35kV Class - 600A
21.1 / 36.6kV
Dead-break Connector
Type Test Report

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INTRODUCTION

The Chardon Deadbreak System is a fully shielded and insulated connector for connecting underground cable to transformers, switchgear, and other apparatus equipped with deadbreak bushings, junctions, or other deadbreak connectors.

The Chardon Deadbreak Connector meets all the requirements of IEEE Standard 386, and is fully interchangeable with competitor's products and mating products that also meet IEEE Standard 386.

TEST PROGRAM

i. OBJECT

To verify the Chardon Power Systems 35kV Class 600 Amp Separable connector that the parts meet ANSI/IEEE Standard 386-2016.

ii. PROCEDURE

Design tests were performed on the number of samples as specified in Table 8 of IEEE Standard 386-2016. The 35kV 600 Amp Separable Connector parts were randomly selected from finished goods inventory and dimensionally checked to ensure that the interfaces were in compliance with the applicable figures of IEEE Standard 386-2016.

iii. PRODUCT LIST

The 35kV class 600 Amp Separable Connector System consists of the products listed below:

1.	35-TB600	35 kV, 600A, Deadbreak T-Body
2.	35-IP600	35 kV, Insulating Plug
3.	35-DCP	35 kV, Connecting Plug
4.	35-DJ600	35 kV, 600A Deadbreak Junction
5.	MPJ	Multi Point Junction
6.	35-ADP	Cable Adapter
7.	SBC	Shear Bolted Connector
8.	35-STUD	Threaded Stud
9.	600BMC	Compression Connector

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1. Sequence A: Partial Discharge Test

Object

To verify the Chardon Deadbreak Systems connectors that the parts meet ANSI/IEEE Standard 386-2016, Section 7.4, 35kV partial discharge requirement of 26kV/5pC.

Procedure and Testing Spec

The purpose of this test is to verify that the partial discharge minimum extinction voltage of the specimen is not less than of the 26kV.

The test voltage shall be raised to 20% above the partial discharge minimum extinction voltage of 26kV. If the partial discharge peak value exceeds 5pC, the test voltage shall be lower to the partial discharge minimum extinction voltage of 26kV and be maintained at this level for at least 3 seconds but not more than 60 seconds. Partial discharge readings taken during the interval 3 seconds to 60 seconds shall not exceed 5pC peak.

Results

The products tested were 1-6 of the Product List on page 1.

For all ten samples of each product tested the corona level was less than 5pC at the specified minimum corona extinction voltage level of 26kV rms.

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2. Sequence A: AC Withstand Voltage Test

Object

To verify the Chardon Deadbreak Systems connectors that the parts meet ANSI/IEEE Standard 386-2016, Section 7.5.1, 35kV AC withstand requirement of 50kV/ 1 min.

Procedure and Testing Spec

The test voltage shall be raised to the value of 50kV in 30 seconds. The test sample shall withstand the specified test voltage for 1 minute without flashover or puncture.

Results

The products tested were 1-6 of the Product List on page 1.

All samples of each product withstood a 50kV rms, 60Hz ac one minute voltage withstand without a puncture or flashover.

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3. Sequence A: Impulse Withstand Voltage

Object

To verify the Chardon Deadbreak Systems connectors that the parts meet ANSI/IEEE Standard 386-2016, Section 7.5.3, impulse withstand testing requirements of 1.2×50μs ±150kV wave., 3 positive and 3 negative full-wave impulses.

Procedure and Testing Spec

The test voltage shall be 1.2/50μs wave having the crest value (BIL) of 150kV. The wave shape shall meet the requirements of IEEE Std 4.

Prior to application of the first full-wave impulse, preconditioning pulses at 50% and then at 75% of the BIL. During a change of polarity, the preconditioning pulse sequence may again be applied.

The connector shall withstand 3 positive and 3 negative full-wave impulses without flashover or puncture.

Results

The products tested were 1-6 of the Product List on page 1.

All samples of each product withstood three positive and three negative full wave impulses with 150kV crests without a puncture or flashover.

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4. Sequence A: Test Point Capacitance Test

Object

To verify the Chardon Deadbreak Systems connectors that the parts meet ANSI/IEEE Standard 386-2016, Section 7.17.1, test point testing requirement.

Procedure and Testing Spec

The purpose of this test is to verify that the capacitance values of the test point meet the requirements of 6.5.1 in IEEE Std 386.

The connector shall be installed on a cable of the type for which it is designed to operate, and the shielding shall be grounded in the normal manner. The capacitances from test point to cable and test point to ground shall be measured with suitable instruments and proper shielding techniques.

