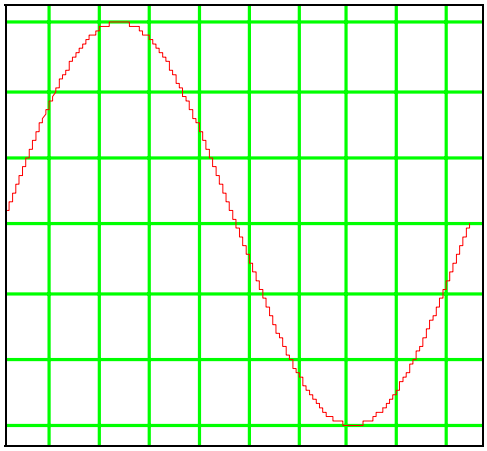

Test Report

PPR 1489-CEE

12.7/22 (24)kV
POLT-24x/1XO (OXSU-F51xx)
Outdoor Termination with 3 sheds
tested in accordance with
CENELEC HD 629.1 S1: 1996
Specification

Pages:	36
Appendix:	-
Date:	5th of October, 2000

Tested by: **T. Vass** (Technician, Energy Products)	Signature:	Date: 6.10.00
Prepared by: **R. Strobl** (Product Manager, Energy Products)	Signature:	Date: 6.10.00
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Test Report PPR 1489-CEE:

Subject of Test: Outdoor Termination POLT-24x/1XO (identical with OXSU-F51xx) for 24 kV single core polymeric unarmoured cables

Date of Tests: August 1999 - October 1999
August 2000 - September 2000

Requirements: CENELEC HD 629.1 S1: 1996

Manufacturer: Tyco Electronics Raychem GmbH Ottobrunn

Location of Tests: Tyco Electronics Raychem EPD Laboratories, Ottobrunn - Germany
Elektrisches Prüfamt Stadtwerke München

Test Purpose: Laboratory Book 4230, page 36, 37,49 and 4228C

Reference: Laboratory Book 4230, page 36, 37,49

Test Results:

The POLT-24D/1XO (OXSU-F5131) 24 kV outdoor termination was tested in accordance with CENELEC HD 629.1 S1:1996. The tests were carried out on single core XLPE Aluminium cables with conductor cross section of 240 mm^2. Two loops with 4 terminations were tested.

All samples passed the test requirements shown in the table on page 5 in accordance with the CENELEC HD 629.1 S1:1996 12,7/22 (24) kV specification. The POLT-24D/1XO (OXSU-F5131) is qualified for cross sections from 70mm^2 to 240mm^2.

Additional tests qualified the remaining kits to cover the cross sections: POLT-24C/1XO (OXSU-F5121) for 25-70 mm^2, POLT-24E/1XO (OXSU-F5141) for 185-400 mm^2, POLT-24F/1XO (OXSU-F5151) for 400-800 mm^2.

Content:

1. CENELEC Test for POLT-24D/1XO (OXSU-F5131) for Cross Section 70-240 mm^2

1.1. Test Sequence

The test sequence of the POLT-24D/1XO (OXSU-F5131) Outdoor Termination for 12,7/22 (24) kV was done in accordance with HD 629.1 S1:1996 table 3 on page 12.

Table 1: Outdoor terminations for extruded insulation cables

	Test	Test clause of HD 628	A1	A2	A3	Test requirements
1	D.C. voltage dry withstand	5	X	X		15 min @ 6 U_0 = 76 kV
2	A.C. voltage dry withstand	4	X	X		5 min @ 4.5 U_0 = 57 kV
3	A.C. voltage wet withstand	4	X			1 min @ 4.0 U_0 = 51 kV
4	Partial discharge at ambient temperature	7	X			XLPE: max 10 pC @ 1.73 U_0 = 22kV
5	Impulse voltage at elevated temperature	6	X			10 impulses of each polarity U = 125 kV 1.2 / 50 µs
6	Electrical heat cycling in air	9	X			3 cycles 5/3h @ 2.5 U_0 = 32 kV conductor temperature 95-100°C
7	Partial discharge at ambient temperature at elevated temperature	7	 X X			 max. 10 pC @ 22 kV max. 10 pC @ 22 kV
8	Electrical heat cycling in air	9	X			113 cycles 5/3 @ 2.5 U_0 = 32 kV conductor temperature 95-100°C
9	Immersion	9.3	X			10 cycles
10	Thermal short circuit (conductor)	11		X		2 short circuit for 1s
11	Impulse voltage at ambient temperature	6	X	X		10 impulses of each polarity U = 125 kV 1.2 / 50 µs
12	AC voltage dry withstand	4	X	X		15 min @ 2.5 U_0 = 32 KV
13	Salt fog	13			X	1000h @ 1.25 U_0=16kV / 160mS/m
14	Examination	-	X	X	X	For information only

1.2. Test Samples

Cable:

Manufacturer:	Kabelmetal
Type:	NA2XS2Y 12/20 kV
Design:	XLPE, extruded screen
Conductor:	stranded Aluminium
Cross section conductor:	240 mm^2
Shielding wires	Copper wires
Cross section shielding	25 mm^2
Voltage rating:	12/20 kV
Length of test loop:	approx. 2,50 m
Number of loops:	2 for 240mm^2

Product:

Kit description	POLT-24D/1XO (*OXSU-F5131)*
Insulating tubing:	HVOT-50/16-440/242 Batch EA13882
Screen cut filler:	S1189-1-100
Sealant:	S1085-3-200
Skirts:	205W325-103/89
Installation instruction:	EPP 0778-8/99

1.3. Test Sequence A1

1.3.1. D.C. Voltage Test according to Section 5 of HD 628

Requirement: D.C. Voltage Withstand 15 min @ 76 kV

Result: No breakdown occurred on the 2 test loops

relative humidity of air	*Atmospheric pressure*	*temperature*
30 %	975 hPa	25° C

1.3.2. A.C. Voltage Test according to Section 4 HD 628

Requirement: A.C. voltage of U_{rms}= 57 kV, 50 Hz was applied between the conductor and the grounded screen for 5 minutes. The voltage was continuously increased within 10 seconds to the specified value and then held constant during the required test period.

