09-1036

TYPE TEST CERTIFICATE OF COMPLETE TYPE TEST

OBJECT 76/132 (145) kV cable system

TYPE

- Single-core power cable, type 76 / 132 (145) kV 1x2000 m^2 CU/XLPE/CW/LEAD/HDPE *(manufacturer Elsewedy, Cairo, Egypt)*
- Outdoor termination, type ESP145-C73-05 *(manufacturer Pfisterer, Switzerland)*
- SF_6 termination, type HV separable connector, size 6, Umax 170 kV, In=2500 A *(man. Pfisterer, Germany)*
- Straight joint, type 138TCJ1N4-6 *(manufacturer Elastimold, USA)*
- Cross-bonding joint, type 138TCJ1S4-6 *(manufacturer Elastimold, USA)*

Rated voltage, U_o/U (U_m)	**76/132 (145)**	**kV**	**Conductor material**	**Cu**
Conductor cross-section	**1x2000**	**mm²**	**Insulation material**	**XLPE**

MANUFACTURER Elsewedy Cables
Cairo, Egypt

CLIENT Elsewedy Cables
Cairo, Egypt

TESTED BY KEMA HIGH-VOLTAGE LABORATORY
Arnhem, the Netherlands

DATE OF TESTS 14 April 2009 until 1 September 2009

The object, constructed in accordance with the description, drawings and photographs incorporated in this Certificate, has been subjected to the series of proving tests in accordance with

IEC 60840

This Type Test Certificate has been issued by KEMA following exclusively the STL Guides.

The results are shown in the record of Proving Tests and the oscillograms attached hereto. The values obtained and the general performance are considered to comply with the above Standard and to justify the ratings assigned by the manufacturer as listed on page 4.

The Certificate applies only to the object tested. The responsibility for conformity of any object having the same designations with that tested rests with the Manufacturer.

This Certificate consists of 103 pages in total.

KEMA Nederland B.V.

P.G.A. Bus
KEMA T&D Testing Services
Managing Director

Arnhem, 14 December 2009

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1 IDENTIFICATION OF THE TEST OBJECTS

1.1 Description of the test objects

1.1.1 Single-core power cable

Manufacturer	Elsewedy Cables
Type	76/132 (145) kV 1x2000 mm^2 CU/XLPE/CW/LEAD/HDPE
Year of manufacture	2009
Sampling procedure	by the manufacturer
Quantity submitted	75 m
Rated voltage, U_0/U (U_m)	76/132 (145) kV
No. of cores	1
Nominal electrical stress at the conductor screen at U_0 (E_i)	6,3 kV/mm
Nominal electrical stress at the insulation screen at U_0 (E_o)	4,15 kV/mm
Marking on the cable	132000 V ELECTRIC CABLE ELSEWEDY CABLES 1X2000 MM2 MANUFACTURING YEAR PROPERTY OF KAHRAMAA

Conductor

- material	plain annealed copper
- nominal cross-sectional area	2000 mm^2
- nominal diameter	55 mm approx.
- type	stranded segmental Milliken
- maximum conductor temperature in normal operation	90 °C

Conductor screen

- material	bonded semi-conductive XLPE
- nominal thickness	1,4 mm
- material designation	LE 500
- manufacturer	Borealis

Insulation

- material	XLPE
- nominal thickness (t_n)	15 mm
- nominal inner diameter of insulation (d_{ii})	58,5 mm
- nominal outer diameter of insulation (D_{io})	88,5 mm
- material designation	LE4201 S
- manufacturer	Borealis

Insulation screen

- material	bonded semi-conductive XLPE
- nominal thickness	1,4 mm
- material designation	LE 500
- manufacturer	Borealis

Metallic screen

- material	copper wire banded with open helix copper tape
- number and nominal diameter of wires	50 wires of Ø 1,75 mm
- nominal thickness and width of tape	0,1 x 20 mm (open helix)
- cross-sectional area	122,2 mm^2
- d.c. resistance	0,145 Ω/km
- nominal capacitance between conductor and metallic screen	0,336 μF/km

Metallic sheath

- material	lead alloy ½ C
- nominal thickness	2,2 mm

Oversheath

- material	HDPE, type ST_7
- nominal thickness	4,5 mm
- nominal overall diameter of the cable	112 mm approx.
- material designation	HE 6062
- manufacturer	Borealis
- colour	black
- graphite coating applied	yes

Longitudinally watertightness

- along insulation screen	yes
- number of swelling tapes	two tapes, one tape under copper screen and one tape over copper screen
- nominal thickness and width (overlap)	tape under copper screen 0,5 x 70 mm (overlap: 10%) tape over copper screen 0,5 x 70 mm (overlap: 50%)
- material designation	helical applied tapes
- manufacturer	Tianrong
- along the conductor	yes
- swelling material	non conductive swellable tape
- material designation	longitudinal
- manufacturer	FUKUOKA

Fire retardant (IEC 60332-1) no

Manufacturing details

- type of extrusion	triple head VCV
- manufacturer of the extrusion line	Nokia
- curing means	Dry curing
- cooling means	Dry cooling

1.1.2 Outdoor termination

Manufacturer	Pfisterer, Altdorf, Switzerland
Type	ESP145-C73-05
Year of manufacture	2009
Rated voltage, U_0/U (U_m)	76/132 (145) kV
Outer shedding type	porcelain shedded
Height without base plate	2200 mm (code C73)
Termination size	05 stress cone B5
Minimum prepared core diameter	82 mm
Maximum prepared core diameter	99 mm
Cable preparation instruction	lead sheath and screen wires without plumbing cone
Connecting conductor type	mechanical torque connector
Filling compound	Silicone oil, Indopol H-50
Serial no stress cone 1	0000554 (art no 190546)
Serial no stress cone 2	0000536 (art no 190546)

1.1.3 SF_6 termination

Manufacturer	Pfisterer, Winterbach, Germany
Type	HV connex separable connector, size 6, Umax 170 kV, In=2500 A
Year of manufacture	2009
Rated voltage, U_0/U (U_m)	76/132 (145) kV
Cable connector size	6
Serial no stress cone 1	00555 year 09 (6/845 size)
Serial no stress cone 2	00557 year 09 (6/845 size)
Filling pressure at ambient temperature	4,2 bar absolute at 20 °C
Maximum operating pressure at elevated conductor temperature	4,5 bar absolute at 97 °C conductor temperature (approx. 50-55 °C SF6 test housing)
Back to back test housing type	CONNEX HV Joint
Serial no housing	STL 07-0115 / 2

1.1.4 Straight joint

Manufacturer	Elastimold, Hackettstown, New Jersey, USA
Type	138TCJ1N4-6
Year of manufacture	2009
Rated voltage, U_0/U (U_m)	76/132 (145) kV
Copper connector type	crimp connector
Inner diameter copper connector	58 mm
Outer diameter copper connector	77,5 mm
Aluminium heat sink covers length	190 mm
Al. heat sink opening diameter conductor	56 mm
Al. heat sink inner diameter	81 mm
Al. heat sink outer diameter	90 mm
Serial no stress cone	11083
Joint housing overall length	812,8 mm
Joint housing inner diameter	72,39 mm
Joint housing overall outer diameter	198,58 mm
Compound filler	two component massive filler
Length of copper tube	1500 mm

1.1.5 Cross-bonding joint

Manufacturer	Elastimold, Hackettstown, New Jersey, USA
Type	138TCJ1S4-6
Year of manufacture	2009
Rated voltage, U_0/U (U_m)	76/132 (145) kV
Copper connector type	crimp connector
Inner diameter copper connector	58 mm
Outer diameter copper connector	77,5 mm
Aluminium heat sink covers length	190 mm
Al. heat sink opening diameter conductor	56 mm
Al. heat sink inner diameter	81 mm
Al. heat sink outer diameter	90 mm
Serial no stress cone	0509496
Joint housing overall length	812,8 mm
Joint housing inner diameter	72,39 mm
Joint housing overall outer diameter	198,58 mm
Compound filler	two component massive filler
Length of copper tube	1500 mm
Length of copper tube insulating ring	150 mm

Bonding cable type

Manufacturer	Elsewedy Cables

Type	Concentric cable
Rated voltage, U_0/U (U_m)	1,9 / 3,3 (3,6) kV
Marking on the cable	ELSEWEDY CABLES ELECTRIC CABLE 1X300 MM2 CU/XLPE/CW/PVC

Conductor

- material	soft drawn copper
- nominal cross-sectional area	300 mm^2
- nominal diameter	20,6 mm approx.
- type	stranded circular compacted
- maximum conductor temperature in normal operation	90 °C

Conductor screen	n.a.

Insulation

- material	XLPE
- nominal thickness (t_n)	2,5 mm
- nominal inner diameter of insulation (d_{ii})	20,6 mm
- nominal outer diameter of insulation (D_{io})	25,6 mm
- material designation	LE4423-4476 LD
- manufacturer	Borealis

Insulation screen	n.a.

Metallic armour

- material	soft drawn copper
- number and nominal diameter of wires	74 wires of Ø 2,26 mm
- nominal thickness and width of tape	0,1 x 20 mm (open helix)
- cross-sectional area	300 mm^2

Oversheath

- material	PVC, type ST_2
- nominal thickness	3 mm
- nominal overall diameter of the cable	41,5 mm approx.
- material designation	extruded
- manufacturer	SED Plaste
- colour	black
- graphite coating applied	yes

1.2 List of documents

The manufacturer has guaranteed that the cable submitted for tests has been manufactured in accordance with the following drawings and documents.
KEMA has verified that these drawings adequately represent the object tested.

The following drawings/documents are included in this Certificate:

drawing no./document no.	rev.	date	title
appendix B			
GB7-TX01-N85-00-00	-	-	data sheet 76 / 132 kV power cable 1x2000 mm^2
GB7-TX01-N85-00-00	A	26 October 2008	cable cross section drawing
appendix C			
131165	3.0	February 2008	fitting instruction ESP 145 -frontsheet outdoor termination -table of contents (page 2) -preparation of cable with lead sheath and screen wires without plumbing cone (page 15)
PRO2107	01	2008-05-16	corona ring
VA 106071-10 (16237)	-	2008-11-28	parts list (4 pages)
appendix D			
no 040 293 603	-	-	additional installation instructions for HV connex separable connectors (6 pages)
040 265 001	-	November 2007	instruction for use CONNEX cable connector -frontsheet -general instructions (page 3)
3378634	-	2009-07-29	packing list 869999999-0066 (2 pages)
appendix E			
-	1	2009-06-25	elastimold straight cable joint 138TCJN4-6
IS-TCN4	1	November 2008	installation instruction TCJN4
-	-	-	kit content for straight cable joint 138TCJ1N4-6 (2 pages)
Appendix F			
-	1	2009-06-25	elastimold insulated cable joint 138TCJS4-6
IS-TCS4	2	November 2008	installation instruction TCJS4
-	-	-	kit content for isolated cable joint 138TCJ1S4-6 (2 pages)
appendix H			

-	1	2009-06-25	elastimold insulated cable joint 138TCJS4-6

The following drawings/documents are only listed for reference and are kept in KEMA's files:

drawing no./document no.	rev.	date	title
131165	3.0	-	fitting instruction ESP 145
040 265 001	-	November 2007	instruction for use CONNEX cable connector
-	-	-	parts list HV-SF6 test joint size 6 – 170 kV (2 pages)
-	-	-	HV-connex Joint operating instructions
SD-138N4	B	12-8-05	138TCJN4 Stress cone
SD-138S4	C	12-8-05	138TCJS4 Stress cone
11115001012090	3	2008-02-30	copper tube for straight joint
11115001011025	1	2009-06-07	coffin box for straight & isolated joint
11102003012360	1	2009-02-17	aluminium heat sink 2000
11102002042180	8	2009-08-02	copper connector 2000
11115001012110	1	2009-06-07	copper tube for isolated joint
11115001011026	2	2009-06-13	coffin box for straight & isolated joint

2 GENERAL INFORMATION

2.1 The tests were witnessed by

Name	Company
Mr Essam Matarawy Mr Wael Mohamed Ali	Elsewedy Cables Cairo, Egypt
Mr Magdy. A. Elsayed	Kahramaa Qatar
Mr S. Sirohi	ETA STAR INTERNATIONAL W.L.L Doha, Qatar

2.2 The tests were carried out by

Name	Company
Mr J.J.M. Mooren Mr H.J. Arnoldus Mr A.G. Visser Mr A.B.G.M. ten Have	KEMA Nederland B.V., Arnhem, the Netherlands

2.3 Subcontracting

The following tests were subcontracted to KEMA Quality B.V.:
- measurement of resistivity of semi-conducting screens in accordance with clause 12.3.9;
- non-electrical type tests in accordance with clause 12.4, with exception of the water penetration test;
- additional tests according Kahramaa technical specification GTC/142/2006 section 3.3.6.

2.4 Purpose of the test

Purpose of the test was to verify whether the material complies with the specified requirements.

2.5 Measurement uncertainty

A table with measurement uncertainties is enclosed in appendix A. unless otherwise indicated in the report, the measurement uncertainties of the results presented are as indicated in this table.

2.6 Applicable standards

When reference is made to a standard and the date of issue is not stated, this applies to the latest issue, including amendments, which have been officially published prior to the date of the tests.

3 ELECTRICAL TYPE TESTS

3.1 General

3.1.1 Tests at elevated conductor temperature

For the tests with the cable system at elevated temperature, a reference loop for temperature control of the conductor was installed. The reference cable was cut from the total cable length submitted by the client intended for the type test. This reference loop was installed close to the main loop in order to create the same environmental conditions as for the test loop.
The heating currents in both the reference loop and the test loop were kept equal at all times, thus the conductor temperature of the reference loop is representative for the conductor temperature of the test loop. Annex A, method 1 of IEC 60840 was used as a guide.
The tests at elevated temperature are carried out two hours after thermal equilibrium has been established.

3.2 Test voltage values

Standard and date

Standard IEC 60840, clause 12.3.1
Test date 27 April 2009

nominal thickness (mm)	maximum allowed thickness (mm)	measured average thickness (mm)
15,0	15,0 + 5% = 15,75	15,41

Result

The average thickness of the insulation did not exceed the nominal value by more than 5%. The test voltages shall be the normal values specified for the rated voltage of the cable.

3.3 Bending test followed by a partial discharge test

3.3.1 Bending test

Standard and date

Standard IEC 60840, clause 12.3.3
Test date 14 April 2009

Environmental conditions

Ambient temperature 18 °C
Temperature of test object 18 °C

Characteristic test data

Bending diameter:
"Cable with lead, corrugated metallic sheath or metal foil" 25(d + D) + 5%

measured outer diameter of cable D (mm)	measured diameter of cable conductor d (mm)	maximum required bending diameter D_r (mm)	diameter of test cylinder D_t (mm)
118,1	56,1	$D_r \leq 4573$	4300

Procedure

The test sample shall be bent around a test cylinder at ambient temperature for at least one complete turn. It shall then be unwound and repeated, except that the bending of the sample shall be in the reverse direction without axial rotation. This cycle of operation shall be carried out three times.

Observation

The test was carried out successfully.

3.3.2 Partial discharge test

Standard and date

Standard	IEC 60840, clause 12.3.4
Test date	22 June 2009

Environmental conditions

Ambient temperature	20	°C
Temperature of test object	20	°C

Characteristic test data

Circuit	balanced	
Calibration	5	pC
Noise	2	pC
Sensitivity	4	pC
Required sensitivity	≤ 5	pC
Bandwidth	40-400	kHz
Test frequency	50	Hz
Coupling capacitor	2600	pF

core	voltage applied, 50 Hz		duration	partial discharge level
	xU_0	(kV)	(s)	(pC)
1	1,75	133	10	
	1,5	114	-	not detectable

Requirement

There shall be no detectable discharge exceeding the declared sensitivity from the test object at $1{,}5xU_0$.

Result

The test was passed.

3.4 Tan δ measurement

Standard and date

Standard	IEC 60840, clause 12.3.5
Test date	25 June 2009

Environmental conditions

Ambient temperature	20	°C
Temperature of test object	97	°C

Characteristic test data

Length of test cable	20,9	m
Length of accessories	10,55	m
Standard capacitor	100	pF

core	voltage applied, 50 Hz		core capacitance [1]	tan δ
	xU_0	(kV)	(μF/km)	
1	1	76	0,262	$5{,}8 \times 10^{-4}$
1) for information only				

Note

The measured core capacitance and tan δ is measured on the complete cable system consisting of two outdoor terminations, two SF6 terminations, back to back, one straight joint and one cross-bonding joint.

Requirement

The measured value shall not be higher than 10×10^{-4} at U_0.

Result

The test was passed.

3.5 Heating cycle voltage test

Standard and date

Standard IEC 60840, clause 12.3.6
Test period 30 June until 20 July 2009

Environmental conditions

Ambient temperature 20 °C

Characteristic test data

Heating method conductor current
Stabilized temperature 97 °C

no. of heating-cycles	required steady conductor temperature	heating current at stable condition	heating per cycle		cooling per cycle	voltage per cycle	
	(°C)	(A)	total duration (hours)	duration of conductor at steady temperature (hours)	total duration (hours)	total duration (hours)	applied voltage $2U_0$ (kV)
20	95-100	2925	8	2	16	24	152

Requirements

No breakdown shall occur.

Procedure

The heating shall be applied for at least 8 hrs. The conductor temperature shall be maintained within the stated temperature limits for at least 2 h of each heating period. This shall be followed by at least 16 h of natural cooling in air to a conductor temperature within 10 K of the ambient temperature.

Observation

The test was carried out successfully.

3.6 Partial discharge tests

3.6.1 Partial discharge test at ambient temperature

Standard and date

Standard	IEC 60840, clause 12.3.4
Test date	21 July 2009

Environmental conditions

Ambient temperature	20	°C
Temperature of test object	20	°C

Characteristic test data

Circuit	balanced	
Calibration	5	pC
Noise	2	pC
Sensitivity	4	pC
Required sensitivity	≤ 5	pC
Bandwidth	40-400	kHz
Test frequency	50	Hz
Coupling capacitor	2600	pF

core	voltage applied, 50 Hz		duration	partial discharge level
	xU_0	(kV)	(s)	(pC)
1	1,75	133	10	-
	1,5	114	-	not detectable

Requirement

There shall be no detectable discharge exceeding the declared sensitivity from the test object at $1{,}5xU_0$.

Result

The test was passed.

3.6.2 Partial discharge test at elevated temperature

Standard and date

Standard	IEC 60840, clause 12.3.4
Test date	22 July 2009

Environmental conditions

Ambient temperature	22	°C
Temperature of test object	97	°C

Characteristic test data

Circuit	balanced	
Calibration	5	pC
Noise	2	pC
Sensitivity	4	pC
Required sensitivity	≤ 5	pC
Bandwidth	40-400	kHz
Test frequency	50	Hz
Coupling capacitor	2600	pF

core	voltage applied, 50 Hz		duration	partial discharge level
	xU_0	(kV)	(s)	(pC)
1	1,75	133	10	-
	1,5	114	-	not detectable

Requirement

There shall be no detectable discharge exceeding the declared sensitivity from the test object at $1{,}5xU_0$.

Result

The test was passed.

3.7 Lightning impulse test followed by a power-frequency voltage test

3.7.1 Impulse test

Standard and date

Standard IEC 60840, clause 12.3.7
Test date 23 July 2009

Environmental conditions

Ambient temperature 20 °C
Temperature of test object 97 °C

Characteristic test data

Specified test voltage 650 kV

The waveshape of the impulse voltage was determined at approximately 50 percent of the specified test value (see figure 1 and 5).

testing arrangement		polarity	voltage applied (% of test voltage)	no. of impulses	see figure
voltage applied to	earthed				
conductor	metallic screen	positive	50 65 80 100	1 1 1 10	1 (waveshape) 2 2 3 and 4
conductor	metallic screen	negative	50 65 80 100	1 1 1 10	5 (waveshape) 6 6 7 and 8

Requirement

No breakdown of the insulation shall occur.

Result

The test was passed.

