

Test Report PPR-3202

Test object: Cold Shrink Indoor Termination type CSTI and Cold Shrink Outdoor Termination Type CSTO for screened single core polymeric cables without armour
TE Connectivity reference: CSTI-6152-ML-7-13, CSTO-6152-ML-7-13, CSTO-6162-ML-8-21

Test performed: Requirements according to CENELEC HD 629.1 S3 from 2015-09 (Draft) Table 6 Sequence A1 and Table 7 Sequence A1 for rated voltage $U_0/U (U_m)$ 20,8/36(42) kV

Test result: All samples passed the test requirements in accordance with the CENELEC HD 629.1 S3:2015 (Draft) table 6 Sequence A1 and table 7 Sequence A1 for rated voltage $U_0/U (U_m)$ 20,8/36(42) kV

Pages: 41

Tested by:	Bayram Cataltepe (Laboratory Technician)	Signature: 	Date: 23.02.17
Prepared by:	Christoph Baier (Laboratory Manager)	Signature: 	Date: 23.02.17
Released by:	Per Christian Olving (Product Manager)	Signature: 	Date: 23/2-17

Tyco Electronics Raychem GmbH
a TE Connectivity LTD. Company
Finsinger Feld 1
D-85521 Ottobrunn
Munich, Germany
Tel.: +49-89-6089-0
Fax: +49-89-6096-345

© Raychem reports may only be used in their original form



Content

1	General information.....	3
1.1	Description of the test objects.....	3
1.2	Description of the test cables.....	3
1.3	Test standards.....	4
1.4	Test facilities.....	4
1.5	Test dates.....	4
2	Test sequence and requirements.....	5
3	Test setups.....	6
3.1	AC voltage dry withstand.....	6
3.2	Partial discharge at ambient temperature.....	7
3.3	Partial discharge at elevated temperature.....	8
3.4	Impulse voltage.....	9
3.5	Heating cycle voltage in air.....	10
3.6	Immersion test for outdoor terminations.....	11
4	Results.....	12
4.1	AC voltage dry withstand.....	12
4.2	Partial discharge at ambient temperature.....	13
4.3	Impulse voltage at elevated temperature.....	14
4.4	Heating cycle voltage in air.....	18
4.5	Immersion test for outdoor terminations.....	19
4.6	Partial discharge at elevated and ambient temperature.....	22
4.7	Impulse voltage at ambient temperature.....	24
4.8	AC voltage dry withstand.....	31
4.9	Partial discharge at ambient temperature.....	32
4.10	Examination.....	33
A.	Appendices.....	34
A.1	Identification of test cable 500 mm ²	34
A.2	Identification of test cable 1000 mm ²	35
A.3	Installation instructions.....	36
A.4	Kit content lists.....	41

1 General information

1.1 Description of the test objects

Test objects:	4 indoor terminations type CSTI-6152-ML-7-13 installed on 500mm ² (test objects A), 4 outdoor terminations type CSTO-6152-ML-7-13 installed on 500mm ² (test objects B), 4 outdoor terminations type CSTO-6162-ML-8-21 installed on 1000mm ² (test objects C)
Manufacturer:	TE Connectivity Kunshan PRC
TE kit reference:	CSTI-6152-ML-7-13, CSTO-6152-ML-7-13, CSTO-6162-ML-8-21
Part description:	CSTI-35-BD-32-583-FS, CSTO-35-BD-32-581-FS
Rated voltage $U_0/U (U_m)$:	20,8/36 (42) kV
Connector type:	Mechanical cable lug type BLMT-500/630 MK2-13 (test object A and B), Mechanical cable lug type BLMT-800/1000-21 (test object C)
Installation instructions:	EPP-2828-2/17 (see Appendix A.3)
List of kit content:	See Appendix A.4

1.2 Description of the test cables

Length of each test loop:	3.5 m (without test object)
Cable type:	Single core cable with XLPE insulation, type VDE 0276 NA2XS(F)2Y (see Appendix A.1)
Cable conductor material:	Copper
Cable conductor cross-section:	500 mm ²
Rated voltage of cable $U_0/U (U_m)$:	18/30 (36) kV
Length of each test loop:	3.5 m (without test object)
Cable type:	Single core cable with XLPE insulation, type Charleroi NEXANS EAXeCWB (see Appendix A.2)
Cable conductor material:	Aluminium
Cable conductor cross-section:	1000 mm ²
Rated voltage of cable $U_0/U (U_m)$:	20.8/36(42) kV

1.3 Test standards

Requirements according to CENELEC HD 629.1 S3 from 2015-09 (Draft): *Test requirements on accessories for use on power cables of rated voltage from 3,6/6 (7,2) kV up to 20,8/36 (42) kV, Part 1: Cables with extruded insulation*; Table 6 Sequence A1 and Table 7 Sequence A1 for rated voltages $U_0/U (U_m)$ 20,8/36(42) kV

1.4 Test facilities

The installation of the test objects as well as the electrical tests were carried out by technicians of Tyco Electronics Raychem GmbH in the High Voltage Laboratory in Ottonbrunn/Germany.

1.5 Test dates

CSTI-6152-ML-7-13:	30.09.2016 – 16.12.2016
CSTO-6152-ML-7-13:	30.09.2016 – 25.01.2017
CSTO-6162-ML-8-21:	19.10.2016 – 06.02.2017

2 Test sequence and requirements

The test requirements are according to CENELEC HD 629.1 S3 from 2015-09 (Draft), Table 6 Sequence A1 and Table 7 Sequence A1 for rated voltage $U_0/U (U_m)$ 20,8/36 (42) kV.

	Test	Test clause of EN 61442	Test requirements	Notes
1	AC voltage dry withstand	4	5 min at 93,5 kV, no breakdown	-
2	Partial discharge at ambient temperature	7	Max. 10 pC at 42 kV	-
3	Impulse voltage at elevated temperature	6	10 impulses of each polarity at ± 200 kV, target temperature 95 - 100°C, no breakdown	-
4	Heating cycle voltage in air	9	126 heat cycles, target temperature 95 - 100°C, 52 kV, no breakdown	-
5	Immersion	9.4	10 heat cycles, target temperature 95 - 100°C	Only required for outdoor terminations;
6	Partial discharge at elevated temperature	7	Heating up, target temperature 95 - 100°C, max. 10 pC at 42 kV	-
7	Partial discharge at ambient temperature	7	Max. 10 pC at 42 kV	-
8	Impulse voltage at ambient temperature	6	10 impulses of each polarity at ± 200 kV, no breakdown	-
9	AC voltage dry withstand	4	5 min at 93,5 kV, no breakdown	-
10	Partial discharge at ambient temperature	7	Max. 10 pC at 42 kV	-
11	Examination	-	-	-

3 Test setups

3.1 AC voltage dry withstand

The cable conductors of the test objects were connected to an AC voltage provided by a test transformer, the screens were put on ground potential (**Figure 1**). The voltage measurement was carried out with a capacitive divider. The measuring uncertainty within a range of 10 kV to 300 kV was 0.91%.

Technical data:

TT	Test transformer:	350 kV, 175 kVA, 50 Hz
C-Div	Capacitive divider:	75 pF (high voltage side)
TO	Test object	

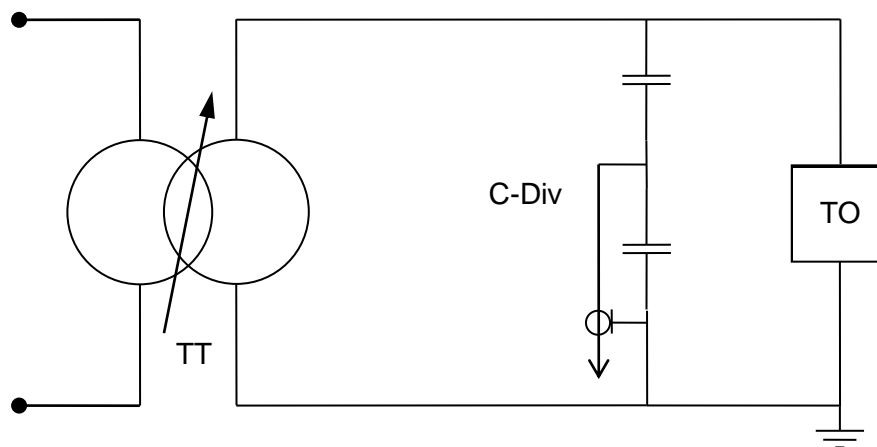


Figure 1: AC voltage dry withstand test setup

Measurement equipment:

Object	Type	Calibration number	Calibration date
Capacitive divider	TUR MCF 75/350 P	000132 D-K-17601-01-00	2015-03
Coaxial cable	-	000132 D-K-17601-01-00	2015-03
AC peak voltmeter	LDIC voltage unit	000132 D-K-17601-01-00	2015-03

3.2 Partial discharge at ambient temperature

The cable conductors of the test objects were connected to an AC voltage provided by a test transformer, the screens were put on ground potential (**Figure 2**). The voltage measurement was carried out with a capacitive divider. The measuring uncertainty within a range of 10 kV to 300 kV was 0.91%. For the extraction of the partial discharge (PD) signals, a coupling capacitor and a quadrupole (i.e. measuring impedance) were used. A coil was installed to block interferences coming from the transformer side of the test setup. Prior to the test, the complete test arrangement including the test object was calibrated using a PD-calibrator.

Technical data:

TT	Test transformer:	350 kV, 175 kVA, 50 Hz
C-Div	Capacitive divider:	75 pF (high voltage side)
C-C	Coupling capacitor:	1000 pF
Q	Quadrupole	
L	Coil	
TO	Test object	

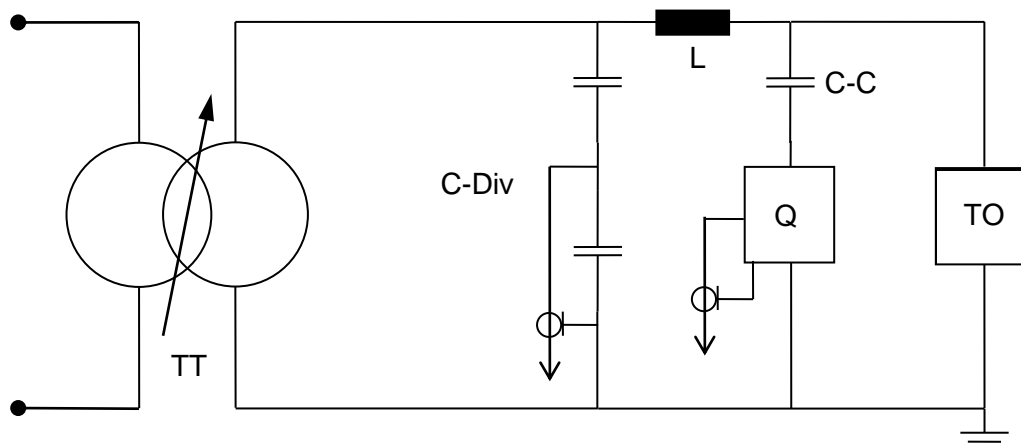


Figure 2: Partial discharge test setup

Measurement equipment:

Object	Type	Calibration number	Calibration date
Capacitive divider	TUR MCF 75/350 P	000132 D-K-17601-01-00	2015-03
Coaxial cable	-	000132 D-K-17601-01-00	2015-03
AC peak voltmeter	LDIC voltage unit	000132 D-K-17601-01-00	2015-03
PD-measurement system	LDIC LDD-5	calibrated with PD-calibrator	n/a
PD-calibrator	LDIC LDC-5	RY-1341 & verified with PD-calibrator tester	2016-06-01
PD-calibrator tester	LDIC LDT-5	RY-1222	2016-07-15

3.3 Partial discharge at elevated temperature

The cable conductors of the test objects were connected to an AC voltage provided by a test transformer, the screens were put on ground potential (**Figure 2**). The voltage measurement was carried out with a capacitive divider. The measuring uncertainty within a range of 10 kV to 300 kV was 0.92%. For the extraction of the partial discharge (PD) signals, a coupling capacitor and a quadrupole (i.e. measuring impedance) were used. A coil was installed to block interferences coming from the transformer side of the test setup. Prior to the test, the complete test arrangement including the test object was calibrated using a PD-calibrator. The test objects were installed in a way that a closed loop was formed, which could be heated using an induced AC current provided by a heating transformer supplied by a variable transformer. The cable should be heated to a conductor temperature 5 - 10 K above the maximum cable conductor temperature in operation, i.e. 95 - 100°C for XLPE-cables. The temperature of the cable conductor was measured in-line using a reference cable of the same type as the test loops with a length of 3 m, a type K thermocouple and fibre optical temperature measurement transmission systems. The current was measured by a clamp meter.

