

IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V

Sponsor

**Transmission and Distribution Committee
of the
IEEE Power Engineering Society**

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Abstract: Definitions, service conditions, ratings, interchangeable construction features, and tests are established for load-break and dead-break separable insulated connector systems rated 601 V and above, 600 A or less, for use on power distribution systems.

Keywords: dead-break connector, elbow connector, load-break connector, power distribution systems, separable conductor, separable insulated connector systems

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Introduction

(This introduction is not part of IEEE Std 386-1995, IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.)

This standard was developed in response to a need created by the rapid expansion of underground distribution systems. A key element that allowed this expansion to become a reality is the separable insulated conductor. This device provides for simple and inexpensive connection and switching to transformers and other equipment used in underground distribution.

When separable insulated conductors became available, the Institute of Electrical and Electronics Engineers (IEEE) and the National Electrical Manufacturers Association (NEMA) worked cooperatively to develop a document that defined the interfaces, ratings, and test conditions for the device. The success of that cooperative effort is apparent from both the vast number of these devices now in interchangeable use in the field and their enviable safety record.

This cooperative effort continues due to the ongoing upgrading and changing nature of these underground systems and products. The recent cooperative effort has been provided by the ANSI C119.2 Subcommittee and the IEEE Working Group on Separable Connectors under the auspices of the Distribution Subcommittee of the Transmission and Distribution Committee of the IEEE Power Engineering Society.

This revision reflects the following major additions:

- An accelerated current-cycling test for 200 A insulated connectors
- Production test requirements calling for test components to duplicate fit and voltage stress
- Stacking dimension criteria for 200 A separable connectors

At the time this revision of the standard was completed, the ANSI C119.2 Subcommittee on Separable Insulated Connectors had the following membership:

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IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V

1. Scope

This standard establishes definitions, service conditions, ratings, interchangeable construction features, and tests for load-break and dead-break separable insulated connector systems rated 601 V and above, 600 A or less, for use on power distribution systems.

2. References

This standard shall be used in conjunction with the following standards. When the following standards are superseded by an approved revision, the revision shall apply.

ANSI C119.4-1991, Electrical Connectors—Connectors for Use between Aluminum-to-Aluminum or Aluminum-to-Copper Bare Overhead Connectors.¹

IEEE Std 4-1995, IEEE Standard Techniques for High-Voltage Testing.²

IEEE Std 100-1992, The New IEEE Standard Dictionary of Electrical and Electronics Terms (ANSI).³

IEEE Std 592-1990, IEEE Standard for Exposed Semiconducting Shields on High-Voltage Cable Joints and Separable Insulated Connectors (ANSI).

IEEE Std C37.09-1979 (Reaff 1988), IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis (ANSI).

IEEE Std C62.1-1989 (Reaff 1994), IEEE Standard for Gapped Silicon-Carbide Surge Arresters for AC Power Circuits (ANSI).

NEMA CC4-1986 (R1992), 8.3 kV and 8.3/14.4 kV Probe for Separable Insulated Loadbreak Connectors.⁴

¹ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

²As this standard goes to press, IEEE Std 4-1995 is approved but not yet published. The draft standard is, however, available from the IEEE. Anticipated publication date is Fall 1995. Contact the IEEE Standards Department at 1 (908) 562-3800 for status information.

³IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

⁴NEMA publications are available from the National Electrical Manufacturers Association, 2101 L Street NW, Suite 300, Washington, DC 20037, USA.

3. Definitions

The following definitions are the intended meanings of terms used in this standard or associated with separable insulated connector systems. Figures 1 and 2 show typical components of separable insulated connectors. The term *connector* as used in this standard means separable insulated connector.

3.1 bushing insert: A connector component intended for insertion into a bushing well (see figure 1).

3.2 bushing well: An apparatus bushing having a cavity for insertion of a connector component, such as a bushing insert (see figure 1).

3.3 continuous current rating: The designated rms alternating or direct current that the connector can carry continuously under specified conditions.

3.4 dead-break connector: A connector designed to be separated and engaged on de-energized circuits only.

3.5 elbow: A connector component for connecting a power cable to a bushing, so designed that when assembled with the bushing, the axes of the cable and bushing are perpendicular (see figure 1).

3.6 environmental temperature: The temperature of the surrounding medium, such as air, water, or earth, into which the heat of the connector is dissipated directly, including the effect of heat dissipation from associated cables and apparatus.

3.7 fault-closure current rating: The designated rms fault current that a load-break connector can close under specified conditions.

3.8 ground bushing: An accessory device designed to electrically ground and mechanically seal a de-energized power cable terminated with an elbow.

3.9 grounding elbow: An accessory device designed to electrically ground and mechanically seal a bushing insert or an integral bushing.