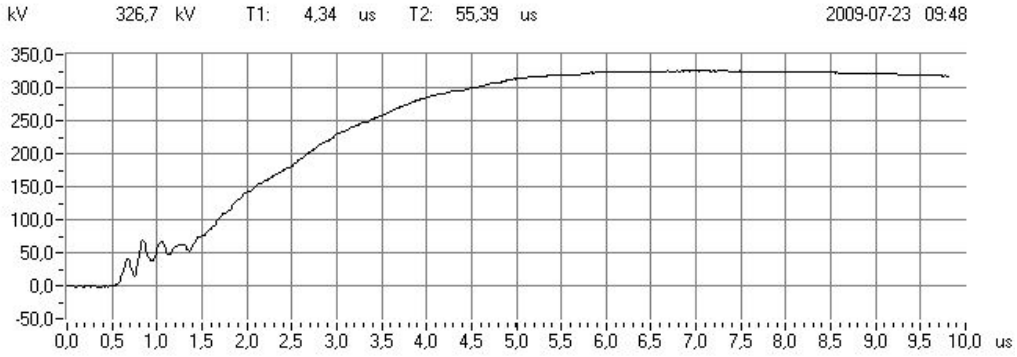


Fig. 1: Waveshape 70870272 Elsewedy 50% of test voltage

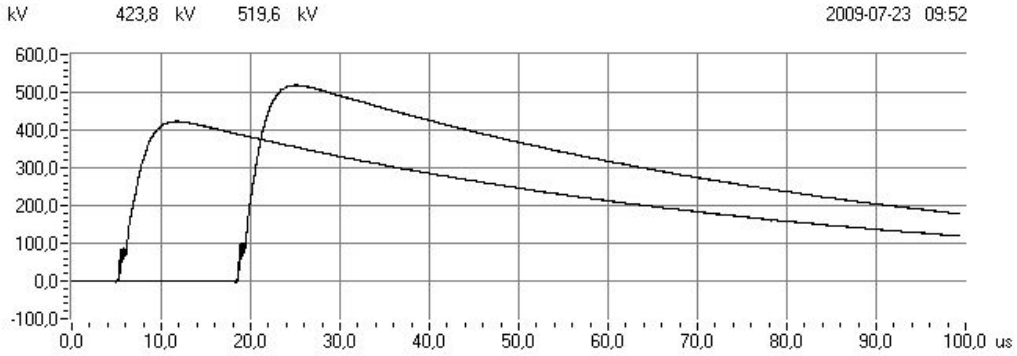


Fig. 2: 70870272 Elsewedy 65% and 80% of test voltage

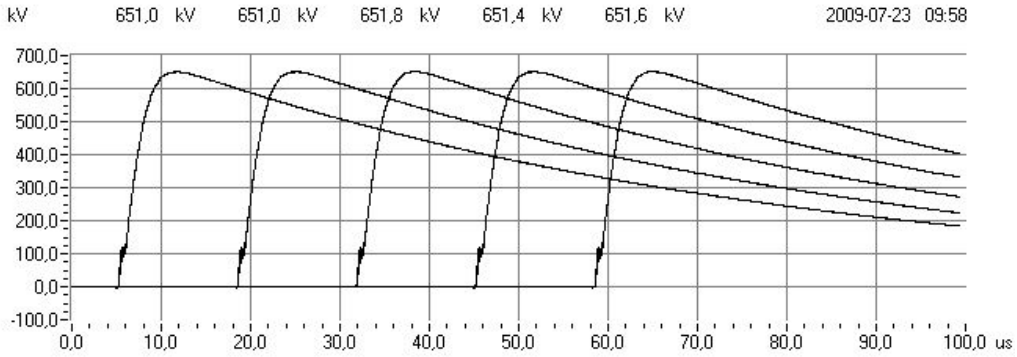


Fig. 3: 70870272 Elsewedy 100% of test voltage

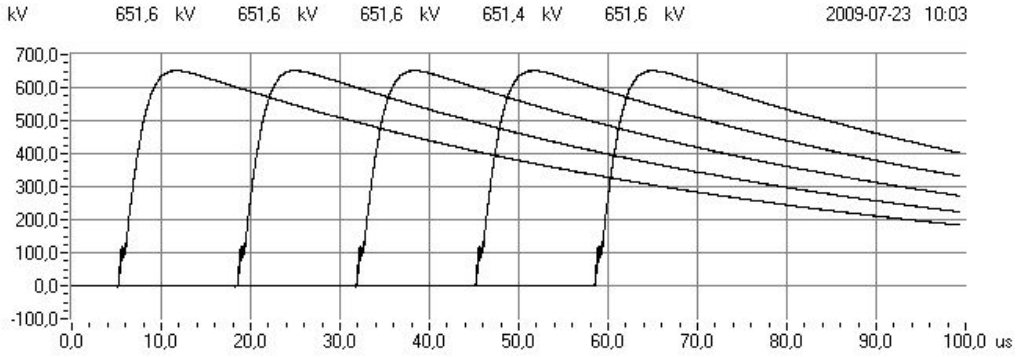


Fig. 4: 70870272 Elsewedy 100% of test voltage

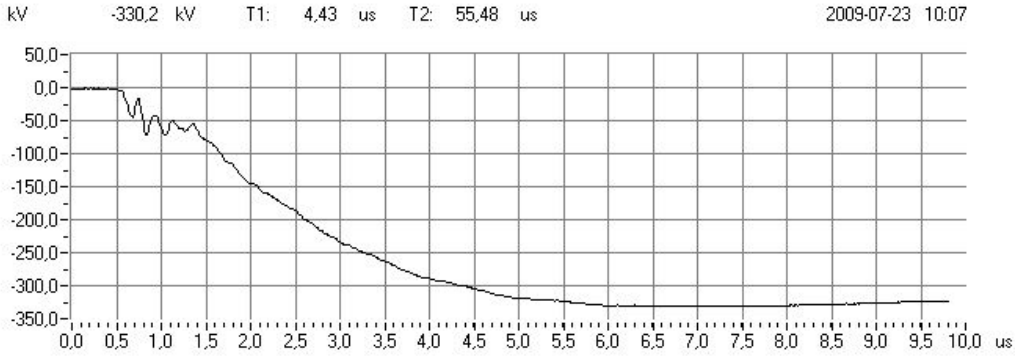


Fig. 5: Waveshape 70870272 Elsewedy -50% of test voltage

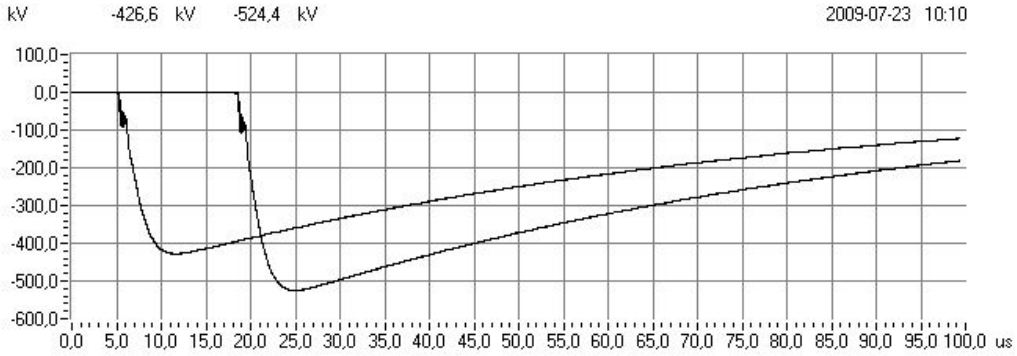


Fig. 6: 70870272 Elsewedy -65% and -80% of test voltage

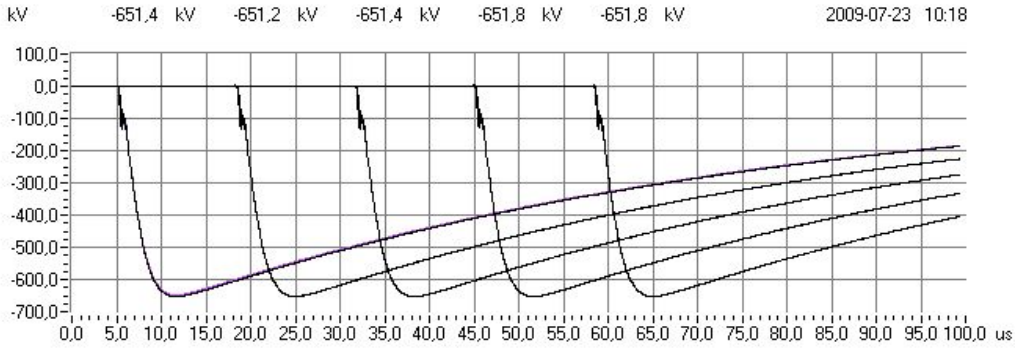


Fig. 7: 70870272 Elsewedy -100% of test voltage

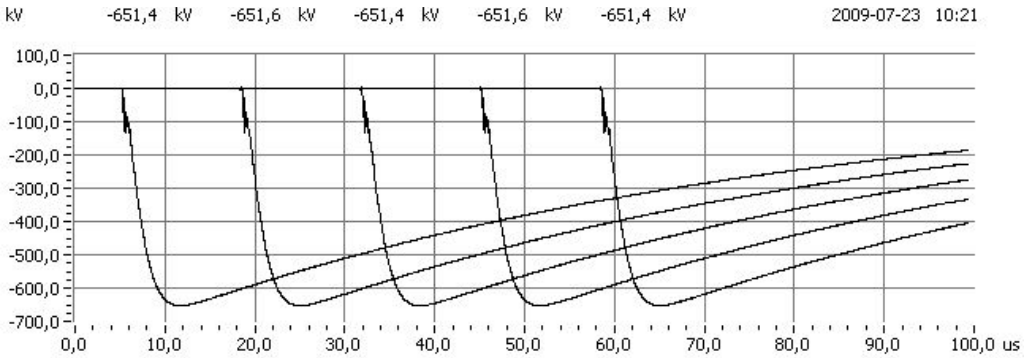


Fig. 8: 70870272 Elsewedy -100% of test voltage

3.7.2 Power frequency voltage test

Standard and date

Standard IEC 60840, clause 12.3.7
Test date 24 July 2009

Environmental conditions

Ambient temperature 20 °C
Temperature of test object 20 °C

testing arrangement		voltage applied, 50 Hz		duration
voltage applied to	earth connected to	xU_0	(kV)	(min)
conductor	metallic screen	2,5	190	15

Requirement

No breakdown of the insulation shall occur.

Result

The test was passed.

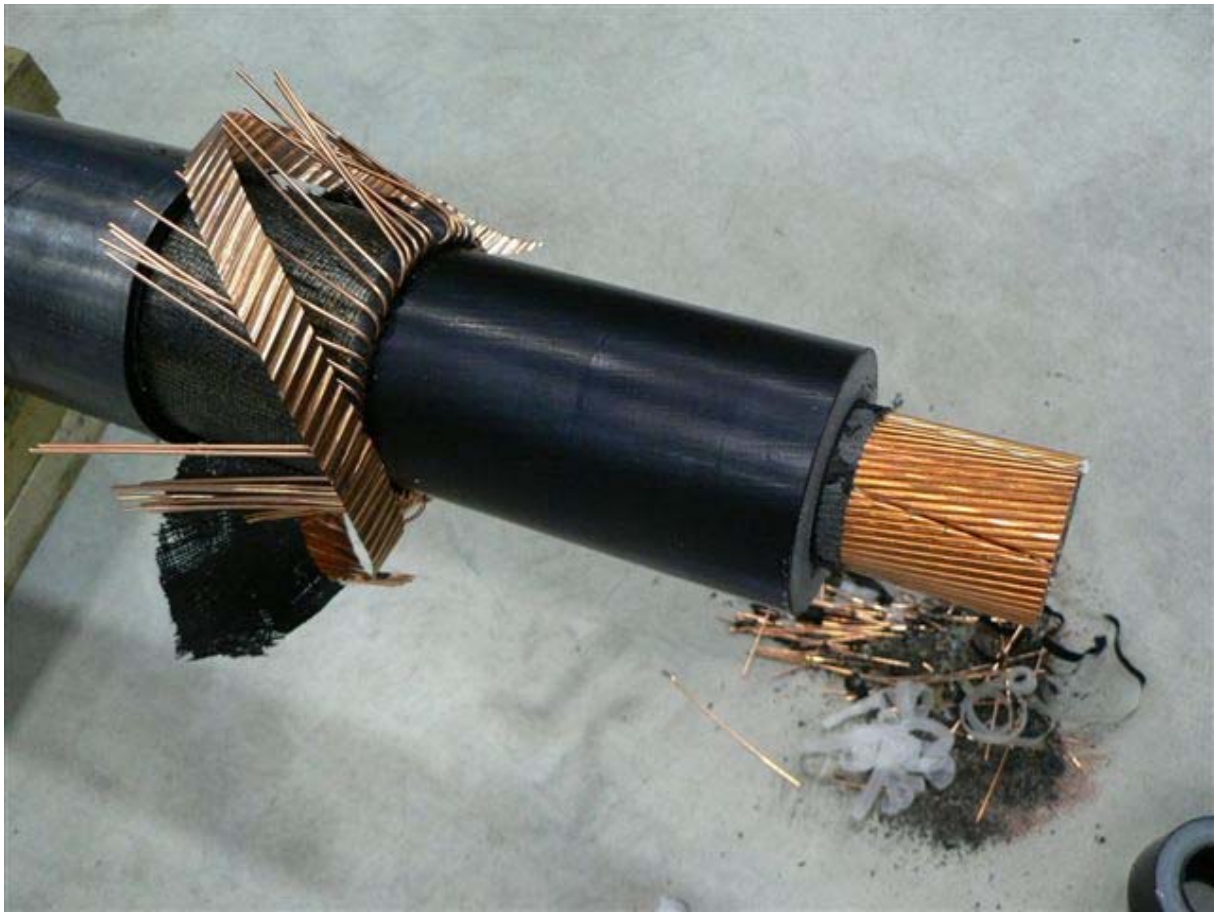
3.8 Examinations

3.8.1 Examination single core power cable

Standard and date

Standard	IEC 60840, clause 12.3.8
Test date	24 July 2009

Examination of cable



No sign of deterioration, e.g. electrical degradation, was found.

Result

The cable passed the examination.

3.8.2 Examination outdoor termination

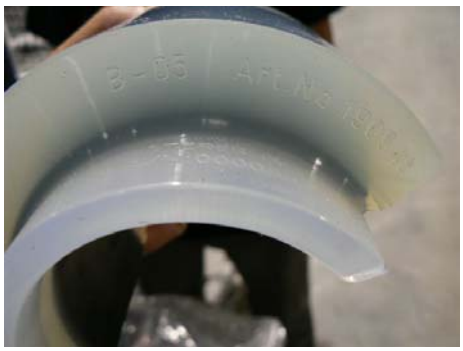
Standard and date

Standard	IEC 60840, clause 12.3.8
Test date	27 till 28 August 2009

Examination outdoor termination





Result

The outdoor termination passed the examination.

No sign of deterioration, e.g. electrical degradation, was found.

3.8.3 Examination SF_6 termination

Standard and date

Standard	IEC 60840, clause 12.3.8
Test date	26 till 28 August 2009

Examination SF_6 termination






Result

The SF6 termination passed the examination.

No sign of deterioration, e.g. electrical degradation, was found.

3.8.4 Examination straight joint

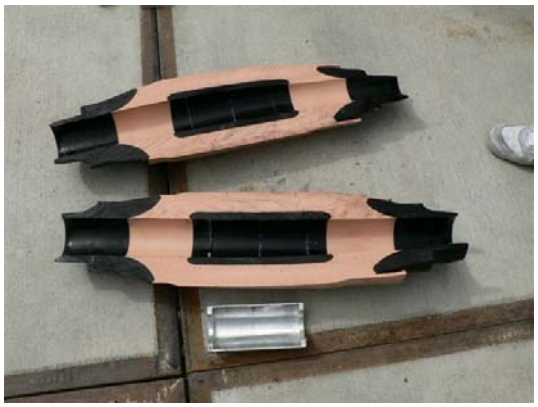
Standard and date

Standard	IEC 60840, clause 12.3.8
Test date	31 August 2009

Examination straight joint





Result

The straight joint passed the examination.

No sign of deterioration, e.g. electrical degradation, was found.

3.8.5 Examination cross-bonding joint

Standard and date

Standard	IEC 60840, clause 12.3.8
Test date	1 September 2009

Examination cross-bonding joint






Result

The cross-bonding joint passed the examination.

No sign of deterioration, e.g. electrical degradation, was found.

3.9 Resistivity of semi-conducting screens

Standard and date

Standard	IEC 60840, clause 12.3.9
Test period	16 April 2009 until 28 April 2009

Characteristic test data

Temperature during ageing	100	°C
Duration	7	days
Resistivity measured at	90 ± 2	°C

item	unit	requirement	measured/determined
conductor screen			
- without ageing	Ωm	≤ 1000	53,5
- after ageing	Ωm	≤ 1000	41,0
insulation screen			
- without ageing	Ωm	≤ 500	5,1
- after ageing	Ωm	≤ 500	2,2

Result

The test was passed.

4 TEST OF OUTER PROTECTION FOR BURIED JOINTS

The joint outer protection test was carried out in accordance with Annex H of IEC 60840. The cross-bonding joint has already passed the heating cycle voltage test (see paragraph 3.5).

The results are presented below.

4.1 Water immersion and heat cycling

Standard and date

Standard	IEC 60840, Annex H3
Test period	13 August 2009 until 27 August 2009

Characteristic test data

Cold water temperature	22	°C
Hot water temperature	90	°C
Water height above cable centre	1	m

no. of cycles	stabilizing temperature (°C)	heating per cycle		cooling per cycle
		total duration (hours:min)	duration of conductor at steady temperature (hours:min)	total duration (hours:min)
20	70-75	3:20	5:20	3:20

Note

The complete cross-bonding joint was mounted in a vessel with a volume of 2 m^3 (length 4 meter and diameter of 0,8 meter). The manufacturer has identified the water barriers given in drawing, attached in appendix H.

Procedure

A total of 20 heating/cooling cycles shall be applied by raising the water temperature to within 15 °C to 20 °C below the maximum temperature of the cable conductor in normal operation In each cycle the water shall be raised to the specified temperature, maintained at the level for at least 5 hours and then be permitted to cool within 10 K above ambient temperature.

Observation

The test was carried out successfully.

4.2 Voltage tests

4.2.1 DC voltage test

Standard and date

Standard	IEC 60840, Annex H4.2.1
Test period	27 August 2009

Atmospheric conditions

Ambient temperature	20	°C
Temperature of test object	28	°C

testing arrangement		voltage applied	duration
voltage applied to	earth connected to	(kV)	(min)
bonding lead conductor	bonding lead screen, vessel, conductor main cable	20	1
bonding lead screen and bonding lead conductor	vessel, conductor main cable	20	1

Requirement

No breakdown of the insulation shall occur.

Result

The test was passed.

4.2.2 Impulse voltage test each part to earth

Standard and date

Standard	IEC 60840, Annex H4.2.2.2
Test period	27 August 2009

Atmospheric conditions

Ambient temperature	21	°C
Temperature of test object	24	°C

Characteristic test data

Specified test voltage	30	kV
Water height above cable centre	1	m

The waveshape of the impulse voltage was determined at approximately 50 percent of the specified test value (see figure 1 and 5).

testing arrangement		polarity	voltage applied (% of test voltage)	no. of impulses	see figure
voltage applied to	earthed				
bonding lead screen and bonding lead conductor	vessel, conductor main cable	positive	50	1	1 (waveshape)
			65	1	2
			80	1	2
			100	10	3 and 4
bonding lead screen and bonding lead conductor	vessel, conductor main cable	negative	50	1	5 (waveshape)
			65	1	6
			80	1	6
			100	10	7 and 8

Requirement

No breakdown of the insulation shall occur.

Result

The test was passed.