3.4 Impulse voltage

The cable conductors of the test objects were connected to a Marx-generator with 8 stages, a maximum cumulative charging voltage of 800 kV and a maximum impulse energy of 24 kJ, the screens were put on ground potential (**Figure 3**). The voltage measurement was carried out with a resistive-capacitive divider and an impulse measurement system. The measuring uncertainty for the voltage amplitude within a range of 50 kV to 450 kV was 0.88% and for the time max. 4.76%.

Technical data:

Configuration	4 times 2 parallel stages in series:	400 kV max. charging voltage
RC-Div	Damped capacitive divider:	670 pF, 100 Ω (high voltage side)
TO	Test object	

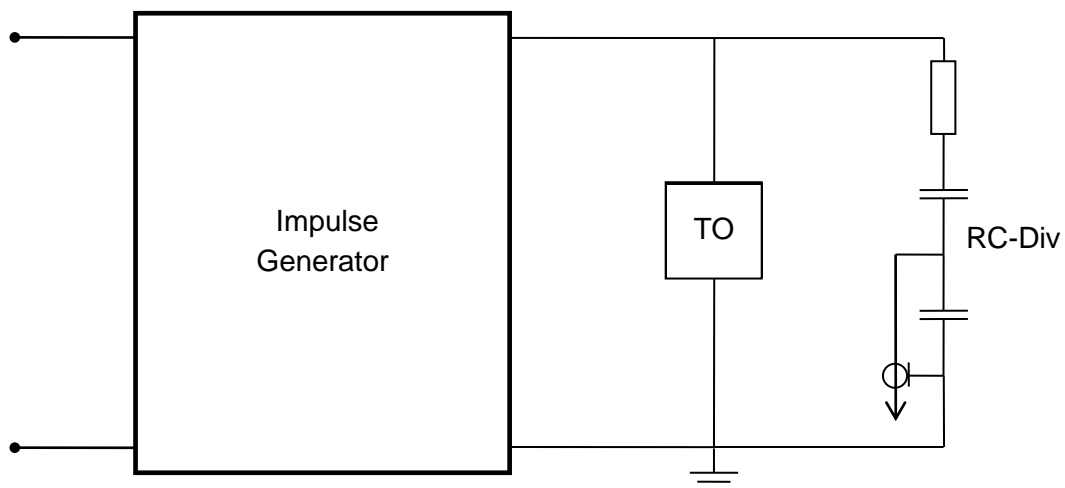


Figure 3: Impulse voltage test setup

Measurement equipment:

Object	Type	Calibration number	Calibration date
Damped capacitive divider	Haefely CS1000	000177 D-K-17601-01-00	2015-03
Coaxial cable	-	000177 D-K-17601-01-00	2015-03
Digital transient recorder	Haefely DiAS 733	000177 D-K-17601-01-00	2015-03

3.5 Heating cycle voltage in air

The cable conductors of the test objects were connected to an AC voltage provided by a test transformer, the screens were put on ground potential (**Figure 4**). The voltage measurement was carried out with a capacitive divider. The measuring uncertainty within a range of 10 kV to 100 kV was 0.59%. The test objects were installed in a way that a closed loop was formed, which could be heated using an induced AC current provided by a heating transformer supplied by a variable transformer. The cable should be heated to a conductor temperature 5 - 10 K above the maximum cable conductor temperature in operation, i.e. 95 - 100°C for XLPE-cables. The temperature of the cable conductor was measured in-line using a reference cable of the same type as the test loops with a length of 3 m, a type K thermocouple and fibre optical temperature measurement transmission systems. The heating cycles were controlled by an automated regulation system.

Technical data:

TT	Test transformer:	100 kV, 100 kVA, 50 Hz
C-Div	Capacitive divider:	100 pF (high voltage side)
VT	Variable transformer:	230 V, 6.9 kVA, 50 Hz
HT	Heating transformer:	9.2 kVA
TC	Thermocouple:	Type K
TO	Test object	

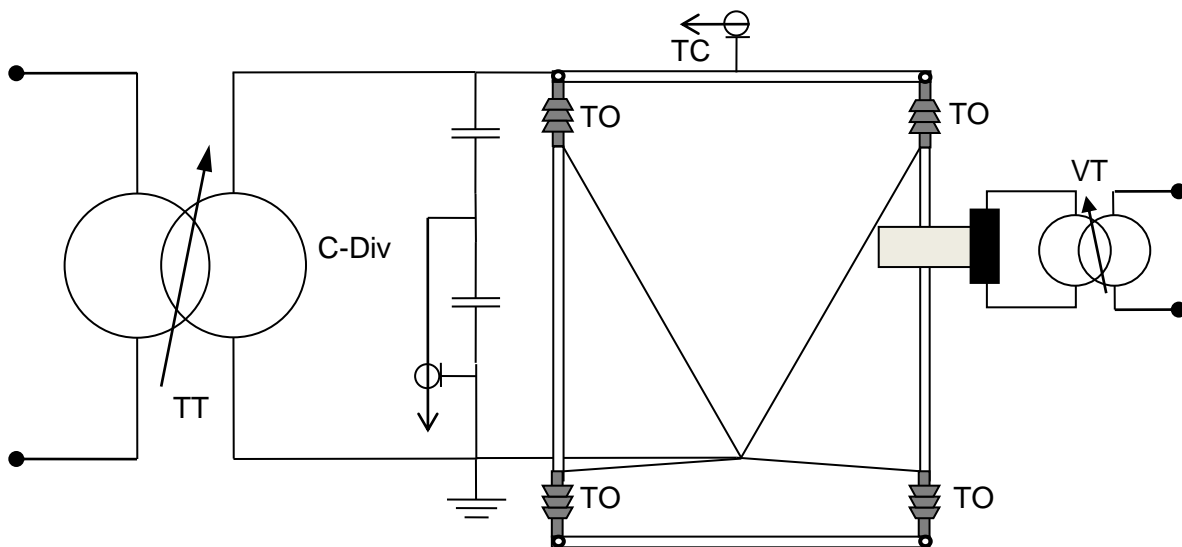


Figure 4: Heating cycle voltage test setup (exemplary for one cable cross section and one type of termination)

3.6 Immersion test for outdoor terminations

The test objects were installed in a way that a closed loop was formed, which could be heated using an induced AC current provided by a heating transformer supplied by a variable transformer. The cable should be heated to a conductor temperature 5 - 10 K above the maximum cable conductor temperature in operation, i.e. 95 - 100°C for XLPE-cables. The temperature of the cable conductor was measured in-line using a reference cable of the same type as the test loops with a length of 3 m, a type K thermocouple and fibre optical temperature measurement transmission systems. The heating cycles were controlled by an automated regulation system. The test objects were mounted upside down in a water tank with a water height of min. 0.3 m above every part of the termination.

4 Results

4.1 AC voltage dry withstand

Date: 2016-09-30 (Test object A and B)
 Ambient temperature: 25°C
 Ambient relative humidity: 33%
 Ambient pressure: 962 hPa

Date: 2016-10-19 (Test object C)
 Ambient temperature: 25°C
 Ambient relative humidity: 43%
 Ambient pressure: 955 hPa

Test objects	Test voltage $\hat{u}/\sqrt{2}$	Duration	Result
A	93,3 kV	5 min	No breakdown
B			No breakdown
C	93,5 kV	5 min	No breakdown

Note: All test objects installed on the same cable cross section were tested simultaneously.

Requirement: No breakdown shall occur.

Result: All test objects passed the test.

4.2 Partial discharge at ambient temperature

Date: 2016-09-30 (Test object A and B)
 Ambient temperature: 25°C
 Ambient relative humidity: 33%
 Ambient pressure: 962 hPa

Date: 2016-10-19 (Test object C)
 Ambient temperature: 25°C
 Ambient relative humidity: 43%
 Ambient pressure: 955 hPa

Test object	Test voltage $\hat{u}/\sqrt{2}$	Calibration charge	Noise	Result
A	42 kV	10 pC	≤ 3 pC	PD-level ≤ 3 pC
B	42 kV	10 pC	≤ 3 pC	PD-level ≤ 3 pC
C	42 kV	10 pC	≤ 3 pC	PD-level ≤ 3 pC

Note: All test objects of the same type of termination and cable cross section were tested simultaneously.

Requirement: Partial discharge level shall not exceed 10 pC.

Result: All test objects passed the test.

4.3 Impulse voltage at elevated temperature

The test object were exposed to 10 impulses of positive and negative polarity each. Before each series of 10 impulses, 3 calibration impulses of 50%, 65% and 80% of the test voltage level were applied. The recorded impulses are shown in **Figure 5** to **Figure 7**.

Date: 2016-10-12 (Test object A and B)
 Ambient temperature: 25°C
 Ambient relative humidity: 38%
 Ambient pressure: 952 hPa

Date: 2016-10-25 (Test object C)
 Ambient temperature: 25°C
 Ambient relative humidity: 50%
 Ambient pressure: 960 hPa

Test object	Voltage \hat{u}	Front time	Time to half-value	Number of impulses	Result
A	±200 kV	1.773 μ s	51.276 μ s	10 of each polarity	No breakdown
B		to 1.786 μ s	to 51.554 μ s		No breakdown
C	±200 kV	1.175 μ s to 1.178 μ s	49.273 μ s to 49.326 μ s	10 of each polarity	No breakdown

Note: All test objects installed on the same cable cross section were tested simultaneously.

Requirement: Each test object shall withstand 10 positive and 10 negative impulses without breakdown.

Result: All test objects passed the test.

Tyco Electronics Raychem GmbH
a TE Connectivity Ltd. company

HV Lab Ottobrunn



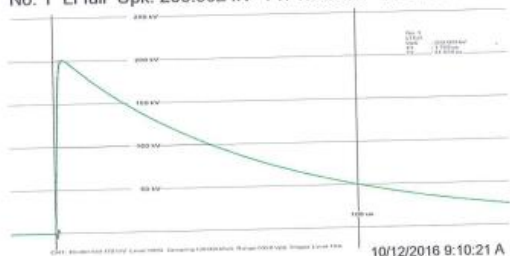
CST/O 4x 1*500 kabel warmer impuls 10x +-200kV
Environmental Conditions: 952 hPa

38 %

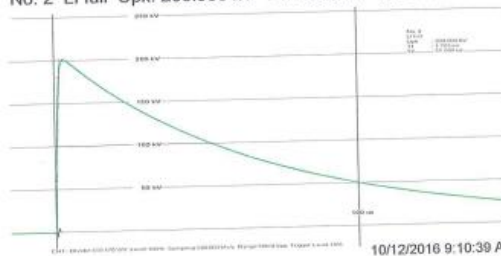
25 °C

Tested by: BAC

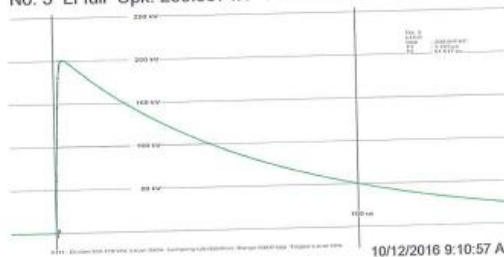
No. 1 LI full Upk: 200.902 kV T1: 1.780 us T2: 51.554 us



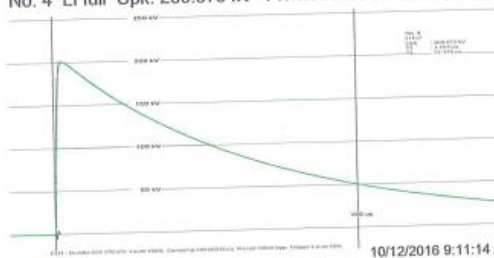
No. 2 LI full Upk: 200.900 kV T1: 1.785 us T2: 51.509 us



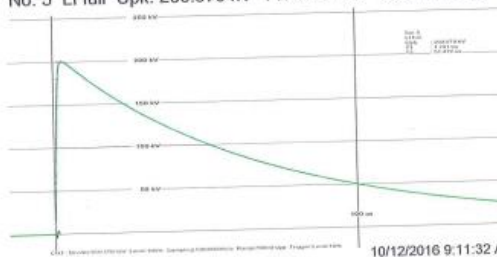
No. 3 LI full Upk: 200.867 kV T1: 1.785 us T2: 51.517 us



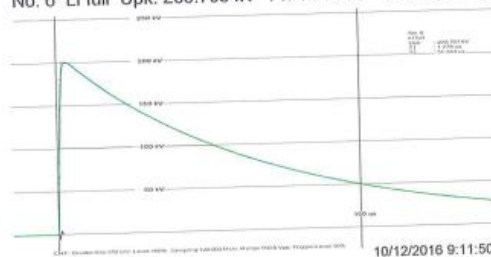
No. 4 LI full Upk: 200.875 kV T1: 1.783 us T2: 51.375 us



