1. Test objects

Power arc device:

Type:	SDI10.2
Tightening torque:	44Nm
No of pcs:	3

2. Testing procedure

The test procedure was acc. to standard.
The marking of the power arc device was rubbed by hand for 15 s with a piece of cloth soaked with water and another 15 s with a piece of cloth soaked with petroleum spirit.
The petroleum spirit used was Mineral turpentine from KIILTO / Finland

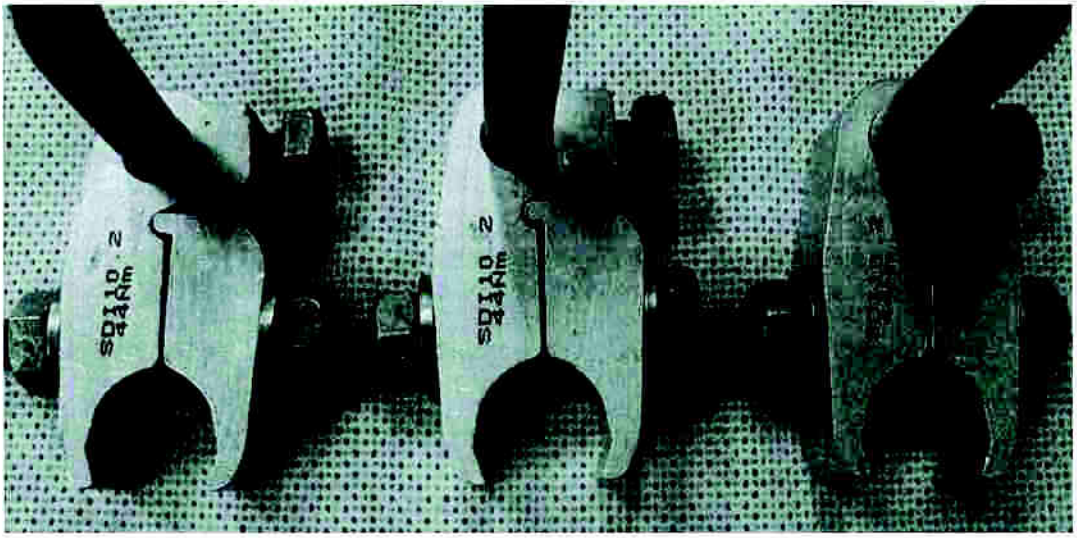
Requirement:

The marking shall remain clear and allow the accessory to be easily identified.

3. Test results

The marking remained clear and was not at all affected of the rubbing.

4. Pictures



Picture 2: Markings after test

5. Test equipment

No special test equipment needed

6. Test Id

791

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 2106S
Revision: A

Date of Test: 19.8.2010

Test object:

Tension clamp SO256.

Purpose of the test and relevant standards:

Part of type test.
Damage and failure load test for tension clamp according to EN 50397-2:2009 clause 7.4.1. Two samples were tested after gas atmosphere test (Method 2) done at Solar Simulator Finland acc. to EN 50397-2:2009 clause 7.10.1.2.2., test report: 050810_SO256_prohesion_test_Solar_TR.pdf and two samples were tested after climatic ageing test (Method 2) acc. to EN50397-2 clause 7.10.2.2., test report: 2191_SO256_UV_test_TR.docx.

Conclusion:

The clamp passed the test.

Picture 1: Tested clamp SO256

ENSTO UTILITY NETWORKS LABORATORY

Date of Report: 15.2.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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Reg. Office: Porvoo

1. Test objects

Clamp:

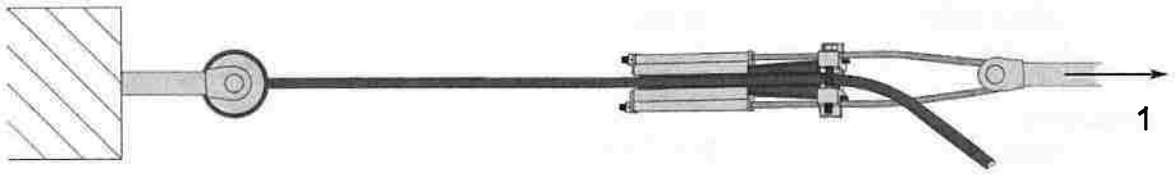
Type:	Tension clamp SO256
Batch number:	0-serie
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40 Nm
Clamp SMFL:	30 kN
No of pcs:	4