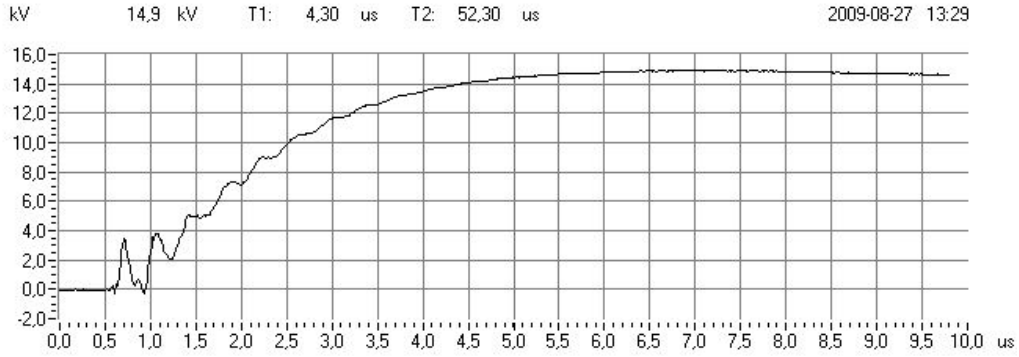


Fig. 1: Waveshape 70870272 Elsewedy annex H test sit 1, 50% of testvoltage

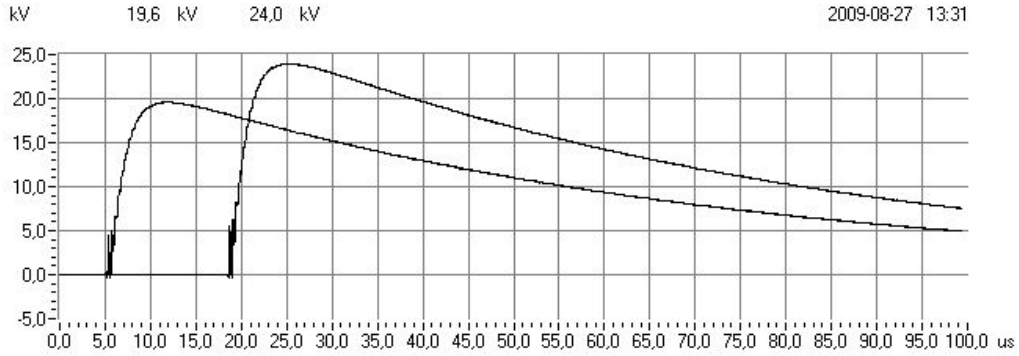


Fig. 2: 70870272 Elsewedy annex H test sit 1, 65% and 80% of testvoltage

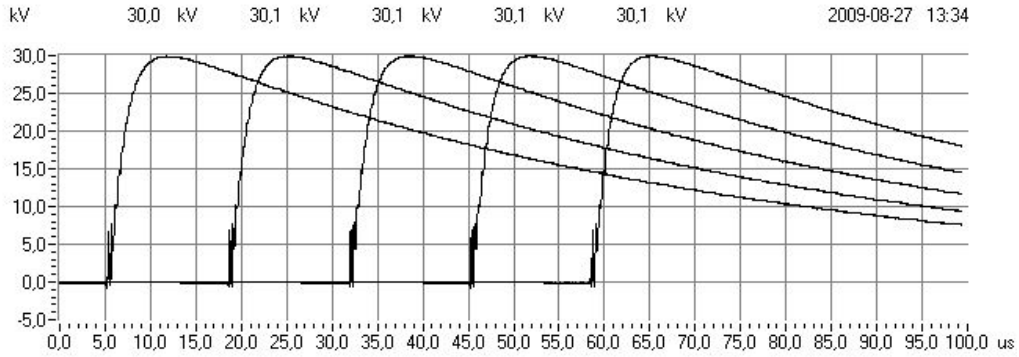


Fig. 3: 70870272 Elsewedy annex H test sit 1, 100% of testvoltage

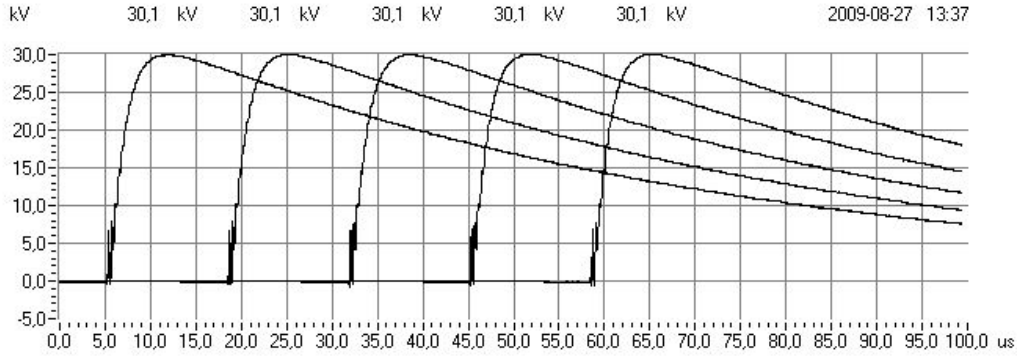


Fig. 4: 70870272 Elsewedy annex H test sit 1, 100% of testvoltage

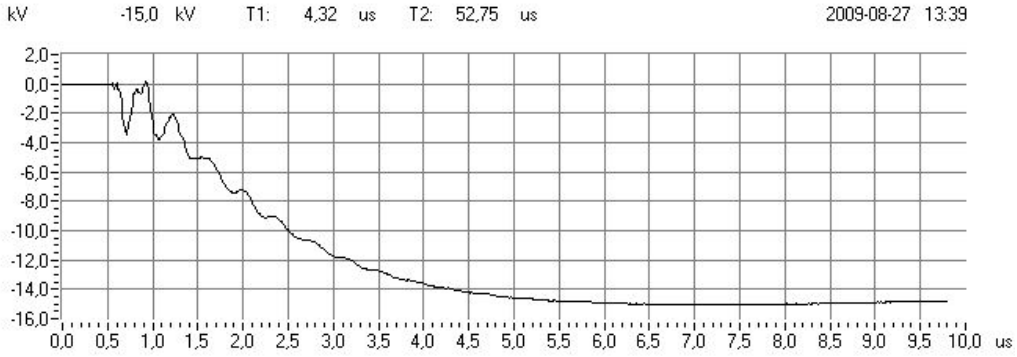


Fig. 5: Waveshape 70870272 Elsewedy annex H test sit 1, -50% of testvoltage

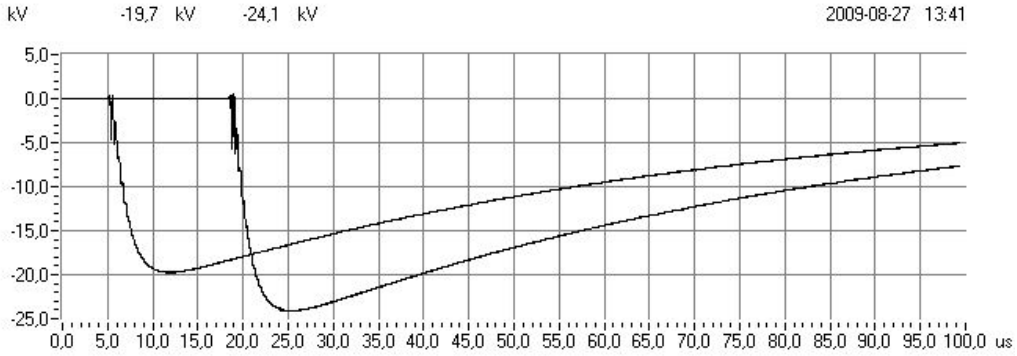


Fig. 6: 70870272 Elsewedy annex H test sit 1, -65% and -80% of testvoltage

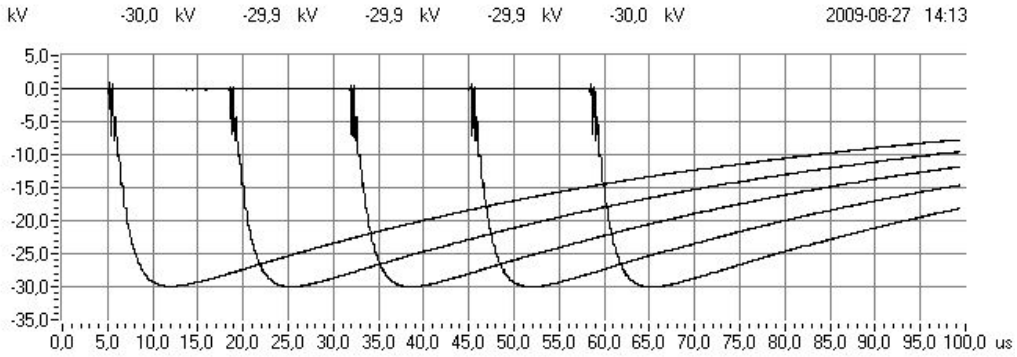


Fig. 7: 70870272 Elsewedy annex H test sit1, -100% of testvoltage

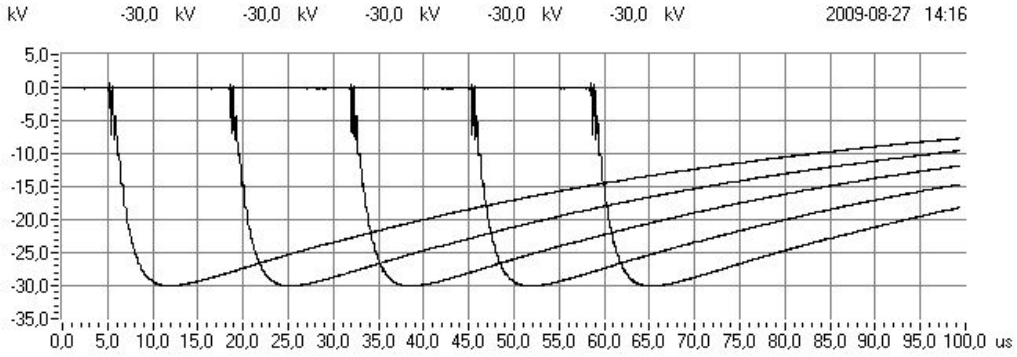


Fig. 8: 70870272 Elsewedy annex H test sit1, -100% of testvoltage

4.2.3 Impulse voltage test between parts

Standard and date

Standard	IEC 60840, Annex H.4.2.2
Test period	27 August 2009

Atmospheric conditions

Ambient temperature	21	°C
Temperature of test object	22	°C

Characteristic test data

Specified test voltage	60	kV
Assembly removed from the water	yes	

The waveshape of the impulse voltage was determined at approximately 50 % of the specified test value (see figure 9 and 13).

testing arrangement		polarity	voltage applied (% of test voltage)	no. of impulses	see figure
voltage applied to	earthed				
bonding lead conductor	bonding lead screen, vessel, conductor main cable	positive	50 65 80 100	1 1 1 10	9 (waveshape) 10 10 11 and 12
bonding lead conductor	bonding lead screen, vessel, conductor main cable	negative	50 65 80 100	1 1 1 10	13 (waveshape) 14 14 15 and 16

Note

The cross-bonding joint was not removed from the vessel.

Requirement

No breakdown of the insulation shall occur.

Result

The test was passed.

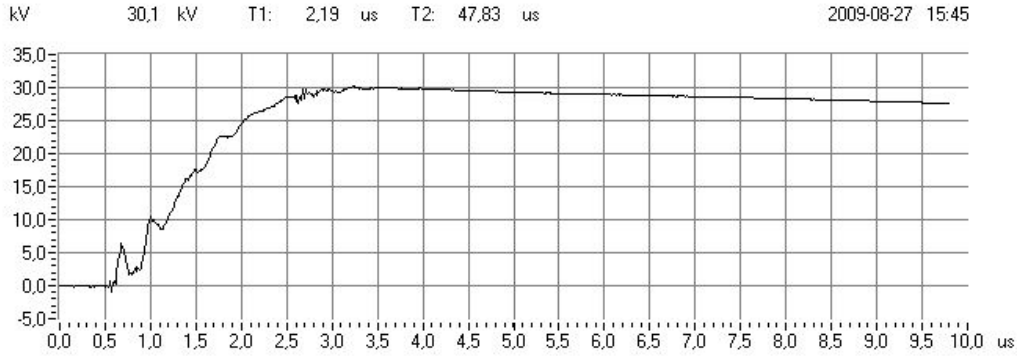


Fig. 9: Waveshape 70870272 Elsewedy annex H test sit2, 50% of testvoltage

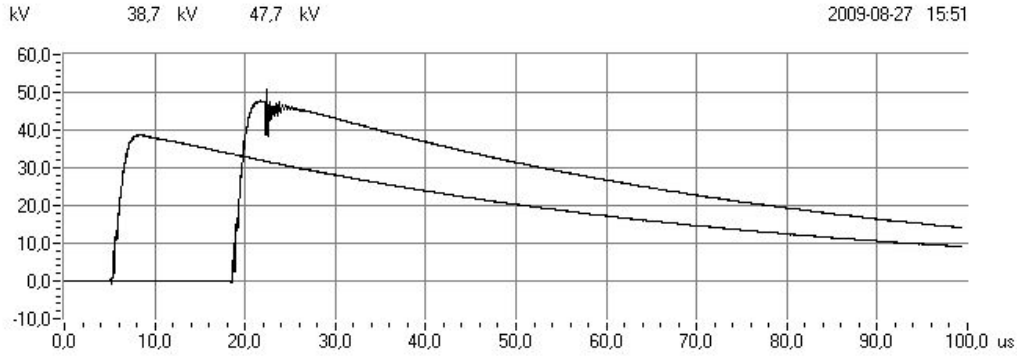


Fig. 10: 70870272 Elsewedy annex H test sit2, 65% and 80% of testvoltage

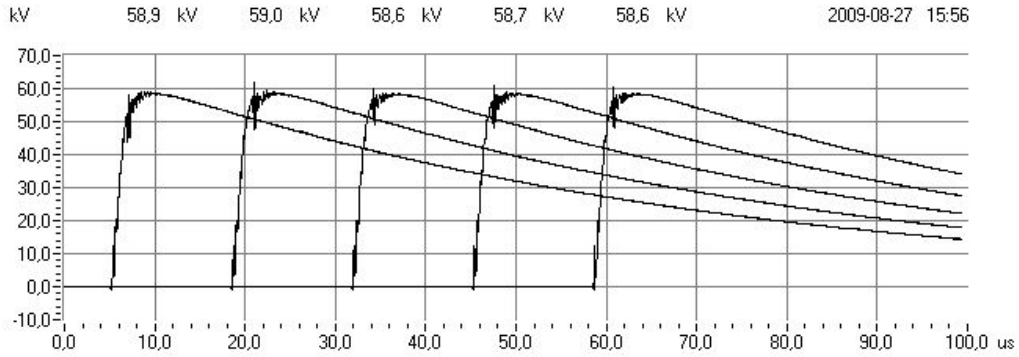


Fig. 11: 70870272 Elsewedy annex H test sit2, 100% of testvoltage

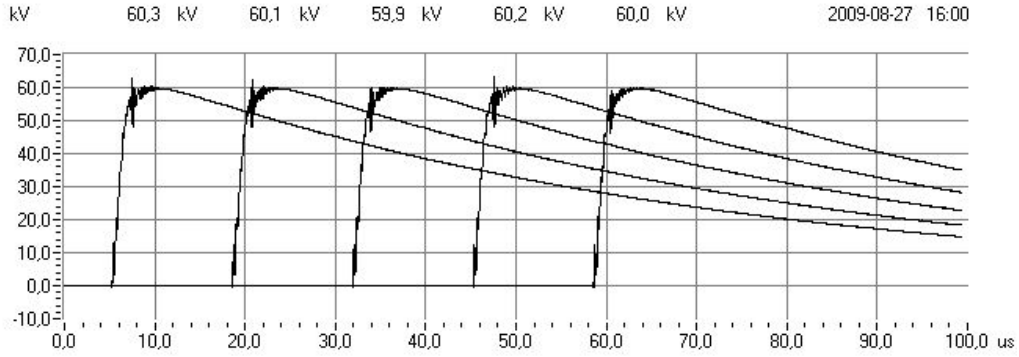


Fig. 12: 70870272 Elsewedy annex H test sit2, 100% of testvoltage

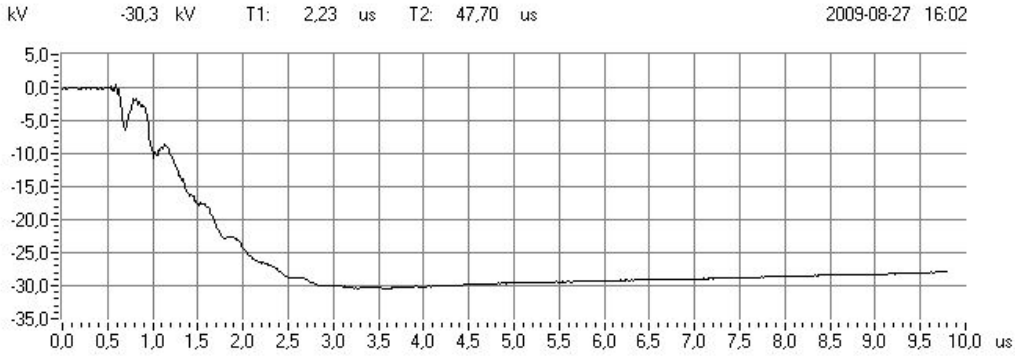


Fig. 13: Waveshape 70870272 Elsewedy annex H test sit2, -50% of testvoltage

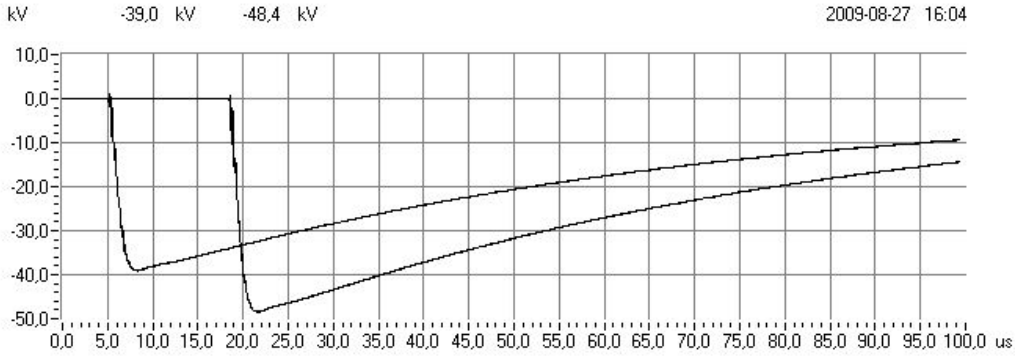


Fig. 14: 70870272 Elsewedy annex H test sit2, -65% and -80% of testvoltage

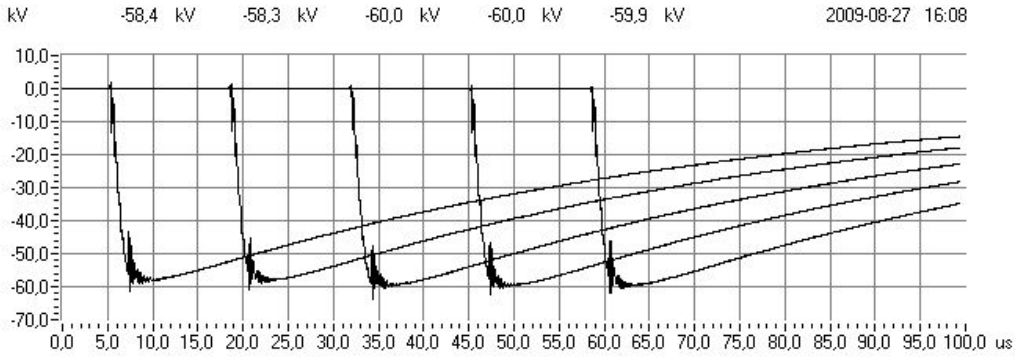


Fig. 15: 70870272 Elsewedy annex H test sit2, -100% of testvoltage

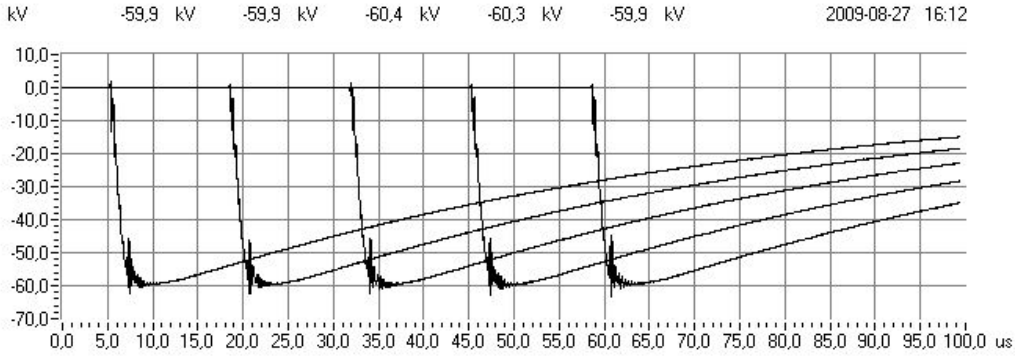


Fig. 16: 70870272 Elsewedy annex H test sit2, -100% of testvoltage

4.2.4 Examination cross-bonding joint

Standard and date

Standard	IEC 60840, annex H.5
Test date	1 September 2009

Examination cross-bonding joint (see also photographs at paragraph 3.8.5)

No signs of water ingress via the identified water barriers, as outlined in the manufacturers drawing in appendix H or internal corrosion was found.

Note

Also there was no water found behind the coffin box. At the entrance of the bonding lead to the coffin box an air gap was detected during examination (see photographs at paragraph 3.8.5).

Result

The cross-bonding joint passed the examination.

5 NON-ELECTRICAL TYPE TESTS

5.1 Check of cable construction

Standard and date

Standard IEC 60840, clause 12.4.1
Test date 16 April 2009 and 14 May 2009

item	unit	requirement	specified	measured/ determined
conductor				
- diameter of conductor	mm	-	55 approx.	56,1 approx.
- number of wires		-	-	61 per segment +7 in centre
- diameter of wires	mm	-	-	2,9 approx.
- resistance at 20°C	Ω/km	≤ 0,009	≤ 0,009	0,009
thickness of insulation				
- nominal	mm	-	15	-
- average	mm	-	-	15,4
- minimum, t_{min}	mm	≥ 13,5	-	14,99
- maximum, t_{max}	mm	-	-	15,74
- $(t_{max} – t_{min}) / t_{max}$	-	≤ 0,15	-	0,05
- concentricity	mm	-	-	0,75
thickness of lead sheath				
- nominal	mm	-	2,2	-
- average	mm	-	-	2,6
- minimum, t_{min}	mm	≥ 1,99	-	2,33
thickness of oversheath				
- nominal	mm	-	4,5	-
- average	mm	≥ 4,5	-	6,7
- minimum, t_{min}	mm	≥ 3,7	-	5,6

Result
The cable construction complied with the requirements.

4.1 Check of cable construction (continued)

	observed/determined
construction	- conductor of copper wires 5 segments stranded (Milliken) - in centre conductor of copper seven wires - construction 1-6-12-18-24 each segment - swellable tape - semi conducting tape 0,4mm - semi conducting conductor screen - XLPE insulation - semi conducting insulation screen - semi conducting swellable double tape 70x0,4mm approx. overlap 14 mm - copper tape 19,5 x 0,1mm open helix - screen of copper wires 50 x Ø 1,9mm approx. - semi conducting swellable double tape 70x0,4mm approx. - leadsheath - bituminized material - oversheath of HDPE
markings	132000 V ELECTRIC CABLE ELSEWEDY CABLES 1X2000MM2 2009 PROPERTY OF KAHRAMAA
outer diameter of the cable average (mm)	118,1
outer diameter of the core average (mm)	92,6

5.2 Tests for determining the mechanical properties of the insulation before and after ageing

Standard and date

Standard	IEC 60840, clause 12.4.2
Test period	17 April 2009 until 28 April 2009

Characteristic test data

Temperature during aging	135 ± 3	°C
Ageing duration	7	days

item	unit	requirement	measured/determined
without ageing			
- tensile strength	N/mm²	≥ 12,5	27,9
- elongation	%	≥ 200	512
after ageing			
- tensile strength	N/mm²	-	28,3
- variation with samples without ageing	%	± 25 max.	1
- elongation	%	-	547
- variation with samples without ageing	%	± 25 max.	7

Result

The test was passed.

5.3 Tests for determining the mechanical properties of oversheaths before and after ageing

Standard and date

Standard	IEC 60840, clause 12.4.3
Test period	17 April 2009 until 28 April 2009

Characteristic test data

Temperature during aging	110 ± 2	°C
Ageing duration	10	days

item	unit	requirement	measured/determined
without ageing			
- tensile strength	N/mm²	≥ 12,5	36,4
- elongation	%	≥ 300	795
after ageing			
- tensile strength	N/mm²	-	33,2
- variation with samples without ageing	%	-	-9
- elongation	%	≥ 300	781
- variation with samples without ageing	%	-	-2

Result

The test was passed.

5.4 Ageing tests on pieces of complete cable to check compatibility of materials

Standard and date

Standard	IEC 60840, clause 12.4.4
Test period	17 April 2009 until April 27 2009

Characteristic test data

Temperature during aging	100 ± 2	°C
Ageing duration	7	days

Insulation

item	unit	requirement	measured/determined
- tensile strength	N/mm²	-	27,4
- variation with samples without ageing	%	± 25 max.	-2
- elongation	%	-	532
- variation with samples without ageing	%	± 25 max.	4

Oversheath

item	unit	requirement	measured/determined
- tensile strength	N/mm²	-	32,7
- variation with samples without ageing	%	-	-10
- elongation	%	-	802
- variation with samples without ageing	%	-	1

Result

The test was passed.

5.5 Pressure test at high temperature on oversheath ST_7

Standard and date

Standard	IEC 60840, clause 12.4.6
Test date	27 April 2009

Characteristic test data

Temperature	110 ± 2	°C
Load	27,5	N
Duration	6	h

item	unit	requirement	measured/determined
- depth of indentation	%	≤ 50	1

Result

The test was passed.

5.6 Hot set test for insulation XLPE

Standard and date

Standard	IEC 60840, clause 12.4.10
Test date	22 April 2009

Characteristic test data

Air temperature	200 ± 3	°C
Time under load	15	min
Mechanical stress	20	N/cm^2

item	unit	requirement	measured/determined
- elongation under load	%	≤ 175	65
- permanent elongation	%	≤ 15	5

Result

The test was passed.

5.7 Measurement of carbon black content of black PE oversheaths

Standard and date

Standard	IEC 60840, clause 12.4.12
Test date	7 May 2009

item	unit	requirement	measured/determined
- carbon black content	%	2,5 ± 0,5	2,6

Result

The test was passed.

5.8 Shrinkage test for XLPE insulation

Standard and date

Standard	IEC 60840, clause 12.4.13
Test date	27 April 2009

Characteristic test data

Temperature	130 ± 3	°C
Duration	6	h

item	unit	requirement	measured/determined
- shrinkage	%	≤ 4	2

Result

The test was passed.