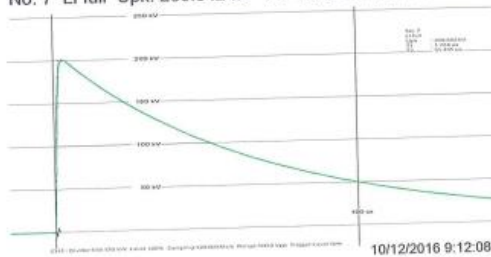
No. 5 LI full Upk: 200.878 kV T1: 1.781 us T2: 51.472 us



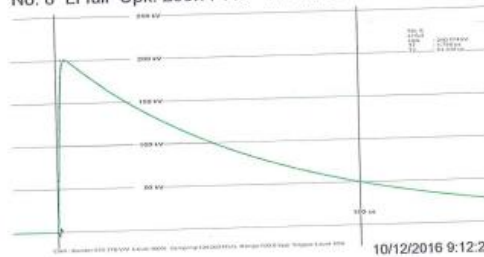
No. 6 LI full Upk: 200.703 kV T1: 1.778 us T2: 51.363 us



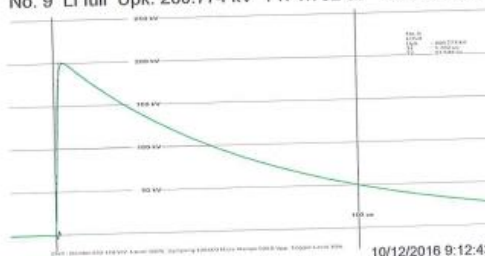
No. 7 LI full Upk: 200.842 kV T1: 1.784 us T2: 51.495 us



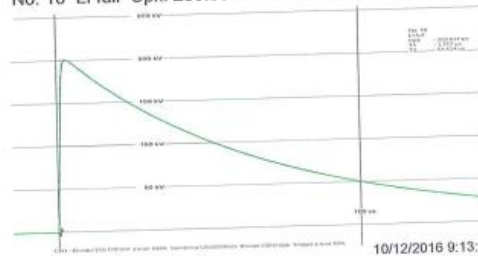
No. 8 LI full Upk: 200.774 kV T1: 1.786 us T2: 51.338 us



No. 9 LI full Upk: 200.774 kV T1: 1.782 us T2: 51.542 us



No. 10 LI full Upk: 200.837 kV T1: 1.777 us T2: 51.524 us



1/2

Figure 5: Positive impulses at elevated temperature on test objects A and B (500 mm²)

Tyco Electronics Raychem GmbH
a TE Connectivity Ltd. company

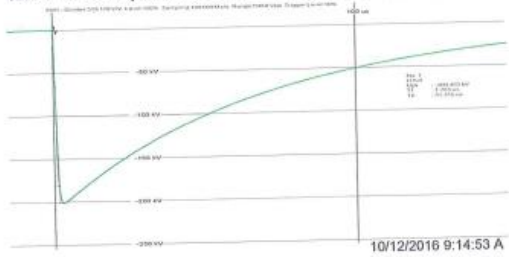
HV Lab Ottobrunn



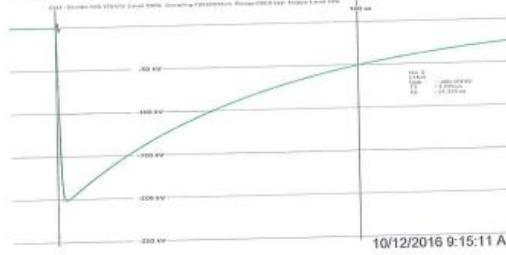
CSTI/O 4x 1*500 kabel warmer impuls 10x +200kV
Environmental Conditions: 952 hPa 38 % 25 °C

Tested by: BAC

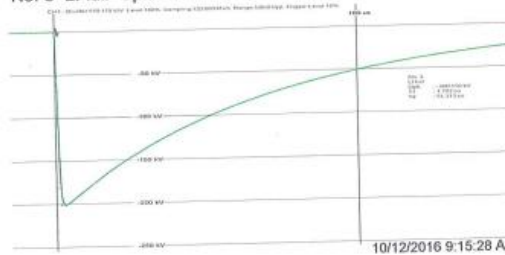
No. 1 LI full Upk: -200.463 kV T1: 1.785 us T2: 51.315 us



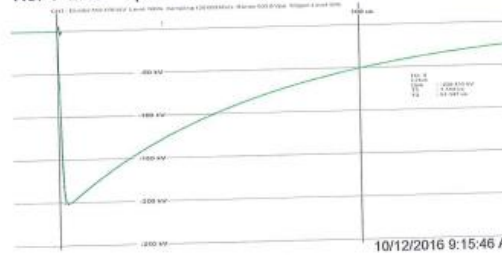
No. 2 LI full Upk: -200.384 kV T1: 1.785 us T2: 51.383 us



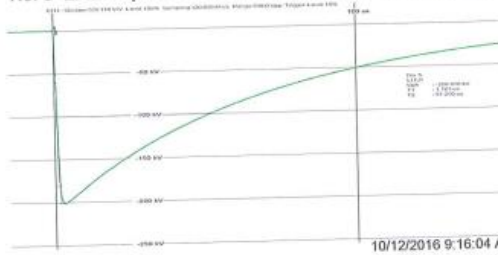
No. 3 LI full Upk: -200.556 kV T1: 1.782 us T2: 51.313 us



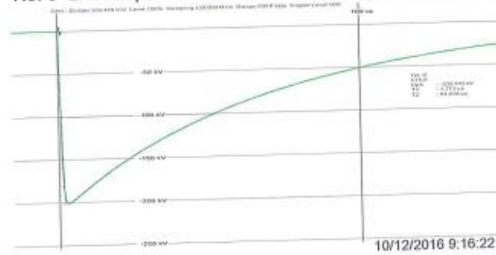
No. 4 LI full Upk: -200.485 kV T1: 1.782 us T2: 51.347 us



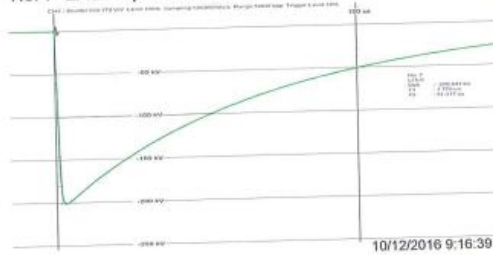
No. 5 LI full Upk: -200.416 kV T1: 1.783 us T2: 51.290 us



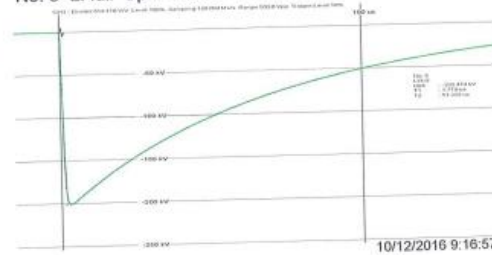
No. 6 LI full Upk: -200.446 kV T1: 1.773 us T2: 51.276 us



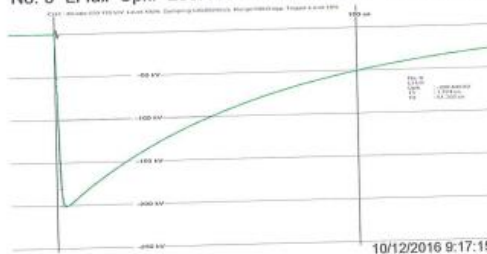
No. 7 LI full Upk: -200.441 kV T1: 1.779 us T2: 51.317 us



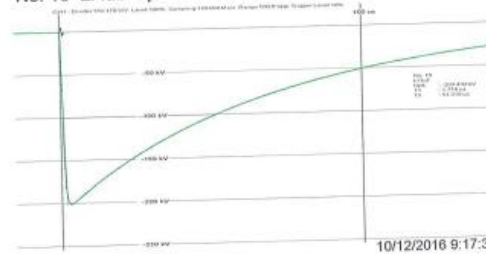
No. 8 LI full Upk: -200.474 kV T1: 1.779 us T2: 51.392 us



No. 9 LI full Upk: -200.446 kV T1: 1.784 us T2: 51.303 us



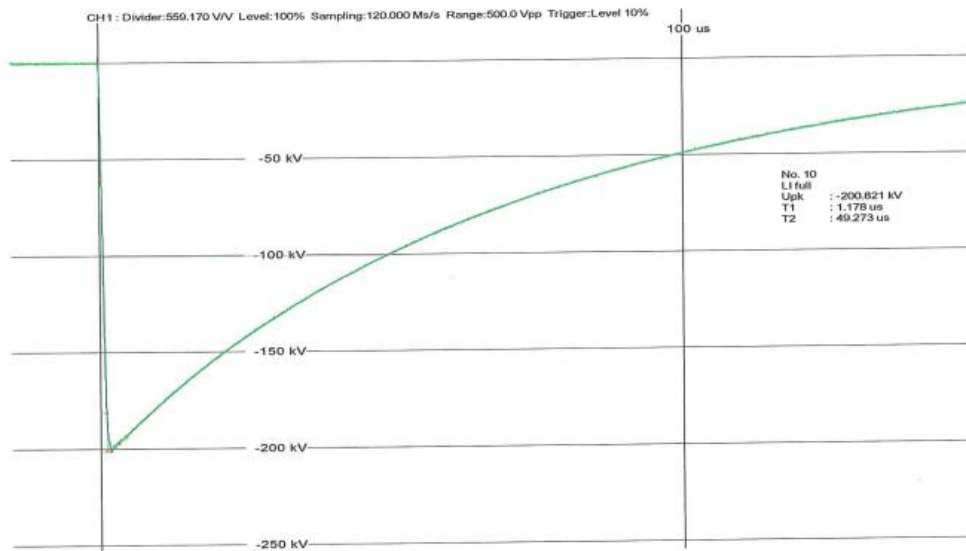
No. 10 LI full Upk: -200.430 kV T1: 1.778 us T2: 51.310 us



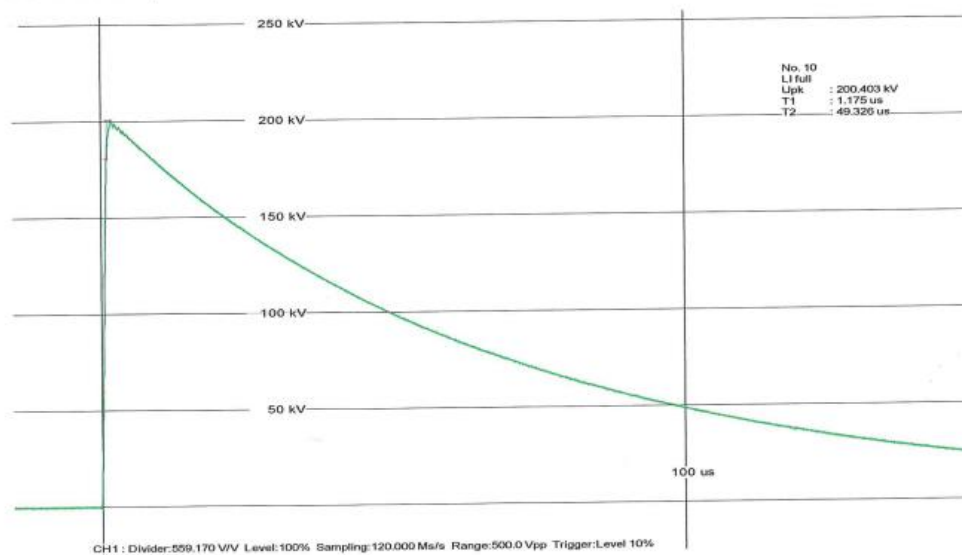
2/2

Figure 6: Negative impulses at elevated temperature on test objects A and B (500 mm²)

No. 10 LI full Upk: -200.821 kV T1: 1.178 us T2: 49.273 us 10/25/2016 6:59:06 P



No. 10 LI full Upk: 200.403 kV T1: 1.175 us T2: 49.326 us 10/25/2016 6:53:37 P



K

Figure 7: 10th positive and 10th negative impulse at elevated temperature on test objects C (1000 mm²)

4.4 Heating cycle voltage in air

The recorded values of the test voltage, heating current, ambient temperature and cable conductor temperature are shown in **Figure 8** and **Figure 9**.

Date: 2016-10-14 to 2016-12-08 (test objects A and B)
2016-11-15 to 2016-12-29 (test object C)

Test object	Test voltage $\hat{u}/\sqrt{2}$	Time of heating	Time of cooling	Number of cycles	Result
A	52 kV	5 h	3 h	126	No breakdown
B					No breakdown
C	52 kV	5 h	3 h	126	No breakdown

Note: All test objects installed on the same cable cross section were tested simultaneously.

Requirement: No breakdown shall occur.

Result: All test objects passed the test.