Conductors:

Type:	BLL-T 157
Used cross-section:	157 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	21,3 – 22,3 mm
Number of strands:	19
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Conductor MBL:	43,7 kN
Refer to standard:	EN50397-1

2. Testing procedure

The test was carried out as in Picture 2. The load was applied in the direction 1. The load was gradually increased until it reached the specified minimum damage load (SMDL). This load was kept constant for 60s. The fitting was then removed and measurement of any permanent deformation was done. The load was gradually increased until it reached the specified minimum failure load (SMFL). This load was kept constant for 60s.



Picture 2

Requirement:

Regarding damage load, the test is passed if no permanent deformation, which can affect the proper function of the fitting, occurs at or below the specified mechanical minimum damage load.

Regarding failure load, the test is passed if failure of the fitting does not occur at a load less than or equal to the specified minimum failure load.

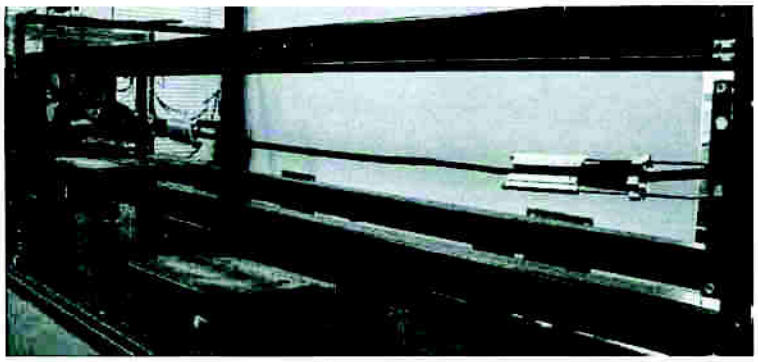
3. Test results

Sample	Conductors	SMDL [kN]	SMFL [kN]	SMDL for 60s	SMFL for 60s	Remarks
1	BLL-T 157	27	30	Passed	Passed	Test piece from prohesion test
2	BLL-T 157	27	30	Passed	Passed	Test piece from prohesion test
3	BLL-T 157	27	30	Passed	Passed	Test piece from UV test
4	BLL-T 157	27	30	Passed	Passed	Test piece from UV test

Table 1: Test data

Summary:
All samples fulfilled standard requirements.

4. Pictures



Picture 1: Test arrangment

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L110	Tensile test machine	50 kN	Tensile tests
L14	Torque wrench	BDS 80 E	Torque adjustment

6. Test Id

882

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 1938S
Revision: A
Page: 1/4
Date of Test: 8.6 and 16.6.2010

Test object:

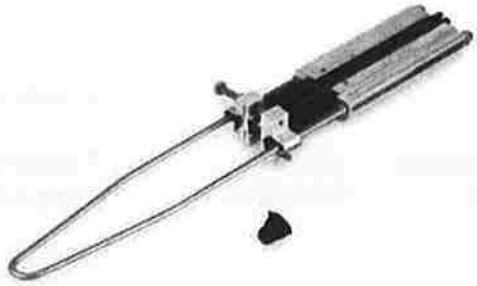
Tension clamp SO256.

Purpose of the test and relevant standards:

Part of type test.
Tensile test for tension clamps at ambient temperature according to EN 50397-2:2009 clause 7.4.7.

Conclusion:

The clamp passed the test.



Picture 1: Tested tension clamp SO256

ENSTO UTILITY NETWORKS LABORATORY

Date of Report: 11.4.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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Reg. Office: Porvoo

1. Test objects

Clamp:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40 Nm
Clamp SMFL:	30 kN
No of pcs:	6

Conductors:

Type:	SAX-W 95
Used cross-section:	95 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	16,1 mm
Number of strands:	7
Insulation material:	XLPE
Conductor material:	AlMgSi
Conductor MBL:	30,4 kN
Refer to standard:	EN50397-1