3.10 hold-down bail: An externally mounted device designed to prevent separation at the operating interface of an elbow and an apparatus bushing.

3.11 insulated cap: An accessory device designed to electrically insulate and shield and mechanically seal a bushing insert or integral bushing.

3.12 insulated parking bushing: An accessory device designed to electrically insulate and shield and mechanically seal a power cable terminated with an elbow.

3.13 integral bushing: An apparatus bushing designed for use with another connector component, such as an elbow (see figures 1 and 2).

3.14 load-break connector: A connector designed to close and interrupt current on energized circuits.

3.15 maximum voltage rating: The highest phase-to-ground or phase-to-ground and phase-to-phase voltage (rms) at which a connector is designed to operate.

3.16 operating interface: The surfaces at which a connector is normally separated (see figures 1 and 2).

3.17 parking stand: A bracket, designed for installation on an apparatus, suitable for holding accessory devices, such as the insulated parking bushing and the grounding bushing.

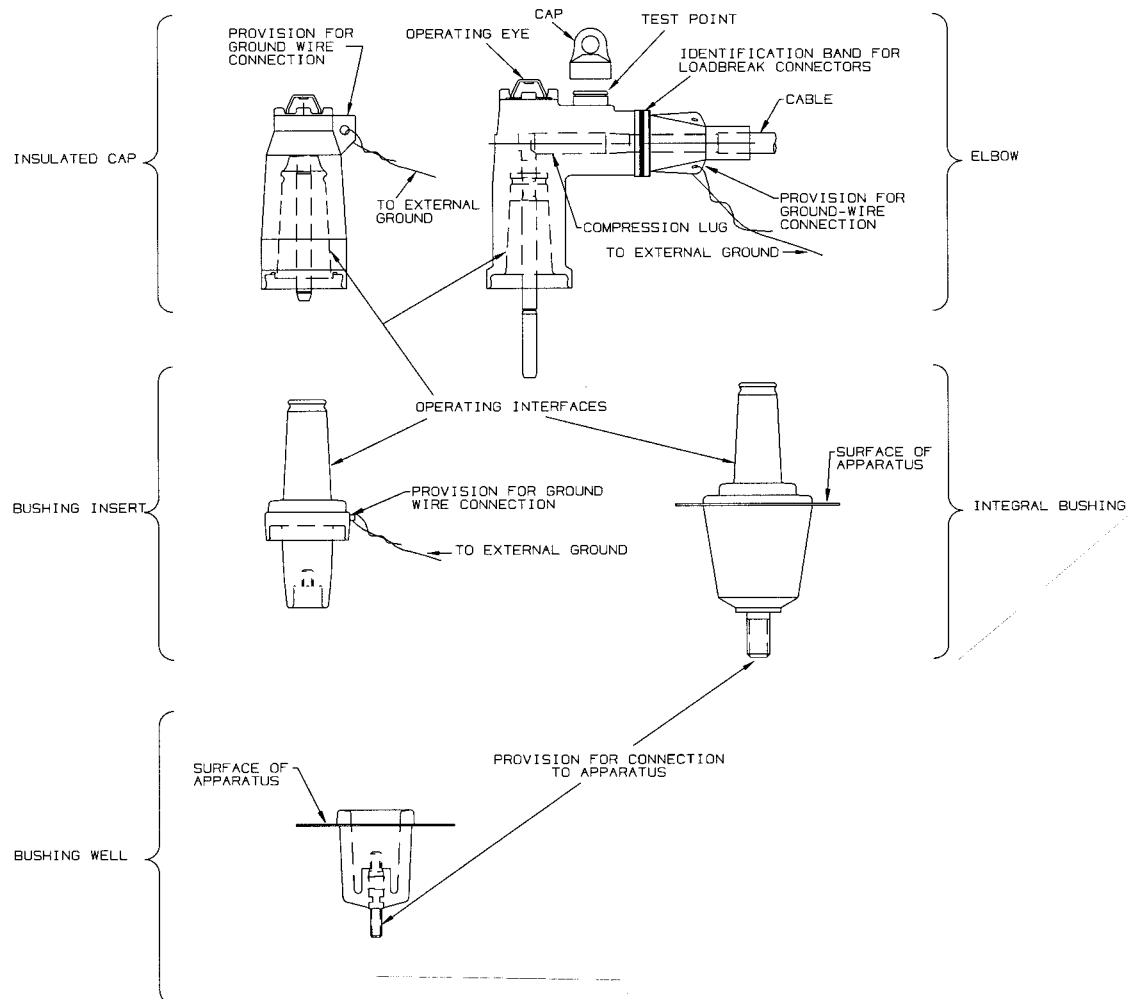


Figure 1—Typical components of 200 A separable insulated connector system

3.18 separable insulated connector: A fully insulated and shielded system for terminating and electrically connecting an insulated power cable to electrical apparatus, other power cables, or both, so designed that the electrical connection can be readily established or broken by engaging or separating the connector at the operating interface (see figures 1 and 2).