The capacitance between the test point and conductor system shall be at least 1.0pF. The ratio of the capacitance between test point and ground shield to the capacitance between the test point and conductor system shall not exceed 12.0.

Results

The product tested were 1 of the Product List on page 1.

The test point capacitance test verified that the capacitance between the test point and conductor was at least 1.0 pF for each of the ten elbow samples. The ratio of capacitance between test point and ground shield to the capacitance between the test point and the conductor system did not exceed 12.0 for each of the ten elbow samples.

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5. Sequence A: Test Point Voltage Test

Object

To verify the Chardon Deadbreak Systems connectors that the parts meet ANSI/IEEE Standard 386-2016, Section 7.17.2, test point testing requirement.

Procedure and Testing Spec

The purpose of this is to verify proper operation of the test point.

The connector shall be installed on a cable of the type for which it is designed to operate, and the shielding shall be grounded in the normal manner. With a test elbow latched to the insert, a voltage of 21±2 kV was applied.

Results

The product tested were 1 of the Product List on page 1.

An energized voltage condition was detected on the test points of all ten elbows at an applied voltage of 21±2 kV.

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6. Sequence A: Thermal Cycle Withstand Test

Object

To verify the Chardon Deadbreak Systems non-elastomeric separable connectors that the parts meet ANSI/IEEE Standard 386-2016, Section 7.20, thermal cycle withstand testing requirement.

Procedure and Testing Spec

The test samples shall be thermal cycled with mating parts installed.

Ten thermal cycles shall be conducted in air. The temperature cycles shall comply with the thermal cycle profile shown in IEEE std 386-2016. The temperature extremes shall have a tolerance of ± 5 °C.

After completion of the thermal cycles the non-elastomeric components shall be tested to the applicable dielectric withstand test levels for the following:

– Partial discharge test.
– AC withstand voltage.

The aged mating parts may be replaced with new mating parts for the dielectric tests.

Ten samples shall withstand the thermal cycle test without cracking or breaking and shall meet the requirements of the corona voltage level and ac withstand voltage tests.

Results

The product tested were 2, 3 of the Product List on page 1.

Ten samples withstand the thermal cycle test without cracking or breaking and meet the requirements of the corona voltage level and ac withstand voltage tests.

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7. Sequence B: Accelerated Sealing Life Test

Object

To verify the Chardon Deadbreak Systems connectors that the parts meet ANSI/IEEE Standard 386-2016, Section 7.12, accelerated sealing life testing requirement.

Procedure and Testing Spec

Four samples shall be assembled in series on 750kcmil XLPE insulated cable.

The cable shall be compatible with the thermal conditions of this test. A mandrel simulating the test cable may be substituted during the oven aging portion of this test.

The four connector assemblies shall be placed in an oven having 121°C temperature and remain there for three weeks. After this time has elapsed, the four samples shall be removed from the oven and each operated once by using the operating eye or an appropriate location on the axis of the separable interface.

The four connector assemblies shall then be subjected to 50 cycles of the following sequence of operations:

a) The assemblies shall be heated in air using sufficient current to raise the temperature of the conductor of the control cable to 90°C ± 5°C for the following time period:

2) 600 A and 900 A connectors: 4 h

b) The assemblies shall be de-energized and within 3 min, submerged in 25°C ± 10°C conductive water (5000 Ω-cm maximum) to a depth of 30 cm (1 ft) for the following time periods:

2) 600 A and 900 A connectors: 2 h

After the 50th cycle, the connector and cable assembly shall withstand a design impulse test (see 7.5.3).

The test point, if provided, shall be capable of passing the voltage test specified in 7.17.2.

Results

The products tested were 1-9 of the Product List on page 1.

Following the 50 accelerated sealing life test cycles, all four assemblies withstood three positive and three negative full wave impulses having 150kV crest values, without a puncture or flashover.

After the impulse test, the elbow test point of each assembly indicated an energized condition with an applied voltage of 21±2 kV.

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8. Individual tests: Short-time Current Test

Object

To verify the Chardon Deadbreak Systems connectors that the parts meet ANSI/IEEE Standard 386-2016, Section 7.6, short-time current testing requirement.

Procedure and Testing Spec

The peak value of the first major loop of a current wave shall be not less than the value specified in Table 4 multiplied by 2.63 (X/R=20) for 600 A connectors. The magnitude shall be measured in accordance with ANSI/IEEE C37.09.

Connectors shall withstand the current without separation of interfaces or impairing the ability to meet the other requirements of the standard.