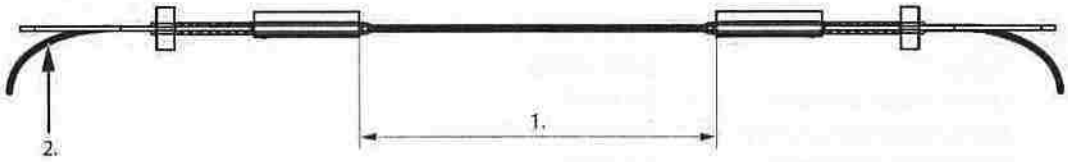
Type:	SAX-W 120
Used cross-section:	120 mm2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	17,6 mm
Number of strands:	7
Insulation material:	XLPE
Conductor material:	AlMgSi
Conductor MBL:	38 kN
Refer to standard:	EN50397-1

Type:	SAX-W 150
Used cross-section:	150 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	18,9 mm
Number of strands:	19
Insulation material:	XLPE
Conductor material:	AlMgSi
Conductor MBL:	47,3 kN
Refer to standard:	EN50397-1

АКЦИОНЕРНО ДРУЖЕСТВО ФИЛКАБ 16 ПЛОВДИВ
ВЯРНО С ОРИГИНАЛА

2. Testing procedure

Two tension clamps were installed in each end of the conductor, see Picture 2. The distance between clamps [1] was 100 x core diameter and the length of the tails [2] was approximately 500mm. The clamping pieces of the clamps were tightened to the nominal tightening torque. The arrangement was installed into a tensile test machine. The load of the arrangement was increased to 20% of SMFL. Then the conductor was marked at the end of the wedges. The load was then increased gradually until it reaches 60% of SMFL and kept there for 60s. After that the load was increased to SMFL and kept there for 60s. The load was then increased until failure occurred.



Picture 2

Requirement:

The test is passed if the movement of the conductor relative the clamp is less than 3 mm. Also no failure of the clamp or covered conductor occurs below the SMFL. SMFL=0,8 x conductor MBL.

Deviation

For some conductors the SMFL (80% of MBL) is higher than SMFL specified for the tension clamp. In these cases the SMFL specified for the tension clamp is used.

3. Test results

Sample	Conductors	MBL [kN]	20% of SMFL [kN]	60% of SMFL [kN]	SMFL [kN]	Result	Broke [kN]	Breaking point
1	SAX-W 95	30,4	4,86	14,59	24,32	OK	31,85	Conductor
2	SAX-W 95	30,4	4,86	14,59	24,32	OK		
3	SAX-W 120	38	6,08	18,24	30,4	OK	37,8	Clamp
4	SAX-W 120	38	6,08	18,24	30,4	OK		
13	SAX-W 150	47,3	6	18	30	OK	34	Clamp
14	SAX-W 150	47,3	6	18	30	OK		

Table 1: Test data

Summary: All samples fulfilled the test requirements.

4. Pictures

Picture 3: Test setup in tensile test machine

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L110	Tensile test machine	50 kN	Tensile tests
L14	Torque wrench	BDS 80 E	Torque adjustment

6. Test Id

850

7. Revision history

A

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО ФИЛКАБ 16 ПЛОВДИВ

Saves Your Energy

LABORATORY REPORT
No.: 1939S
Revision: A

Date of Test: 8.6.2010

Test object:

Waterproof tension clamp SO256.

Purpose of the test and relevant standards:

Tensile test for tension clamps at ambient temperature according to EN 50397-2:2009 clause 7.4.7.

Conclusion:

The tension clamp passed the test.

Picture 1: Tested tension clamp SO256

ENSTO UTILITY NETWORKS LABORATORY

Date of Report: 18.10.2010

Tested by: Patrick Ekholm

Reviewed by: Janne Lappalainen

Witnessed by: Sami Hakonen / SGS Fimko

Ordered by: V.Vilenius
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1. Test objects

Clamp:

Type:	Waterproof tension clamp SO256
Batch number:	0-serie
Conductor range:	95 – 157 mm^2
Tightening torque:	40 Nm
Clamp SMFL:	30 kN
No of pcs:	4

Conductors:

Type:	BLL-T 99
Used cross-section:	99 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	17,8 - 18,8 mm
Number of strands:	7
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Conductor MBL:	25,3 kN
Refer to standard:	EN50397-1