3.19 short-time current rating: The designated rms current that a connector can carry for a specified time under specified conditions.

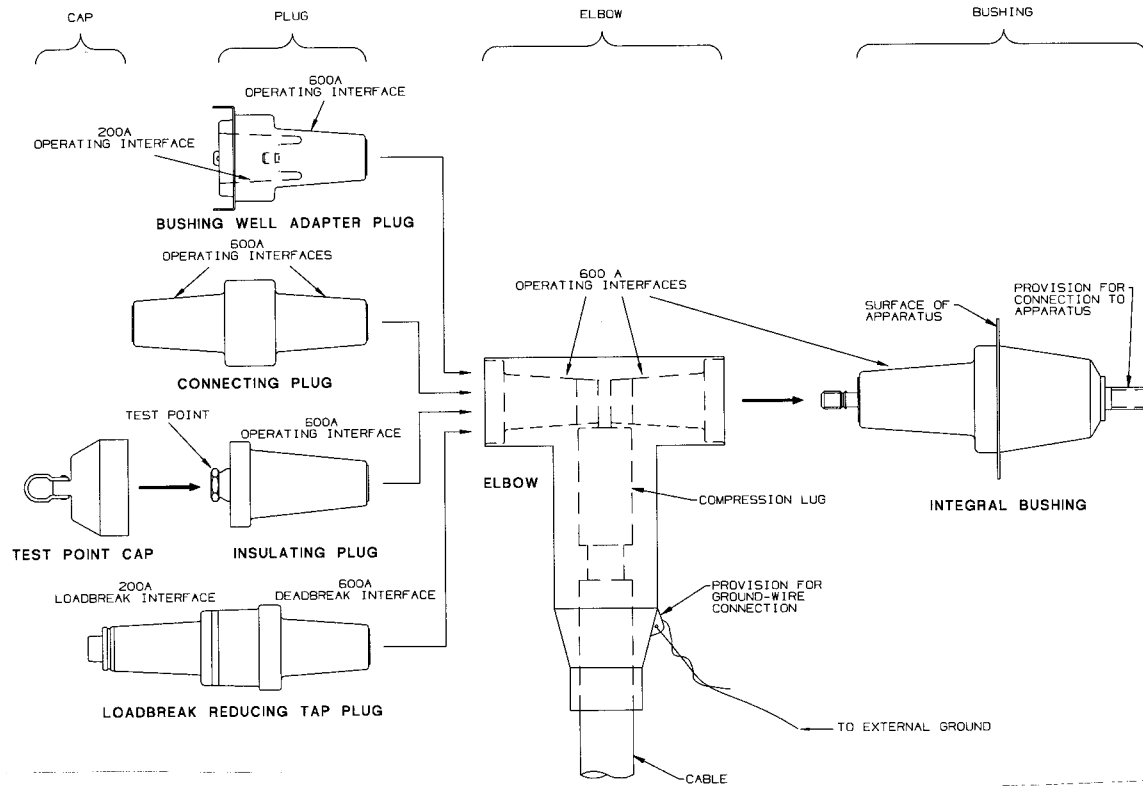


Figure 2—Typical components of 600 A separable insulated connector system

3.20 switching current rating: The designated rms current that a load-break connector can connect and disconnect for a specified number of times under specified conditions.

3.21 test point: A capacitively coupled terminal for use with voltage sensing devices (see figures 1 and 2).

3.22 withstand voltage: The specified voltage that, under specified conditions, can be applied to insulation without causing flashover or puncture.

4. Service conditions

4.1 Usual service conditions

Connectors shall be suitable for use under the following service conditions:

- a) In air, including exposure to direct sunlight
- b) Buried in earth
- c) Intermittently or continuously submerged in water at a depth not exceeding 2 m (6 ft)
- d) Environmental temperatures within the range of $-40\text{ }^{\circ}\text{C}$ to $+65\text{ }^{\circ}\text{C}$ (load-break connectors can be closed and separated within the range of $-20\text{ }^{\circ}\text{C}$ to $+65\text{ }^{\circ}\text{C}$)
- e) Altitudes not exceeding 1800 m (6000 ft) above sea level (applicable to load-break connectors only)

4.2 Unusual service conditions

Conditions other than those listed in 4.1 are considered to be unusual. (The manufacturer should be consulted for recommendations.)

