shall be the greater of the following:

(1) The phasor difference between the conductors involved

NOTE: A phasor relationship of 180° is considered appropriate where the actual phasor relationship is unknown.

(2) The phase-to-ground voltage of the higher-voltage circuit

b. When the circuits have the same nominal voltage, either circuit may be considered to be the higher-voltage circuit.

- E. Clearances in any direction at or near a support from line conductors to supports, and to vertical or lateral conductors, service drops, and span or guy wires, attached to the same support

1. Fixed supports

Clearances shall be not less than those given in Table 235-6.

EXCEPTION: For voltages exceeding 98 kV ac to ground or 139 kV dc to ground, clearances less than those required by Table 235-6 are permitted for systems with known switching-surge factor. (See Rule 235E3.)

NOTE 1: For clearances in any direction from supply line conductors to communication antennas in the supply space attached to the same supporting structure, see Rule 235I.

NOTE 2: For antennas in the communication space, see Rule 236D1 and Rule 238.

2. Suspension insulators

Where suspension insulators are used and are not restrained from movement, the clearance shall be increased so that the string of insulators may swing transversely throughout a range of insulator swing up to its maximum design swing angle without reducing the values given in Rule 235E1. The maximum design swing angle shall be based on a 290 Pa (6 lb/ft²) wind on the conductor at final sag at 15 °C (60 °F). This may be reduced to a 190 Pa (4 lb/ft²) wind in areas sheltered by buildings, terrain, or other obstacles. Trees are not considered to shelter a line. The displacement of the wires, conductors, and cables shall include deflection of flexible structures and fittings, where such deflection would reduce the clearance.

3. Alternate clearances for voltages exceeding 98 kV ac to ground or 139 kV dc to ground

The clearances specified in Rules 235E1 and 235E2 may be reduced for circuits with known switching-surge factors but shall not be less than the following:

- a. Alternate clearances to anchor guys, surge-protection wires, and vertical or lateral conductors

The alternate clearances shall be not less than the crossing clearances required by Rule 233B2 and Rules 233C3a and 233C3b for the conductor voltages concerned. For the purpose of this rule, anchor guys and surge-protection wires shall be assumed to be at ground potential. The limits of Rule 235E3b(2) shall apply to the clearance derived from Rules 233C3a and 233C3b.

- b. Alternate clearance to surface of support arms and structures

(1) Alternate clearance

(a) Basic computation

The alternate clearances shall be maintained under the expected loading conditions and shall be not less than the electrical clearances computed from the following equation. For convenience, clearances for typical system voltages are shown in Table 235-7.

$$D = 1.00 \left[\frac{V \cdot (PU) \cdot a}{500K} \right]^{1.667} b \quad (\text{m})$$

$$D = 39.37 \left[\frac{V \cdot (PU) \cdot a}{500K} \right]^{1.667} b \quad (\text{in})$$

where

V = maximum ac crest operating voltage to ground or maximum dc operating voltage to ground in kilovolts

PU = maximum switching-surge factor expressed in per-unit peak voltage to ground and defined as a switching-surge level for circuit breakers corresponding to 98% probability that the maximum switching surge generated per breaker operation does not exceed this surge level, or the maximum anticipated switching-surge level generated by other means, whichever is greater

a = 1.15, the allowance for three standard deviations with fixed insulator supports

= 1.05, the allowance for one standard deviation with free-swinging manipulators

b = 1.03, the allowance for nonstandard atmospheric conditions

K = 1.2, the configuration factor for conductor-to-tower window

(b) Atmospheric correction

The value of D shall be increased 3% for each 300 m (1000 ft) in excess of 450 m (1500 ft) above mean sea level.

(2) Limits

The alternate clearance shall not be less than the clearance of Table 235-6 for 169 kV ac. The alternate clearance shall be checked for adequacy of clearance to workers and increased, if necessary, where work is to be done on the structure while the circuit is energized. (Also see Part 4.)

in

Table 235-6—
Clearance in any direction from line conductors at or near a support to supports, and to vertical or lateral conductors, service drops, span or guy wires, and to communication antennas attached to the same support
 [See also Rules 235A, 235E1, 235E3b(2), and 235I.]