5.9 Shrinkage test for PE oversheaths

Standard and date

Standard	IEC 60840, clause 12.4.14
Test date	21 April 2009 until 27 April 2009

Characteristic test data

Temperature	80 ± 2	°C
Duration	5	h
Heating cycles	5	

item	unit	requirement	measured/determined
- shrinkage	%	≤ 3	1

Result

The test was passed.

5.10 Water penetration test

Standard and date

Standard IEC 60840, clause 12.4.18 and Annex F
Test period 13 – 27 July 2009

Environmental conditions

Ambient temperature 20 °C

Characteristic test data

Length of cable sample 6 m
Water height above cable centre 1 m
Heating method conductor current
Stabilized conductor temperature 96 °C

no. of heating cycles	required steady conductor temperature	heating current at stable condition	heating per cycle		cooling per cycle
	(°C)	(A)	total duration (hours)	duration of conductor at steady temperature (hours)	total duration (hours)
10	95-100	2800	8	2	16

Note

The manufacturer has claimed that barriers have been included, which prevents longitudinal water penetration in the region of the metallic layers and along the conductor.

Requirement

No water shall emerge from the ends of the cable sample.

Result

The test was passed.

6 ADDITIONAL TEST ACCORDING KAHRAMAA SPECIFICATION

6.1 Measurement of insulation concentricity

Client specification and date

Specification GTC/142/2006 section 3.3.6 clause 1.4.3.8.4
Test period 16 April 2009

item	unit	requirement	measured/determined
thickness of insulation			
- average, t_{ave}	mm	-	15,4
- minimum, t_{min}	mm	-	14,99
- maximum, t_{max}	mm	-	15,74
- $(t_{max} – t_{min}) / t_{ave}$	-	≤ 0,10	0,05
- concentricity maximum allowable deviation 8% of the minimum thickness	mm	< 1,20	0,75

Result

The test was passed.

6.2 Measurement of insulation purity

Client specification and date

Specification GTC/142/2006 section 3.3.6 clause 1.4.3.8.5
Test period 19 May 2009 until 1 July 2009

item	unit	requirement	measured
-void in insulation	mm	≤ 0,05	0
-any contaminant	mm	≤ 0,15	0
-any translucent	mm	≤ 0,6	0,05

Result

The test was passed.

6.3 Measurement of insulation & screen moisture content

Client specification and date

Specification GTC/142/2006 section 3.3.6 clause 1.4.3.8.6
Test period 19 May 2009 until July 2009

item	unit	requirement	measured
moisture content in extruded insulation	ppm	≤ 150	12, 7, 11

item	unit	requirement	measured
moisture content in extruded conductor screen	ppm	≤ 500	0, 0, 0

item	unit	requirement	measured
moisture content in extruded insulation screen	ppm	≤ 500	15, 23, 18

Result

The test was passed.

6.4 Measurement of semi-conducting screen protrusions

Client specification and date

Specification GTC/142/2006 section 3.3.6 clause 1.4.3.8.10
Test period 19 May 2009 until 1 July 2009

item	unit	requirement	measured
-protrusions and irregularities between the conductor screen and insulation	mm	≤ 0,03	0
-protrusions and irregularities between the insulation screen and insulation	mm	≤ 0,03	0
-outer screen examination	-	no screen defects	no screen defects

Result

The test was passed.

6.5 Impact test on metallic sheath

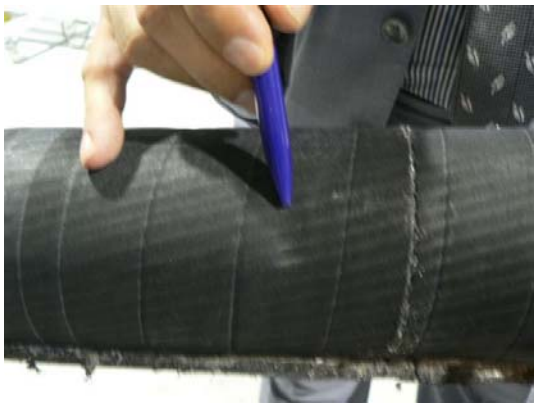
Client specification and date

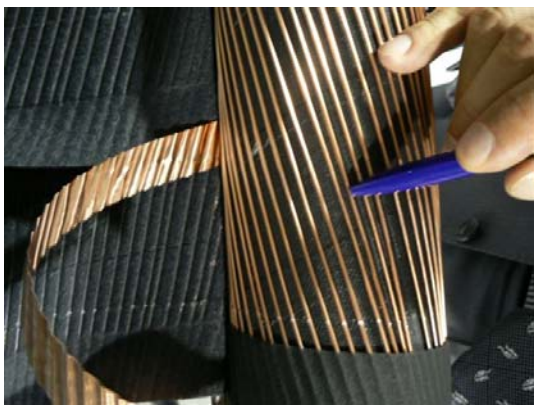
Specification	GTC/142/2006 section 3.3.6 clause 1.4.2.3.m
Test period	23 July 2009

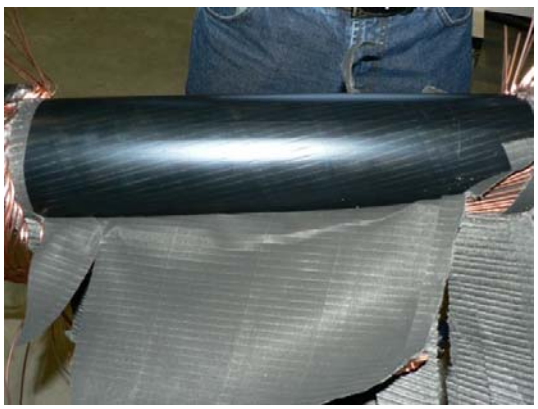
Characteristic test data

Temperature	20	°C
Impact weight	5	kg
Dropping height	1	m
Dropping angle	90	degree
Length of test sample	1	m
Quantity of impacts at different points	5	

item	unit	requirement	measured/determined
- oversheath examination	-	no cracks after test	no cracks after test







Result

The test was passed.

APPENDIX A MEASUREMENT UNCERTAINTIES

The measurement uncertainties in the results presented are as specified below unless otherwise indicated.

measurement	**measurement uncertainty**
dielectric tests and impulse current tests	peak value: ≤ 3% time parameters: ≤ 10%
capacitance measurement tan δ measurement	0,3% ± 0,5% ± 5x10^{-5}
partial discharge measurement	< 10 pC : 2 pC 10 - 100 pC : 5 pC > 100 pC : 20%
measurement of impedance ac-resistance measurement	≤ 1%
measurement of losses	≤ 1%
measurement of insulation resistance	≤ 10%
measurement of dc resistance	1 μΩ - 5 μΩ : 1% 5 μΩ - 10 μΩ : 0,5% 10 μΩ - 200 μΩ : 0,2%
radio interference test	2 dB
calibration of current transformers	2,2 x 10^{-4} Ii/Iu and 290 μrad
calibration of voltage transformers	1,6 x 10^{-4} Ui/Uu en 510 μrad
measurement of conductivity	5%
measurement of temperature	-50 °C - -40 °C : 3 K -40 °C - 125 °C : 2 K 125 °C - 150 °C : 3 K
tensile test	1%
sound level measurement	type 1 meter as per IEC 651 and ANSI S1.4.1971
measurement of voltage ratio	0,1%

APPENDIX B MANUFACTURER'S DRAWING/DATA SHEET SINGLE CORE CABLE

4 pages (including this page)

drawing no./document no.	revision	date	title
GB7-TX01-N85-00-00	-	-	data sheet 76 / 132 kV power cable 1x2000 mm^2
GB7-TX01-N85-00-00	A	26 October 2008	cable cross section drawing

El Sewedy Cables Co. Technical Department

76/132 kV Cable

Cable Construction

1. Conductor		
Material		**Plain, annealed Copper**
Size	mm^2	**2000**
No. of Segments		**5**
No. of wires for each segment		**61**
Conductor Diameter	mm	**55**
Conductor Type		**Segmental Milliken Conductor Including non-conducting water blocking tapes inside each segment and separate each segment from each other.**
2. Semi Conductive Swelling Tape		
Material		**Semi-Conducting Water blocking tapes**
Diameter	mm	**55.7**
3. Conductor Screen		
Material		**Extruded semi-conducting**
Thickness	**mm**	**1.4 (nominal)**
		1.2 (minimum)
Diameter	**mm**	**58.5 (Approx.)**
4. Insulation		
Material		**Cross Linked Polyethylene (XLPE)**
Thickness	mm	**15 (nominal)**
	mm	**13.5 (minimum)**
Diameter	mm	**88.5 (Approx.)**
5. Insulation Screen		
Material		**Extruded semi-conducting**
Thickness	**mm**	**1.4 (nominal)**
		1.2 (minimum)
Diameter	**mm**	**91.3 (Approx.)**
6. Semi Conductive Swelling Tape		
Material		**Semi-Conducting water Blocking tape**
Thickness	mm	**Nominal 0.5 (before application)**
	mm	**Minimum 0.1 (after application)**
Diameter	mm	**92.3 (Approx.)**
7. Metallic Screen		
Material		**Copper Wires**
No. / Diameter of wires	mm	**50 / 1.75**
Material		**Open Helix Copper Tape**
Thickness of tape	mm	**0.1 (Nominal)**
Diameter	mm	**96 (Approx.)**

El Sewedy Cables Co. Technical Department

76/132 kV Cable

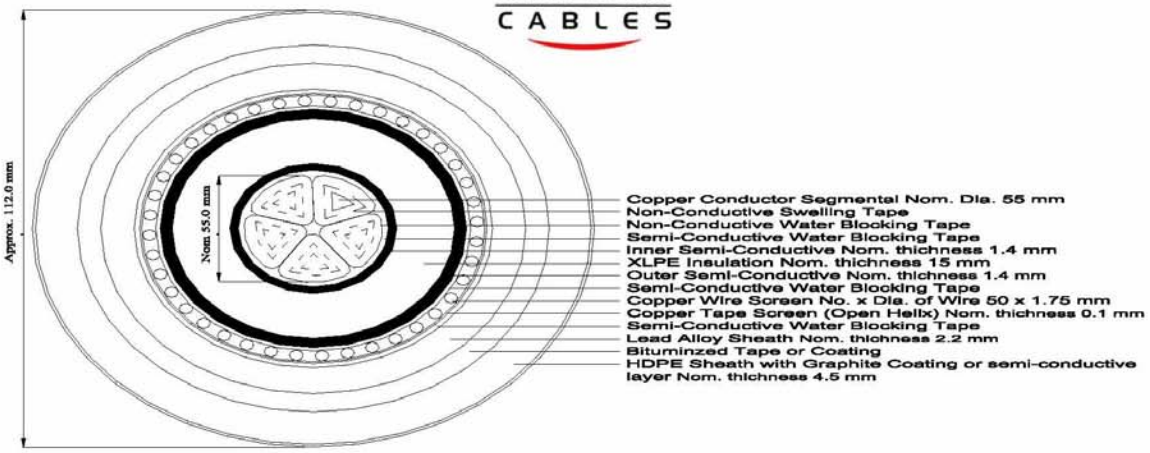
Cable Construction

8. Semi Conductive Swelling Tape		
Material		**Semi-Conducting Water Blocking tape**
Thickness	mm	**Nominal 0.5 (before application)**
	mm	**Minimum 0.1 (after application)**
Diameter	mm	**97 (Approx.)**
9. Metallic Sheath		
Material		**Lead Alloy**
Type		**½ C**
Thickness	mm	**2.2 (Nominal)**
		2.09 (Minimum)
Diameter	mm	**101.4 (Approx.)**
10. Anti Corrosion Tape		
Material		**Bituminized Tape**
Diameter	mm	**103 (Approx.)**
11. outer Jacket		
Material		**HDPE**
Thickness	mm	**4.5 (nominal)**
		3.73 (minimum)
Outer Diameter	mm	**112.0 (Approx.)**
12. Semi conductive Jacket		
Material		**Graphite Coating or extruded semi conductive layer**

Applicable Standards :

- **IEC 60228**
- **IEC 60840**
- **IEC 60811**

ELSEWEDY CABLES



NOTE

Overall Diameter: Approx. 112 mm

1. weight: Approx. 33.1 kg/km
2. DC Conductor Resistance: Max. 0.009 Ω/km at 20 °C
3. Capacitance: Norm. 0.336 μF/km

Size : 1 x2000 *mm²*		*Type :* Cu/XLPE/CW/LEAD/HDPE	
Voltage: 76/132 *kV*		*Standard:* IEC 60840 & IEC 60811	
Code : GB7-TX01-N85-00-00		*EL-SEWEDY CABLES*	
Sr.	*Description*	*Thickness mm*	*Diameter mm*
1.	Copper *Conductor*		Approx. 55
2.	Non-Conductive Swelling Tape		
3.	Non-Conductive Water Blocking Tape		
4.	Semi-Conductive Water Blocking Tape		
5.	Inner Semi-Conductive	Nom. 1.4	Approx. 58.5
6.	XLPE *Insulation*	Nom.15	Approx.88.5
7.	Outer Semi-Conductive	Nom.1.4	Approx.91.3
8.	Semi-Conductive Water Blocking Tape	Nom.0.5(before application)	Approx.92.3
9.	Copper Wire Screen	50x1.75	Approx.95.8
10.	Copper Tape Screen (Open Helix)	Nom. 0.1	Approx.96
11.	Semi-Conductive Water Blocking Tape	Nom.0.5(before application)	Approx.97
12.	Lead Alloy Sheath	Nom. 2.2	Approx.101.4
13.	Bituminzed Tape or Coating		
14.	HDPE Sheath	Nom. 4.5	
15.	Graphite Coating or semi-conductive layer		Approx.112
Not to Scale			

Rev. No.	Date	Description	DGN	APP
A	26/10/2008	ISSUED FOR COMMENTS	H.D.	T.B.
3	26/08/2008	ISSUED FOR COMMENTS	H.D.	T.B.
2	04/08/2008	ISSUED FOR COMMENTS	H.D.	T.B.
1	21/05/2008	ISSUED FOR COMMENTS	H.D.	T.B.
0	10/4/2008	ISSUED FOR COMMENTS	H.D.	T.B.

ELSEWEDY CABLES

KAHRAMAA — Qatar General Electricity & Water Corporation

POWER CABLE CROSS SECTION
132 KV XLPE 1C x 2000 SQMM

SCALE	UNIT	Project	SHEET No.	REV.
NTS	MM	GTC 142/2004	10 OF 10	A

EL SEWEDY CABLES QATAR

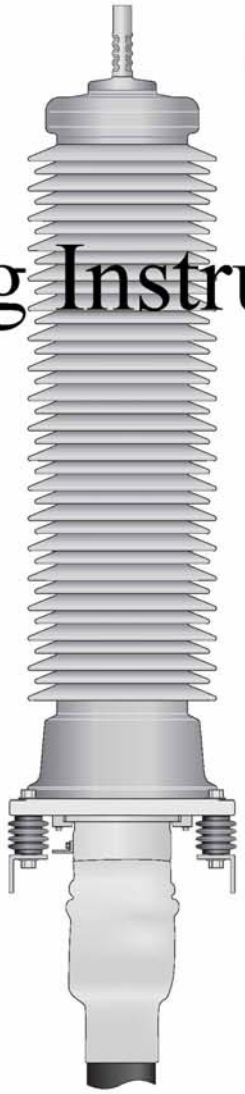
APPENDIX C MANUFACTURER'S DRAWING/DATA SHEET OUTDOOR TERMINATION

9 pages (including this page)

drawing no./document no.	revision	date	title
131165	3.0	February 2008	fitting instruction ESP 145 -frontsheet outdoor termination -table of contents (page 2) -preparation of cable with lead sheath and screen wires without plumbing cone (page 15)
PRO2107	01	2008-05-16	corona ring
VA 106071-10 (16237)	-	2008-11-28	parts list (4 pages)

PFISTERER | IXOSIL
THE POWER CONNECTION

Fitting Instruction



ESS/ESP 145

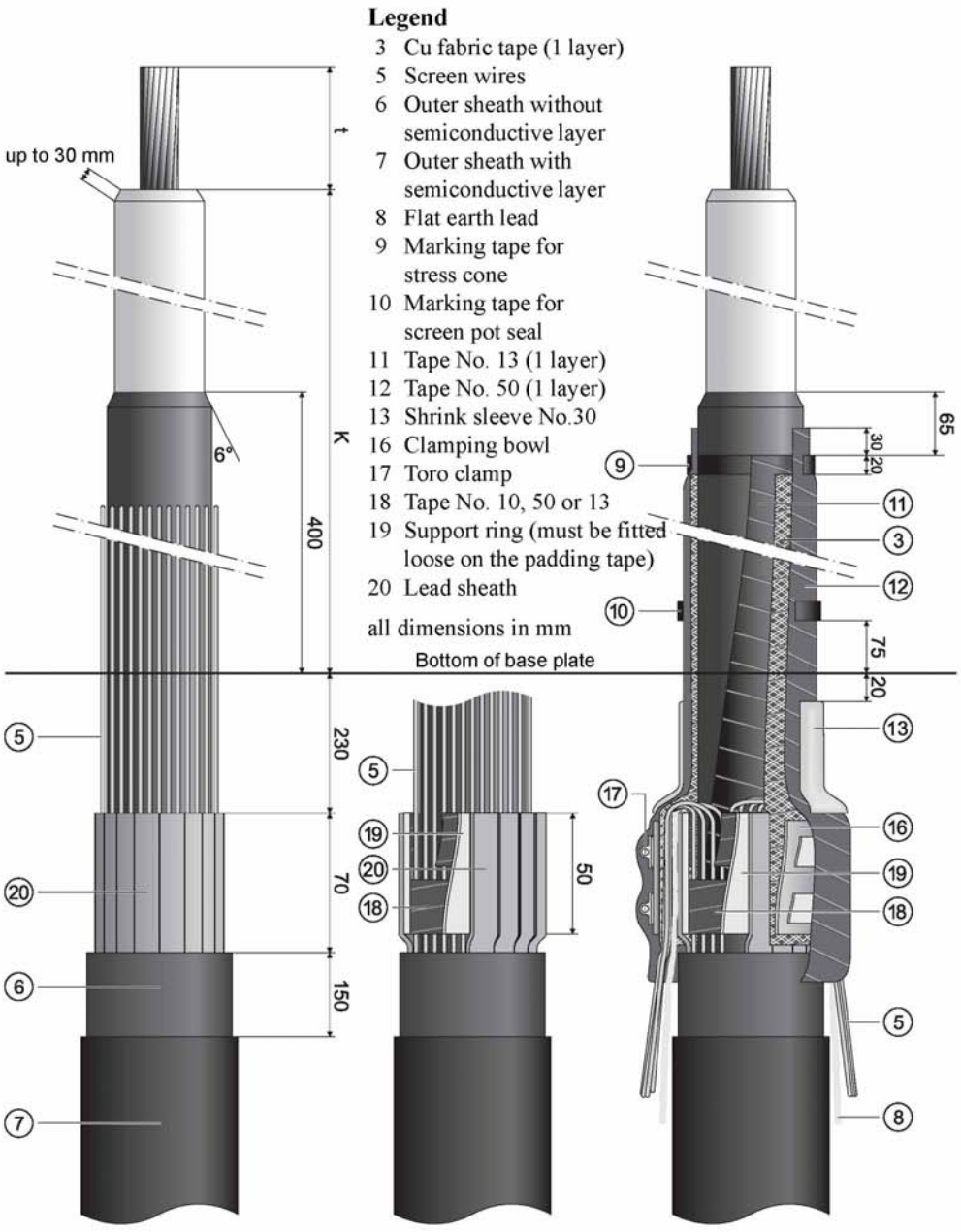
HV Silicone and Porcelain sheded termination

PFISTERER Ixosil Ltd.
Cable Systems
Altdorf / Switzerland

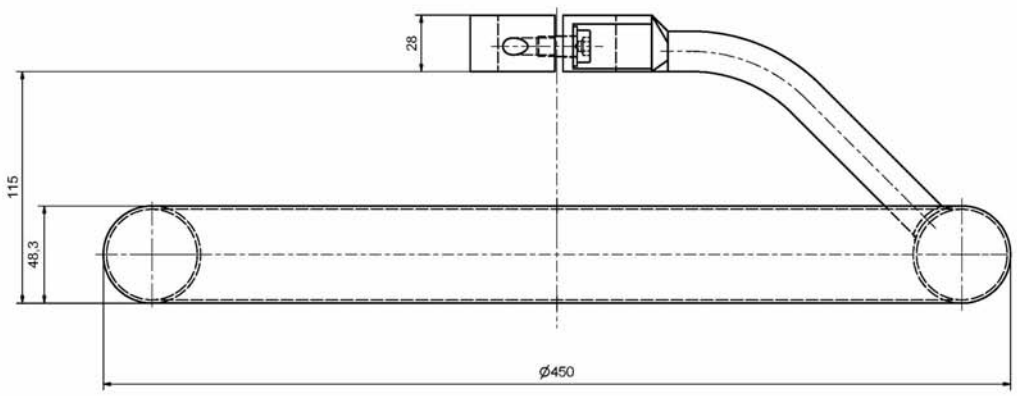
3.0 english – 131165 – © PFISTERER Ixosil Ltd. 02.08

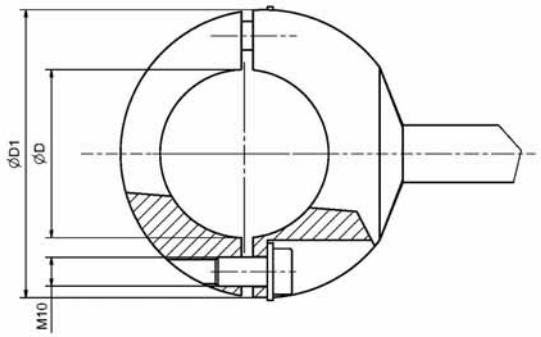
Table of contents

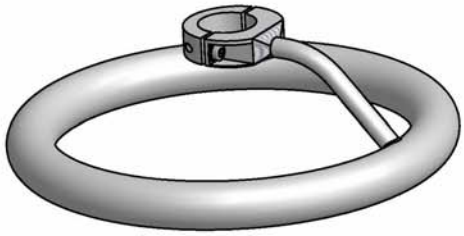
6.5F Preparation of cable with lead sheath and screen wires without plumbing cone