Results

The products tested were 1-9 of the Product List on page 1.

All samples of each product withstood short-time currents with magnitudes and durations of 10,000 amperes symmetrical for 3 seconds and 25,000 amperes symmetrical for 0.17 seconds (10 cycles) without any separation of the interfaces or impairing the connector's ability to meet the other requirements of IEEE Standard 386-2016.

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9. Individual tests: Current-cycling Test

Object

To verify the Chardon Deadbreak Systems connectors that the parts meet ANSI/IEEE Standard 386-2016, Section 7.11, current-cycling test for uninsulated components of 600 A and 900A connectors.

Procedure and Testing Spec

A control cable, used for the purpose of obtaining conductor temperature, shall be installed in the current cycling loop between two equalizers. Its length shall be 183 cm (72 in). The control cable shall be the same type as the cable used to join the connectors under test.

Four samples shall be assembled in series on 750kcmil XLPE insulated cable having a length of 91 cm (36 in). The cable insulation thickness shall be selected according to its voltage class.

Current-cycling tests shall be conducted at an ambient temperature of 15°C to 35°C in a space free of drafts.

The current-cycle amperes shall be adjusted to result in a steady-state temperature of 90 °C ± 5 °C on the surface of the conductor of the control cable. The temperature shall be measured at the approximate center of the control cable.

The test shall consist of 50 current cycles, with the current on 6 h and off 6 h for each cycle. The temperature of the hottest spot of the connector shall be measured every ten cycles and shall not exceed the temperature of the conductor of the control cable.

Results

The products tested were 1-9 of the Product List on page 1.

The temperatures at each transfer point did not exceed the temperature of the control conductor during the test.

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10. Individual tests: Cable Pull-out Test (tensile strength)

Object

To verify the Chardon Deadbreak Systems connectors that the parts meet ANSI/IEEE Standard 386-2016, Section 7.13, cable pull-out testing requirement.

Procedure and Testing Spec

The purpose of this is to determine if the connection between the cable conductor and compression lug of the connector is capable of withstanding a tensile force of 890 N (200 lbf)

The compression lug shall be held in a manner that does not affect the strength of the connection. The tensile force shall be applied to the cable connector.

The connection shall withstand the applied force for 1 min without impairing the connector's ability to meet the other requirement of this standard.

Results

The products tested were 9 of the Product List on page 1.

One set of two test samples was pulled through an 890N cable with no deformation or strain.

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11. Individual tests: Test Point Cap Test

Object

To verify the Chardon Deadbreak Systems connectors that the parts meet ANSI/IEEE Standard 386-2016, Section 7.16, test point cap testing requirement.

Procedure and Testing Spec

A tensile force shall be gradually applied to the test point cap in the direction parallel with the probe axis at −20°C, +25°C, and +65°C.

A tensile force of 445 N (100 lbf) shall be applied to the test point cap operating eye for 1 min at −20°C, +25°C, and +65°C.

Some distortion of the operating eye is acceptable provided the test point cap is serviceable after the test.

Results

The product tested were 1 of the Product List on page 1.

The test point cap operating force of each sample was within the specified requirements of 8 to 49 pounds-force at each temperature of -20°C, +25°C and +65°C.

The test point cap operating eye of each sample withstood the applied tensile force of 100 pounds-force at each temperature of -20°C, +25°C and +65°C.

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12. Individual tests: Shielding Resistance Test

Object

To verify the Chardon Deadbreak Systems connectors that the parts meet ANSI/IEEE Standard 592-2007, Section 4.2, shielding resistance requirement.

Procedure and Testing Spec

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.

IEEE Std 592 4.2 Shield resistance test:

The resistance of the semiconducting shield shall be measured using the voltmeter-ammeter method, with either an AC or DC current supply. The current connections shall be as follows:

- For a separable insulated connector, the current connections shall be made on the shield at the cable entrance and at the farthest shield extremity, using a circumferential connection at both locations to give a uniform current distribution.
- For a joint, the current connections shall be made on the shield at the cable entrance and at the physical center of the shield, using a circumferential connection at both points to give a uniform current distribution.

The voltage shall be measured with the current adjusted to 1.0 mA ± 0.2 mA.

- Resistance measurements shall be made on test specimens that have had the following histories:

  a) Unaged
  b) Air oven aged for 504 h at 121°C ± 5°C

- Resistance measurements shall be made with the test specimen temperature at 20°C ± 5°C and at 90°C ± 5°C.

Results

The product tested were 1 of the Product List on page 1.

The shield resistance measurements between the extremities of the elbow were all less than the maximum allowable 5000 ohms.