



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

IEEE Power Engineering Society

Sponsored by the
Insulated Conductors Committee

386TM

IEEE
3 Park Avenue
New York, NY 10016-5997, USA

1 March 2007

IEEE Std 386TM-2006
(Revision of IEEE Std 386-1995)

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

Sponsor

**Insulated Conductors Committee
of the
IEEE Power Engineering Society**

Approved 15 September 2006

IEEE-SA Standards Board

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

Keywords: deadbreak connector, elbow connector, loadbreak connector, power distribution systems, separable conductor, separable insulated connector systems

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SECOND PRINTING 12 November 2009: Corrections to Table 1, Figure 5, and Figure 18 are included in this version.

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Print: ISBN 0-7381-5219-6 SH95570
PDF: ISBN 0-7381-5220-X SS95570

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Introduction

This introduction is not part of IEEE Std 386-2006, 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 connector. This device provides for simple and inexpensive connection and switching to transformers and other equipment used in underground distribution.

When separable insulated connectors 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 Insulated Conductors Committee of the IEEE Power Engineering Society.

This revision reflects the following major additions:

- Definitions of new and previously omitted connector components
- Overload current ratings for deadbreak connectors
- Optional color coding for 200 A loadbreak connectors
- Clarification of interchangeability requirements
- Bushing well stud torque withstand requirement
- Thermal cycle withstand test for non-elastomeric components
- Stacking dimensions for 200 A deadbreak and 600 A deadbreak connectors
- Test table reviewed to indicate sequence of tests
- Operating procedures for switching test expanded
- Trial-use guide for testing separable connector lubricants
- Operating interface ac withstand test for 200 A loadbreak connectors

For information on the application of separable connectors, refer to IEEE Std 1215™-2001 [B9].^a

^a The numbers in brackets correspond to those of the bibliography in Annex C.

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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 loadbreak and deadbreak separable insulated connector systems rated above 600 V, 600 A or less, for use on power distribution systems.

2. Normative references

The following referenced documents are indispensable for the application of this document. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

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

ANSI/ASQC Z1.4, Sampling Procedures and Tables for Inspection by Attributes.

ASTM F467, Standard Specification for Nonferrous Nuts for General Use.²

IEEE Std 4™, IEEE Standard Techniques for High-Voltage Testing.^{3,4}

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

¹ ANSI publications are available from the Sales Department, American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

² ASTM publications are available from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA (<http://www.astm.org/>).

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3. Definitions

For the purposes of this standard, the following terms and definitions apply. *The Authoritative Dictionary of IEEE Standards Terms* [B7]⁵ should be referenced for terms not defined in this clause.

The following definitions are the intended meanings of terms used in this standard or associated with separable insulated connector systems. Figure 1, Figure 2, Figure 16, Figure 17, and Figure 18 show typical components of separable insulated connectors. The term *connector* as used in this standard means separable insulated connector.

3.1 arc quenching rod: An ablative material added to the end of a probe that serves to pressurize and cool the arc and help deionize the arc by products while approaching current zero, assisting in the arc interruption process.

3.2 arc ring: Material inserted between the metal contact area of a loadbreak probe and the arc quenching rod for the purpose of limiting arc damage to the probe metal.

NOTE—See Figure 8 and Figure 9.⁶

3.3 bushing extender: A connector that provides two in-line elbow interfaces.

3.4 bushing insert: A connector component intended for insertion into a bushing well designed for use with another connector component, such as an elbow.

NOTE—See Figure 1.

3.5 bushing well: An apparatus bushing having a cavity for insertion of connector component, such as a bushing insert.

NOTE—See Figure 1.

3.6 bushing well plug: An accessory device designed to electrically insulate, electrically shield, and mechanically seal a bushing well.

3.7 cable adapter: A connector component that fits over the insulation of the cable increasing its diameter to properly mate with the cable accessory.

3.8 compression lug: The internal current carrying part of an elbow designed for the transition of the current path from the cable conductor to the connector.

3.9 connecting plug: A connector that provides two in-line bushing interfaces.

