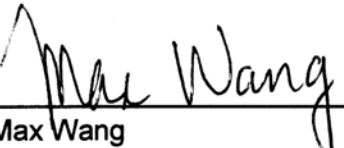
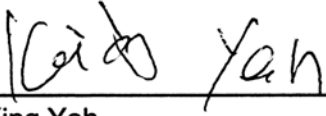
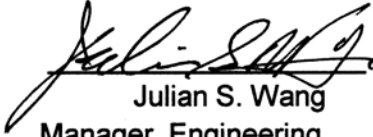


Date : Oct. 12, 2015
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Type Test Report for
CableMate[®] 25kV, 200A Loadbreak Elbow and
Insert, Type 2LBE & 2LBI
(IEEE Std. 386-2006)


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Product Description:

The CableMate® 2LBE loadbreak elbow connector and 2LBI loadbreak bushing insert are fully-shielded, fully submersible, insulated plug-in terminations for connecting underground cables to distribution apparatus such as transformers and switchgear. The CableMate® 2LBE elbow is a fully rated 25kV, 200 amp switching device, designed in accordance to the latest IEEE Std 386™. It includes provisions for energized operation using standard hotstick tools allowing loadmake/break operation and a visible disconnect. An optional capacitive voltage test point is available for application of fault indicators and determining if the circuit is energized. The CableMate® 2LBI loadbreak bushing insert is fully rated with a 25kV class, 200 Amp loadbreak insert bushing interface. The 2LBI loadbreak bushing insert connects to a universal bushing well and becomes the apparatus bushing interface for elbow connections. When mated with a comparably rated component, the 2LBI bushing insert provides a fully shielded and submersible connection for loadbreak operation. All CableMate® 2LBE1 loadbreak elbows and 2LBI loadbreak bushing inserts are interchangeable with other manufacturers' products that also comply with the IEEE 386 standard.

Objective and Certification:

The objective of these tests are to verify and confirm the CableMate® 2LBE 25kV, 200 amp loadbreak elbow and 2LBI 25kV, 200 amp loadbreak bushing insert meet or exceed the requirements of the IEEE Standard 386-2006, "Separable Insulated Connector Systems for Power Distribution Systems above 600 Volts". These products comply with the interface dimensions in Figures 7 and 15 of this standard. This report certifies that the tests shown below have been successfully performed on the CableMate® 2LBE 25kV, 200 amp loadbreak elbow and 2LBI 25kV, 200 amp loadbreak bushing insert in accordance with IEEE 386-2006.

1. Partial discharge test	section 7.4
2. AC withstand voltage test	section 7.5.1
3. DC withstand voltage test	section 7.5.2
4. Impulse withstand voltage test (BIL)	section 7.5.3
5. Test point test	section 7.17
6. Accelerated sealing life test	section 7.12
7. Cable pull out test	section 7.13
8. Operating force test	section 7.14
9. Operating eye test	section 7.15
10. Test point cap test	section 7.16

Test Samples and Test Cable:

Ten (10) pieces of the CableMate® 25kV, 200 amp loadbreak elbow kit with test point, catalog number 2LBE1H03B07, were installed on 1/0 AWG AL 25kV class cable with 6.6 mm insulation thickness. The complete elbow kit contained:

- 1 piece 25kV, 200 amp loadbreak elbow housing with test point, CableMate® catalog number 2LBE1H03
- 1 piece 25kV, 200 amp loadbreak elbow probe, CableMate® catalog number 2LBEPR
- 1 piece Bi-metal compression lug connector, CableMate® catalog number LACB07

Each loadbreak elbow kit was mated with a CableMate® 25kV, 200 amp loadbreak bushing insert, catalog number 2LBI, and an Elastimold K1601PC-T1 25kV, 200 amp universal bushing well.

1. IEEE 386-2006 Sec. 7.4: Partial Discharge Test:

The purpose of this test is to verify that the partial discharge level of the CableMate® 2LBE 25kV, 200 amp loadbreak elbow and CableMate® 2LBI loadbreak bushing insert meet the IEEE 386 requirement of 3pC at 19kV. After installation on the test stand, the test voltage was raised to 24kV and higher until the partial discharge peak value exceeded 3 pC. The test voltage was then lowered to 19kV and was maintained at this level for at least three (3) seconds but not more than one (1) minute. Partial discharge readings taken during this interval did not exceed 3 pC peak.