Leiterqueschnitt conductor cross-section	ØD	ØD1
1000mm²	58.5	100
2000mm²	80.5	120







surface: galvanized

Koronaring Corona ring	Erstellt durch created by	Gubis M.	2008-05-15
	Genehmigt von approved by	Ferrazza E.	2008-05-16
PFISTERER I IXOSIL CH-Altdorf Switzerland	Datei Nr. file no.	S04-130667	
	Zeichnungs Nr. / drawing no.	PRO2107	Index / rev. 01

PFISTERER I IXOSIL

Kunde: customer:	**Pfisterer Kontaktsysteme**					
Projekt: project:	**16237 / Loop test**					
Komissions-Nr: order no:	**VA106071-10**					
Anzahl Garnituren: quantity of Accessories:	**2**	Stück pieces				
Montageanleitung: fitting instruction:	X	Deutsch	English			
Verpackung: packing:	X	Standard standard	Seemässig seaworthy	Karton cardboard	Abnahme: inspection befor shipment by client:	**Nein** **no**
Liefertermin: delivery date:	**28.11.2008**				Prüfprotokoll Typ: Testreport type:	

880 266110	ESP145-C73-05 ESP145-C73-05	KW 7335mm, 45mm/kV CD 7335mm, 45mm/kV	Typ B; i=325mm	H=2232mm, D=400mm	bestehend aus: consisting of:

Position	Ar.-Nr. part. No.	Bezeichnung description	Bezeichnung 2 description 2	Spezifikation specification	Dimension dimension	Pro Stück per piece	Komplett qty per unit
10	190546	Steuerteil B5 stress cone	<170 kV; ESS/ESP	LSR	Isol.-ø82-99mm	1	2
20	190470	Erdanschluss Topf kompl. screen pot complete	Schirmquerschnitt max.300mm² cross section 300mm² (max.)	ø 79-95mm	Gr. 05	1	2
30	180727	Porzellan-Stützer 170kV porcelain	KW 7250 mm	i=325mm	ø 390*2200 mm	1	2
40	180061	O-Ring o-ring	DIN 3535 / Teil 1	EPDM 70 Shore° A	ø 278.77*6.99 mm	1	2
50	134363	Grundplatte (LSR) base plate	Tk-ø 325 mm, i=8	Lochabstand 400 mm bore distances	500/500*32 mm	1	2

880 266110	ESP145-C73-05 ESP145-C73-05	KW 7335mm, 45mm/kV CD 7335mm, 45mm/kV	Typ B; i=325mm	H=2232mm, D=400mm	bestehend aus: consisting of:	

Position	Ar.-Nr. part. No.	Bezeichnung description	Bezeichnung 2 description 2	Spezifikation specification	Dimension dimension	Pro Stück per piece	Komplett qty per unit
60	180054	6kt-Schraube hexagonal screw	DIN 933	A2	M12*50 mm	8	16
70	155805	Federring M12 spring washer	DIN 127 B	A2	ø 12.2/21.1*2.5	8	16
80	178414	Füllmasse 10.0 kg filling compound	Indopol H-50			4	8
90	190029	Gleitfett P8 lubricant P8	Beutel bag	P8	20 gr.	8	16
100	149560	Band 13 tape 13	Halbleiterband semi conductive tape	schwarz black	38.1 mm*9.14 m	1	2
110	190014	Band 35 tape 35	PVC PVC	rot red	19.1 mm*20.1 m	2	4
120	178392	Band 50 tape 50	PVC PVC	schwarz black	50 mm * 30.0 m	1	2
130	166050	Cu-Gewebeband cu-fabric tape	Schlauchgestrick aus Cu sn	Cu sn	50 mm*11.5 m	2	4
140	190478	Schrumpfschlauch 160/50*200 mm shrink sleeve	Typ SST	No.30		1	2
150	162754	Schmirgelleinen 180 emery cloth (sandpaper)		Körnung 180 grain 180	2 m	1	2
160	180827	Schmirgelleinen 320 emery cloth (sandpaper)		Körnung 320 grain 320	2 m	1	2
170	176718	Schmirgelleinen 80 emery cloth (sandpaper)	Typ 869	Körnung 80 grain 80	2 m	1	2

880 266110	ESP145-C73-05 ESP145-C73-05	KW 7335mm, 45mm/kV CD 7335mm, 45mm/kV	Typ B; i=325mm	H=2232mm, D=400mm	bestehend aus: consisting of:	

Position	Ar.-Nr. part. No.	Bezeichnung description	Bezeichnung 2 description 2	Spezifikation specification	Dimension dimension	Pro Stück per piece	Komplett qty per unit
180	175857	Handschuh Set à 4 Stück glove	Grösse: Gross size: big	Venitactyl	Set à 4 Stück 4 pieces	1	2
190	156740	Staubbindetuch dust towel	Staubfix Standard			1	2
200	195000	Putztuch cleaning cloth		Baumwolle cotton	400*400 mm	4	8
210	266072	Kontaktschutzfett Contact protection grease	Typ P1		20 ml	1	2
220	145776	Dichtungsband Sealing tape	SFTS-G SFTS-G		25 mm*1.9 m	2	4
230	265053	Schrumpfschlauch 200/50*500 mm shrink sleeve	Typ SST			1	2
240	165882	Kabelbinder cable tie	PLT5S-C		4.8*445 mm	1	2
250	149556	Stützisolator SGF kpl. post insulator SGF compl.	ESS/P ESS/P	Typ SGF	ø 80*80 mm	4	8
260	266457	Al-Kopfarmatur 2000mm² geschraubt head armature	Typ ESP; versilbert	Leiter ø53.8-56.8	ø 50*100 mm	1	2
270	190064	Schrumpfschlauch 115/49*125 mm shrink sleeve	Typ HVGT			1	2
280	158069	Zyl-Schraube mit I-6kt socket head screw	DIN 912	A2	M8*30 mm	6	12
290	180723	Unterlagsscheibe M8 washer	DIN 433	A2	ø 8.4/15*1.6	6	12

880 266110	ESP145-C73-05 ESP145-C73-05	KW 7335mm, 45mm/kV CD 7335mm, 45mm/kV	Typ B; i=325mm	H=2232mm, D=400mm	bestehend aus: consisting of:	

Position	Ar.-Nr. part. No.	Bezeichnung description	Bezeichnung 2 description 2	Spezifikation specification	Dimension dimension	Pro Stück per piece	Komplett qty per unit
300	190493	Cu-Flachlitze Earthing lead flat	copper tinned	Cu Sn	95 mm²*0.5 m	1	2
310	180884	Erdungsring earthing ring		1.4301	108/104*50 mm	1	2
320	180875	Klemmspange clamping bowl	Typ 3 (ø146-90)	Al Aluminium	150/146*50 mm	1	2
330	180043	Schlauchschelle eathing hose clamp type TORO	A2	TORO	110-140 mm	2	4
340	173331	Cu-Presskabelschuh 120mm² compression cable lug		Cu Sn; KZ20	ø 13.0 mm	2	4

APPENDIX D MANUFACTURER'S DRAWING/DATA SHEET SF6 TERMINATION

11 pages (including this page)

drawing no./document no.	revision	date	title
No 040 293 603	-	-	additional installation instructions for HV connex separable connectors (6 pages)
040 265 001	-	November 2007	instruction for use CONNEX cable connector -frontsheet -general instructions (page 3)
3378634	-	2009-07-29	packing list 869999999-0066 (2 pages)

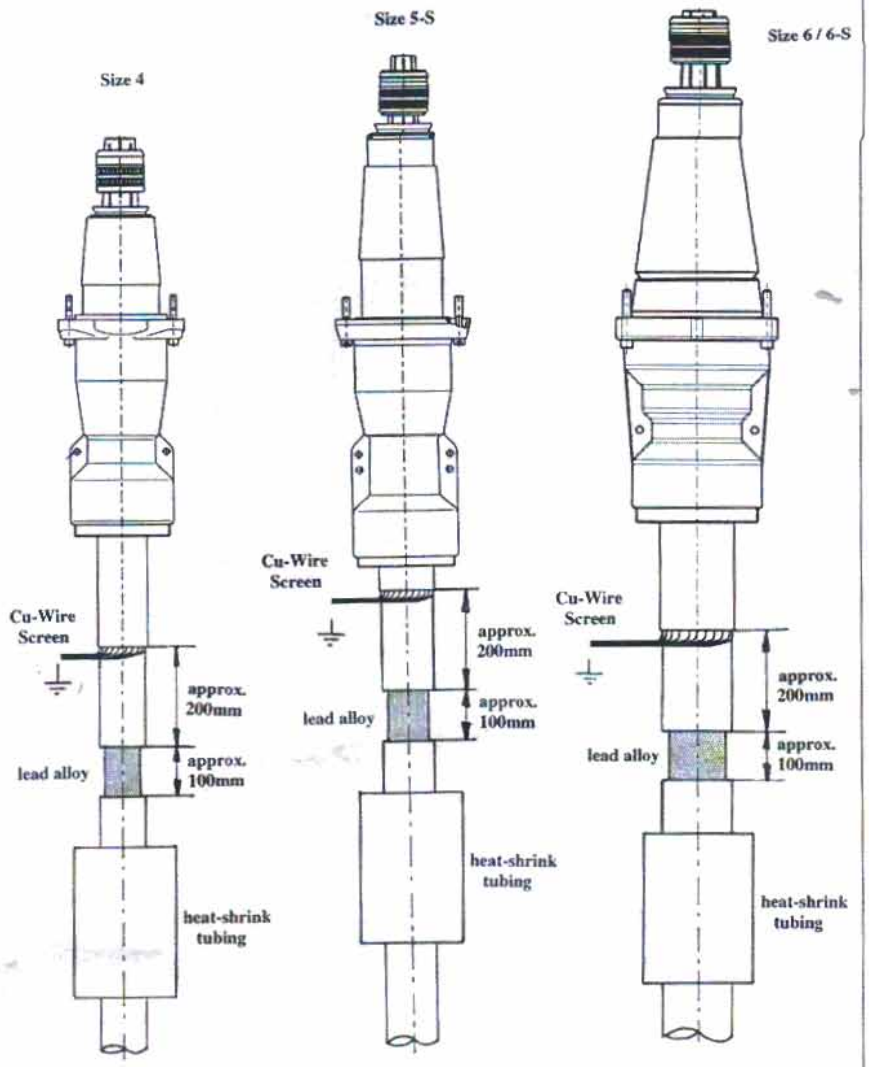
PFISTERER

Additional operating instructions for HV-CONNEX Separable Connectors

1-core-cable 72,5 – 245 kV / Cu-Wire Screen / Lead Alloy Sheath

No. 040 293 603	Page 1/6	Size 4 / 5-S / 6 / 6-S

For installation the HV-CONNEX Separable Connectors see also "Operating Instructions....."
Size 4, No. 040 187 001 / Size 5-S, No. 040 195 011 / Size 6, No. 040 265 001 / Size 6-S, No. 040 265 002



Attention ! Place the "heat-shrink tubing" over the cable before start to install the HV-CONNEX Separable Connectors !

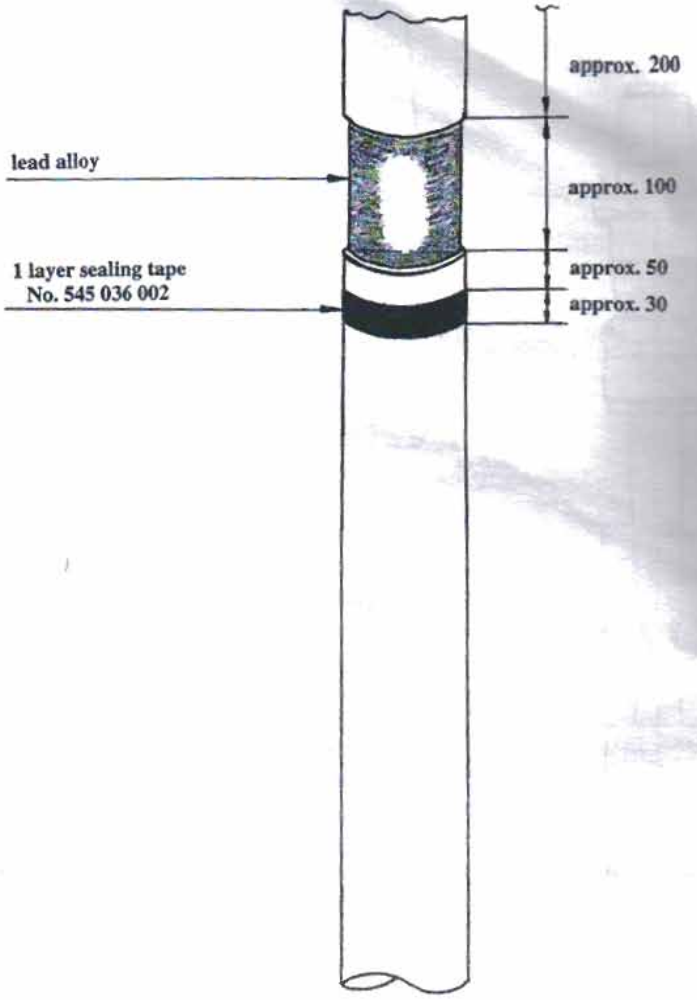
Drawing not to scale	Only for Information

PFISTERER

Additional operating instructions for HV-CONNEX Separable Connectors

1-core-cable 72,5 – 245 kV / Cu-Wire Screen / Lead Alloy Sheath

No. 040 293 603	Page 2/6	Size 4 / 5-S / 6 / 6-S



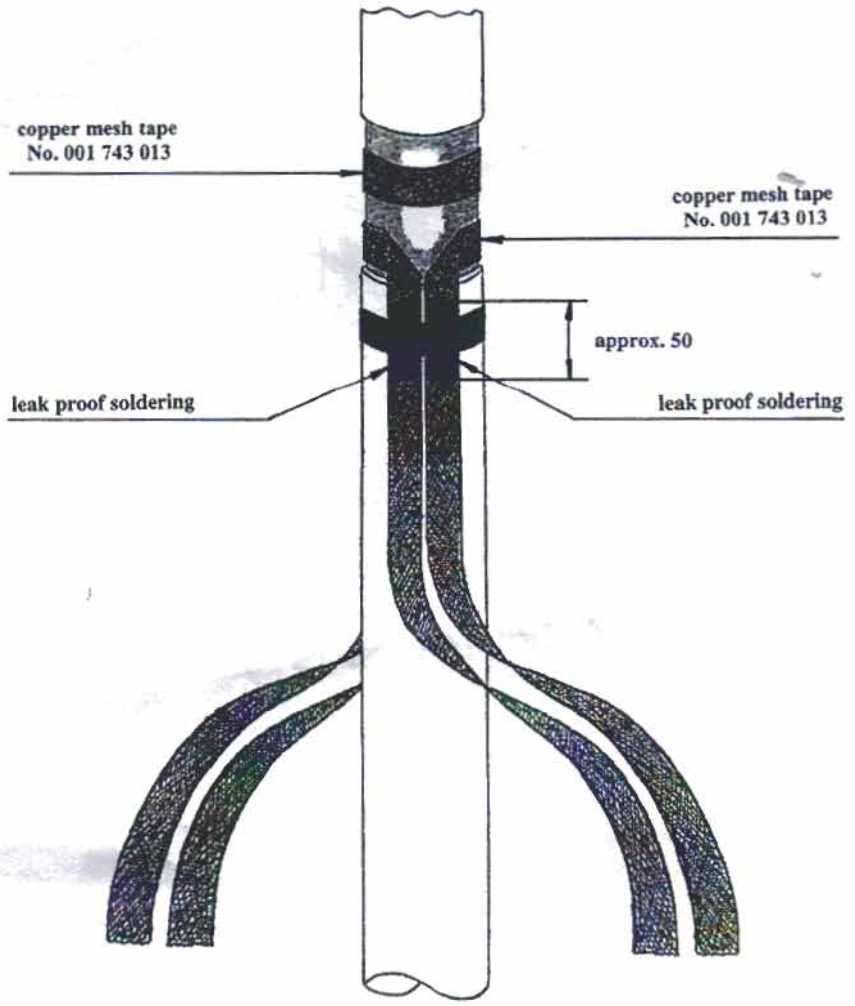
Drawing not to scale	Only for Information

PFISTERER

Additional operating instructions for HV-CONNEX Separable Connectors

1-core-cable 72,5 – 245 kV / Cu-Wire Screen / Lead Alloy Sheath

No. 040 293 603	Page 3/6	Size 4 / 5-S / 6 / 6-S



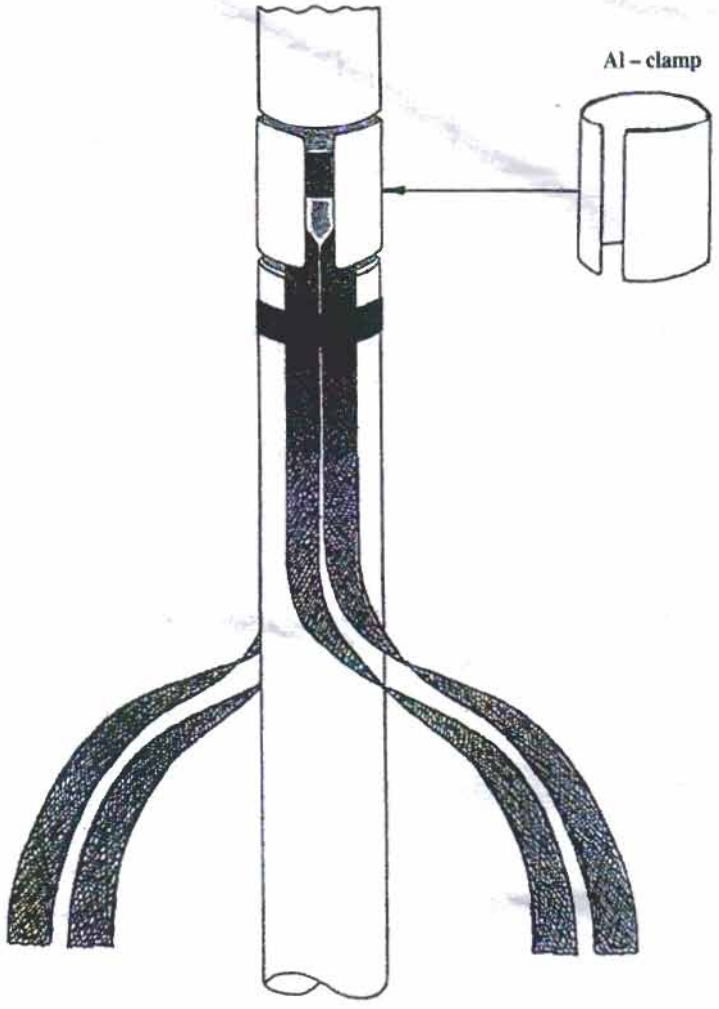
Drawing not to scale | Only for Information

PFISTERER

Additional operating instructions for HV-CONNEX Separable Connectors

1-core-cable 72,5 – 245 kV / Cu-Wire Screen / Lead Alloy Sheath

No. 040 293 603	Page 4/6	Size 4 / 5-S / 6 / 6-S



Drawing not to scale	Only for Information

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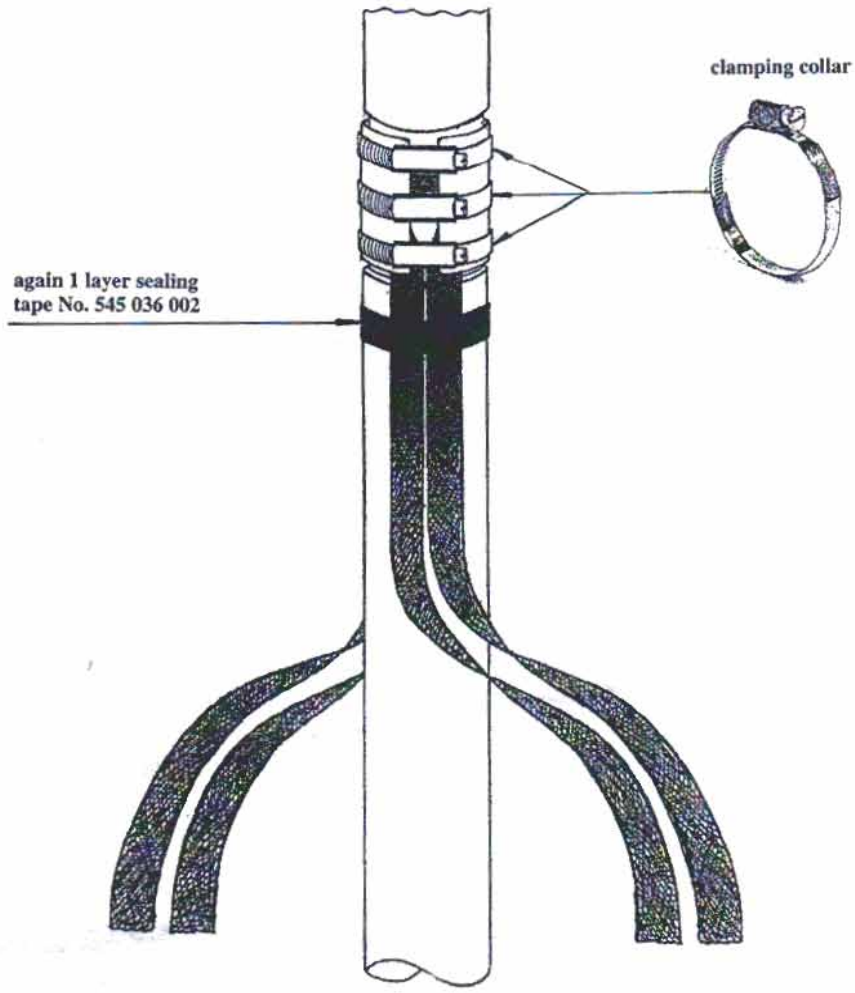
Additional operating instructions for HV-CONNEX Separable Connectors