5. Ratings and characteristics

5.1 Voltage ratings

The voltage ratings and characteristics of connectors shall be in accordance with table 1.

Table 1—Voltage ratings and characteristics

Maximum voltage rating (kV rms) ^a	Withstand voltages			
	BIL and full wave (kV crest)	AC 60 Hz for 1 min (kV rms)	DC for 15 min (kV)	Minimum corona (kV rms) ^b
8.3 ^c	95	34	53	11
8.3/14.4 ^d	95	34	53	11
15.2 ^c	125	40	78	19
15.2/26.3 ^d	125	40	78	19
21.1 ^c	150	50	103	26
21.1/36.6 ^d	150	50	103	26

^aThe highest steady-state voltage across the open contacts that a load-break connector is rated to switch is the maximum phase-to-ground rms voltage for phase-to-ground rated devices or the maximum phase-to-phase rms voltage for phase-to-ground/phase-to-phase rated devices.

^bBased on a sensitivity of 3 pC (see 7.4)

^cPhase-to-ground

^dPhase-to-ground/phase-to-phase

5.2 Current ratings

The current ratings and characteristics of connectors shall be in accordance with table 2.

Table 2—Current ratings and characteristics

Continuous current rating (A rms ^a)	Switching current rating (A rms)	Fault-closure current rating ^b			Short-time current rating		
		A rms, symmetrical	Duration (s) ^c	Minimum x/r	A rms, symmetrical	Duration (s)	Minimum x/r
200	200	10 000	0.17	6	10 000	0.17	6
					3500	3.00	6
600	—	—	—	—	25 000	0.17	20
					10 000	3.00	20

^aIn general, the overload capability of a connector exceeds its continuous current rating. Overload capability varies with environment, cable sizes, etc. The connector manufacturer's recommendations should be obtained for the particular combination involved.

^bApplicable to load-break connectors only. Equipment to which these assemblies are affixed may have lower safe limits of current performance.

^cThe manufacturer shall designate the fault-closure duration.

6. Construction

6.1 Identification

Mating components of a separable insulated connector shall be permanently (for example, ink stamped, branded, or molded in) and legibly identified with the following information:

- a) Manufacturer's identification
 - 1) Company name or logo
 - 2) Part identification
 - 3) Date of manufacture
- b) Continuous current rating (when applicable)
- c) Maximum voltage rating
- d) Cable insulation diameter range (when applicable)
- e) Whether load-break or dead-break (when applicable). In addition, elbows of load-break connectors shall have the following marking:
 - 1) Connectors with a phase-to-ground voltage rating shall be identified with a removable white band 13–32 mm (0.5–1.25 in) wide, located on the cable entrance portion of the connector not less than 25 mm (1.00 in) from the cable entrance. The removable band shall be clearly visible from the normal operating position, and affixed to minimize its accidental dislodgment.
 - 2) Connectors with both phase-to-ground and phase-to-phase voltage ratings shall be identified with a removable white band 13–32 mm (0.5–1.25 in) wide, having a centered black stripe 4.8 mm ± 1.6 mm (0.188 in ± 0.062 in) in width located on the cable entrance portion of the connector not less than 25 mm (1.00 in) from the cable entrance. The removable band shall be

clearly visible from the normal operating position, and affixed to minimize its accidental dislodgment.

6.2 Operating means

Connectors shall be operable by means of a suitable live-line tool that clamps the elbow so that operation is along the probe axis. The required operating force over the environmental range of -20°C to $+65^{\circ}\text{C}$ shall be as follows (see 7.14):

- a) 222–890 N (50–200 lbf) for connectors without hold-down bails
- b) 44–890 N (10–200 lbf) for connectors with hold-down bails

If an operating eye is provided, it shall support a 14 N·m (120 lbf·in) rotational force and shall support a static operating force as shown in table 3.

Table 3—Static operating force

Connector type	Force	
	N	lbf
Dead-break elbow	1334	300
Load-break elbow	2224	500
Grounding elbow	1779	400
Insulated cap	2224	500

6.3 Shielding

Connectors shall have an electrically conductive shield and, where required, shall have provision for connecting an external ground to the shield. Except for nonelastomeric components, connectors shall meet the requirements of IEEE Std 592-1990.⁵

6.4 Interchangeability

6.4.1 Complete interchangeability

Intermixed bushings and elbows of different manufacture shall be considered interchangeable provided that they meet all of the applicable requirements of this standard.

6.4.2 Limited interchangeability

Intermixed bushings and elbows of different manufacture meeting all of the requirements of this standard, except for those in 7.7 and 7.8, shall be considered interchangeable, except for switching and fault closure.

⁵Information on references can be found in clause 2.