Test result: All ten (10) samples tested had partial discharge levels less than or equal to 3pC at 19kV or greater. All ten (10) samples tested meet the requirements of Section 7.4 of IEEE Standard 386 - 2006.

2. IEEE 386-2006 Sec. 7.5.1: AC Withstand Voltage Test:

The purpose of this test is to verify the CableMate® 2LBE 25kV, 200 amp loadbreak elbow and CableMate® 2LBI loadbreak bushing insert meet the IEEE 386 AC Withstand Voltage requirement of 40kV for one minute. Using the same ten (10) test samples that just completed the partial discharge test above, (Sec. 7.4), the test voltage was raised on all test samples to 40kV AC rms in less than thirty (30) seconds. Each of the ten (10) test samples withstood the 40kV AC test voltage for one (1) minute without flashover or puncture.

Test result: All ten (10) samples passed the test at 40kV AC, 60 Hz, 1 minute. All ten (10) samples tested meet the requirements of Section 7.5.1 of IEEE Standard 386 - 2006.

3. IEEE 386-2006 Sec. 7.5.2: DC Withstand Voltage Test:

The purpose of this test is to verify the CableMate® 2LBE 25kV, 200 amp loadbreak elbow and CableMate® 2LBI loadbreak bushing insert meet the IEEE 386 DC Withstand Voltage requirement of 78kV DC for fifteen (15) minutes. Using the same ten (10) test samples used in the partial discharge test (sec 7.4) and AC Withstand Voltage Test (Sec 7.5.1) above, the test voltage was raised to 78kVdc for fifteen (15) minutes. Each of the ten (10) test samples withstood the 78kV DC test voltage for fifteen (15) minutes without flashover or puncture.

Test result: All 10 samples passed the test at 78kV DC for 15 minutes. All ten (10) samples tested meet the requirements of Section 7.5.2 of IEEE Standard 386 - 2006.

4. IEEE 386 Sec. 7.5.3: Impulse Withstand Voltage (BIL) Test:

The purpose of this test is to verify the CableMate® 2LBE 25kV, 200 amp loadbreak elbow and CableMate® 2LBI loadbreak bushing insert meet the IEEE 386 requirement of 125kV crest, 3 positive and 3 negative full-wave impulses. Using the same ten (10) test samples used in the partial discharge test (sec 7.4), AC Withstand Voltage Test (Sec 7.5.1), and DC Withstand Voltage Test (Sec. 7.5.2) a test voltage having 1.2 x 50 µs wave with crest value at 125kV was applied to all ten (10) samples for three positive and three negative full-wave impulses.

Test result: All ten (10) samples passed 3 positive and 3 negative full wave impulse at 125kV crest. All ten (10) samples tested meet the requirements of Section 7.5.3 of IEEE Standard 386 - 2006.

5. IEEE 386 Sec. 7.17: Test Point Test:

The purpose of this test is to verify that the capacitance values of the CableMate® 2LBE 25kV, 200 amp loadbreak elbow test point meet the requirements of section 7.17.1 test point capacitance test and section 7.17.2 test point voltage test. Following the above tests, all ten (10) samples were subject to the test point test 7.17.1. The capacitance from the test-point of the elbow to the cable conductor and the test point to the shield was measured with appropriate instrumentation. The measured capacitance value was no less than 1.0pF. The capacitance ratio between the test point and the shield and the shield to the conductor was less than 12.0. Subsequent to the above, all (ten) 10 test samples were subject to section 7.17.2 test point voltage test. A test voltage was applied to the conductor system of the connectors. A voltage indicator (Elastimold V2) mounted on a hotstick was placed on the test point and all samples responded with positive voltage indication.

Test result: All ten (10) samples passed. All ten (10) samples tested meet the requirements of Sections 7.17.1 and 7.17.2 of IEEE Standard 386 - 2006.

6. IEEE 386 Section 7.12: Accelerated Sealing Life Test.

The purpose of this test is to verify the CableMate® 2LBE 25kV, 200 amp loadbreak elbow and CableMate® 2LBI loadbreak bushing insert can maintain a long-term seal at all interfaces to prevent the entrance of moisture. Four (4) new sets of test sample assemblies were prepared for this test (using the same components identified in the Test Samples and Test Cable section above) and subject to the test procedure defined in section 7.12. All four (4) test samples were placed in an oven having 121 °C temperature for three weeks. Once removed from the oven, all four (4) test samples were operated once using the operating eye, then connected in series, and subjected to 50 cycles of the following sequence:

- a) The assemblies were heated in air using sufficient current to raise the temperature of the conductor of the control cable to 90 °C ± 5 °C for 1 hour;
- b) The assemblies were de-energized and within 3 minutes were submerged in 25 °C ± 10 °C conductive water (5000 Ω-cm maximum) to a depth of 30 cm (1 ft) for 1 hour.