1-core-cable 72,5 – 245 kV / Cu-Wire Screen / Lead Alloy Sheath

No. 040 293 603	Page 5/6	Size 4 / 5-S / 6 / 6-S



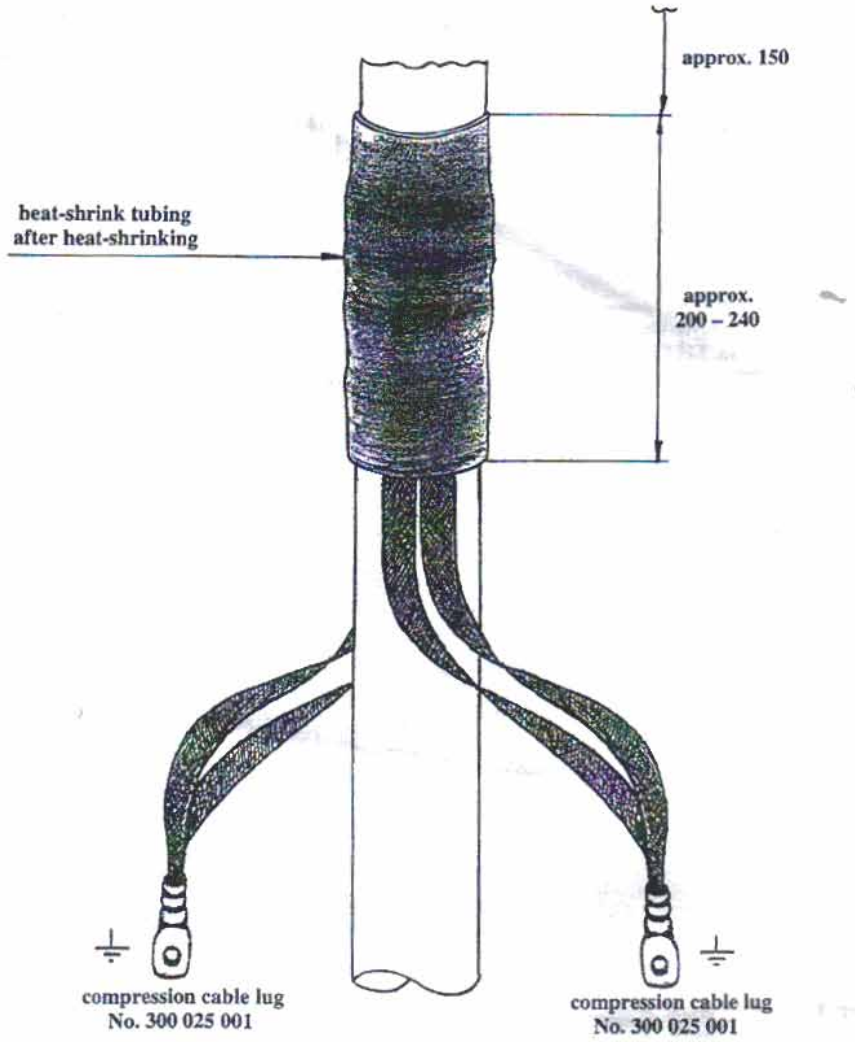
Drawing not to scale	Only for Information

PFISTERER

Additional operating instructions for HV-CONNEX Separable Connectors

1-core-cable 72,5 – 245 kV / Cu-Wire Screen / Lead Alloy Sheath

No. 040 293 603	Page 6/6	Size 4 / 5-S / 6 / 6-S



Drawing not to scale	Only for Information

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PFISTERER

Installationsanleitung
CONNEX-Kabelanschlussteile
Größe 6 U_{max} = 170 kV I_N= 2500 A
Größe 6-S U_{max} = 245 kV I_N= 2500 A

Instructions for use
CONNEX Cable Connector
Size 6 U_{max} = 170 kV I_N = 2500A
Größe 6-S U_{max} = 245 kV I_N= 2500 A

040 265 001 / 11.2007

PFISTERER Kontaktsysteme GmbH & Co. KG
Rosenstraße 44
73650 Winterbach
Germany

Phone + 49(0)7181-70 05-0
Email: dialog@pfisterer.de
http://www.pfisterer.de

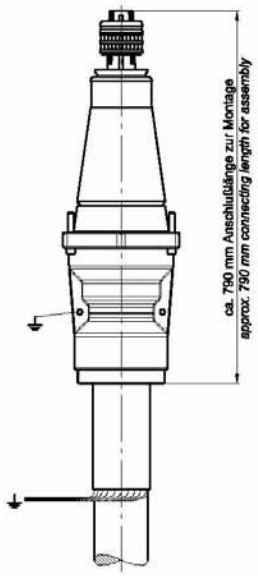
PFISTERER

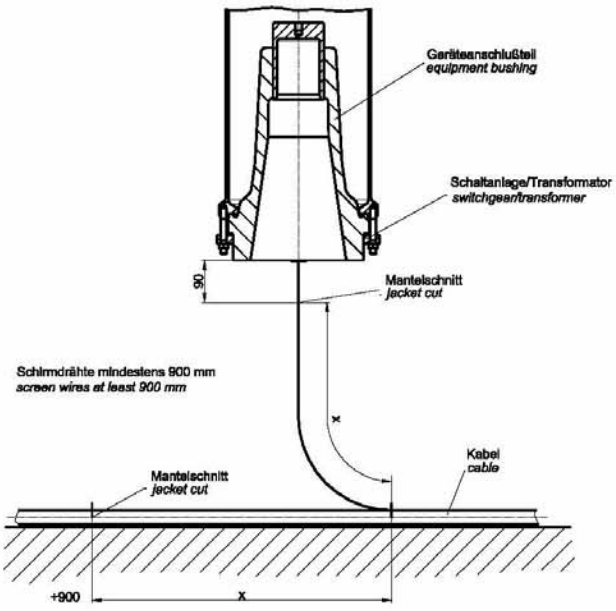
Allgemeine Hinweise

- Diese Anleitung ist nicht für Kabel mit Bleimantel, hierzu bitte spezielle Anleitung Nr. 040 266 001 heranziehen
- Die Montage ist sauber und trocken auszuführen
- Um dem „Kabelschrumpf" entgegenzuwirken, muss das Kabel mindestens 4-6 h mit min. 80° /max. 100° C geheizt werden
- Das Kabel muss gerade sein, evtl. nach dem Heizen mit Geradebiegevorrichtung ausrichten
- Kabel nur in geradem Zustand schälen
- Alle Maße in mm

General Instructions

- *This instruction is not for lead shield cables, please refer to special instruction no. 040 266 001*
- *the assembly should be carried out neatly and in dry conditions*
- *to avoid cable shrink the cable has to be heated for minimum 4-6 h at a min. heat of 80°C / max. heat of 100°C*
- *the cable must be straight, if necessary straighten the cable after heating using a cable straight equipment*
- *peel the cable only when it's absolute straight*
- *all dimensions are indicated in mm*





PFISTERER

3378634

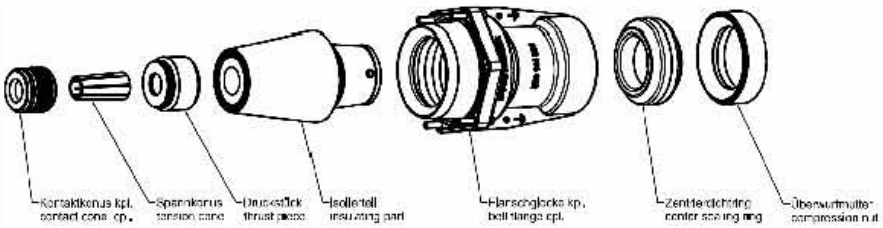
Packliste CONNEX-Kabelanschlußteile
Packing list of CONNEX Separable Connectors

Einheit Unit	Artikelnr. Item No.	Variante Variant	Beschreibung Description
1 STK	**869999999**	**0066**	CONNEX Kabelanschlussteil Gr.6-170kV, 6S-245kV CONNEX separable connector size6-170kV/6S-245kV

Groesse/size

Leiter/over conductor-Ø	**55 mm**
Isolations/over insulation-Ø	**88,5 mm**
Außen/overall-Ø	**113,6 mm**
Zubehoer/Accessories	

Spannung/voltage	
Querschnitt/cross section	**2.000 mm²**
Leiterform/conductor shape	**RM - Rund mehrdrähtig round stranded**
Kabelaufbau/cable design	
Schirmung/shield	



Artikel-Nr. Reference No.	Beschreibung Title	Menge Quantity
562976026	Spannkonus Gr. 6, 6-S / 2000rm, ØC=54,5 tension cone Gr.6, 6-S/2000RM, ØC=54,5	1
562978028	Kontaktkonus kpl.Gr. 6 & 6-S, 2000rm contact cone,cpl.,size 6/6-S, 2000RM	1
565604009	Druckstück kpl. Gr. 6 / 6-S, D=57 Thrust Piece Size 6 / 6-S, D=57Ø range 50,0-56,9	1
565541845	Isolierteil f. Kabelanschlußteil Gr.6/245kV A=84,5 Isolierteil f. Kabelanschlußteil Gr.6/245kV A=84,5Ø Bereich 87-90	1
565548002	Flanschglocke kpl. Gr. 6 bell flange size 6	1
565558001	Zentrierdichtring 130 Gr. 6 center sealing ring 130 size 6	1
546150003	Putztuch Scott Wypall L40 (1 Stück) cleaning rag Scott Wyball	3
002854002	HV-Spezialfett 8g-Beutel HV Special Grease	6
002891891	Einweg-PE-Handschuhe one-way gloves	1
040265001	Gebrauchsanl. CONNEX-Kabelanschluß. Gr.6 instructions for use,separable connector,size 6for cable with shield wires	1
613199403	Flachbeutel 180x340x0.1 plane bolter 180x340x0,1	1

Datum: 29.07.09
Ersteller: Patrick Krassotoulomos

PFISTERER

3378634

Packliste CONNEX-Kabelanschlußteile
Packing list of CONNEX Separable Connectors

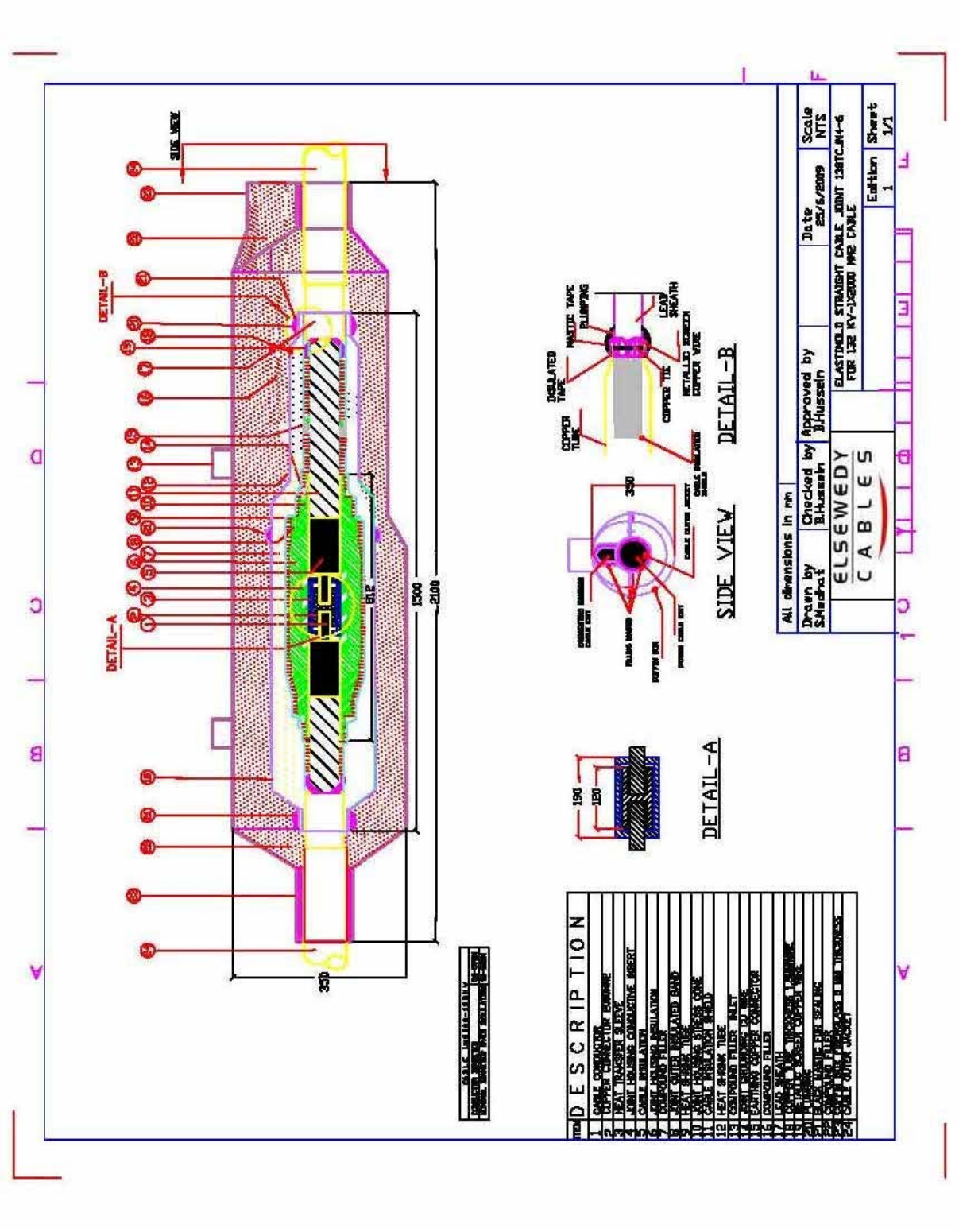
Artikel-Nr. Reference No.	Beschreibung Title	Menge Quantity
613199204	Flachbeutel 100x180x0,1 plane bolter 100x180x0,1	1
545036002	Dichtungsband 25,4x1,6x300 Sealing Tape 25,4 x 1,6 x 300	2
564281002	Silberleitlack 10ml in Glasflasche Silver varnish 10 ml	1
545103002	Ölmalpinsel Gr.8 brush size 8	1
564900007	Elektroschmirgel-Set Korn 80/641,120/641,240/641PF sanding paper 80/641, 120/641, 240/64140mm x 1000mm	1
564278003	Schraubenfederring 92x3x0,55 VA Stahl,Anfang u. helical spring ring, 92x3x0,55 VA steel	2
564054001	Knopf knob	1
021937057	O-Ring-Dichtung, 110 x 3 O-Ring 110 x 3	1
001743007	Kupfergestrick-Schlauch Breite =100 Dm=0,1 copper mesh hose	2
040025001	Datenblatt HV- CONNEX-System data sheet HV-CONNEX-system	1
001743016	Gewebe-Klebeband schwarz cotton insulating tape	1
564596001	Verpackungsschild 102x48 label	1
300028002	Presskabelschuh Cu verz. DIN 46235 Compression Cable Lug Cu el.tinned DIN 462351 hole 10,5 Cross Section 150 RM/SM	1
020696695	Sechskantschraube M10 X 40 hexagon bolt, M10 x 40	1
020647647	Sechskantmutter M10 Hexagonal nut M10	1
020621618	Scheibe A 10,5 washer A 10,5	1
040293603	Zusatzmontageanl. f.HV-CONNEX-Kabelanschlt. Additional operating instr. f.HV-CONNEX Sep.Con.	1
545036002	Dichtungsband 25,4x1,6x300 Sealing Tape 25,4 x 1,6 x 300	2
619528001	Schrumpfschlauch WCSM 130/36-225/S-CS019 heat-shrink tube WCSM 130/36-225/S-CS019	1
001743013	Kupfergewebeband 35qmm, 3m abgelängt Copper braided band 35sqmm, length 3m	2
564279005	Klemmspange D=115mm Al clamp D=115mm	1
617825006	Schlauchschelle DIN 3017-AL-100-120x9-W5 Clamping CollarDiameter Range 100-120 mm, Width 10 mm	3
300025001	Presskabelschuh Cu verz. DIN 46235 Compression Cable Lug Cu el.tinned DIN 462351 hole 10,5 Cross Section 120 RM/SM	2

Datum: 29.07.09
Ersteller: Patrick Krassotoulomos

APPENDIX E MANUFACTURER'S DRAWING/DATA SHEET STRAIGHT JOINT

11 pages (including this page)

drawing no./document no.	revision	date	title
-	1	2009-06-25	elastimold straight cable joint 138TCJN4-6
IS-TCN4	1	November 2008	installation instruction TCJN4
-	-	-	kit content for straight cable joint 138TCJ1N4-6 (2 pages)


SIDE VIEW
DETAIL-A
DETAIL-B
1500
2100
350
812
190
150
ELSEWEDY CABLES
All dimensions in mm
Drawn by S.Nesheiwat
Checked by B.Hussein
Approved by B.Hussein
Date 25/6/2009
Scale NTS
Edition 1
Sheet 1/1
ELASTIMOLD STRAIGHT CABLE JOINT 132KV-N4-G
FOR 132 KV-1X2000 MM2 CABLE
DESCRIPTION

ELASTIMOLD

Installation Instructions
TCJN4

The TCJN4 is a permanent, shielded, submersible joint with *a* rated voltage as indicated on the housing and with a continuous operating current rating equal to that of the cable on which it is installed.

DANGER

All apparatus must be de-energized during installation or removal of part(s).

All apparatus must be installed and operated in accordance with individual user, local, and national work rules. These instructions do not attempt to provide for every possible contingency.

Do not touch or move energized products.

Excess distortion of the assembled product may result in its failure.

Inspect parts for damage, rating and compatibility with mating parts.

This product should be installed only by competent personnel trained in good safety practices involving high voltage electrical equipment. These instructions are not intended as a substitute for adequate training or experience in such safety practices.

Failure to follow these instructions will result in damage to the product and serious or fatal injury.

If this product is supplied with a protective shipping cover(s), remove this shipping cover(s) and replace with the appropriate HV insulated cap(s) or connector(s) before submerging or energizing the circuit.

FOR MORE INFORMATION ON PARTS, INSTALLATION RATINGS AND COMPATIBILITY, CALL THE NEAREST ELASTIMOLD OFFICE.

IMPORTANT

1. Using the component list, check contents of package to ensure they are complete and undamaged.
2. Check all components to ensure proper fit with cable and/or mating products.
3. Read entire installation instructions before starting.
4. Have all required tools at hand and maintain cleanliness throughout the procedure.
5. Examine the mating cable ends, both cables should be free from moisture and other contaminants.
6. Graphite coatings shall be scrapped off 12" (30.5cm) beyond the cable jacket cut.
7. Examine the conductors), if strand filled or water-blocking material is present, the customer must contact the cable manufacturer on their procedures and/or recommendations on welding and/or crimping the conductor

---

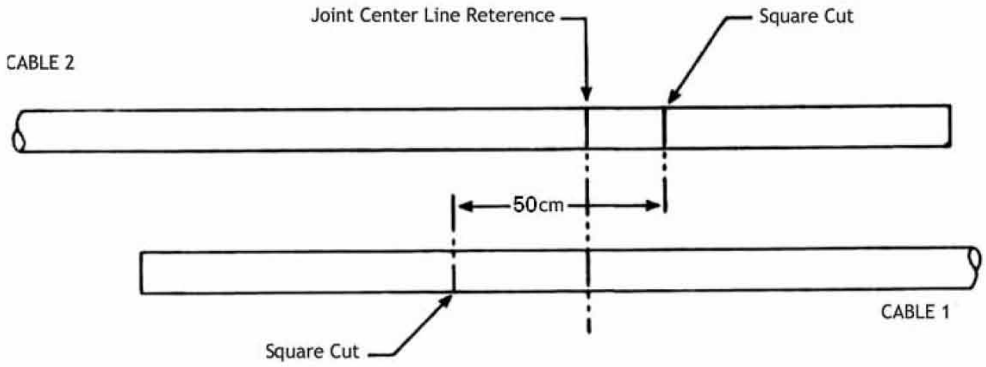
CAUTION

Finished insulation diameter must not be less than
Verify the housing size by looking within the leading Edge of the stress cone

HOUSING SIZE	INSULATION RANGE
3	2.25" (57.3 mm- 2.61"(66.2 mm)
4	2.56"(65.2 mm – 2.59"(74.9 mm)
5	2.90" (73.6mm – 3.29"(83.6mm)
6	3.24" (82.5mm – 3.62"(91.9mm)

STEP A

1-The cables to be joined need to be treated and positioned so that the cable cores are aligned and each cable will be straight for at least 1.25 meters on each side of the joint.
2-Overlap both cables and square cut cables to provide 50 cm overlap.
*If the cables do not naturally conform to this requirement, heating, straightening and cooling will be necessary; this step may take up to 24 hours to complete.

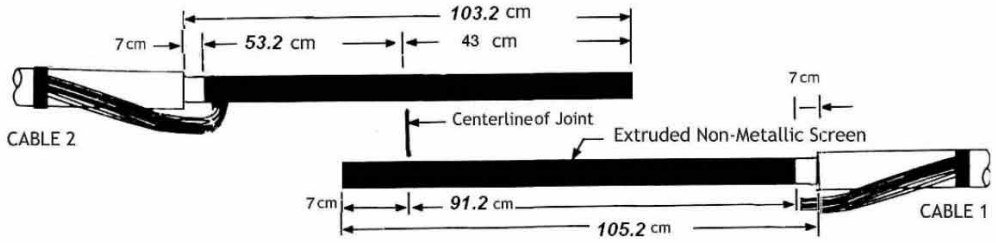


STEP B

1. Place cables in FINAL position.
2. Mark each cable at the center line of the joint.
3. Measure 7cm for cable 1 and 43 am for cable 2 from the center line of joint and square cut cables
3. Carefully remove outer jacket to expose the lead sheath of Cable 1 for a distance of 105.2cm and Cable 2 for a distance of 103.2cm.
4. Carefully remove the lead sheath of both cables to within 7 cm of outer jacket end.
5. Fold back the metallic screen wires of both cables and tape ends of wires to outer jacket.
6. Remove the bedding tape over the extruded non metallic screen.

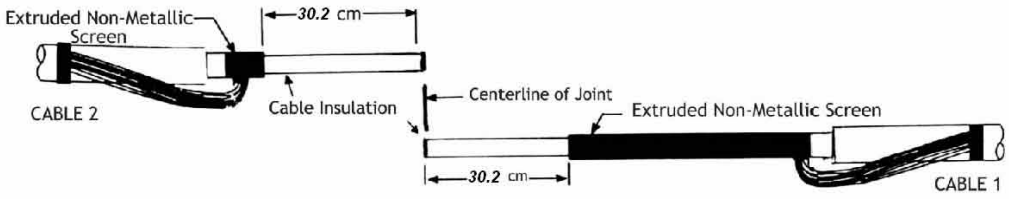
7-Using square cut remove 7cm of cable 1 and 43cm of cable2.