Result: No breakdown occurred on the 2 test loops

1.3.3. A.C. Voltage Test under rain according to Section 4 HD 628

Requirement: A.C. voltage of 51 kV_{rms}, 50 Hz was applied between the conductor and the grounded screen for 1 minute. The voltage was continuously increased within 10 seconds to the specified value and then held constant during the required test period.

Result: No breakdown occurred on the 2 test loops

1.3.4. Partial Discharge Test at ambient temperature acc. Sec. 7 HD 628

Requirement: Maximum PD level @ 22kV ≤ 10pC

The lugs were made corona free by using ring electrodes and an A.C test voltage of 1.25*U = 30 kV was applied for 1 min. Then the voltage was decreased to the A.C. test voltage of U_{PD} = 22 kV and within 1 minute the maximum value of the partial discharge magnitude was measured.

Result: Measured PD level is below the limit of 10 pC

	Loop 1 240 mm²	*Loop 2 240 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl.....basic noise level $q_n \leq 1$ pC

1.3.5. Impulse Voltage at Elevated Temperature

Requirement: An impulse voltage with rise time of approx. 1.2 µs and half-value decay time with approx. 50 µs was applied. The test loops were exposed to 10 impulses each of an impulse voltage of 125 kV of positive and negative polarity between the conductor and the grounded screen. The test loops were heated up to a temperature of 95-100°C.

Result: No breakdown occurred on the 2 test loops. The impulse diagrams below show no discrepancies to the calibration oscillogram.

relative humidity of air	*atmospheric pressure*	*temperature*
57 %	962 hPa	21° C

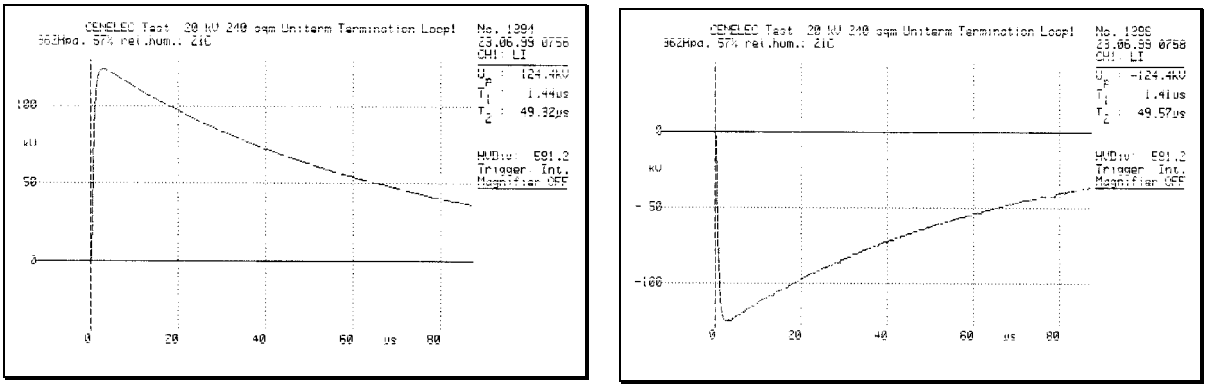

Fig. 1: Impulse oscillograms 240mm^2 XLPE cables

1.3.6. Electrical Heat Cycling in Air acc. to Section 9 HD 628

Requirement: The test loops, suspended free in air, were subjected to 3 load cycles with a continuously applied AC test voltage of 32 kV. Each load cycle consists of a 5 hours heating period and a 3 hours cooling period. The test loops were heated up to a temperature of 95-100°C.

Result: No breakdown occurred on the 2 test loops.

*relative humidity of air**	*atmospheric pressure**	*temperature**
33 %	937 hPa	20° C

*) beginning of load cycling

1.3.7. PD at Elevated and Ambient Temperature acc. to Sec 7 of HD 628

a) Partial Discharge at Ambient Temperature after 3rd Load Cycle

Requirement: Maximum PD level @ 22kV ≤ 10pC
Identical test as in 1.3.3

Result: Measured PD level was below the limit of 10 pC

relative humidity of air	*atmospheric pressure*	*temperature*
33 %	946 hPa	24° C

	Loop 1 240 mm²	*Loop 2 240 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl.....basic noise level $q_n \leq 1$ pC

b) Partial Discharge at Elevated Temperature after 3rd Load Cycle

Requirement: Maximum PD level @ 22kV ≤ 10pC

The conductors were heated up to a temperature of 95-100°C. Then identical test as in 1.3.3.

Result: Measured PD level was below the limit of 10 pC

	Loop 1 240 mm²	*Loop 2 240 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl.....basic noise level $q_n \leq 1$ pC

1.3.8. Electrical Heat Cycling in Air acc. to Section 9 HD 628

Requirement: Test equivalent to 1.3.5, but 113 cycles

Result: No breakdown occurred on the 2 test loops.

1.3.9. Continuous A.C. Voltage Test with Cyclic Current Load immersed in water according to Section 9.3 HD 628

Requirement: The test loops, immersed in water, were subjected to 10 load cycles. Each load cycle consists of a 3 hours load period, a 2 hours hold period and a 3 hours cooling period. The current was adjusted to a level which heated up the cable core to a temperature of 100°C. Temperature of the water during the load cycles: approx. 20°C.

Result: All samples passed

1.3.10. PD at Elevated and Ambient Temperature acc. to Sec 7 of HD 628

a) Partial Discharge at Ambient Temperature after 10th Load Cycle (Immersion)

Requirement: Maximum PD level @ 22 kV ≤ 10 pC
Identical test as in 1.3.3

Result: Measured PD level was below the limit of 10 pC

relative humidity of air	*atmospheric pressure*	*temperature*
40 %	978 hPa	24° C

	Loop 1 240 mm²	*Loop 2 240 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl.....basic noise level $q_n \leq 1$ pC

b) Partial Discharge at Elevated Temperature after 10th Load Cycle (Immersion)

Requirement: Maximum PD level @ 22kV ≤ 10pC

The conductors were heated up to a temperature of 95-100°C. Then identical test as in 1.3.3.