Clearance of line conductors from	Communication lines in general (in)	Communication lines on jointly used structures (in)	Supply lines			
			Circuit phase-to-phase voltage			
			Neutral conductors meeting Rule 230E1 (in)	0 to 8.7 kV ⁽¹⁾ (in)	Over 8.7 kV to 50 kV (in)	Over 50 kV to 814 kV ^{(1) (2)} (in)
1. Vertical and lateral conductors— at the support						
a. Of the same circuit	3	3	3	3	3 plus 0.25 per kV in excess of 8.7 kV	No value specified
b. Of other circuits ⁽³⁾	3	3	3	6 ⁽²⁾	6 plus 0.4 per kV in excess of 8.7 kV	23 plus 0.4 per kV in excess of 50 kV
c. Communication antennas ⁽⁴⁾	3	3	3	6 ⁽²⁾	6 plus 0.4 per kV in excess of 8.7 kV	23 plus 0.4 per kV in excess of 50 kV
2. Span or guy wires⁽¹⁾, or messengers attached to same structure—at or near the support						
a. When parallel to line	3 ⁽²⁾	6 ^{(1) (2)}	6 ^{(1) (2)}	12 ⁽¹⁾	12 plus 0.4 per kV in excess of 8.7 kV	29 plus 0.4 per kV in excess of 50 kV
b. Anchor guys	3 ⁽²⁾	6 ^{(1) (2)}	6 ^{(1) (2)}	6 ⁽¹⁾	6 plus 0.25 per kV in excess of 8.7 kV	16 plus 0.25 per kV in excess of 50 kV
c. All other	3 ⁽²⁾	6 ^{(1) (2)}	6 ^{(1) (2)}	6 ⁽¹⁾	6 plus 0.4 per kV in excess of 8.7 kV	23 plus 0.4 per kV in excess of 50 kV

in

Table 235-6— (continued)
Clearance in any direction from line conductors at or near a support to supports, and to vertical or lateral conductors, service drops, span or guy wires, and to communication antennas attached to the same support

[See also Rules 235A, 235E1, 235E3b(2), and 235I.]

Clearance of line conductors from	Communication lines in general (in)	Communication lines on jointly used structures (in)	Supply lines			
			Circuit phase-to-phase voltage			
			Neutral conductors meeting Rule 230E1 (in)	0 to 8.7 kV ^(a) (in)	Over 8.7 kV to 50 kV (in)	Over 50 kV to 814 kV ^{(a), (b)} (in)
3. Surface of support arms—at the support	3 ^(c)	3 ^(c)	3 ^{(c), (d)}	3 ^(c)	3 plus 0.2 per kV in excess of 8.7 kV ^{(a), (b)}	11 plus 0.2 per kV in excess of 50 kV
4. Surface of structures—at the support						
a. On jointly used structures	—	5 ^(c)	5 ^{(c), (d)}	5 ^{(c), (d)}	5 plus 0.2 per kV in excess of 8.7 kV ^{(a), (b)}	13 plus 0.2 per kV in excess of 50 kV
b. All other	3 ^(c)	—	—	3 ^(c)	3 plus 0.2 per kV in excess of 8.7 kV ^{(a), (b)}	11 plus 0.2 per kV in excess of 50 kV
5. Service drops—in the span^(e)						
a. Communication	12	12	30 ^(d)	30	30 plus 0.4 per kV in excess of 8.7 kV	47 plus 0.4 per kV in excess of 50 kV
b. Supply	N/A	30	12	12	12 plus 0.4 per kV in excess of 8.7 kV	29 plus 0.4 per kV in excess of 50 kV

^(a)For guy wires, if practical. For clearances between span wires and communication conductors, see Rule 238C.

On jointly used structures, guys that pass within 12 in of supply conductors, and also pass within 12 in of communication cables, shall be protected with a suitable insulating covering where the guy passes the supply conductors, unless the guy is effectively grounded or insulated with a strain insulator at a point below the lowest supply conductor and above the highest communication cable.

The clearance from an insulated or effectively grounded guy to a communication cable may be reduced to 3 in when abrasion protection is provided on the guy or communication cable.

^(b)Communication conductors may be attached to supports on the sides or bottom of cross arms or surfaces of poles with less clearance.

^(c)This clearance applies only to supply conductors at the support below communication conductors, on jointly used structures.

Where supply conductors are above communication conductors, this clearance may be reduced to 3 in.