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

⁵ The numbers in brackets correspond to those of the bibliography in Annex C.

⁶ Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

3.11 dead-front bushing arrester: An insulated and shielded surge protective device with a bushing operating interface.

3.12 dead-front elbow arrester: An insulated and shielded surge protective device with an elbow operating interface.

3.13 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.

NOTE—See Figure 1 and Figure 2.

3.14 feed-thru bushing insert: An accessory device with two electrically interconnected bushing interfaces that can be installed into a bushing well.

3.15 feed-thru parking bushing: An accessory device with two electrically interconnected bushing interfaces that can be installed into a parking stand.

3.16 grounding parking bushing: An accessory device designed to electrically ground and mechanically seal a de-energized power cable terminated with an elbow and to be installed into a parking stand.

3.17 grounding tab: A projection on a connector component or accessory device designed for the placement of a drain wire for the purpose of grounding the outer shield of the device.

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

3.19 insulated parking bushing: An accessory device designed to electrically insulate, electrically shield, and mechanically seal a power cable terminated with an elbow and to be installed into a parking stand.

3.20 insulated plug: An accessory device designed to electrically insulate, electrically shield, and mechanically seal an elbow interface.

3.21 integral bushing: An apparatus bushing designed for use with another connector component, such as an elbow.

NOTE—See Figure 1 and Figure 2.

3.22 loadbreak connector: A connector designed to close and interrupt rated load current or less on energized circuits under specified conditions.

3.23 maximum voltage rating: The highest phase-to-ground voltage (rms) for single phase systems or phase-to-ground and phase-to-phase voltage (rms) for three phase systems at which a connector is designed to operate.

3.24 multi-way junction: An accessory device with two or more interconnected bushing and/or bushing well interfaces.

3.25 operating eye: An integral part of an elbow or other accessory device designed for the attachment of a live-line tool used to handle or operate the device.

3.26 operating interface: The surfaces at which a connector is normally separated.

NOTE—See Figure 1 and Figure 2.

3.27 parking stand feed-thru well: A multi-way junction device consisting of interconnected bushing wells that can be mounted in a parking stand.

3.28 probe: The internal, separable, current carrying part of an elbow, tee connector, or insulated cap (usually in the form of a metal rod or bolt) that connects the conductor compression lug to the bushing portion of the separable connector.

3.29 reducing tap plug: An accessory device designed for the transition of a 600 A deadbreak system to a 200 A deadbreak or loadbreak system.

3.30 reducing tap well: A connector that provides a transition from a 600 A elbow to a 200 A bushing well.

3.31 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.

NOTE—See Figure 1 and Figure 2.

3.32 short-time current rating: The designated rms current that a connector can carry for a specified, limited period of time under specified conditions.

3.33 straight plug: An in-line connector that provides a transition from a cable to a bushing interface.

3.34 straight receptacle: An in-line connector that provides a transition from a cable to an elbow interface.

3.35 tee connector: A receptacle connector component for connecting a power cable to two in-line bushing interfaces, so designed that the axes of the cable and bushing interfaces are perpendicular.

NOTE—See Figure 2.

3.36 test point: A capacitively coupled terminal for use with voltage sensing devices.

NOTE—See Figure 1 and Figure 2.

3.37 test point cap: A shielded cover for the capacitive test point.