Result: Measured PD level was below the limit of 10 pC

	Loop 1 240 mm²	*Loop 2 240 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl....basic noise level $q_n \leq 1$ pC

1.3.11. Impulse Voltage at Ambient Temperature

Requirement: An impulse voltage with rise time of approx. 1.2 µs and half-value decay time with approx. 50 µs was applied. The test loops were exposed to 10 impulses each of an impulse voltage of 125 kV of positive and negative polarity between the conductor and the grounded screen.

Result: No breakdown occurred on the 2 test loops. The impulse diagrams below show no discrepancies to the calibration oscillogram.

relative humidity of air	*atmospheric pressure*	*temperature*
35 %	930 hPa	23° C

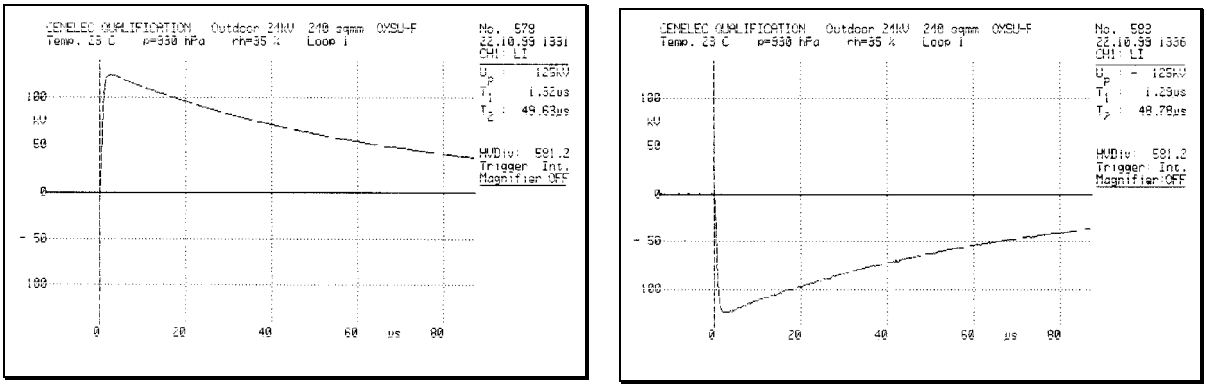

Fig. 2: 240mm^2 XLPE cables after heat cycling (Immersion)

1.3.12. A.C. Voltage Dry Withstand

Requirement: A.C. voltage of U_{rms}= 32 kV, 50 Hz was applied between the conductor and the grounded screen for 15 minutes. The voltage was continuously increased within 10 seconds to the specified value and then held constant during the required test period.

Result: No breakdown occurred on the 2 test loops

1.3.13. Examination

All tested samples looked optically good. After cutting open no signs of destruction could be seen.

1.4. Test Sequence A2

1.4.1. D.C. Voltage Test according to Section 5 of HD 628

Requirement: D.C. Voltage Withstand 15 min @ 76 kV

Result: No breakdown occurred on the 2 test loops

relative humidity of air	*Atmospheric pressure*	*temperature*
42 %	951 hPa	20° C

1.4.2. A.C. Voltage Test according to Section 4 HD 628

Requirement: A.C. voltage of U_{rms}= 57 kV, 50 Hz was applied between the conductor and the grounded screen for 5 minutes. The voltage was continuously increased within 10 seconds to the specified value and then held constant during the required test period.

Result: No breakdown occurred on the 2 test loops

1.4.3. Thermal Short Circuit Test according to Section 11 HD 628

Requirement:
The thermal equivalent short circuit current of a one second duration was calculated based on CENELEC HD 628 S1:1996. This short circuit load application was repeated once, each time after the conductor had cooled down to ambient temperature. (Ambient temperature 21°C)

cross section [mm^2]	*Conductor*	*Short circuit current [kA]*
240	Aluminium	28,8

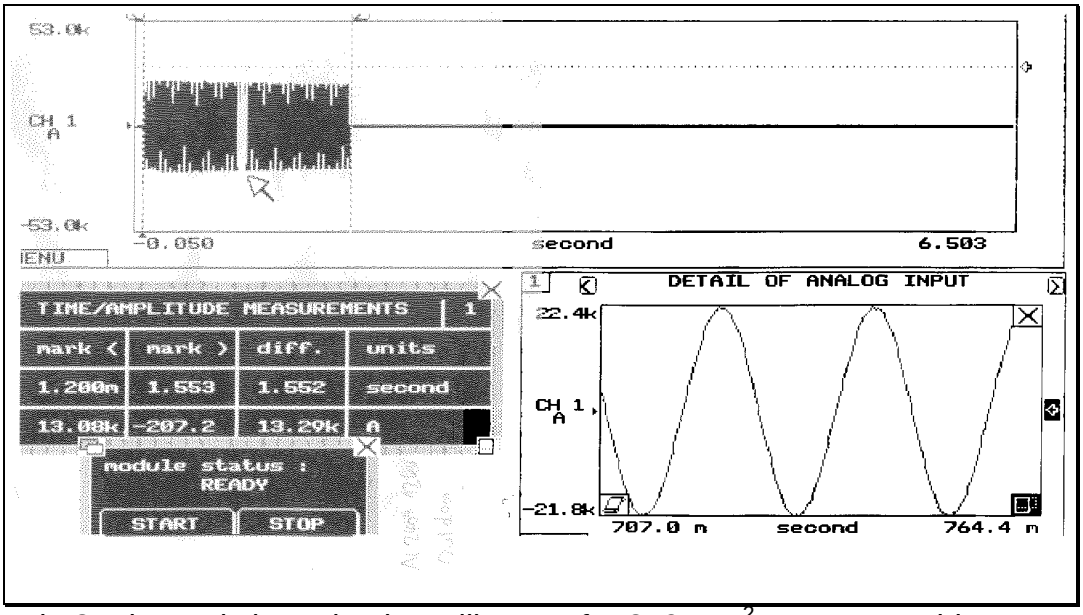

Fig 3: Thermal short circuit oscillogram for 240 mm^2 XLPE AL cables
Carried out in “Elektrisches Prüfamt München”

Result: No breakdown occurred on the 2 test loops

The thermal short circuit oscillograms in figure 3 do not show any discrepancies to the calibration oscillogram. A visual check did not show any damage on the test loops.