8- On cables 1 and 2 measure 1.2m back from the edge of the conductor. Place a piece of tape around the jacket to serve as a locating mark when centering joint



STEP C

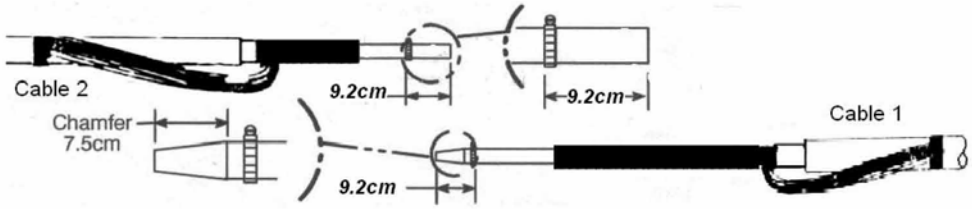
1. **WARNING: BE SURE TO MEASURE FROM END OF CONDUCTOR AND NOT FROM END OF INSULATION.** Do not cut or nick the exposed insulation. This could result in failure of the cable
2. **WARNING:** Remove the Extruded Non-Metallic Screen On Cable 1 and Cable 2 for A Distance Of 30.2cm As Shown.



STEP D

1. **WARNING: BE SURE TO MEASURE FROM END OF CONDUCTOR AND NOT FROM END OF INSULATION.**
2. Using a hose clamp as a guide, square cut the insulation of Cable 1 for a distance of 9.2cm and also for Cable 2 .Being careful not to nick the conductor. Remove hose clamp. Leave insulation on cables.
3. Chamfer extruded non-metallic screen edge of both cables for 1.25 cm minimum.

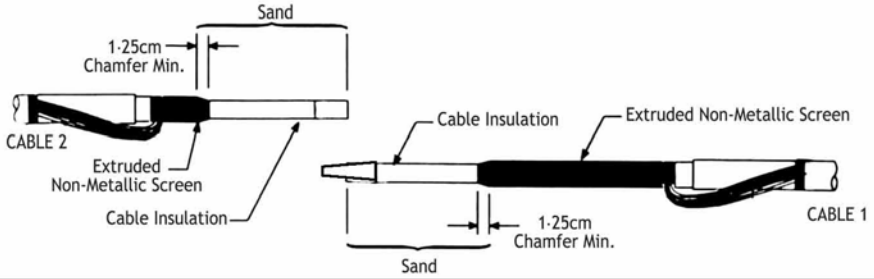
WARNING: DO NOT PENETRATE EXTRUDED NON- METALLIC SCREEN



STEP E

1-Chamfer extruded non-metallic screen edge of both cables for 1.25 cm minimum

2-Use 180 grit aluminum oxide cloth to sand out all nicks and abrasions on cable insulation. Sand smooth the chamfered Semi-conductive edge. Smooth the Insulation with 240 grit and polish with 320 grit.



STEP F

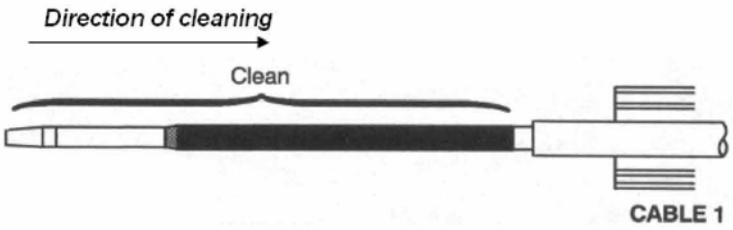
1- Wrap protection tape over the insulation and non metallic screen of both cables during storing process.

2- Store heat shrink tube sizes 18 cm* 90 cm then long copper tube half then heat shrink tube size 18cm* 60cm on outer jacket of cable 1.

3- Store heat shrink tube size 26.5cm* 125 cm then short copper tube half then heat shrink tube size 26.5cm* 100 cm on outer jacket of cable 2.

4- Remove the protection tape.

5- Using cable cleaner, clean cable insulation and extruded non-metallic screen of both cables. Wipe each cable toward the Outer Jacket to prevent semi- conductive particles from contaminating the insulation.

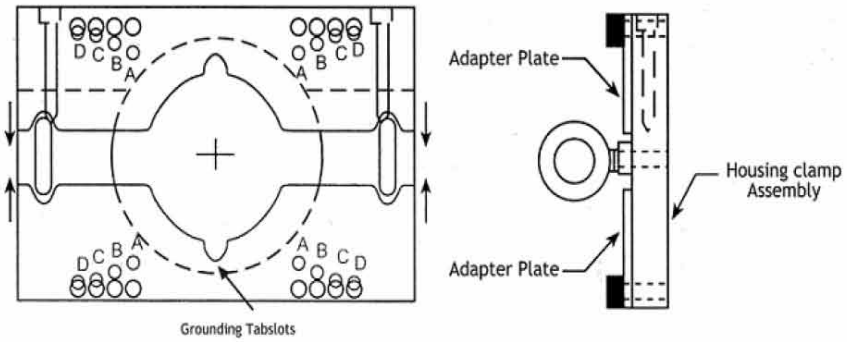


STEP G-1 WINCH ASSEMBLY

Before utilizing the joint assembly tool, inspect it for proper operation. Inspect it for rust, damaged cables, or other obvious Damage. If any of these conditions exist, the tool should be repaired or replaced.

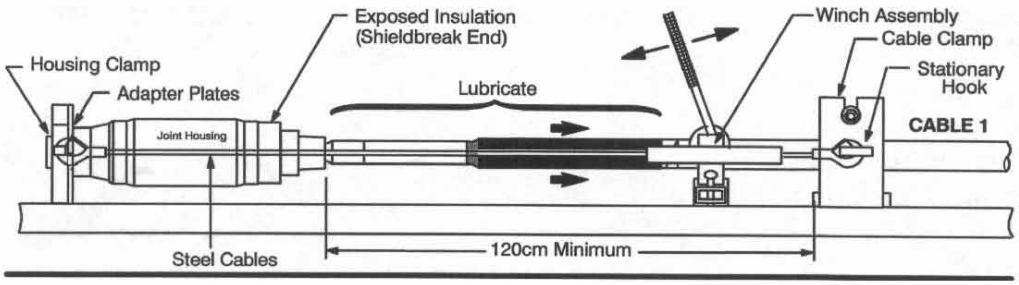
1- Determine the housing size which is branded on black stress cones of joint housing.
2- Adjust the adaptor plates to the hole corresponding to the housing size.

Housing Size	Hole Location
	A
1,2,3	B
4,5	C
6	D



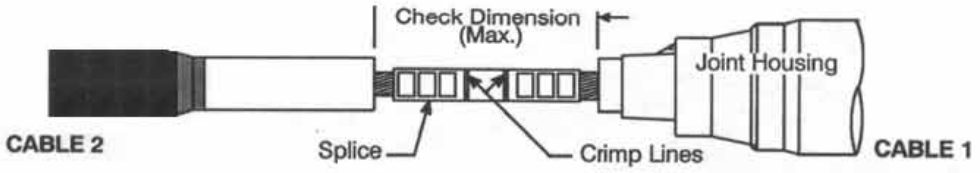
STEP G-2 JOINT ASSEMBLY TOOL PROCEDURES FOR STORING THE JOINT HOUSING

1. On Cable 1 assemble cable clamp at least 120cm back from conductor. Tighten clamp securely.
2. Place Winch Assembly in front of Cable Clamp and attach stationary hooks to Cable Clamp.
3. Attach Adapter plates to the housing clamp with bolts supplied. Assemble Housing Clamp around joint housing . Position joint housing grounding tab into slot of Housing Clamp Adapter Plates.
4. Extend steel cable(s) on Winch Assembly until hooks reach Housing Clamp. Hook cables to Housing Clamp.
5. **Thoroughly** lubricate Cable 1 in the area and direction shown only with lubricant supplied.
6. Assemble housing up to the metallic shield.
7. Release tension on each steel cable. Remove hooks from Housing Clamp and Cable Clamp.
8. Remove Assembly Tool.



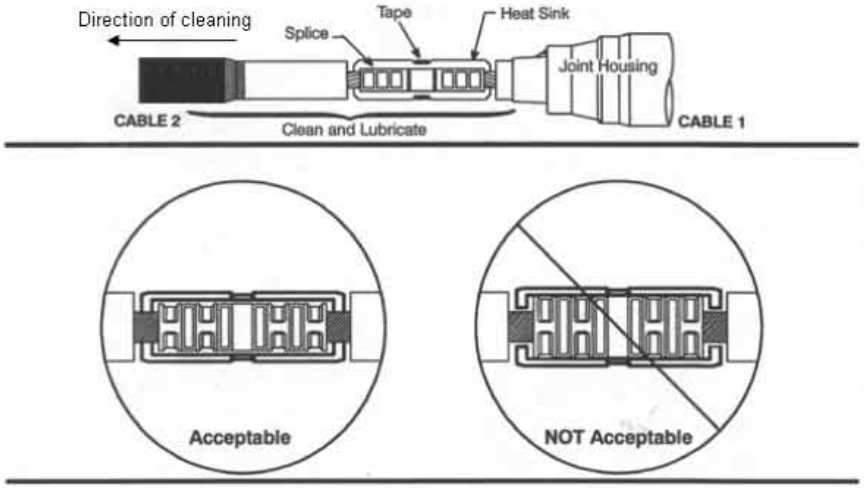
STEP H CRIMPED CONNECTOR

1. Remove cut section of insulation on both cables to expose the conductor.
2. Wire brush the conductors of Cable 1 and Cable 2 then **immediately** insert into the splice. BE SURE conductors are fully inserted into the splice.
3. Check dimension (before crimping) should not exceed 20.3cm, otherwise redo assembly.
4. Crimp the splice, locating first crimp on each cable next to the crimp line. BE SURE check dimension (after crimping)does not exceed 22.0 cm ;otherwise redo assembly.
5. Clean the insulation of cable 2.



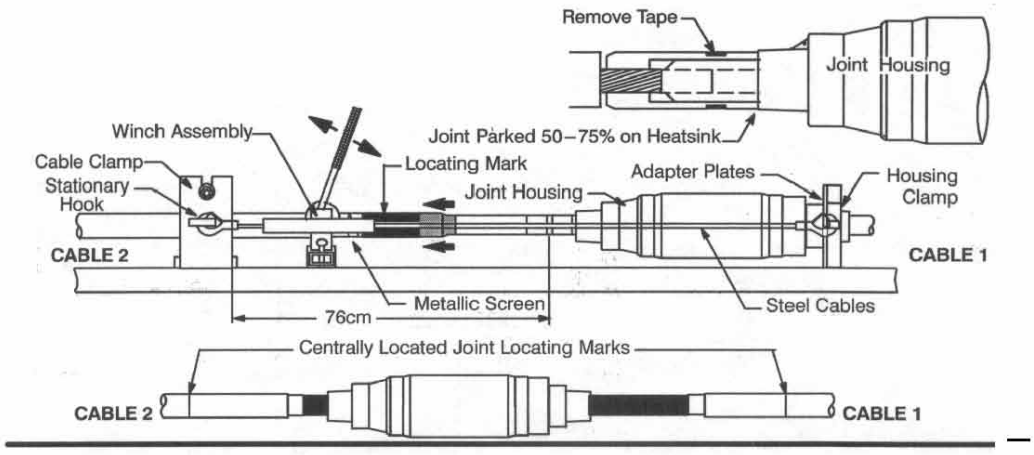
STEP I

1- Center heat sink between insulation of cable 1 and cable 2.Wrap two(2)layers of tape around heat sink.
2- Clean and lubricate the insulation of cable 1 and cable 2 and the outside of heat sink



STEPJ ASSEMBLY TOOL PROCEDURES FOR CENTERING JOINT

1. Assemble Cable Clamp onto Cable 2 at least 76cm back from center of conductor.Tighten Clamp securely.
2. Place Winch Assembly in front of Cable Clamp and attach the stationary hooks to Cable Clamp.
3. Assemble Housing Clamp around joint housing with adapter plates facing housing. Position joint housing grounding tab into slot of Housing Clamp Adapter Plates.
4. Extend steel cable(s) on Winch Assembly until hooks reach Housing Clamp. Hook cables to Housing Clamp.
5. Pull joint housing towards cable 2 until the joint is 50 to 75% parked on the first half of the heat sink as shown, Remove the tape.
6. Pull joint housing towards Cable 2 until the joint housing is centered between locating marks. **Do not pull the joint housing past locating marks**. If the housing is pulled beyond the locating marks the procedure must be repeated with the Assembly Tool on Cable 1.
7. Release tension on each steel cable. Disconnect hooks from Housing Clamp and Cable Clamp. Remove both clamps.



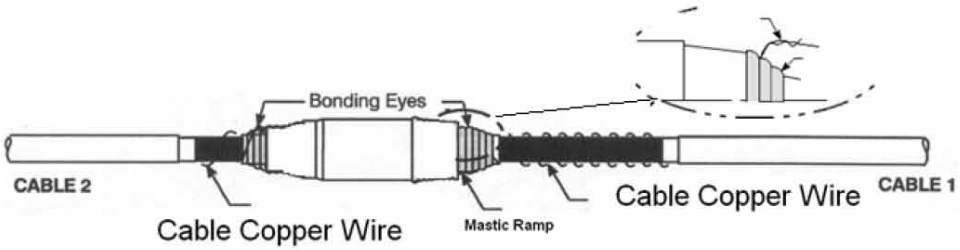
STEP K SHIELDBREAK JOINT HOUSING BONDING PROCEDURE

1- Wrap copper mesh tape with 50% overlap over the joint housing to be fully covered.

2- Attach copper wire of the cable to the housing bonding eye of cable 1.Wrap it around extruded non-metallic screen towards the lead edge then fold it with copper wires folded before as indicated below. Repeat for cable 2.

3- Build a ramp of mastic tape in the stress cone step on both sides of joint housing. See detail.

4- Connect the metallic screen wires of both cables with suitable connectors



STEP L

1- Slide the heat shrink tube size 18 cm * 60 cm over the non metallic screen of cable 1 then shrink it using suitable flame until it is completely and uniformly shrinkage.

2- Slide the heat shrink tube 26.5* 100 cm over the non metallic screen of cable 2 and the joint body and overlap the edge of the heat shrink tube 18 cm * 60 cm then shrink it using suitable flame until it is completely and uniformly shrinkage.

STEP M

1- Slide the supplied copper tube (two halfs) into each other firmly then carefully weld to each other.

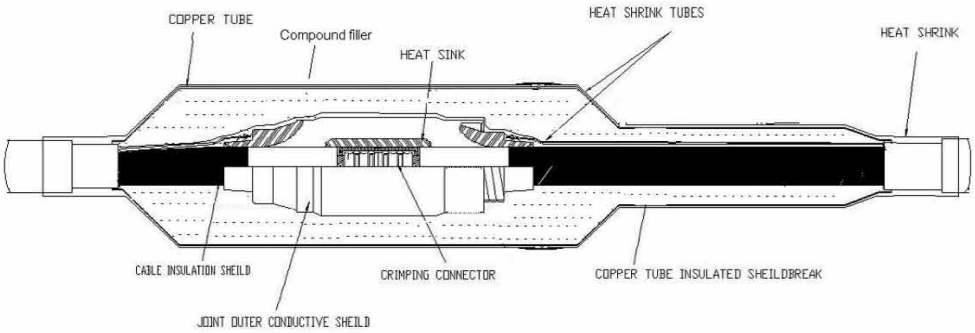
2- Using the supplied lead sheet, full the space between the cable lead and copper tube end (if applicable) then weld to the lead screen. Repeat for both sides.

3- Mix the compound filler, with its hardener, be sure that it's completely mixed then slowly pour the it into copper tube and allow it to be hard.

4- Apply insulating tape then mastic tape over the welding areas of the two half's of copper tube with lead sheath.

5- Slide the heat shrink tube size 18 cm* 90 cm over the long half copper tube then shrink it using suitable flame until it is completely and uniformly shrinkage.

6- Slide the heat shrink 26.5 cm* 125 cm over the middle of copper tube then shrink it using suitable flame until it is completely and uniformly shrinkage.



STEP N : FITTING THE COFFIN BOX

1- Position bottom half of coffin box under joint housing

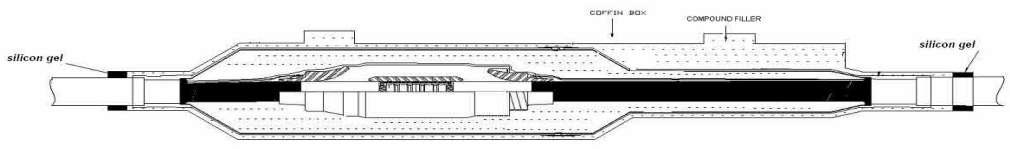
2- Place silicon gel/ mastic tape over the edges of the coffin box and at ends where cable fits.

3- Bolt two half's of coffin box together

4- Support coffin box and cables with supports.

5- Mix the compound filler, be sure that it is completely mixed then slowly pour into coffin box and leave it sometime to be hard.

6 Check for leaks around seals as you proceed then place the top cover of the coffin box.



ELSEWEDY CABLES

Kit content for Straight Cable Joint 138TCJ1N4-6 2000mm2, 132kv

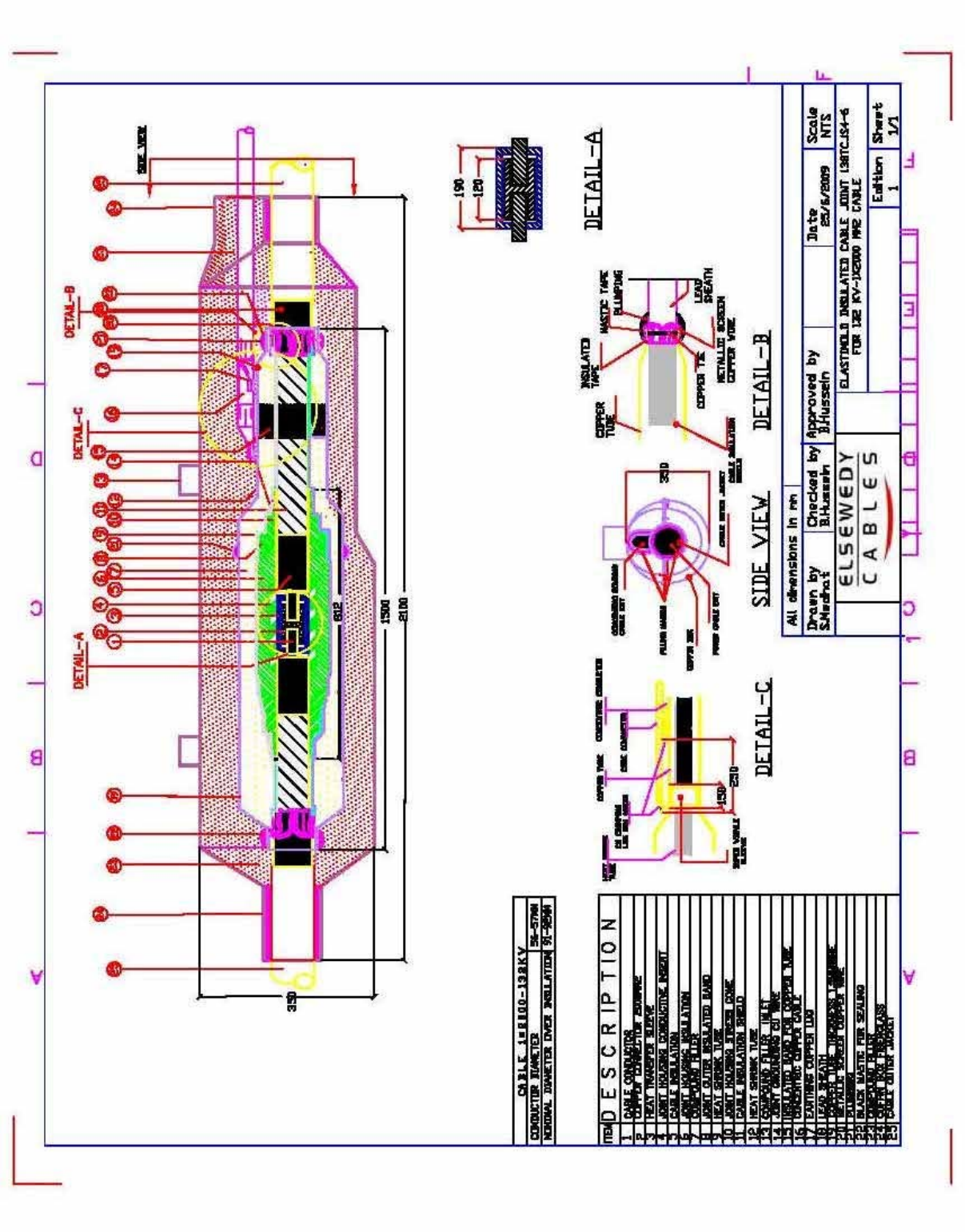
item	description	Code	Manufacturer	Country of origin	quantity
1	Housing 138TCJ1N4-6 (Elastimold U.S.A – Size6)	11101004051005	Elastimold	U.S.A	1
13	Silicon grease	11113001011025	Elastimold	U.S.A	150gm
2	Conductor copper connector	11102002042180	Elsewedy	Egypt	1
3	Heat sink	11102003012360	Elsewedy	Egypt	1
4	Tube 265/75-1000	11103002131027	Elsewedy	Egypt	1
5	Tube 265/75-1250	11103002131029	Elsewedy	Egypt	1
6	Tube 180/60-900	11103002112085	Elsewedy	Egypt	1
7	Tube 180/60-600	11103002121086	Elsewedy	Egypt	1
17	Earthing copper connector	11102001011132	Elsewedy	Egypt	5
9	straight copper tube	11115001012090	Elsewedy	Egypt	1
10	Coffin box	11115001011025	Elsewedy	Egypt	1
22	Copper mesh	11106001013010	Imported	--------	16mt
11	Black mastic tape	11105001012013	Imported	---------	6mt
23	Self amalgamating tape reel	1110501013010	Imported	---------	3
24	Silicon gel tube	8400345	Imported	--------	15
12	PVC tape	11105001011010	Local	Egypt	1
8	Wrap sleeve-400	1390017	Elsewedy	Egypt	2
14	Sand paper 180	11113001014012	Local	Egypt	3
15	Sand paper 320	11113001014013	Local	Egypt	3
16	Sand paper 400	11113001014014	Local	Egypt	3

18	Cleaning solvent	11204103011001	Local	Egypt	2
19	cleaning cloth	11113001013010	Local	Egypt	36
20	Welding agent	11106003011028	Local	Egypt	1
21	Cooling agent	11106003011023	Local	Egypt	2
27	Compound filler	11110001012050	Local	Egypt	10 barrel
28	Instruction sheet	**11112001012057**	Local	Egypt	1