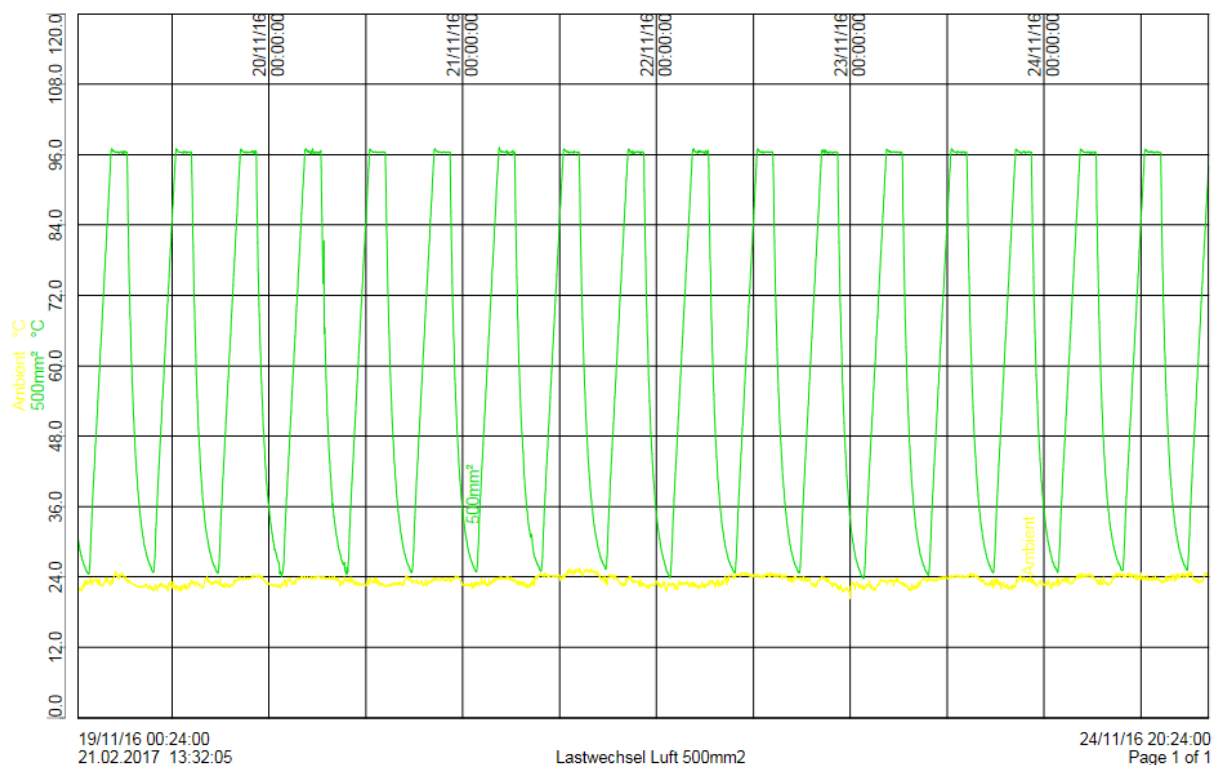


Figure 8: Recorded values of ambient temperature (yellow) and cable conductor temperature 500 mm² (green) during heat cycle voltage test in air

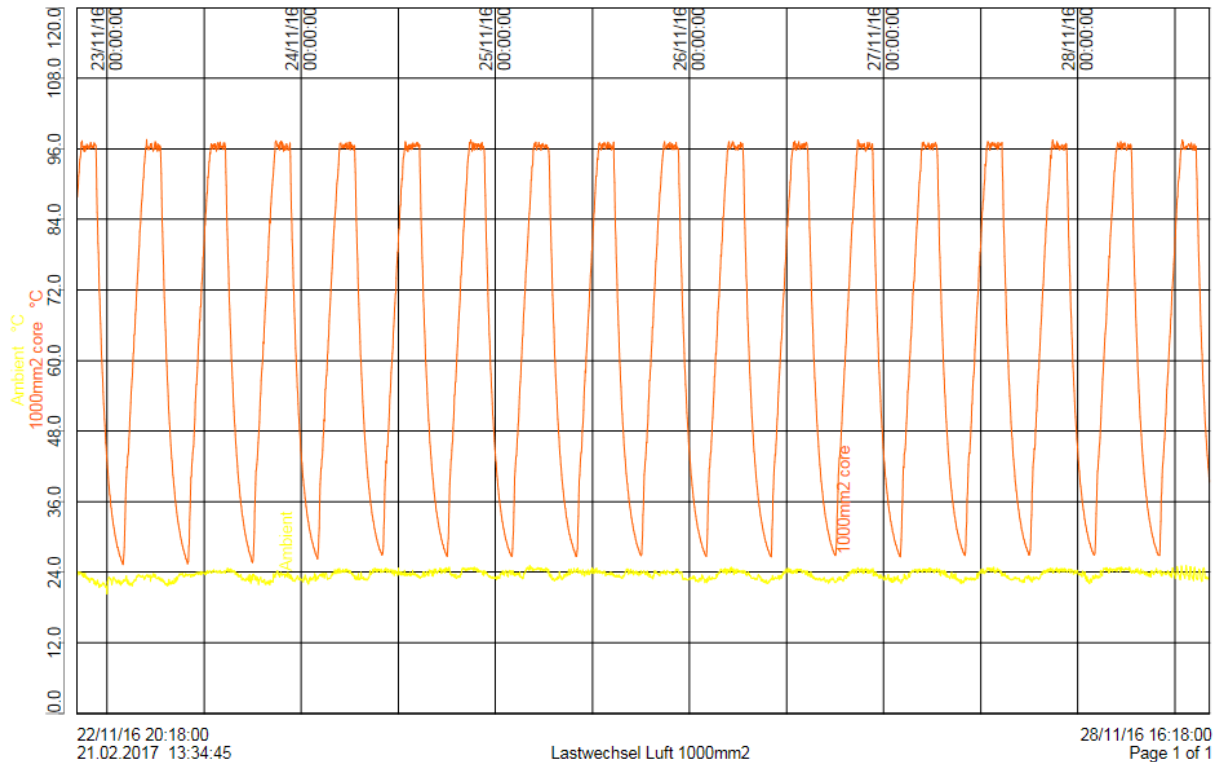


Figure 9: Recorded values of ambient temperature (yellow) and cable conductor temperature 1000 mm² (orange) during heat cycle voltage test in air

4.5 Immersion test for outdoor terminations

The recorded values ambient temperature and cable conductor temperatures are shown in **Figure 10** and **Figure 11**.

Date: 2017-01-16 to 2017-01-24 (test object B)
2017-01-24 to 2017-02-03 (test object C)

Test object	Time of heating	Time of cooling	Number of cycles	Result
A	n/a			-
B	5 h	3 h	10	Ok
C	5 h	3 h	10	Ok

Note: Based on the large cable-cross section and the test setup only two test objects have been tested in parallel. Therefore in total 20 cycles are shown on **Figure 10** and **Figure 11**.

Result: All test objects passed the test.

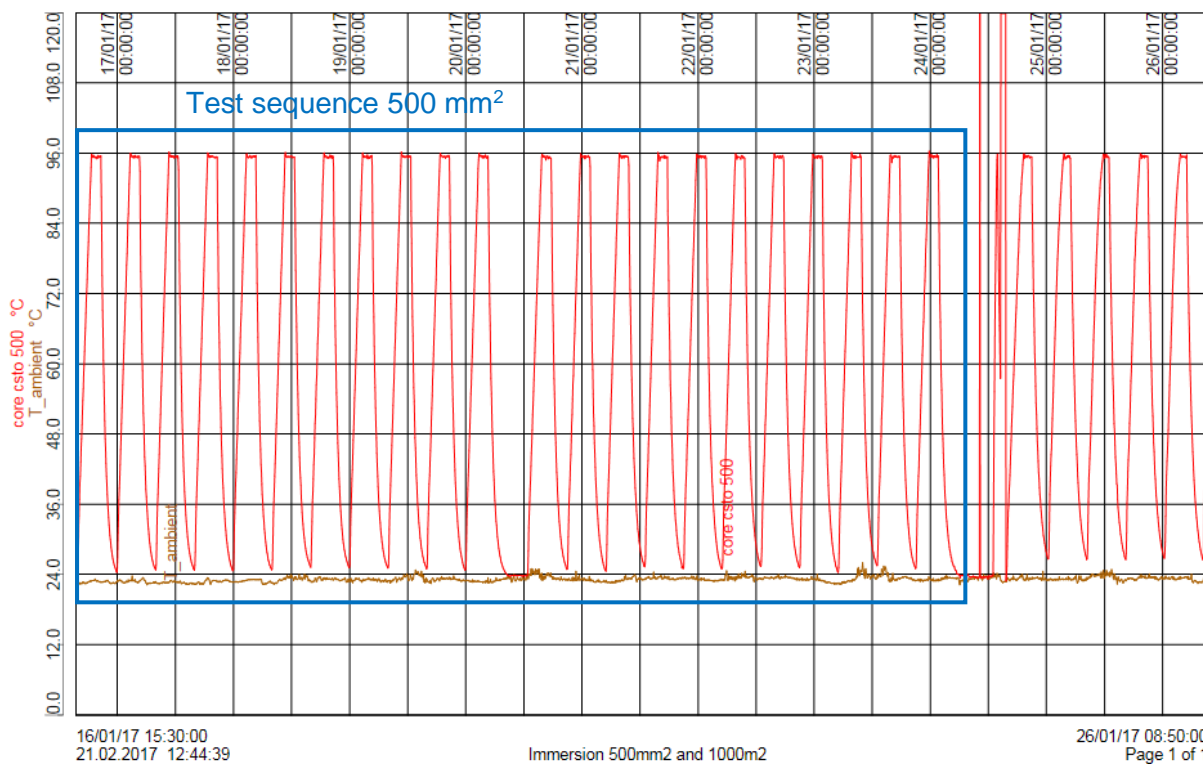


Figure 10: Recorded values of ambient temperature (brown) and cable conductor temperature 500 mm² (red) during immersion test of test objects B

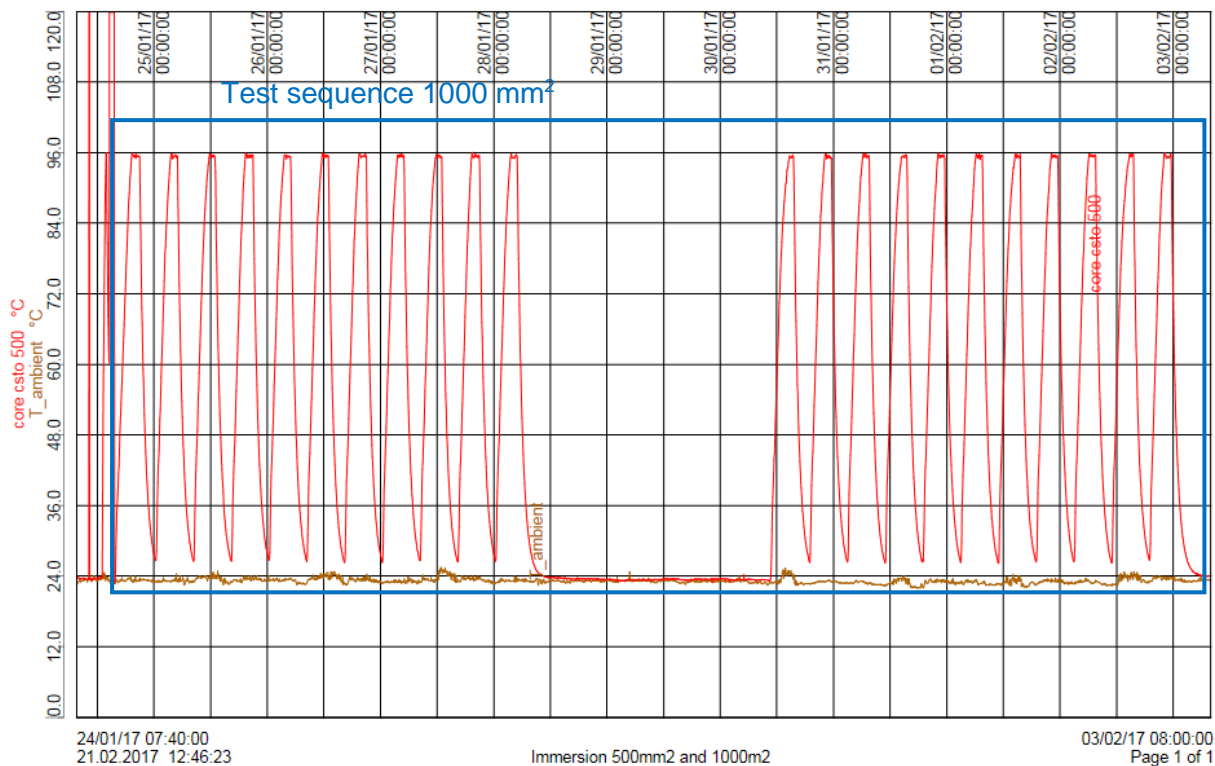


Figure 11: Recorded values of ambient temperature (brown) and cable conductor temperature 1000 mm² (red) during immersion test of test objects C

4.6 Partial discharge at elevated and ambient temperature

4.6.1 Elevated temperature

Date: 2016-12-15 (Test object A)
 Ambient temperature: 25°C
 Ambient relative humidity: 33%
 Ambient pressure: 960 hPa

Date: 2017-01-24 (Test object B)
 Ambient temperature: 25°C
 Ambient relative humidity: 33%
 Ambient pressure: 960 hPa

Date: 2017-02-03 (Test object C)
 Ambient temperature: 25°C
 Ambient relative humidity: 33%
 Ambient pressure: 945 hPa

Test object	Test voltage $\hat{u}/\sqrt{2}$	Time of heating	Calibration charge	Noise	Result
A	42 kV	5 h	10 pC	≤ 3 pC	PD-level ≤ 3 pC
B					PD-level ≤ 3 pC
C	42 kV	5 h	10 pC	≤ 3 pC	PD-level ≤ 3 pC

Note: All test objects installed on the same cable cross section were tested simultaneously.