1.4.4. Impulse Voltage at Ambient Temperature

Requirement: An impulse voltage with rise time of approx. 1.2 µs and half-value decay time with approx. 50 µs was applied. The test loops were exposed to 10 impulses each of an impulse voltage of 125 kV of positive and negative polarity between the conductor and the grounded screen.

Result: No breakdown occurred on the 2 test loops. The impulse diagrams below show no discrepancies to the calibration oscillogram.

relative humidity of air	*atmospheric pressure*	*temperature*
50 %	960 hPa	22° C

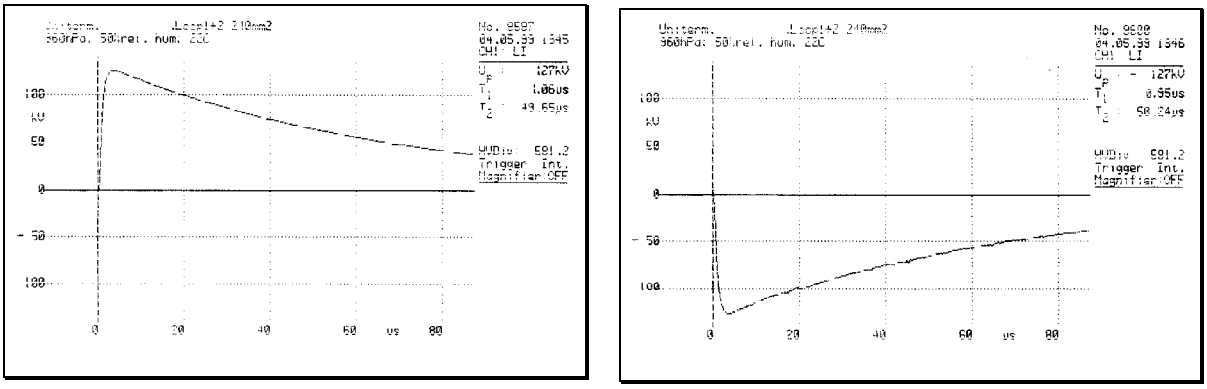

Fig. 4: Impulse oscillograms 240mm^2 XLPE cables after thermal short circuit

1.4.5. A.C. Voltage Test according to Section 4 HD 628

Requirement: A.C. voltage of U_{rms}= 32 kV, 50 Hz was applied between the conductor and the grounded screen for 15 minutes. The voltage was continuously increased within 10 seconds to the specified value and then held constant during the required test period.

Result: No breakdown occurred on the 2 test loops

1.4.6. Examination

All tested samples looked optically good. After cutting open no signs of destruction could be seen.

1.5. Test Sequence A3

The 1000 h saltfog test was done in accordance with section 13 HD 628.

A.C. voltage of U_{rms} = 16 kV, 50 Hz was applied between the conductor and the grounded screen for 1000 h. The voltage was continuously increased within 10 seconds to the specified value and was then held constant during the required test. The water with a conductivity of 160 ± 10 mS/m was sprayed continuously at rate of 0.4 ± 0.1 l/(h*m³) into the test chamber.