APPENDIX F MANUFACTURER'S DRAWING/DATA SHEET CROSS-BONDING JOINT

12 pages (including this page)

drawing no./document no.	revision	date	title
-	1	2009-06-25	elastimold insulated cable joint 138TCJS4-6
IS-TCS4	2	November 2008	installation instruction TCJS4
-	-	-	kit content for isolated cable joint 138TCJ1S4-6 (2 pages)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ELASTIMOLD INSULATED CABLE JOINT 132KV-S4-6
FOR 132 KV-1X2000 MM2 CABLE
CABLE 1x1200-132KV
CONDUCTOR DIAMETER 56-67MM
NOMINAL DIAMETER OVER INSULATION 91-95MM
1500
2100
612
350

ELASTIMOLD

Installation Instructions
TCJS4

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STEP B

1. Place cables in FINAL position and square cut cables .
2. Carefully remove outer jacket to expose the lead sheath of Cable 1 for a distance of 98.2cm and Cable 2 for a distance of 60.2cm.
3. Carefully remove the lead sheath of both cables to within 7 cm of outer jacket end.
4. Fold back the metallic screen wires of both cables and keep only 60 mm for both sides then cut the extra lengths and tape ends of wires to lead sheath.
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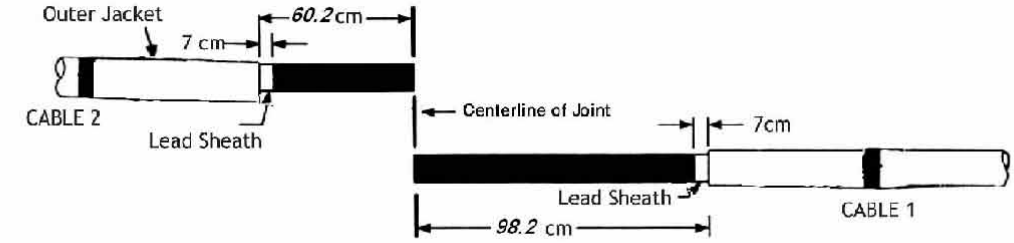

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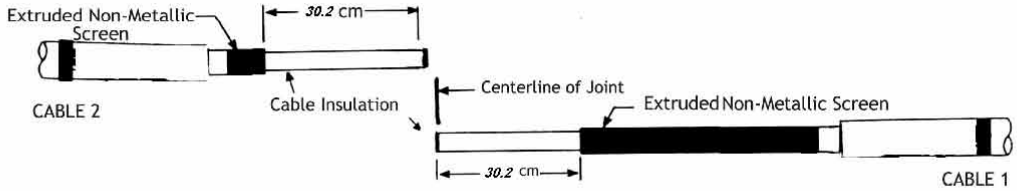

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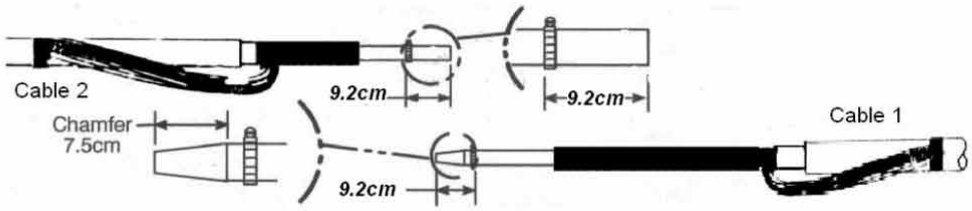

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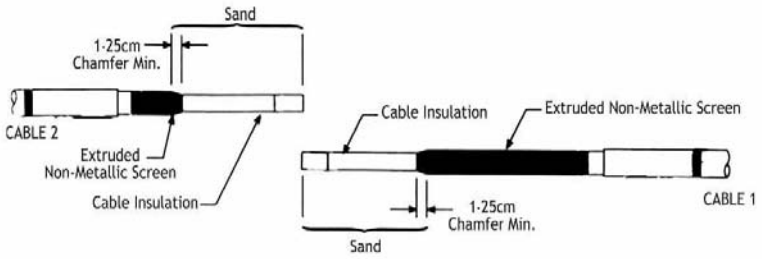

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1- Wrap protection tape over the insulation and non metallic screen of both cables during storing process.

2- Store heat shrink tube sizes 18 cm* 90 cm then long copper tube half then heat shrink tube size 18cm* 60cm on outer jacket of cable 1.

3- Store heat shrink tube size 26.5cm* 125 cm then short copper tube half then heat shrink tube size 26.5cm* 100 cm on outer jacket of cable 2.

4- Remove the protection tape.

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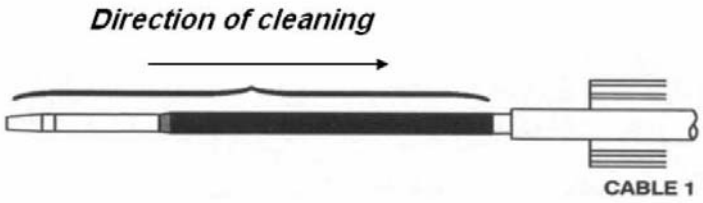

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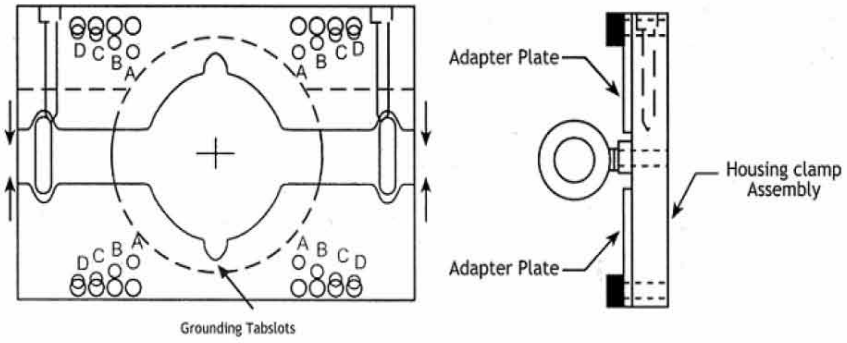
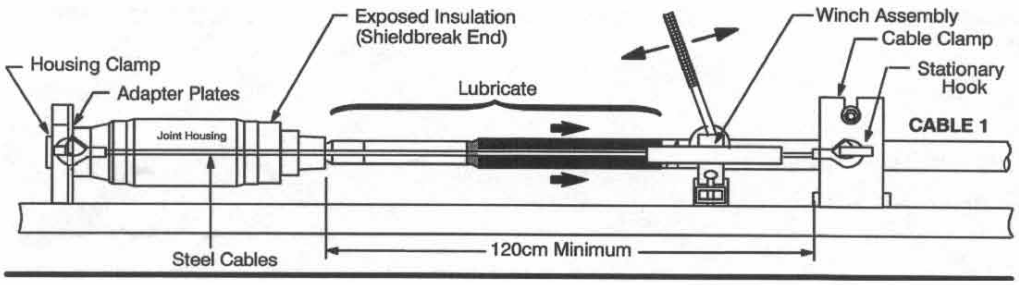


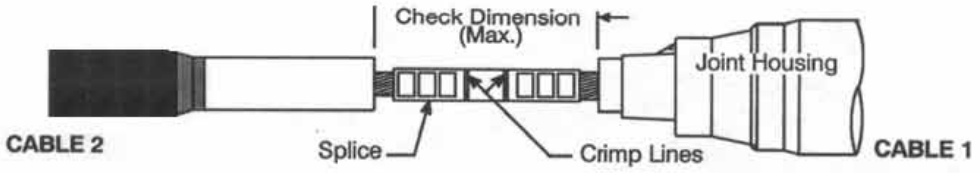
STEP G-2 JOINT ASSEMBLY TOOL PROCEDURES FOR STORING THE JOINT HOUSING

1. On Cable 1 assemble cable clamp at least 120cm back from conductor. Tighten clamp securely.
2. Place Winch Assembly in front of Cable Clamp and attach stationary hooks to Cable Clamp.
3. Position the exposed insulation (shield break end) of the housing onto the cable first.
4. Attach Adapter plates to the housing clamp with bolts supplied. Assemble Housing Clamp around joint housing . Position joint housing grounding tab into slot of Housing Clamp Adapter Plates.
5. Extend steel cable(s) on Winch Assembly until hooks reach Housing Clamp. Hook cables to Housing Clamp.
6. **Thoroughly** lubricate Cable 1 in the area and direction shown only with lubricant supplied.
7. Assemble housing up to the metallic shield.
8. Release tension on each steel cable. Remove hooks from Housing Clamp and Cable Clamp.
9. Remove Assembly Tool.



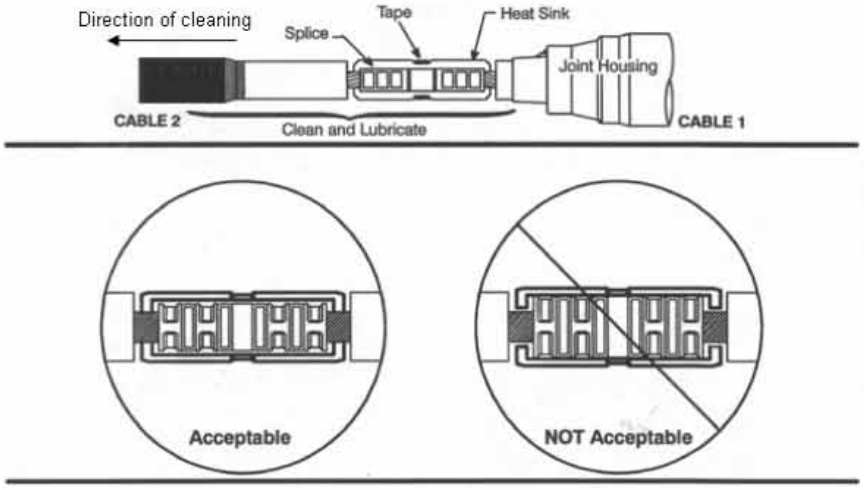
STEP H CRIMPED CONNECTOR

1. Remove cut section of insulation on both cables to expose the conductor.
2. Wire brush the conductors of Cable 1 and Cable 2 then **immediately** insert into the splice. BE SURE conductors are fully inserted into the splice.
3. Check dimension (before crimping) should not exceed 20.3cm, otherwise redo assembly.
4. Crimp the splice, locating first crimp on each cable next to the crimp line. BE SURE check dimension (after crimping)does not exceed 22.0 cm ;otherwise redo assembly.
5. Clean the insulation of cable 2.



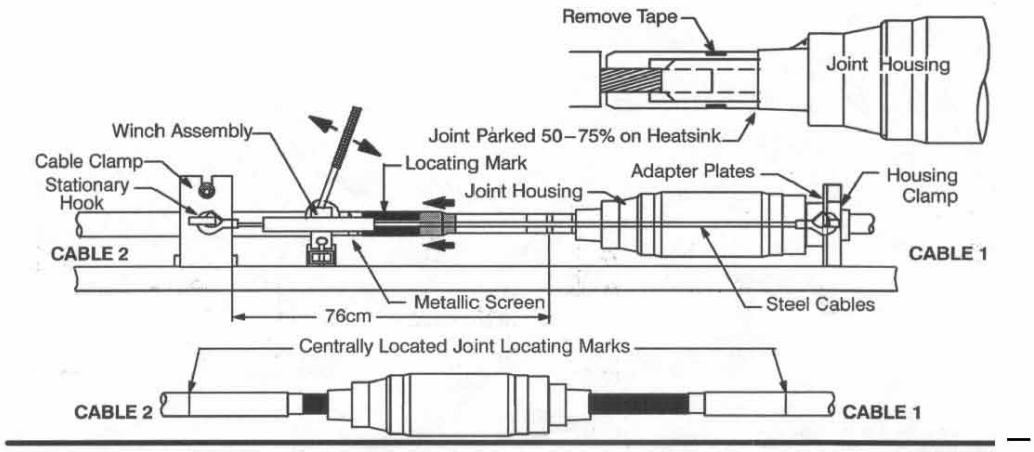
STEP I

1- Center heat sink between insulation of cable 1 and cable 2.Wrap two (2)layers of tape around heat sink.
2- Clean and lubricate the insulation of cable 1 and cable 2 and the outside of heat sink



STEPJ ASSEMBLY TOOL PROCEDURES FOR CENTERING JOINT

1. Assemble Cable Clamp onto Cable 2 at least 76cm back from center of conductor.Tighten Clamp securely.
2. Place Winch Assembly in front of Cable Clamp and attach the stationary hooks to Cable Clamp.
3. Assemble Housing Clamp around joint housing with adapter plates facing housing. Position joint housing grounding tab into slot of Housing Clamp Adapter Plates.
4. Extend steel cable(s) on Winch Assembly until hooks reach Housing Clamp. Hook cables to Housing Clamp.
5. Pull joint housing towards cable 2 until the joint is 50 to 75% parked on the first half of the heat sink as shown, Remove the tape.
6. Pull joint housing towards Cable 2 until the joint housing is centered between locating marks. **Do not pull the joint housing past locating marks**. If the housing is pulled beyond the locating marks the procedure must be repeated with the Assembly Tool on Cable 1.
7. Release tension on each steel cable. Disconnect hooks from Housing Clamp and Cable Clamp. Remove both clamps.

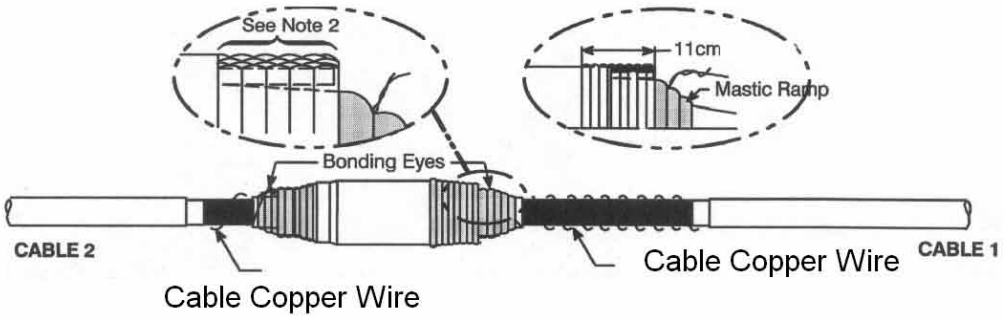


STEP K SHIELDBREAK JOINT HOUSING BONDING PROCEDURE

1- Attach copper wire of the cable to the housing bonding eye of cable 1.Wrap it around extruded non-metallic screen towards the lead edge then fold it with copper wires folded before as indicated below. Repeat for cable 2.

2- On shield break side of housing (exposed insulation) wrap the shown area, see detail (2) .Use the entire roll of insulating tape. Starting with the exposed insulation , wrap the stretched tape ; apply half-lapped layers back and forth within the exposed area , about 8 layers .When the taped area is equal in height / thickness to the conductive jacket over the housing , then include the jacket in the taping , making the taped shield break about 11 cm in overall length .

3- Build a ramp of mastic tape in the stress cone step on both sides of joint housing. See detail.



STEP L

1- Slide the heat shrink tube size 18 cm * 60 cm over the non metallic screen of cable 1 then shrink it using suitable flame until it is completely and uniformly shrinkage.

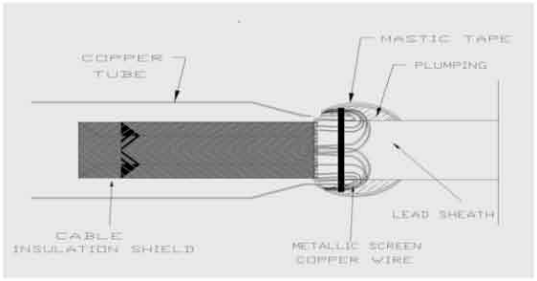
2- Slide the heat shrink tube 26.5* 100 cm over the non metallic screen of cable 2 and the joint body and overlap the edge of the heat shrink tube 18 cm * 60 cm then shrink it using suitable flame until it is completely and uniformly shrinkage.

STEP M

1- Slide the supplied copper tube (two halfs) into each other firmly then carefully weld to each other.

2- At the end of the copper tubes half's, put the copper wires (folded back before) and the grounding wire above the copper tube end.

3- Using the supplied lead sheet, full the space between the cable lead and copper tube end (if applicable) then weld all of them (copper tube end + copper wires+ grounding wire) to the lead screen. Repeat for both sides.



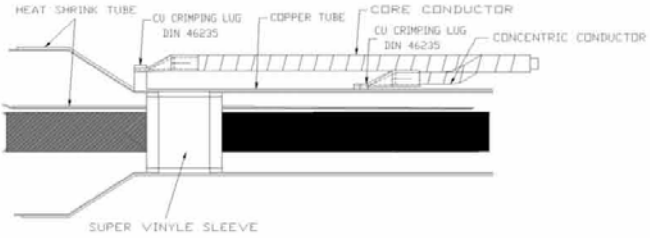
4- Mix the compound filler, with its hardener, be sure that it is completely mixed then slowly pour the it into copper tube and allow it to be hard .

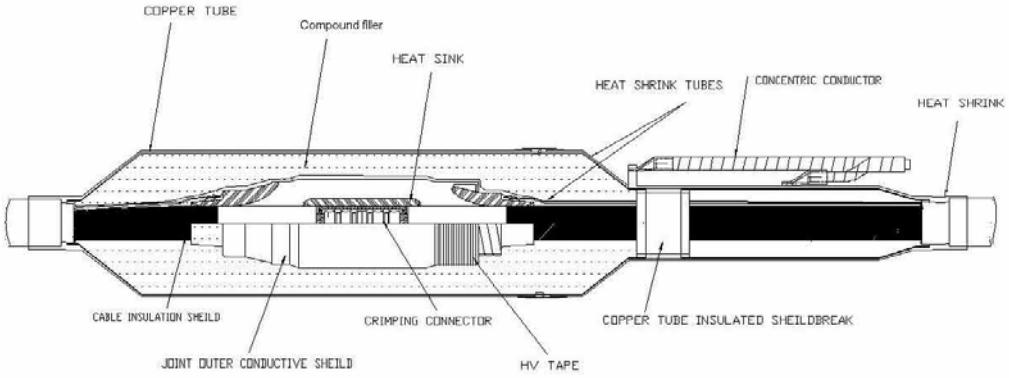
5- Apply insulating tape over the insulation part of the copper tube and insulating tape then mastic tape over the welding areas of the two half's of copper tube with lead sheath.

6- Slide the heat shrink tube size 18 cm* 90 cm over the long half copper tube then shrink it using suitable flame until it is completely and uniformly shrinkage.

7- Slide the heat shrink 26.5 cm* 125 cm over the middle of copper tube and the short half copper tube then shrink it using suitable flame until it is completely and uniformly shrinkage.

8- Prepare the concentric grounding cable and crimp supported lugs then bolt lugs in their places on copper tube then Slide the heat shrink 5.5 cm* 75 cm over the cable then shrink it using suitable flame until it is completely and uniformly shrinkage.





STEP N : FITTING THE COFFIN BOX

1- Position bottom half of coffin box under joint housing

2- Place silicon gel / mastic tape over the edges of the coffin box and at ends where cable fits.

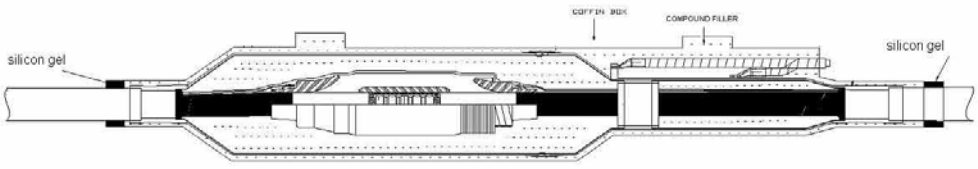
3- Pass the concentric cable by cutting its outlet in coffin box.

4- Bolt two half's of coffin box together then Shrink the heat shrink tube 12.4cm* 25 cm over the concentric cable and the outlet.

5- Support coffin box and cables with supports.

6- Mix the compound filler, be sure that it is completely mixed then slowly pour into coffin box and leave it sometime to be hard.

7- Check for leaks around seals as you proceed then place the top cover of the coffin box.



ELSEWEDY CABLES

Kit content for Straight Cable Joint 138TCJ1N4-6 2000mm2, 132kv

item	description	Code	Manufacturer	Country of origin	quantity
1	Housing 138TCJ1N4-6 (Elastimold U.S.A – Size6)	11101004051005	Elastimold	U.S.A	1
13	Silicon grease	11113001011025	Elastimold	U.S.A	150gm
2	Conductor copper connector	11102002042180	Elsewedy	Egypt	1
3	Heat sink	11102003012360	Elsewedy	Egypt	1
4	Tube 265/75-1000	11103002131027	Elsewedy	Egypt	1
5	Tube 265/75-1250	11103002131029	Elsewedy	Egypt	1
6	Tube 180/60-900	11103002112085	Elsewedy	Egypt	1
7	Tube 180/60-600	11103002121086	Elsewedy	Egypt	1
17	Earthing copper connector	11102001011132	Elsewedy	Egypt	5
9	straight copper tube	11115001012090	Elsewedy	Egypt	1
10	Coffin box	11115001011025	Elsewedy	Egypt	1
22	Copper mesh	11106001013010	Imported	--------	16mt
11	Black mastic tape	11105001012013	Imported	---------	6mt
23	Self amalgamating tape reel	1110501013010	Imported	---------	3
24	Silicon gel tube	8400345	Imported	--------	15
12	PVC tape	11105001011010	Local	Egypt	1
8	Wrap sleeve-400	1390017	Elsewedy	Egypt	2
14	Sand paper 180	11113001014012	Local	Egypt	3
15	Sand paper 320	11113001014013	Local	Egypt	3
16	Sand paper 400	11113001014014	Local	Egypt	3

18	Cleaning solvent	11204103011001	Local	Egypt	2
19	cleaning cloth	11113001013010	Local	Egypt	36
20	Welding agent	11106003011028	Local	Egypt	1
21	Cooling agent	11106003011023	Local	Egypt	2
27	Compound filler	11110001012050	Local	Egypt	10 barrel
28	Instruction sheet	**11112001012057**	Local	Egypt	1

APPENDIX G PHOTOGRAPH OF THE TEST OBJECT

APPENDIX H WATERBARRIER ANNEX H TEST