Requirement: Partial discharge level shall not exceed 10 pC.

Result: All test objects passed the test.

4.6.2 Ambient temperature

Date: 2016-12-15 (Test object A)
 Ambient temperature: 25°C
 Ambient relative humidity: 33%
 Ambient pressure: 960 hPa

Date: 2017-01-25 (Test object B)
 Ambient temperature: 25°C
 Ambient relative humidity: 33%
 Ambient pressure: 960 hPa

Date: 2017-02-06 (Test object C)
Ambient temperature: 23°C
Ambient relative humidity: 33%
Ambient pressure: 950 hPa

Test object	Test voltage $\hat{u}/\sqrt{2}$	Calibration charge	Noise	Result
A	42 kV	10 pC	≤ 3 pC	PD-level ≤ 3 pC
B	42 kV	10 pC	≤ 4 pC	PD-level ≤ 4 pC
C	42 kV	10 pC	≤ 4 pC	PD-level ≤ 4 pC

Note: All test objects of the same type of termination and cable cross section were tested simultaneously.

Requirement: Partial discharge level shall not exceed 10 pC.

Result: All test objects passed the test.

4.7 Impulse voltage at ambient temperature

The test object were exposed to 10 impulses of positive and negative polarity each. Before each series of 10 impulses, 3 calibration impulses of 50%, 65% and 80% of the test voltage level were applied. The recorded impulses are shown in **Figure 12** to **Figure 17**.

Date: 2016-12-16 (Test object A)
 Ambient temperature: 25°C
 Ambient relative humidity: 33%
 Ambient pressure: 963 hPa

Date: 2017-01-25 (Test object B)
 Ambient temperature: 25°C
 Ambient relative humidity: 33%
 Ambient pressure: 960 hPa

Date: 2017-02-06 (Test object C)
 Ambient temperature: 23°C
 Ambient relative humidity: 33%
 Ambient pressure: 950 hPa

Test object	Voltage \hat{u}	Front time	Time to half-value	Number of impulses	Result
A	± 200 kV	1.375 μ s to 1.443 μ s	50.404 μ s to 50.651 μ s	10 of each polarity	No breakdown
B	± 200 kV	1.400 μ s to 1.422 μ s	50.537 μ s to 50.667 μ s	10 of each polarity	No breakdown
C	± 200 kV	1.204 μ s to 1.251 μ s	49.907 μ s to 50.143 μ s	10 of each polarity	No breakdown

Note: All test objects of the same type of termination and cable cross section were tested simultaneously.

Requirement: Each test object shall withstand 10 positive and 10 negative impulses without breakdown.

Result: All test objects passed the test.

Tyco Electronics Raychem GmbH
a TE Connectivity Ltd. company

HV Lab Ottobrunn



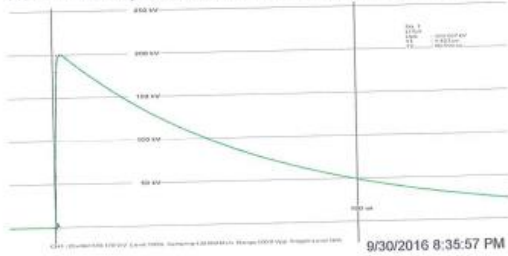
CSTI 500mm² kabel Loop 1+2 10x +200kV
Environmental Conditions: 962 hPa

Walter impuls

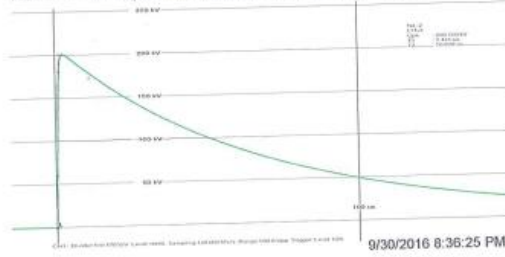
33% 25 °C

Tested by: BAC

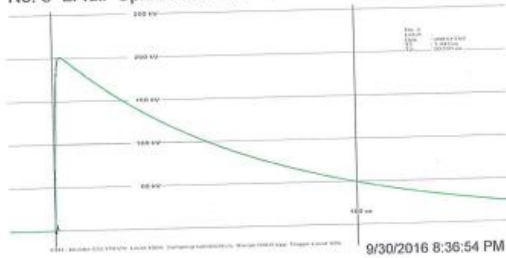
No. 1 LI full Upk: 199.867 kV T1: 1.423 us T2: 50.598 us



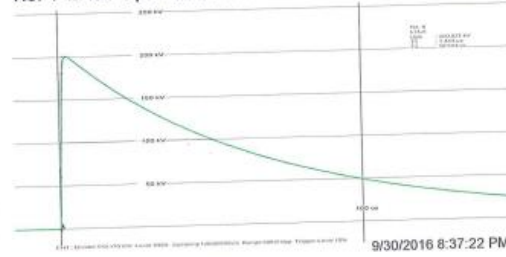
No. 2 LI full Upk: 200.700 kV T1: 1.431 us T2: 50.600 us



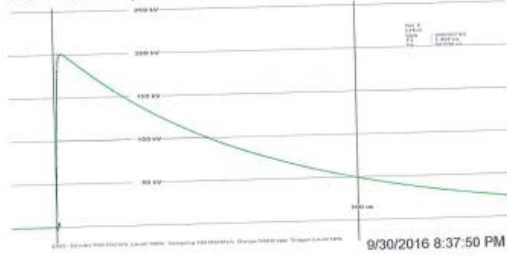
No. 3 LI full Upk: 200.913 kV T1: 1.443 us T2: 50.593 us



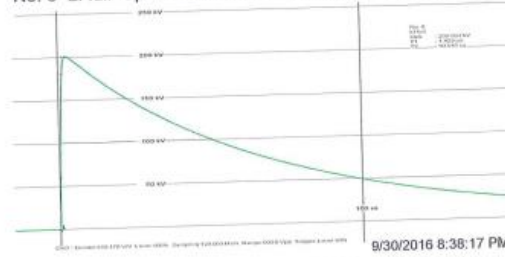
No. 4 LI full Upk: 200.821 kV T1: 1.433 us T2: 50.583 us



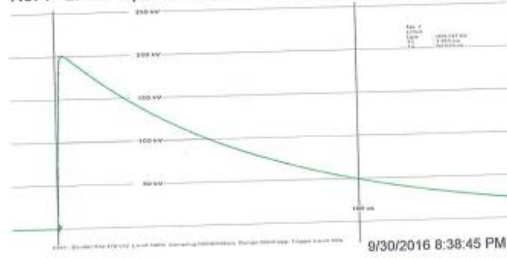
No. 5 LI full Upk: 200.957 kV T1: 1.427 us T2: 50.606 us



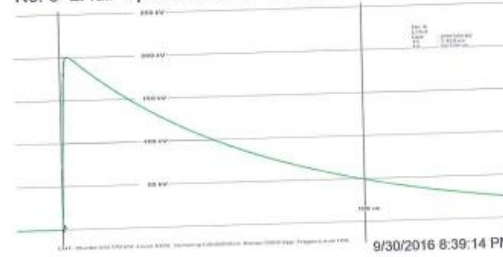
No. 6 LI full Upk: 200.892 kV T1: 1.425 us T2: 50.545 us



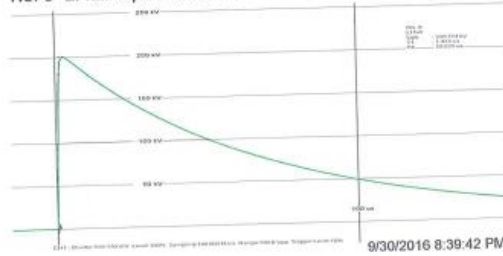
No. 7 LI full Upk: 200.747 kV T1: 1.415 us T2: 50.629 us



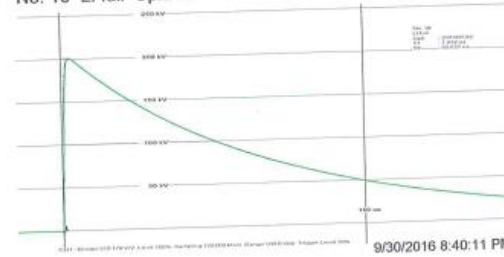
No. 8 LI full Upk: 200.528 kV T1: 1.428 us T2: 50.599 us



No. 9 LI full Upk: 200.774 kV T1: 1.435 us T2: 50.628 us



No. 10 LI full Upk: 200.905 kV T1: 1.432 us T2: 50.651 us



1/2

Figure 12: Positive impulses at ambient temperature on test object A (500 mm²)

Tyco Electronics Raychem GmbH
a TE Connectivity Ltd. company

HV Lab Ottobrunn

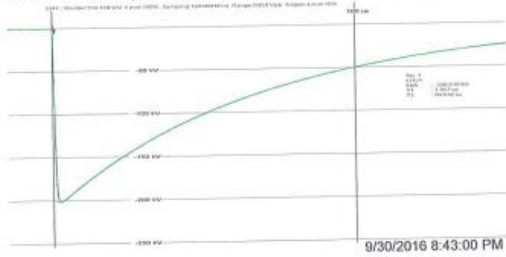


CSTI 500mm2 kabel Loop 1+2 10x +-200kV
Environmental Conditions: 962 hPa

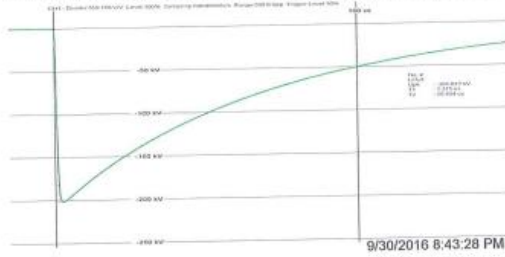
kalter impuls
33% 25 °C

Tested by: BAC

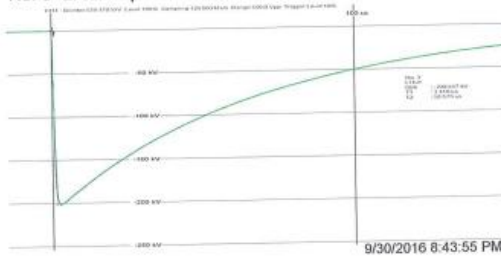
No. 1 LI full Upk: -200.810 kV T1: 1.417 us T2: 50.532 us



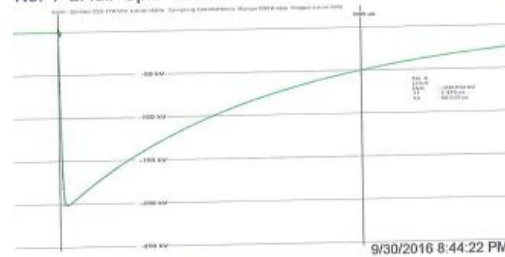
No. 2 LI full Upk: -201.017 kV T1: 1.375 us T2: 50.404 us



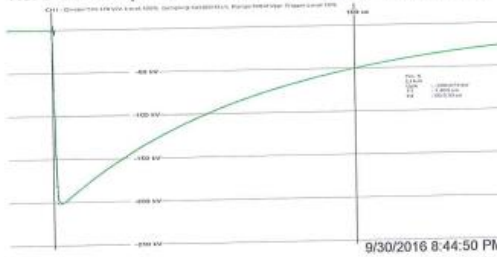
No. 3 LI full Upk: -200.867 kV T1: 1.416 us T2: 50.575 us