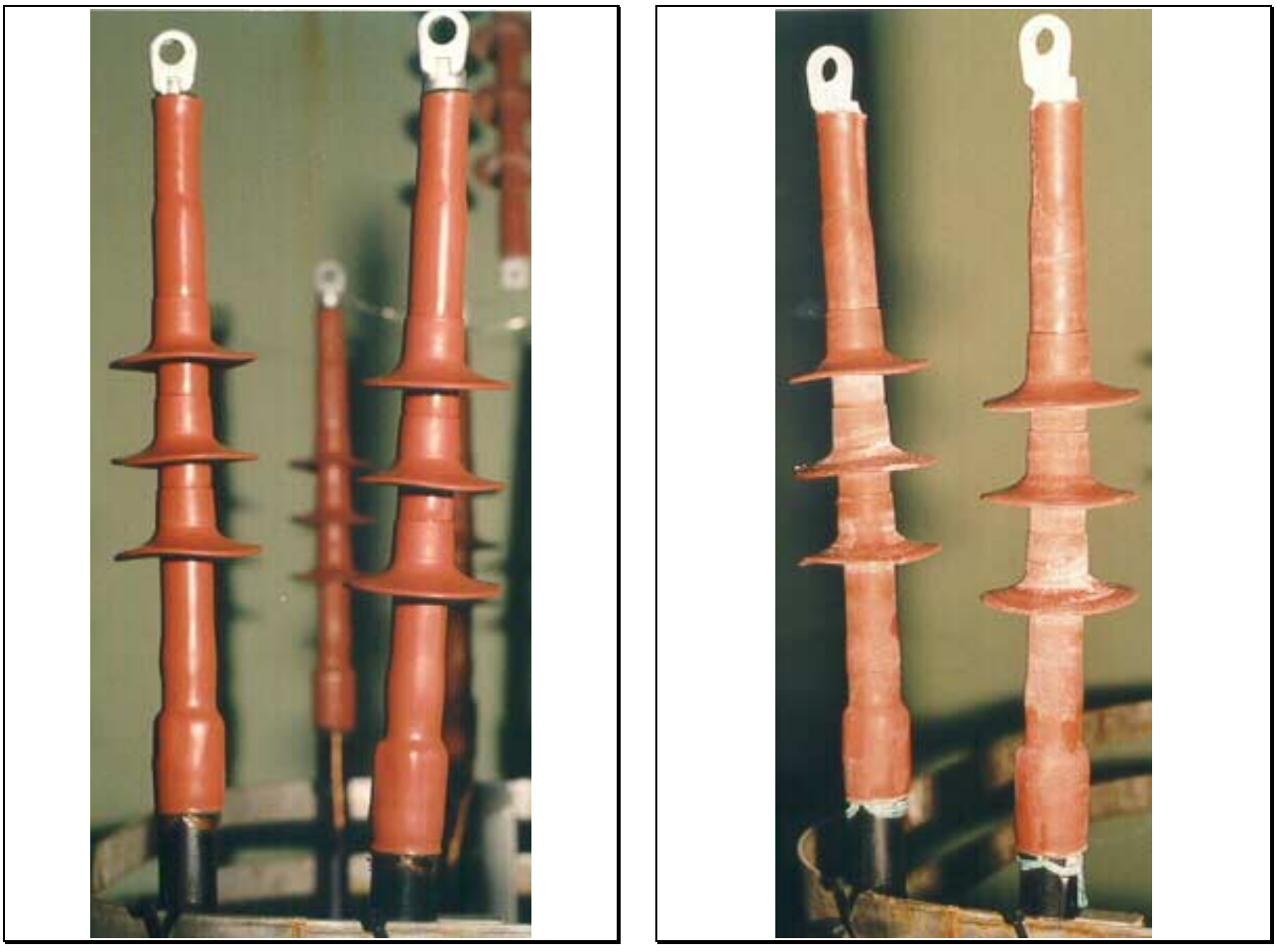

Fig 5: Photos show terminations before/after saltfog test

Result: No fuse trip occurred on the 2 test loops

1.6. Summary Test Results

The POLT-24D/1XO (OXSU-F5131) 24kV outdoor termination was tested in accordance with the CENELEC HD 629.1 S1:1996. The tests were carried out on 24kV XLPE cables with cross section 240 mm^2.

All samples passed the test requirements in accordance with the CENELEC HD 629.1 S1: 1996 12,7/22 (24) kV specification.

2. Additional CENELEC Test for POLT-24E/1XO (OXSU-F5141) (185-400 mm2)

2.1. Test Programme

Additional tests for other cross sections of the POLT-24x/1XO (OXSU-F) Outdoor Termination product familiy for 12.7/22 (24kV) was done in accordance with the test sequence in HD 629.1 S1:1996 table 10, page 20.

Table 2: Test sequence according to CENELEC

	Test	Test clause of HD 628	Test sequence	Test requirements
1	DC voltage dry withstand	5	X	15 min @ 6 U_0 = 76 kV
2	AC voltage dry withstand	4	X	5 min @ 4.5 U_0 = 57 kV
3	Partial discharge at ambient temperature	7	X	XLPE: max 10 pC @ 1.73U_0=22kV
4	Impulse voltage at elevated temperature	6	X	10 impulses of each polarity U=125kV 1.2/50µs
5	Electrical heat cycling in air	9	X	10 cycles 5/3h @ 32 kV conductor temperature 95-100°C
6	Partial discharge at ambient temperature at elevated temperature	7	 X X	 max. 10 pC @ 22 kV max. 10 pC @ 22 kV
7	AC voltage dry withstand	4	X	15 min @ 2.5 U_0 = 32 KV
8	Examination	-	X	For information only

2.2. Test samples

Cable:

Manufacturer:	Kabelmetal
Type:	NA2XS2Y 12/20 kV
Design:	XLPE, extruded screen
Conductor:	stranded Aluminium
Cross section conductor:	300 mm^2
Shielding wires	Copper wires
Cross section shielding	25 mm^2
Voltage rating:	12/20 kV
Length of test loop:	approx. 2,50 m
Quantity of loops:	2

Product:

Kit description	POLT-24E/1XO (OXSU-F5141)
Insulating tubing:	HVOT-62/21-440/242 Batch EB10821
Screen cut filler:	S1189-1-150
Sealant:	S1085-3-200
Skirts:	205W336-103/89
Installation instruction:	EPP 0778 3/99

2.3. Test Sequence

2.3.1. D.C. Voltage Test according to Section 5 of HD 628

Requirement: D.C. Voltage Withstand 15 min @ 6 U_0 = 76 kV

Result: No breakdown occurred on the 2 test loops

relative humidity of air	*atmospheric pressure*	*temperature*
50 %	960 hPa	22° C

2.3.2. A.C. Voltage Test according to Section 4 HD 628

Requirement: A.C. voltage of U_{rms}= 57 kV, 50 Hz was applied between the conductor and the grounded screen for 5 minutes. The voltage was continuously increased within 10 seconds to the specified value and then held constant during the required test period.

Result: No breakdown occurred on the 2 test loops

2.3.3. Partial Discharge Test at Ambient Temp. acc. to Sec. 7 HD 628

Requirement: Maximum PD level @ 22kV ≤ 10 pC

The lugs were made corona free by using ring electrodes and an A.C test voltage of 1.25*U = 30 kV was applied for 1 min. Then the voltage was decreased to the A.C. test voltage of U_{PD} = 22 kV and within 1 minute the maximum value of the partial discharge magnitude was measured.

Result: Measured PD level is below the limit of 10 pC

	Loop 1 300 mm²	*Loop 2 300 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl.....basic noise level q_n≤ 1 pC

2.3.4. Impulse Voltage at Elevated Temperature

Requirement: An impulse voltage with rise time of approx. 1.2 µs and half-value decay time with approx. 50 µs was applied. The test loops were exposed to 10 impulses each of an impulse voltage of 125 kV of positive and negative polarity between the conductor and the grounded screen. The test loops were heated up to a temperature of 95-100°C.

