

DEDSTF – Lines Subgroup

Clearance Requirements DRAFT

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Phase to phase and phase to ground clearances shall be set to accommodate live line maintenance.

Clearances between subconductors of a bundle are not defined in this section.

### Clearance Requirements

The clearance requirements presented in this section of the standards will be maintained with the reference conductor at maximum sag and after experiencing the maximum loading conditions (“final” conditions). Maximum sag conditions may be experienced at elevated temperatures or under iced conductor conditions. For conductor-to-conductor clearances between different circuits, the upper conductor shall be at maximum sag and the lower conductor at “minimum” sag. Minimum sag is defined as -10°F, no wind, no ice, initial conditions. In the absence of the necessary data to perform this analysis, the lower conductor’s position may be approximated by a straight line interpolation between the attachment points.

Clearances shall assume maximum operating voltages as defined in PJM Manual 3. These are nominally 5% overvoltage for the high voltage lines (<=345kV) and 10% for extra-high voltage lines (>345kV). The system transient overvoltages (TOV) shall then be applied and any elevation factors added.

The clearance requirements relating to the National Electrical Safety Code (NESC) shall be based on the version specified by local ordinance. If no such version is specified, the latest effective version at the beginning of design shall apply (based on NESC Rule 016 “effective date”).

The DE is responsible for ensuring the correct conditions are applied.

### Clearances between phase and grounded metal

This requirement defines clearance minimums between the phase conductor and any grounded metal surface, such as the structure or shield wire.

<b>Voltage</b>	69kV	115kV & 138kV	230kV	345kV	500kV	765kV
<b>Phase-ground clearance (in)</b>		52	97		132	

Maintain avian clearances – For clearances between the phase conductor and the arm of the phase below, additional clearance shall be maintained to prevent electrocutions to perching birds. An

additional 7 feet of clearance shall be maintained based on the wing span of a bald eagle or turkey vulture.

#### Clearances between phases of the same circuit

Maintain avian clearances

#### Clearances to ground – Based on NESC Rule 232

All clearances over ground shall be set to accommodate vehicle access, plus a 3 foot clearance buffer at maximum sag. All terrain points shall be considered vehicle-accessible regardless of terrain changes or the presence of access roads. In addition, the requirements of Rule 232C1.c (5mA rule) must be factored in to all designs exceeding 98kV AC to ground to limit the steady state current to 5mA rms of the largest vehicle anticipated under the lines were short circuited to ground.

When a subject line has a known or controlled switching surge, the alternate clearances described in Rule 232D may be used as a base value, with the 3 foot clearance buffer applied above that value.

#### Clearances to waterways – Based on NESC Rule 232

Clearances over Waters of the United States shall be based, at a minimum, on the NESC requirements in Rule 232, plus a 3 foot buffer. In the event that the Army Corps of Engineers (ACOE) determines higher clearances are required, the ACOE requirements shall be held, plus a 3 foot buffer. It is important that the navigable waterways are CHARTED by the National Oceanic and Atmospheric Administration (NOAA) and the US Coast Guard to include the appropriate electrical clearances between the conductor position and the highest passable vessel under the conductors.

NOTE: Example – can't have a 40ft conductor height and chart it for a 40ft sailboat. The sailboat can't be higher than 34ft or you introduce a risk of flashover.

#### Clearances to crossing lines – Based on NESC Rule 233

Clearances shall assume a 180° phase relationship between the conductors.

Vertical: As stated previously, clearances between crossing lines shall be measured with the upper conductor at maximum sag and the lower conductor at minimum sag. Lines of higher voltage shall always cross above lines of lower voltage. A 3 foot buffer shall be used above the clearances required in the NESC Rule 233.

Horizontal: Horizontal clearances shall be calculated using NESC rule 233 with a 3 foot buffer.

When a subject line has a known or controlled switching surge, the alternate clearances described in Rule 233B3 and 233 C3 may be used as base values with the respective vertical and horizontal buffers applied above those values.

### Clearances to other obstacles – Based on NESC Rule 234

The horizontal, vertical, and transitional clearances specified under NESC Rule 234 shall all have a 3 foot buffer added to the clearance requirement. Vertical clearances shall be measured with the conductor at maximum sag. Horizontal clearances shall be measured with the conductor at 60°F with 6psf wind. In addition, the requirements of Rule 234G3 (5mA rule) must be factored in to all designs exceeding 98kV AC to ground to limit the steady state current to 5mA rms in any ungrounded portion of or attachment to a metal fence, building, sign, billboard, chimney, antenna, tank, or other installation under the lines were short circuited to ground.

When a subject line has a known or controlled switching surge, the alternate clearances described in Rule 234H may be used as base values with the respective vertical and horizontal clearance buffers applied above those values.

### Clearances to co-located lines – Based on NESC Rule 235

Clearances in this section are required between the phase conductors of one circuit and the phase conductors of another circuit attached to the same structure. These are required for double circuit transmission structures (typical double circuit arrangements) or structures with transmission and distribution on the same structure (i.e. underbuild). Clearances shall assume a 180° phase relationship between the conductors.

The clearances calculated based on Rule 235 shall all have a 3 foot buffer added to the horizontal and vertical clearance requirement. Vertical clearances shall be measured using the clearance criteria of Rule 233 (top wire at max sag, bottom at “cold” or straight line). Horizontal clearance requirements shall be measured assuming suspension insulator swing

When a subject line has a known or controlled switching surge, the alternate clearances described in Rule 235B3 and 235C3 may be used as base values with the respective vertical and horizontal clearance buffers applied above those values.

### Additional clearance topics to include or specifically call out?

- Clearance requirements within controlled switchyards?
  - Clearances over crossing equipment, fences, etc.
- Application of clearance requirements with bundled conductors?
  - Assume nearest sub-conductor position or centroid of bundle?
- Clearance alternatives with respect to compact line design or control of field effects?
  - E-field, B-field, corona, TVI, RFI, audible noise, etc.
- Clearances with respect to minimum insulation levels?
  - Leakage distance, dry arc distance?
  - Shielding angles?
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