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

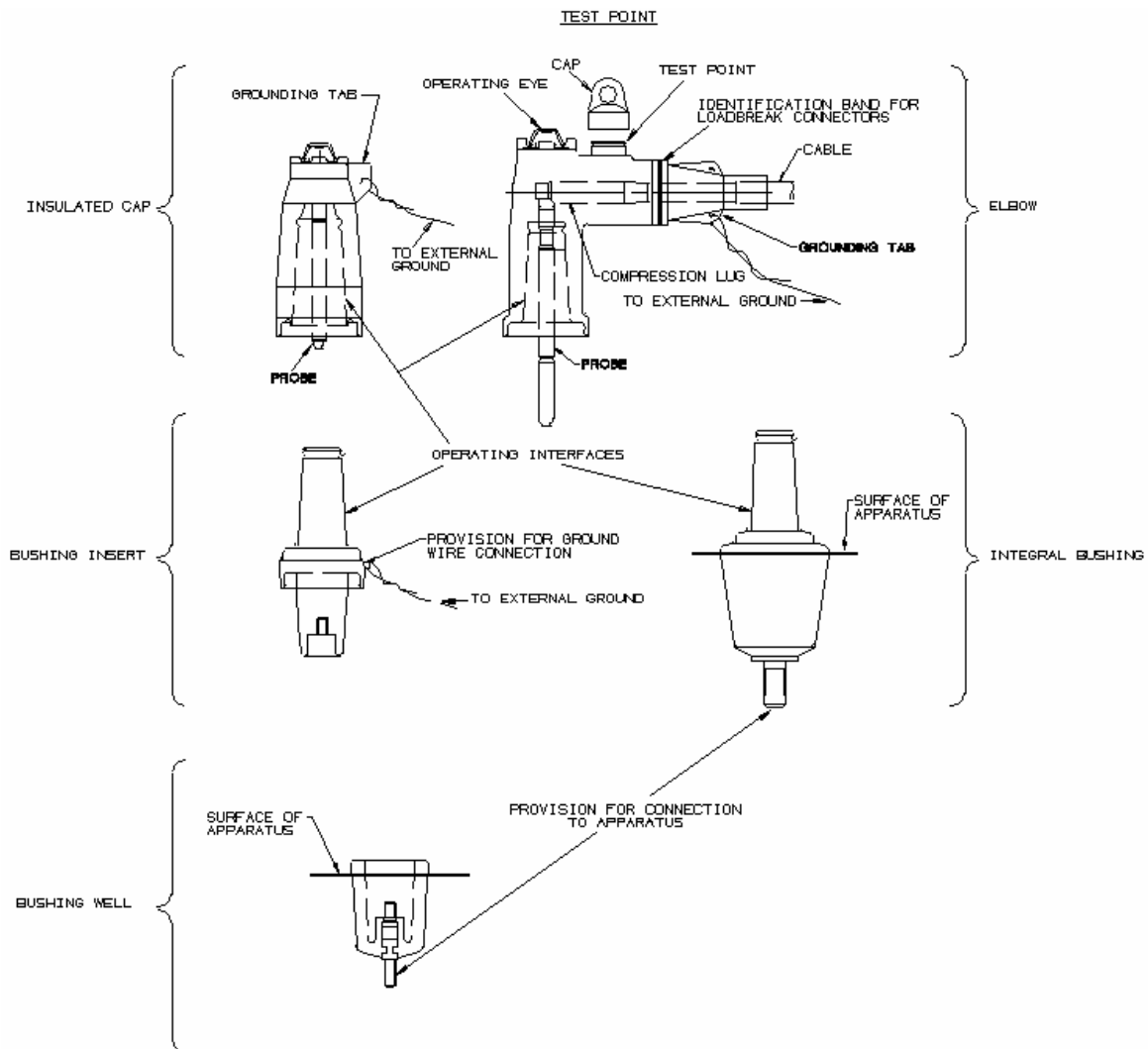


Figure 1—Typical components of 200 A separable insulated connector system

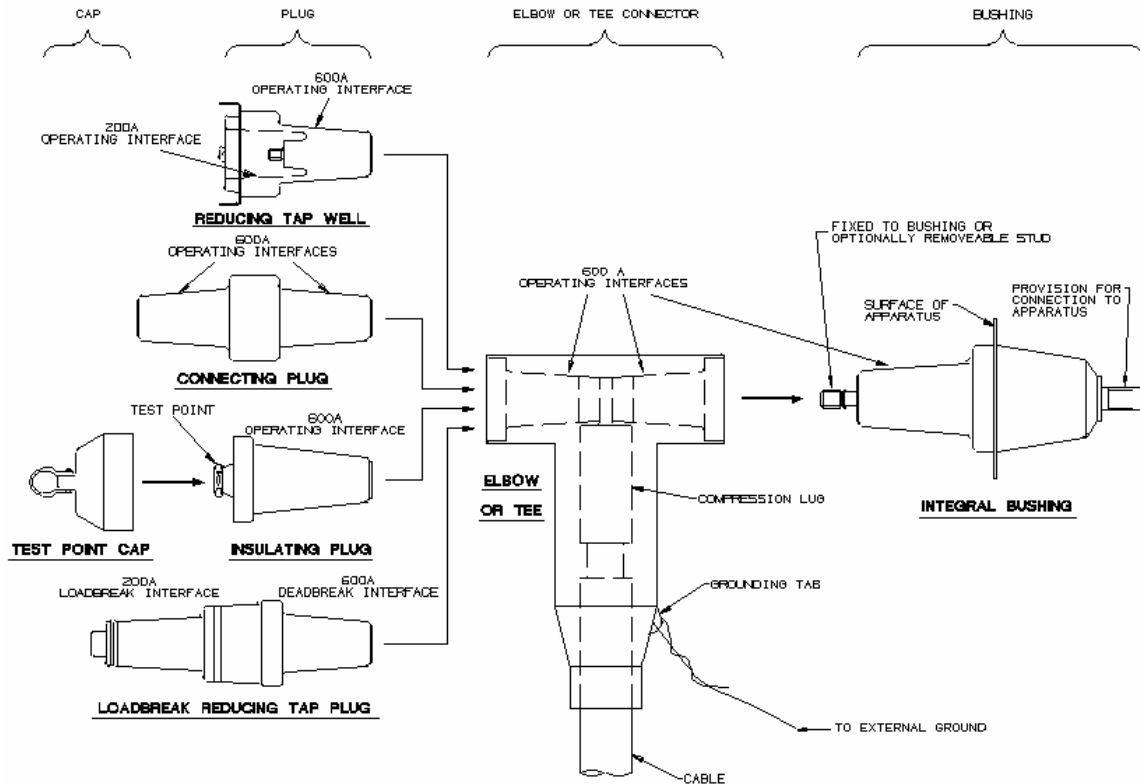


Figure 2—Typical components of 600 A separable insulated connector system

4. Service conditions

4.1 Usual service conditions

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

- In air, including exposure to direct sunlight
- Buried in earth
- Intermittently or continuously submerged in water at a depth not exceeding 1.8 m (6 ft)
- Environmental temperatures within the range of $-40\text{ }^{\circ}\text{C}$ to $+65\text{ }^{\circ}\text{C}$ (loadbreak connectors can be closed and separated within the range of $-20\text{ }^{\circ}\text{C}$ to $+65\text{ }^{\circ}\text{C}$)
- Altitudes not exceeding 1800 m (6000 ft) above sea level (applicable to loadbreak 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 and characteristics

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)	Partial discharge minimum extinction voltage (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

^a The highest steady-state voltage across the open contacts that a loadbreak 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.

^b Based on a sensitivity of 3 pC (see 7.4).

^c Phase-to-ground.

^d Phase-to-ground/phase-to-phase.

5.2 Current ratings and characteristics

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

Table 2—Current ratings and characteristics

Connector type	Continuous current rating (A rms) ^a	Switching current rating (A rms)	Overload current ^{a, b, c} 4 hour rating (A rms)	Fault-closure current rating ^d			Short-time current rating		
				A rms, sym	Duration (s)	Min x/r	A rms, sym	Duration (s)	Min x/r
Loadbreak	200	200	—	10 000	0.17	6	10 000	0.17	6
							3 500	3.00	6
Deadbreak	200	—	300	—	—	—	10 000	0.17	6
							3 500	3.00	6
Deadbreak	600	—	900	—	—	—	25 000	0.17	20
							10 000	3.00	20

^a In 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.

^b Consult the manufacturer for ratings that exceed those listed in Table 2.

^c One overload cycle during a 24 h period.