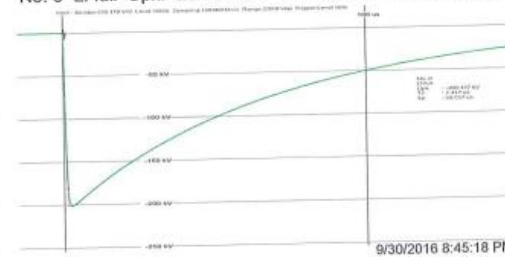
No. 4 LI full Upk: -200.692 kV T1: 1.415 us T2: 50.529 us



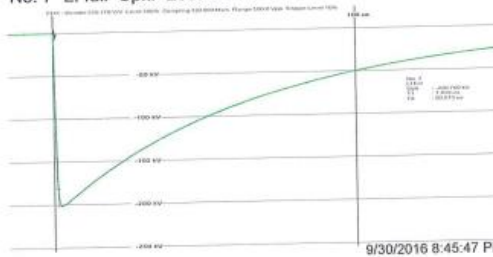
No. 5 LI full Upk: -200.973 kV T1: 1.408 us T2: 50.530 us



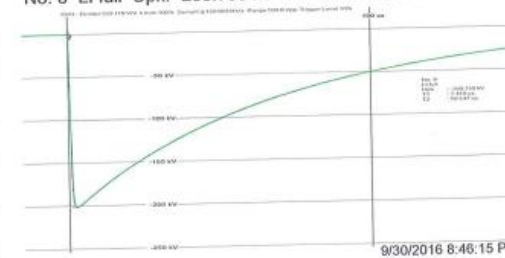
No. 6 LI full Upk: -200.487 kV T1: 1.417 us T2: 50.557 us



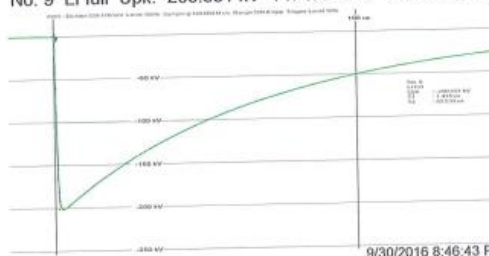
No. 7 LI full Upk: -200.700 kV T1: 1.416 us T2: 50.573 us



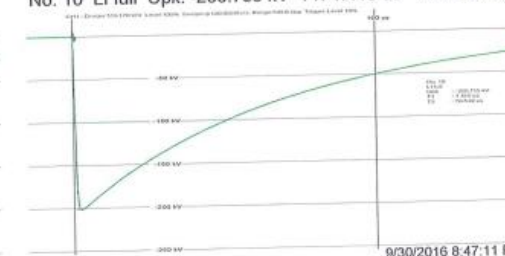
No. 8 LI full Upk: -200.750 kV T1: 1.418 us T2: 50.547 us



No. 9 LI full Upk: -200.851 kV T1: 1.414 us T2: 50.530 us



No. 10 LI full Upk: -200.755 kV T1: 1.415 us T2: 50.522 u



2/2

Figure 13: Negative impulses at ambient temperature on test object A (500 mm²)

Tyco Electronics Raychem GmbH
a TE Connectivity Ltd. company

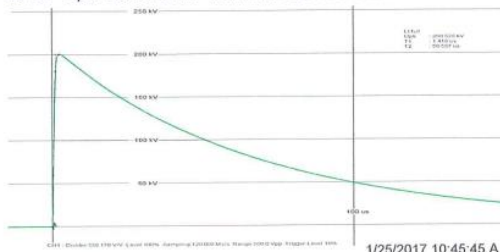
HV Lab Ottobrunn



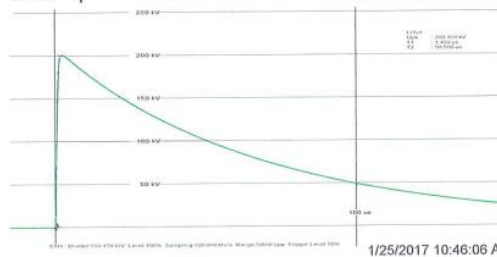
CSTI-O 500mm² Loop 3+4 outdoor kalter Impuls \square 10x +/-200kV

Environmental Conditions: 960 hPa 33 % 25 °C Tested by: BAC

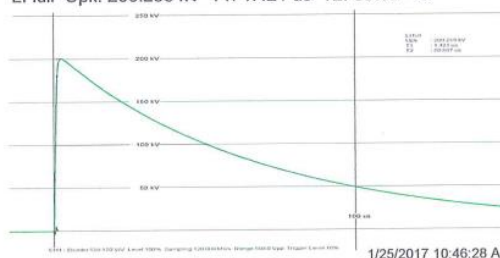
LI full Upk: 200.526 kV T1: 1.418 us T2: 50.557 us



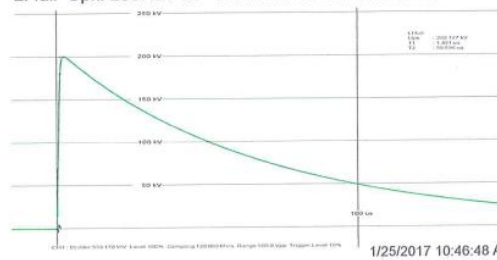
LI full Upk: 200.466 kV T1: 1.409 us T2: 50.560 us



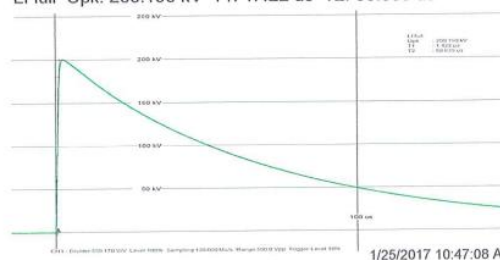
LI full Upk: 200.258 kV T1: 1.421 us T2: 50.607 us



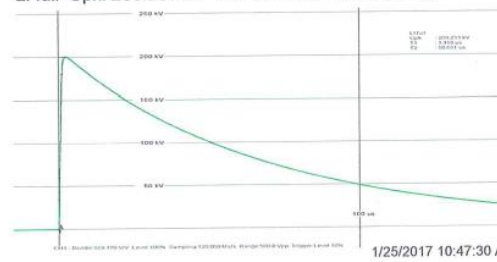
LI full Upk: 200.127 kV T1: 1.421 us T2: 50.596 us



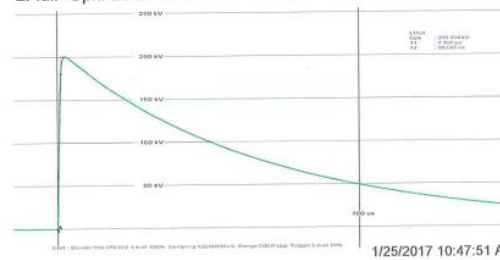
LI full Upk: 200.190 kV T1: 1.422 us T2: 50.635 us



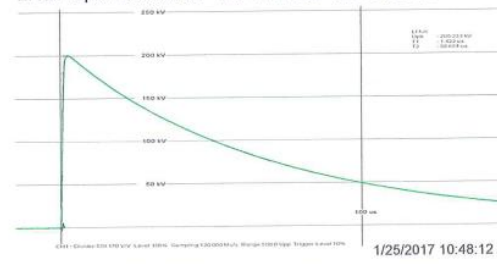
LI full Upk: 200.233 kV T1: 1.416 us T2: 50.661 us



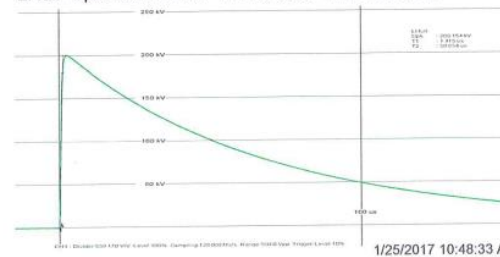
LI full Upk: 200.490 kV T1: 1.406 us T2: 50.585 us



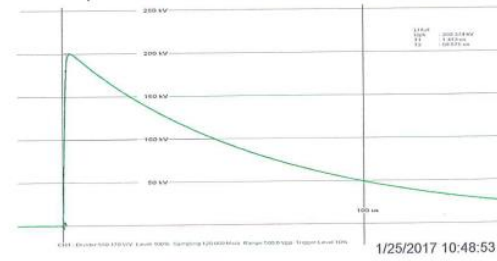
LI full Upk: 200.233 kV T1: 1.422 us T2: 50.664 us



LI full Upk: 200.154 kV T1: 1.415 us T2: 50.654 us



LI full Upk: 200.334 kV T1: 1.413 us T2: 50.575 us



1/2

Figure 14: Positive impulses at ambient temperature on test object B (500 mm²)

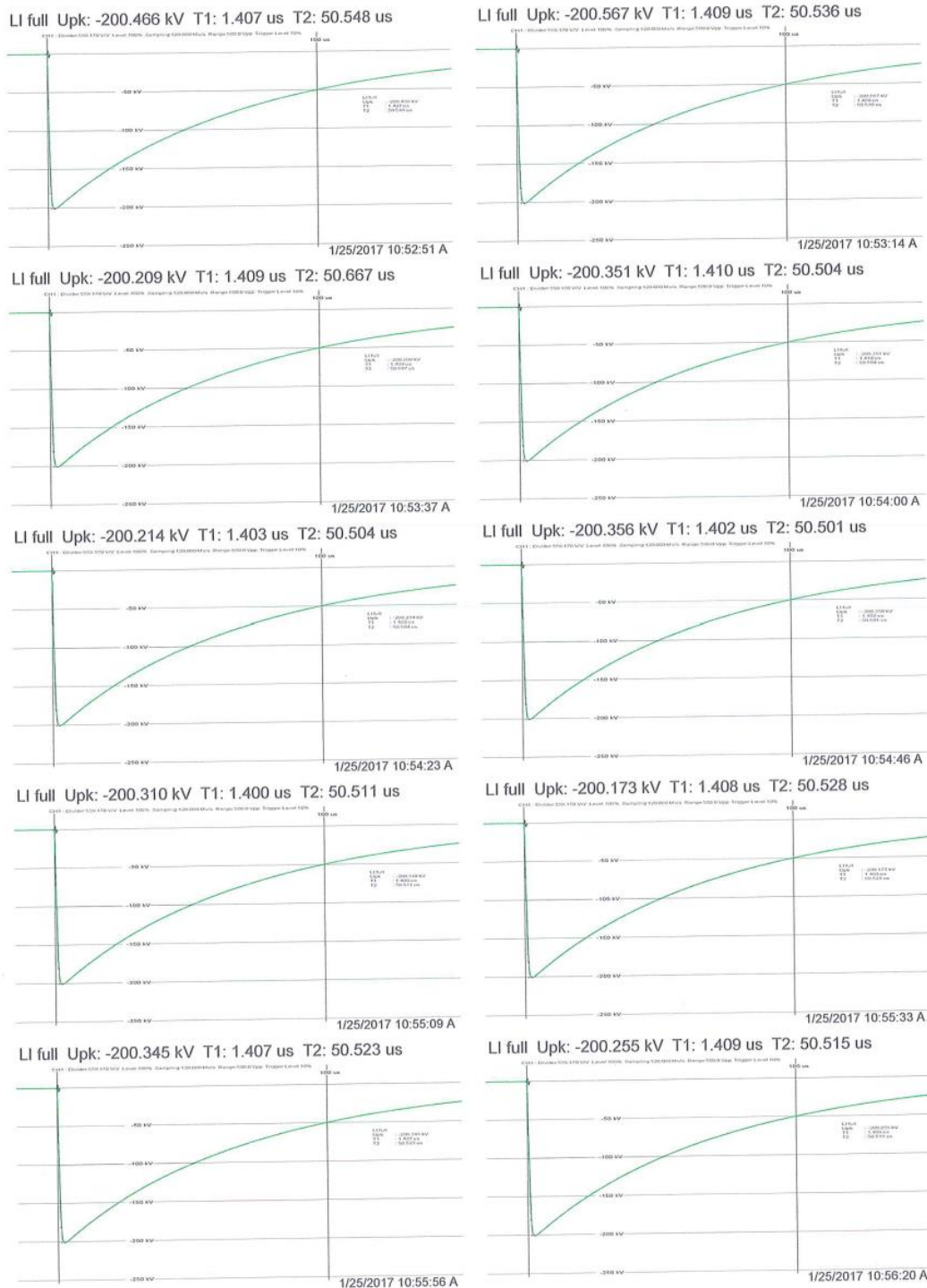
Tyco Electronics Raychem GmbH
a TE Connectivity Ltd. company

HV Lab Ottobrunn



CSTI-O 500mm² Loop 3+4 outdoor kalter Impuls □□ 10x +200kV
Environmental Conditions: 960 hPa 33 % 25 °C

Tested by: BAC



2 / 2

Figure 15: Negative impulses at ambient temperature on test object B (500 mm²)