Result: No breakdown occurred on the 2 test loops. The impulse diagrams below show no discrepancies to the calibration oscillogram.

relative humidity of air	*atmospheric pressure*	*temperature*
50 %	960 hPa	22° C

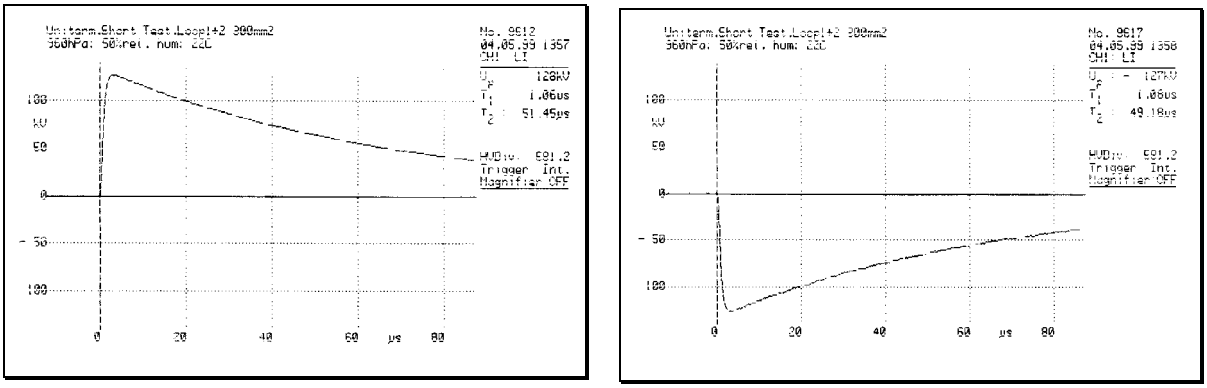

Fig. 6: Impulse oscillograms for 300mm^2 XLPE cables

2.3.5. Electrical Heat Cycling in Air acc. to Section 9 HD 628

Requirement: The test loops, suspended free in air, were subjected to 10 load cycles with a continuously applied AC test voltage of 32 kV. Each load cycle consists of a 5 hours heating period and a 3 hours cooling period. The test loops were heated up to a temperature of 95-100°C.

Result: No breakdown occurred on the 2 test loops.

2.3.6. PD at Elevated and Ambient Temperature acc. to Sec 7 of HD 628

a) Partial Discharge at Ambient Temperature after 10th Load Cycle

Requirement: Maximum PD level @ 22kV ≤ 10pC
Identical test acc. to 1.3.3

Result: Measured PD level was below the limit of 10 pC

relative humidity of air	*atmospheric pressure*	*temperature*
35 %	948 hPa	24° C

	Loop 1 300 mm²	*Loop 2 300 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl....basic noise level $q_n \leq 1$ pC

b) Partial Discharge at Elevated Temperature after 10th Load Cycle

Requirement: Maximum PD level @ 22kV ≤ 10pC

The conductors were heated up to a temperature of 95-100°C. Then identical test as in 1.3.3.

Result: Measured PD level was below the limit of 10 pC

	Loop 1 300 mm²	*Loop 2 300 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl....basic noise level $q_n \leq 1$ pC

2.3.7. A.C. Voltage Dry Withstand

Requirement: A.C. voltage of U_{rms}= 32 kV, 50 Hz was applied between the conductor and the grounded screen for 15 minutes. The voltage was continuously increased within 10 seconds to the specified value and then held constant during the required test period.

Result: No breakdown occurred on the 2 test loops

2.3.8. Examination

All tested samples looked optically good. After cutting open no signs of destruction could be seen.

3. Additional CENELEC Test for POLT-24C/1XO (OXSU-F5121) (25-70 mm²)

3.1. Test Programme

Additional tests for other cross sections of the POLT-24x/1XO (OXSU-F) Outdoor Termination product familiy for 12.7/22 (24kV) were done in accordance with the test sequence in HD 629.1 S1:1996 table 10, page 20.

Table 2: Test sequence according to CENELEC

	Test	Test clause of HD 628	Test sequence	Test requirements
1	DC voltage dry withstand	5	X	15 min @ 6 U_0 = 76 kV
2	AC voltage dry withstand	4	X	5 min @ 4.5 U_0 = 57 kV
3	Partial discharge at ambient temperature	7	X	XLPE: max 10 pC @ 1.73U_0=22kV
4	Impulse voltage at elevated temperature	6	X	10 impulses of each polarity U=125kV 1.2/50µs
5	Electrical heat cycling in air	9	X	10 cycles 5/3h @ 32 kV conductor temperature 95-100°C
6	Partial discharge at ambient temperature at elevated temperature	7	 X X	 max. 10 pC @ 22 kV max. 10 pC @ 22 kV
7	AC voltage dry withstand	4	X	15 min @ 2.5 U_0 = 32 KV
8	Examination	-	X	For information only

3.2. Test samples

Cable:

Manufacturer:	Kabelmetal
Type:	N2XSY 12/20 kV
Design:	XLPE, extruded screen
Conductor:	stranded Aluminium respectively Copper
Cross section conductor:	35 mm^2
Shielding wires	Copper wires
Cross section shielding	16 mm^2
Voltage rating:	12/20 kV
Length of test loop:	approx. 2,50 m
Quantity of loops:	2 for 35 mm^2

Product:

Kit description	POLT-24C/1XO (OXSU-F5121)
Insulating tubing:	HVOT-38/12-440/242 Batch EB10831
Screen cut filler:	S1189-1-100
Sealant:	S1085-3-150
Skirts:	205W320-103/89
Installation instruction:	EPP 0778 3/99

3.3. Test Sequence

3.3.1. D.C. Voltage Test according to Section 5 of HD 628

Requirement: D.C. Voltage Withstand 15 min @ 6 U_0 = 76 kV

Result: No breakdown occurred on the 2 test loops

relative humidity of air	*atmospheric pressure*	*temperature*
53 %	958 hPa	28° C

3.3.2. A.C. Voltage Test according to Section 4 HD 628

Requirement: A.C. voltage of U_{rms}= 57 kV, 50 Hz was applied between the conductor and the grounded screen for 5 minutes. The voltage was continuously increased within 10 seconds to the specified value and then held constant during the required test period.