- Ⓢ All clearances for line over 50 kV shall be based on the maximum operating voltage. For voltages exceeding 814 kV, the clearance shall be determined by the alternate method given by Rule 235E3.
 - Ⓢ For supply circuits of 0 to 750 V, this clearance may be reduced to 3 in.
 - Ⓢ A neutral conductor meeting Rule 230E1 may be attached directly to the structure surface.
 - Ⓢ Guys and messengers may be attached to the same strain plates or to the same through bolts.
 - Ⓢ For open supply circuits of 0 to 750 V and supply cables of all voltages meeting Rule 230C1, 230C2 or 230C3, this clearance may be reduced to 1 in. No clearance is specified for phase conductors of such cables where they are physically restrained by a suitable bracket from abrasion against the pole.
 - Ⓢ The additional clearance for voltages in excess of 50 kV specified in Table 235-6 shall be increased 3% for each 1000 ft in excess of 3300 ft above mean sea level.
 - Ⓢ Where the circuit is effectively grounded and the neutral conductor meets Rule 230E1, phase-to-neutral voltage shall be used to determine the clearance from the surface of support arms and structures.
 - Ⓢ These clearances may be reduced by not more than 25% to a guy insulator, provided that full clearance is maintained to its metallic end fittings and the guy wires. The clearance to an insulated section of a guy between two insulators may be reduced by not more than 25% provided that full clearance is maintained to the uninsulated portion of the guy.
 - Ⓢ Phase-to-phase voltages shall be determined according to Rule 235A3.
 - Ⓢ These clearances apply to communication antennas operated at a radio frequency of 3 kHz to 300 GHz. Also see Rules 235I4, 238, and 239.
 - Ⓢ Does not include neutral conductors meeting Rule 230E1.
 - Ⓢ These service drop values apply anywhere in the span but not at the support. For vertical clearances at the support, see Table 235-5.
- NOTE:* These values were derived from Table 235-5 and Rule 235C2(1)(a).
- Ⓢ This value may be reduced to 12 in if the supply neutral and communication are electrically bonded together.

Table 235-7—Clearance in any direction from line conductors to supports

[See also Rules 235A, 235E3b, and 235E3b(1)(a).]

Maximum operating voltage phase to phase (kV)	Switching-surge factor (per unit)	Switching surge (kV)	Computed clearance to supports			
			Fixed		Free swinging at maximum angle	
			(m)	(in)	(m)	(in)
242	2.4	474	0.88	35 ⁽¹⁾	0.88 ⁽¹⁾	35 ⁽¹⁾
	2.6	514	1.01	40	0.88 ⁽¹⁾	35 ⁽¹⁾
	2.8	553	1.14	45	0.98	39
	3.0	593	1.24 ⁽²⁾	49 ⁽³⁾	1.10	44
	3.2	632	1.24 ⁽²⁾	49 ⁽³⁾	1.22	49
362	1.6	473	0.88 ⁽¹⁾	35 ⁽¹⁾	0.88 ⁽¹⁾	35 ⁽¹⁾
	1.8	532	1.07	42	0.92	36
	2.0	591	1.27	50	1.09	43
	2.2	650	1.49	59	1.28	51
	2.4	709	1.72	68	1.48	59
	2.5	739	1.84	73	1.59	63
	550	1.6	719	1.76	69	1.51
	1.8	808	2.14	84	1.84	73

Table 235-7—Clearance in any direction from line conductors to supports[See also Rules 235A, 235E3b, and 235E3b(1)(a).] *(continued)*

Maximum operating voltage phase to phase (kV)	Switching-surge factor (per unit)	Switching surge (kV)	Computed clearance to supports			
			Fixed		Free swinging at maximum angle	
			(m)	(in)	(m)	(in)
	2.0	898	2.55	100	2.19	87
	2.2	988	2.78 [ⓐ]	111 [ⓐ]	2.57	102
800	1.6	1045	3.3	129	2.82	111
	1.8	1176	4.0	157	3.5	136
	1.9	1241	4.1 [ⓐ]	161 [ⓐ]	3.8	148
	2.0	1306	4.1 [ⓐ]	161 [ⓐ]	4.1 [ⓐ]	161

[ⓐ] Shall be not less than that required by Rule 235E3b(2), including the altitude correction for lines as specified in Footnote 9 of Table 235-6.

[ⓑ] Need not be greater than specified in Rules 235E1 and 235E2.