Tyco Electronics Raychem GmbH
a TE Connectivity Ltd. company

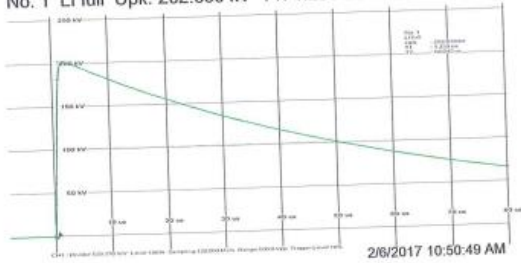
HV Lab Ottobrunn



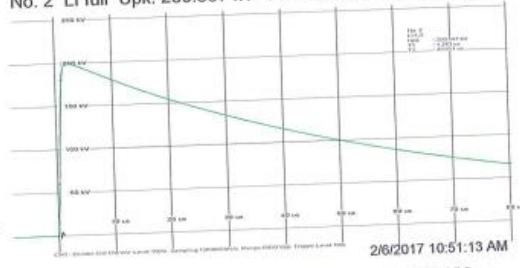
CSTI-O 1000mm² Loop 3+4 kalter Impuls \square 10 x +200kV
Environmental Conditions: 950 hPa 33% 23 °C

Tested by: BAC

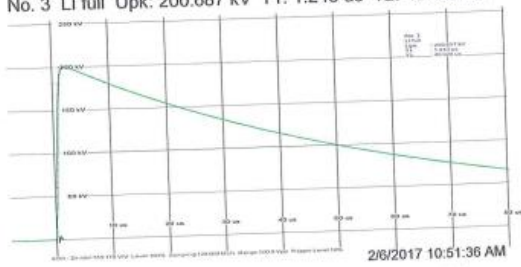
No. 1 LI full Upk: 202.030 kV T1: 1.239 us T2: 50.045 us



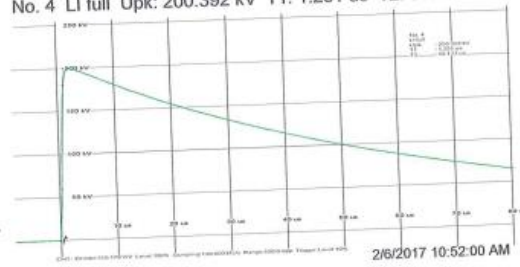
No. 2 LI full Upk: 200.567 kV T1: 1.243 us T2: 49.951 us



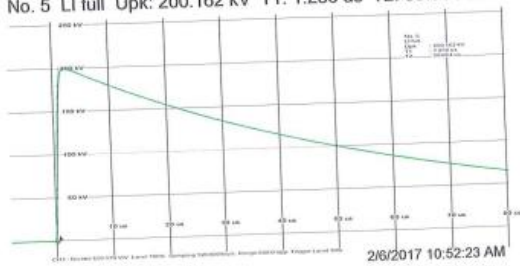
No. 3 LI full Upk: 200.687 kV T1: 1.243 us T2: 49.926 us



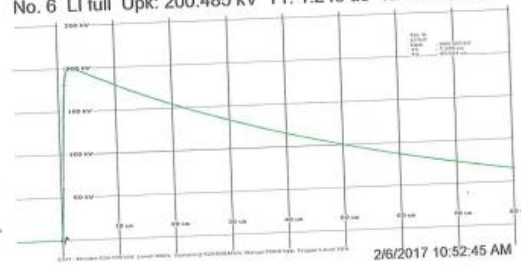
No. 4 LI full Upk: 200.392 kV T1: 1.251 us T2: 50.133 us



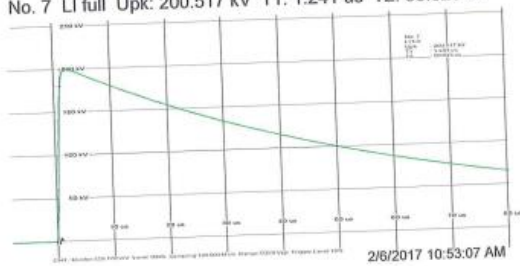
No. 5 LI full Upk: 200.162 kV T1: 1.236 us T2: 50.064 us



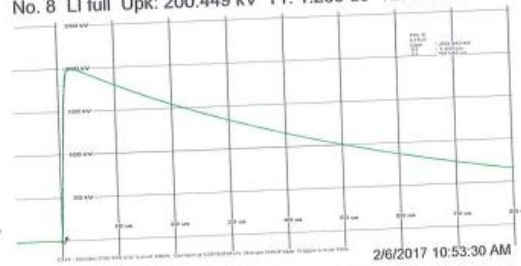
No. 6 LI full Upk: 200.485 kV T1: 1.245 us T2: 49.991 us



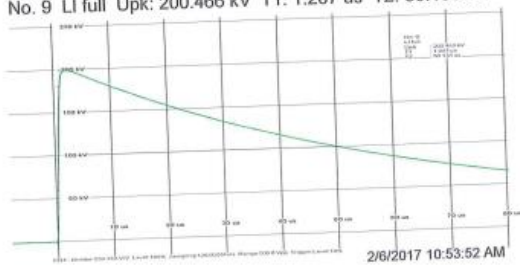
No. 7 LI full Upk: 200.517 kV T1: 1.241 us T2: 50.023 us



No. 8 LI full Upk: 200.449 kV T1: 1.238 us T2: 50.143 us



No. 9 LI full Upk: 200.466 kV T1: 1.207 us T2: 50.133 us



No. 10 LI full Upk: 200.487 kV T1: 1.241 us T2: 50.115 us

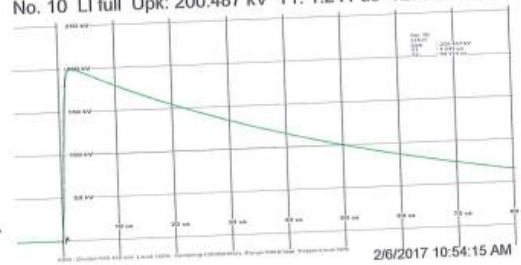


Figure 16: Positive impulses at ambient temperature on test object C (1000 mm²)

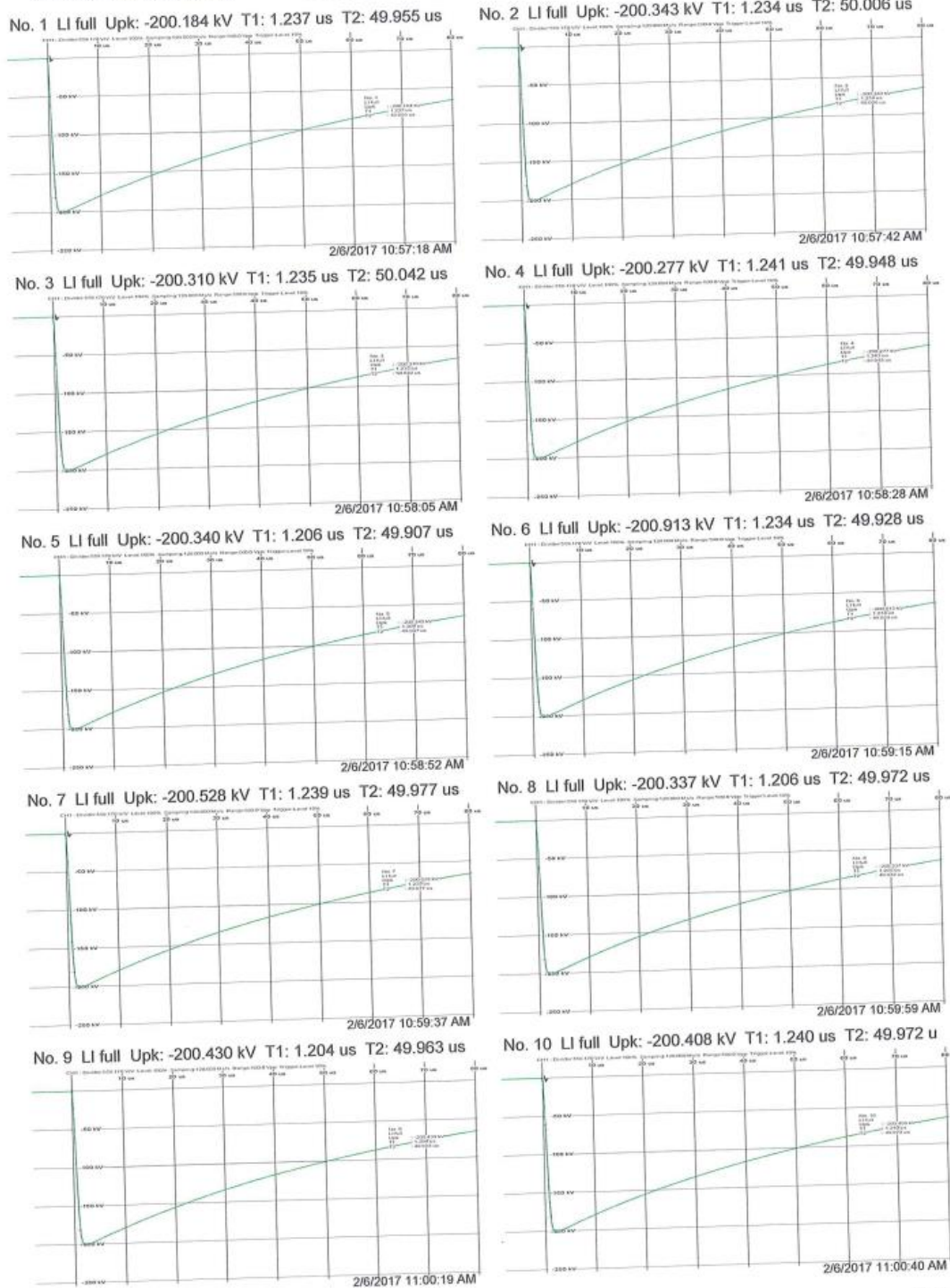
Tyco Electronics Raychem GmbH
a TE Connectivity Ltd. company

HV Lab Ottobrunn



CSTI-O 1000mm2 Loop 3+4 kalter Impuls $\square \square 10 \times +200\text{kV}$
Environmental Conditions: 950 hPa 33% 23 °C

Tested by: BAC



2/2

Figure 17: Negative impulses at ambient temperature on test object C (1000 mm²)

4.8 AC voltage dry withstand

Date: 2016-12-16 (Test object A)
 Ambient temperature: 25°C
 Ambient relative humidity: 33%
 Ambient pressure: 963 hPa

Date: 2017-01-25 (Test object B)
 Ambient temperature: 25°C
 Ambient relative humidity: 33%
 Ambient pressure: 960 hPa

Date: 2017-02-06 (Test object C)
 Ambient temperature: 23°C
 Ambient relative humidity: 33%
 Ambient pressure: 950 hPa

Test object	Test voltage $\hat{u}/\sqrt{2}$	Duration	Result
A	93,5 kV	5 min	No breakdown
B			No breakdown
C	93,5 kV	5 min	No breakdown

Note: All test objects installed on the same cable cross section were tested simultaneously.

Requirement: No breakdown shall occur.

Result: All test objects passed the test.

4.9 Partial discharge at ambient temperature

Date: 2016-12-16 (Test object A)
 Ambient temperature: 25°C
 Ambient relative humidity: 33%
 Ambient pressure: 963 hPa

Date: 2017-01-25 (Test object B)
 Ambient temperature: 25°C
 Ambient relative humidity: 33%
 Ambient pressure: 960 hPa

Date: 2017-02-06 (Test object C)
 Ambient temperature: 23°C
 Ambient relative humidity: 33%
 Ambient pressure: 950 hPa

Test object	Test voltage $\hat{u}/\sqrt{2}$	Calibration charge	Noise	Result
A	42 kV	10 pC	≤ 4 pC	PD-level ≤ 4 pC
B	42 kV	10 pC	≤ 4 pC	PD-level ≤ 4 pC
C	42 kV	10 pC	≤ 4 pC	PD-level ≤ 4 pC

Note: All test objects of the same type of termination and cable cross section were tested simultaneously.

Requirement: Partial discharge level shall not exceed 10 pC.

Result: All test objects passed the test.