Result: No breakdown occurred on the 2 test loops

3.3.3. Partial Discharge Test at Ambient Temp. acc. to Sec. 7 HD 628

Requirement: Maximum PD level @ 22kV ≤ 10 pC

The lugs were made corona free by using ring electrodes and an A.C test voltage of 1.25*U = 30 kV was applied for 1 min. Then the voltage was decreased to the A.C. test voltage of U_{PD} = 22 kV and within 1 minute the maximum value of the partial discharge magnitude was measured.

Result: Measured PD level is below the limit of 10 pC

	Loop 1 35 mm²	*Loop 2 35 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl.....basic noise level q_n≤ 1 pC

3.3.4. Impulse Voltage at Elevated Temperature

Requirement: An impulse voltage with rise time of approx. 1.2 µs and half-value decay time with approx. 50 µs was applied. The test loops were exposed to 10 impulses each of an impulse voltage of 125 kV of positive and negative polarity between the conductor and the grounded screen. The test loops were heated up to a temperature of 95-100°C.

Result: No breakdown occurred on the 2 test loops. The impulse diagrams below show no discrepancies to the calibration oscillogram.

relative humidity of air	*atmospheric pressure*	*temperature*
53 %	958 hPa	28° C

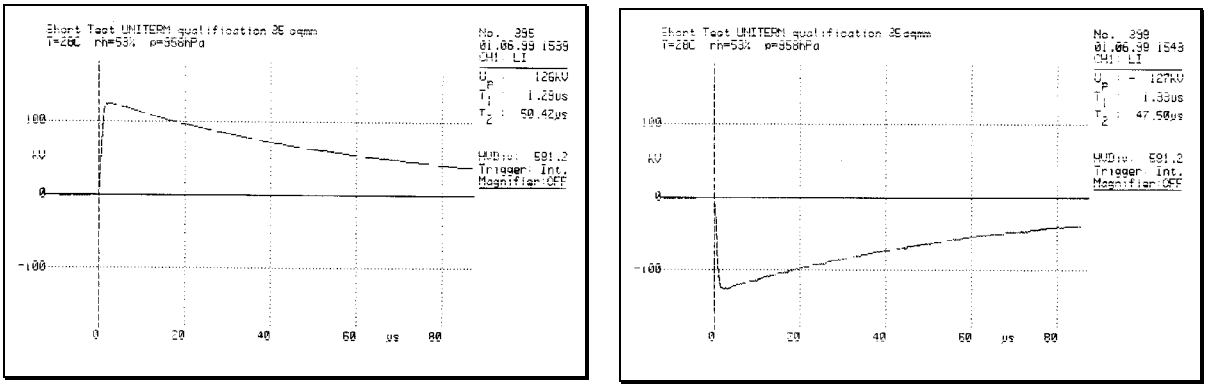

Fig. 9: Impulse oscillograms for 35mm^2 XLPE cables

3.3.5. Electrical Heat Cycling in Air acc. to Section 9 HD 628

Requirement: The test loops, suspended free in air, were subjected to 10 load cycles with a continuously applied AC test voltage of 32 kV. Each load cycle consists of a 5 hours heating period and a 3 hours cooling period. The test loops were heated up to a temperature of 95-100°C.

Result: No breakdown occurred on the 2 test loops.

3.3.6. PD at Elevated and Ambient Temperature acc. to Sec 7 of HD 628

a) Partial Discharge at Ambient Temperature after 10th Load Cycle

Requirement: Maximum PD level @ 22kV ≤ 10pC
Identical test acc. to 1.3.3

Result: Measured PD level was below the limit of 10 pC

relative humidity of air	*atmospheric pressure*	*temperature*
35 %	948 hPa	24° C

	Loop 1 35 mm²	*Loop 2 35 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl....basic noise level $q_n \leq 1$ pC

b) Partial Discharge at Elevated Temperature after 10th Load Cycle

Requirement: Maximum PD level @ 22kV ≤ 10pC

The conductors were heated up to a temperature of 95-100°C. Then identical test as in 1.3.3.

Result: Measured PD level was below the limit of 10 pC

	Loop 1 35 mm²	*Loop 2 35 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl.....basic noise level $q_n \leq 1$ pC

3.3.7. A.C. Voltage Dry Withstand

Requirement: A.C. voltage of U_{rms}= 32 kV, 50 Hz was applied between the conductor and the grounded screen for 15 minutes. The voltage was continuously increased within 10 seconds to the specified value and then held constant during the required test period.

Result: No breakdown occurred on the 2 test loops

3.3.8. Examination

All tested samples looked optically good. After cutting open no signs of destruction could be seen.

4. Additional CENELEC Test for POLT-24F/1XO (OXSU-F5151) (400-800 mm²)

4.1. Test Programme

Additional tests for other cross sections of the POLT-24x/1XO (OXSU-F) Outdoor Termination product familiy for 12.7/22 (24kV) were done in accordance with the test sequence in HD 629.1 S1:1996 table 10, page 20.

Table 2: Test sequence according to CENELEC

	Test	Test clause of HD 628	Test sequence	Test requirements
1	DC voltage dry withstand	5	X	15 min @ 6 U_0 = 76 kV
2	AC voltage dry withstand	4	X	5 min @ 4.5 U_0 = 57 kV
3	Partial discharge at ambient temperature	7	X	XLPE: max 10 pC @ 1.73U_0=22kV
4	Impulse voltage at elevated temperature	6	X	10 impulses of each polarity U=125kV 1.2/50µs
5	Electrical heat cycling in air	9	X	10 cycles 5/3h @ 32 kV conductor temperature 95-100°C
6	Partial discharge at ambient temperature at elevated temperature	7	 X X	 max. 10 pC @ 22 kV max. 10 pC @ 22 kV
7	AC voltage dry withstand	4	X	15 min @ 2.5 U_0 = 32 KV
8	Examination	-	X	For information only

4.2. Test samples

Cable:

Manufacturer:	Kabelmetal
Type:	NA2XS2Y 12/20 kV
Design:	XLPE, extruded screen
Conductor:	stranded Aluminium
Cross section conductor:	400 mm^2
Shielding wires	Copper wires
Cross section shielding	35 mm^2
Voltage rating:	12/20 kV
Length of test loop:	approx. 2,50 m
Quantity of loops:	2 for 400 mm^2

Product:

Kit description	POLT-24F/1XO (OXSU-F5151)
Insulating tubing:	HVOT-82/29-440/242 Batch EA12212
Screen cut filler:	S1189-1-200
Sealant:	S1085-3-300
Skirts:	205W346-103/89
Installation instruction:	EPP 0778 3/99

4.3. Test Sequence

4.3.1. D.C. Voltage Test according to Section 5 of HD 628

Requirement: D.C. Voltage Withstand 15 min @ 6 U_0 = 76 kV

Result: No breakdown occurred on the 2 test loops

relative humidity of air	*atmospheric pressure*	*temperature*
52 %	956 hPa	26° C

4.3.2. A.C. Voltage Test according to Section 4 HD 628

Requirement: A.C. voltage of U_{rms}= 57 kV, 50 Hz was applied between the conductor and the grounded screen for 5 minutes. The voltage was continuously increased within 10 seconds to the specified value and then held constant during the required test period.

Result: No breakdown occurred on the 2 test loops

4.3.3. Partial Discharge Test at Ambient Temp. acc. to Sec. 7 HD 628

Requirement: Maximum PD level @ 22kV ≤ 10 pC

The lugs were made corona free by using ring electrodes and an A.C test voltage of 1.25*U = 30 kV was applied for 1 min. Then the voltage was decreased to the A.C. test voltage of U_{PD} = 22 kV and within 1 minute the maximum value of the partial discharge magnitude was measured.

Result: Measured PD level is below the limit of 10 pC

	Loop 1 400 mm²	*Loop 2 400 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl.....basic noise level q_n≤ 1 pC

4.3.4. Impulse Voltage at Elevated Temperature

Requirement: An impulse voltage with rise time of approx. 1.2 µs and half-value decay time with approx. 50 µs was applied. The test loops were exposed to 10 impulses each of an impulse voltage of 125 kV of positive and negative polarity between the conductor and the grounded screen. The test loops were heated up to a temperature of 95-100°C.

Result: No breakdown occurred on the 2 test loops. The impulse diagrams below show no discrepancies to the calibration oscillogram.

relative humidity of air	*atmospheric pressure*	*temperature*
52 %	956 hPa	26° C

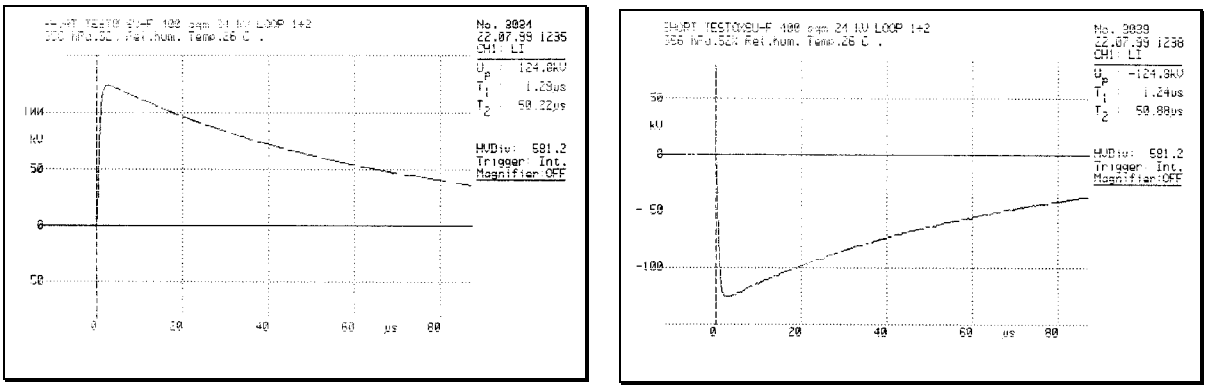

Fig. 9: Impulse oscillograms for 400 mm^2 XLPE cables

4.3.5. Electrical Heat Cycling in Air acc. to Section 9 HD 628

Requirement: The test loops, suspended free in air, were subjected to 10 load cycles with a continuously applied AC test voltage of 32 kV. Each load cycle consists of a 5 hours heating period and a 3 hours cooling period. The test loops were heated up to a temperature of 95-100°C.

Result: No breakdown occurred on the 2 test loops.

4.3.6. PD at Elevated and Ambient Temperature acc. to Sec 7 of HD 628

a) Partial Discharge at Ambient Temperature after 10th Load Cycle

Requirement: Maximum PD level @ 22kV ≤ 10pC
Identical test acc. to 1.3.3

Result: Measured PD level was below the limit of 10 pC

relative humidity of air	*atmospheric pressure*	*temperature*
35 %	948 hPa	24° C

	Loop 1 400 mm²	*Loop 2 400 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl.....basic noise level $q_n \leq 1$ pC

b) Partial Discharge at Elevated Temperature after 10th Load Cycle

Requirement: Maximum PD level @ 22kV ≤ 10pC

The conductors were heated up to a temperature of 95-100°C. Then identical test as in 1.3.3.

Result: Measured PD level was below the limit of 10 pC

	Loop 1 400 mm²	*Loop 2 400 mm²*
PD value [pC] @ 22kV	bnl	bnl

bnl.....basic noise level $q_n \leq 1$ pC

4.3.7. A.C. Voltage Dry Withstand

Requirement: A.C. voltage of U_{rms}= 32 kV, 50 Hz was applied between the conductor and the grounded screen for 15 minutes. The voltage was continuously increased within 10 seconds to the specified value and then held constant during the required test period.

Result: No breakdown occurred on the test loop

4.3.8. Examination

The tested sample looks optically good. After cutting open no signs of destruction could be seen.