Following the above sequence, each test sample assembly passed the Impulse Withstand Test at 125kV crest, 3 positive and 3 negative full-wave impulses according to Section 7.5.3 and the Test Point Test according to Sections 7.17.1 and 7.17.2 of the IEEE 386-2006 standard.

Test result: All four (4) test sample assemblies passed. All four (4) samples tested meet the requirements of Section 7.12 of IEEE Standard 386-2006.

7. IEEE 386 Sec. 7.13: Cable Pull Out Test:

The purpose of this test is to determine if the connection between the cable conductor and the compression lug of the connector is capable of withstanding a tensile force of 890 N (200 lbf) for 1 minute without impairing the connector's ability to meet the other requirements of the IEEE 386-2006 standard. Four (4) CableMate® bi-metal compression lugs catalog number LACB07 were appropriately crimped onto 1/0 AWG aluminum conductor for this test.

Test result: All four (4) samples passed. All four (4) samples tested meet the requirements of Section 7.13 of IEEE Standard 386-2006.

8. IEEE 386 Sec. 7.14: Operating Force Test:

The purpose of this test is to verify that the that the force necessary to operate the CableMate® 2LBE 25kV, 200 amp loadbreak elbow connector meets the requirements of IEEE 386-2006 standard section 6.2. and 7.14. The force required to open or close the loadbreak connector shall be within the range of 222 N to 890 N (50 lbf to 200 lbf). Four (4) new sets of test samples were prepared for this test. Each test sample was assembled and lubricated in accordance with CableMate®'s instructions and consisted of:

- One (1) CableMate® 25kV, 200 amp loadbreak elbow, catalog number 2LBE1H.
- One (1) CableMate® 25kV, 200 amp loadbreak elbow probe, catalog number 2LBEPR.
- One (1) CableMate® Bi-metal compression lug connector, catalog number LACB07.
- One (1) CableMate® 2LBI loadbreak bushing insert.

The temperature of the loadbreak elbow was at -20°C, +25°C, and +65°C respectively for three independent tests. A force was applied parallel to the probe axis at a rate of 13 cm/min (5 in/min). Each test consisted of closing (loadmake) and then reopening (loadbreak) each connector within 10 minutes.

Test result: All four (4) samples passed. All four (4) samples tested meet the requirements of Section 7.14 of IEEE Standard 386 – 2006.

9. IEEE 386 Sec. 7.15: Operating Eye Test:

The purpose of this test is to verify the CableMate® 2LBE 25kV, 200 amp loadbreak elbow operating eye meets the requirements of IEEE standard 386-2006 section 6.2 and 7.15 at 25°C ± 5°C. Four (4) new sets of samples were prepared for this test. A static tensile force of 500 lbf was gradually applied to the operating-eye of each elbow parallel to the probe access for a minimum of one minute. A rotational force of 120 lbf-in was then applied to the operating-eye in a clockwise direction, then in a counter-clockwise direction with a suitable live-line tool. After the tensile and rotational forces were applied, each elbow was subjected to the Partial Discharge Test from Section 7.4.

Test result: All four (4) samples passed. All four (4) samples tested meet the requirements of Section 7.15 of IEEE Standard 386 – 2006.

10. IEEE 386 Sec. 7.16: Test Point Cap Test:

The purpose of this test is to demonstrate that force required to remove the test point cap is within the range of 36 N – 218 N (8 lbf – 49lbf) and the cap operating eye is capable of withstanding a maximum static operating force of 445 N (100 lbf) over the environmental temperature range of -20 °C to +65 °C. Four (4) new sets of samples were prepared for this test. A tensile force was gradually applied to the test point cap in the direction parallel with the operating interface axis at -20°C, +25°C, and +65 °C. The force required to remove the test-point cap was within the range of 8 to 49 lbf for all four (4) samples tested. A tensile force of 100 lbf was then applied to all four (4) samples for 1 minute at -20 °C, +25 °C, and +65 °C.

Test result: All four (4) samples passed. All four (4) samples tested meet the requirements of Section 7.16. of IEEE Standard 386 – 2006.