4.10 Examination

Date: 2017-02-10 (CSTI-6152-ML-7-13, CSTO-6152-ML-7-13)
2017-02-10 (CSTO-6162-ML-8-21)

The test samples were examined for the following criteria:

- (i) cracking in the filling media and/or tape or tube components
- (ii) a moisture path bridging a primary seal
- (iii) corrosion and/or tracking and/or erosion
- (iv) leakage of any insulating material

Test object	Criteria (i)	Criteria (ii)	Criteria (iii)	Criteria (iv)
A	Not found	Not found	Not found	Not found
B	Not found	Not found	Not found	Not found
C	Not found	Not found	Not found	Not found

A. Appendices

A.1 Identification of test cable 500 mm²

Rated voltage $U_0/U (U_m)$: 18/30 (36) kV

Cable construction: 1-core 3-core Individually screen
 Overall screen

Conductors: Al Cu
 Stranded Solid
 Circular Shaped
 120mm² 150mm² 185mm²
 240mm²
 Other cross section: 500 mm²

Insulation: XLPE Other:
 EPR HEPR

Insulation screen: Bonded Strippable

Metallic screen: Wires Tapes Extruded
 Al Cu Other

Armour: Wire Tape

Oversheath: PVC PE (state type)

Water blocking, if any: Within conductor Under oversheath

Diameters: Conductor: 26.0 mm
 Insulation: 43.1 mm
 Insulation screen: 44.7 mm
 Oversheath: 52.4 mm

Cable marking: VDE0276 NA2XS(F)2Y 1 x 500/35RM 18/30kV 2015 FACAB 06201

A.2 Identification of test cable 1000 mm²

Rated voltage $U_0/U (U_m)$: 20.8/36 (42) kV

Cable construction: 1-core 3-core Individually screen

Overall screen

Conductors: Al Cu

Stranded Solid

Circular Shaped

120mm² 150mm² 185mm²

240mm²

Other cross section: 1000 mm²

Insulation: XLPE Other:

EPR HEPR

Insulation screen: Bonded Strippable

Metallic screen: Wires Tapes Extruded

Al Cu Other

Armour: Wire Tape

Oversheath: PVC PE (state type)

Water blocking, if any: Within conductor Under oversheath

Diameters: Conductor: 40.0 mm

Insulation: 53.5 mm

Insulation screen: 56.0 mm

Oversheath: 65.5 mm

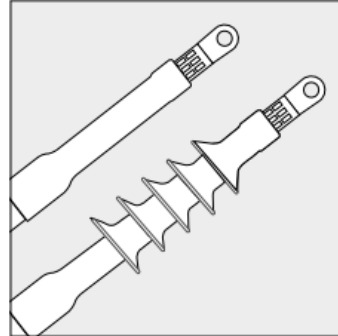
Cable marking: Charleroi NEXANS EAXeCWB 20.8/36(42)kV 1 x 1000/35 6.0mm
2010

A.3 Installation instructions



Raychem

from TE Connectivity



Installation Instruction

EPP-2828-2/17

Raychem

**Termination for Screened
Single Core Polymeric Cable
without Armour**

Type: CSTI/CSTO

Indoor/Outdoor

36 kV / 42 kV

To view the TE Energy website:



Tyco Electronics Raychem GmbH

a TE Connectivity Ltd. Company

TE Energy

Finsinger Feld 1

85521 Ottobrunn/Munich, Germany

Tel: +49-89-6089-0

Fax: +49-89-6096-345

energy.te.com

Before Starting

Check to ensure that the kit you are going to use fits the cable.

Refer to the kit label and the title of the installation instructions.

Components or working steps may have been modified since you last installed this product.

Carefully read and follow the steps in the installation instructions.

General Instructions

Clean and degrease all parts that will come into contact with adhesive.

If a solvent is used follow the manufacturer's handling instructions.

Check core preparation dimensions before installing the termination.

Grease the prepared cable only with the provided grease.

Check cable ends for ingress of moisture before starting with cable preparation.

For easy strip screen layers always use a round file to cut radially through the core screen.

The Information contained in these installation instructions is for use only by installers trained to make electrical power installations and is intended to describe the correct method of installation for this product. However, TE Connectivity has no control over the field conditions which influence product installation. It is the user's responsibility to determine the suitability of the installation method in the user's field conditions. TE Connectivity's only obligations are those in TE Connectivity's standard Conditions of Sale for this product and in no case will TE Connectivity be liable for any other incidental, indirect or consequential damages arising from the use or misuse of the products.

Raychem, TE, TE Connectivity and TE connectivity (logo) are trademarks.

© 2017 TE Connectivity. All Rights Reserved.

Cable Preparation

Before Starting

Check to ensure that the kit you are going to use fits the cable.
 Refer to the kit label and the title of the installation instruction.
 Components or work steps may have been improved since you last installed this product.
 Carefully read and follow the steps in the installation instruction.

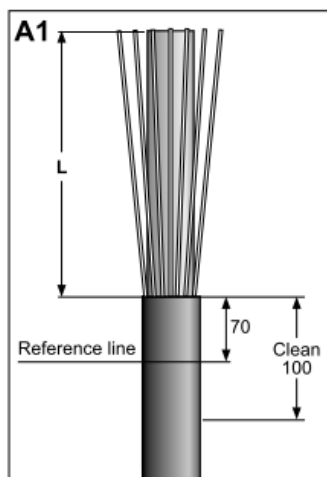
Table for cutback dimensions

Mechanical lug BLMT	Cable	L
	Cross Section AL / Cu mm ²	Indoor/Outdoor 36 kV/42 kV mm
BLMT 25/95	95	435
BLMT 35/150	50	460
BLMT 35/150	95	450
BLMT 35/150	150	450
BLMT 95/240	120	430
BLMT 95/240	185	450
BLMT 95/240	240	440
BLMT 185/400	185	475
BLMT 185/400	400	445
BLMT 500/630	500	485
BLMT 500/630	630	485
BLMT 800/1000	1000	460

For cable cross section 50 - 630 mm²

Cut the cable to the required length.
 Remove the oversheath according to L. Clean and degrease the end of the oversheath for approximately 100 mm.

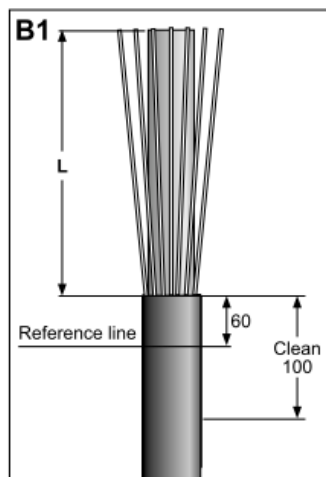
Mark a line 70 mm below the oversheath cut.



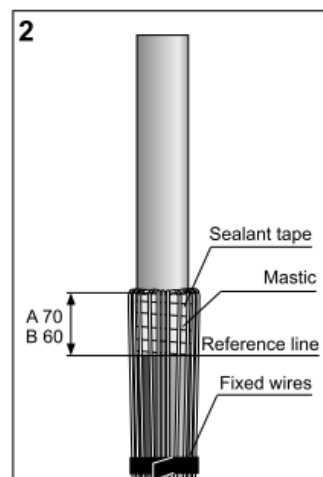
For cable cross section 800 - 1000 mm²

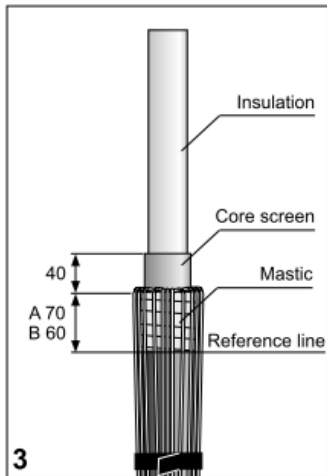
Cut the cable to the required length.
 Remove the oversheath according to L. Clean and degrease the end of the oversheath for approximately 100 mm.

Mark a line 60 mm below the oversheath cut.



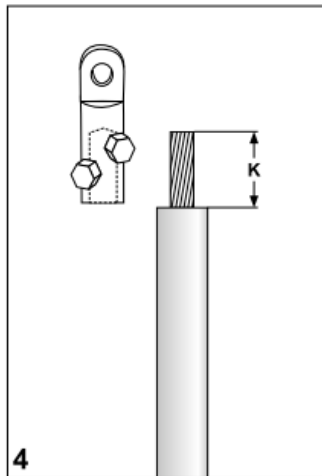
Wrap two layers of sealant tape (grey) with a small overlap and slight tension around the end of the oversheath as shown. Bend the shielding wires back onto the oversheath. Avoid crossing the individual wires. Fix the shielding wires with a tape to the oversheath.



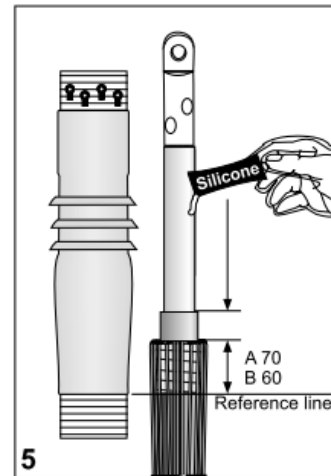


3
Thoroughly remove the core screen to within 40 mm of the overshoot cut. The surface of the insulation should be free from all traces of conductive material. Smooth out any irregularities.

Note: Do not nick the insulation.



4
Cut back the insulation according to **Mechanical lugs:**
K = depth of cable lug barrel hole
Install the cable lug and remove all sharp edges. Clean and degrease the core insulation and the lug.



5
Apply a thin layer of silicone grease onto the insulation and the core screen cut.

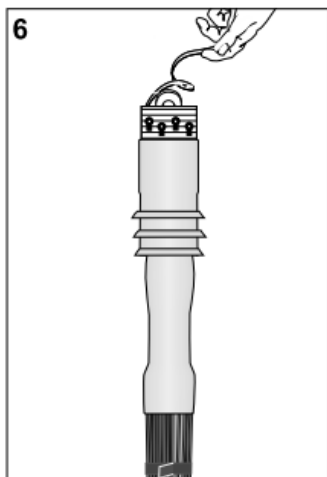
Position the termination body.

Pull the spiral gently until the termination body butts to the reference line.

If the termination is not correctly positioned, it is possible to gently slide it into place.

Remove the spiral holdout completely from the termination by pulling it counterclockwise.

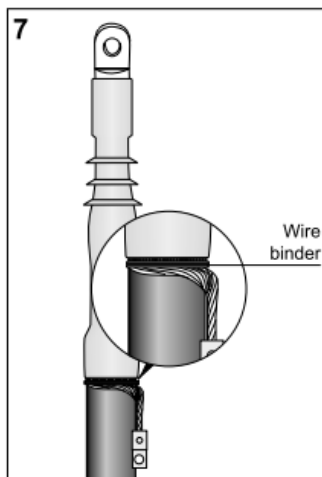
Do not twist the spiral holdout during removal. Avoid the spiral to hook up over the termination.



Degrease and clean the termination.

Fix the shield wires with a wire binder along the lower edge of the termination body. Install the cable lug on the shield wires.

Termination completed.



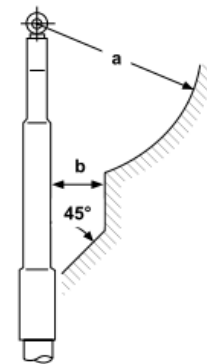
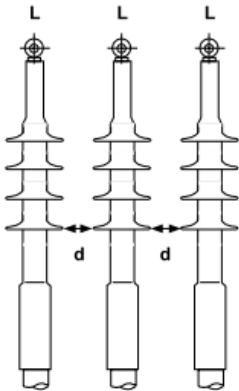
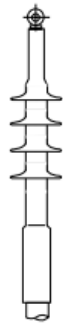
Please dispose of all waste according to local environmental regulations.



CSTI/CSTO – Product family

Indoor

Outdoor



Min. clearances	Max. system voltage in kV	
	36	42
a Air clearance	as for local specifications	
b ph/ph and ph/ground in mm	35	45
d Between skirts in mm	25	35

A.4 Kit content lists

CSTO-6152-ML-7-13

1	482406-000	S1278-1-300(B100)
2	EK3103-001	EPP-2828-8/16
3	E74727-000	EPPA-004
4	724277N001	EXRM-0568
5	CV2903-000	EPPA-076-5
6	989771-000	EPPA-029-3-3000
7	E43601-000	HEL-2070.1-Z-AK
8	2107410-1	BLMT-500/630 MK2-13
9	2304322-6	CSTO-35-BD-32-581-FS

CSTI-6152-7-13

1	482406-000	S1278-1-300(B100)
2	EK3103-001	EPP-2828-8/16
3	E74727-000	EPPA-004
4	724277N001	EXRM-0568
5	CV2903-000	EPPA-076-5
6	989771-000	EPPA-029-3-3000
7	E43601-000	HEL-2070.1-Z-AK
8	2107410-1	BLMT-500/630 MK2-13
9	2304321-6	CSTI-35-BD-32-583-FS

CSTO-6162-ML-8-21

1	482406-000	S1278-1-300(B100)
2	EK3103-001	EPP-2828-8/16
3	E74727-000	EPPA-004
4	724277N001	EXRM-0568
5	CV2903-000	EPPA-076-5
6	989771-000	EPPA-029-3-3000
7	E43601-000	HEL-2070.1-Z-AK
8	2304322-6	CSTO-35-BD-32-581-FS
9	2832081-2	BLMT-800/1000-21