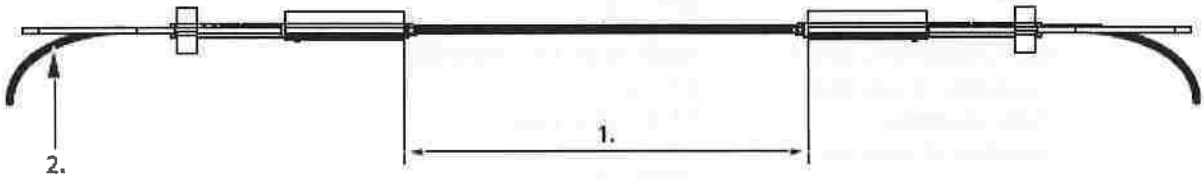
Type:	BLL-T 157
Used cross-section:	157 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	21,3 – 22,3 mm
Number of strands:	19
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Conductor MBL:	43,7 kN
Refer to standard:	EN50397-1

ВЯРНО С ОРИГИНАЛА

ФИЛИАЛ 16

2. Testing procedure

Two tension clamps were tested for each conductor cross-section. The tension clamps were assembled upon the conductor according to manufacturers' instructions. The test arrangement can be seen in picture 2. The test load SMFL was SMFL = 0,8 x conductor MBL. The load was increased to 20% of SMFL. Then the conductor was marked where it exits from the tension clamp. The load was then gradually increased to 60% of SMFL and kept there for 60 s. Without any subsequent adjustment of the fitting the load was increased to SMFL and kept there for 60 s. After this the tension clamps where then checked for any movement relative the conductor. Then the load was steadily increased until failure occurred. The failure load was recorded.



Picture 2: Tensile test arrangement

1. Min. 100 x covered conductor diameter
2. Length of tail 500mm

Requirement:

The movement of the tension clamp relative the conductor shall be less than 3 mm and no failure of the clamp or the cover conductor shall occur below SMFL.

3. Test results

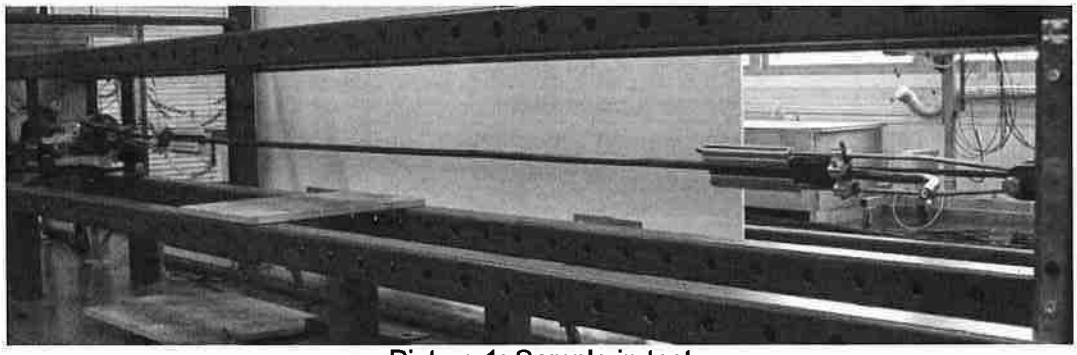
Sample	Conductors	MBL [kN]	20% of SMFL [kN]	60% of SMFL [kN]	SMFL [kN]
7	BLL-T 99	25,3	4,05	12,14	20,24
8	BLL-T 99	25,3	4,05	12,14	20,24
9	BLL-T 157	43,7	7	20,98	34,96
10	BLL-T 157	43,7	7	20,98	34,96

Table 1: Tension during test

Sample	Conductors	Result	Broke [kN]	Breaking point
7	BLL-T 99	No slippage at SMFL	29,4	Conductor
8	BLL-T 99	No slippage at SMFL		
9	BLL-T 157	No slippage at SMFL	44,5	Clamp
10	BLL-T 157	No slippage at SMFL		

Summary: All samples fulfilled the test requirements.

4. Pictures



Picture 1: Sample in test

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L109	Tensile test machine	170 kN	Tensile tests
L14	Torque wrench	BDS 80 E	Torque adjustment

6. Test Id

850

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 2087S
Revision: A

Date of Test: 25.10 – 27.10.2010

Test object:

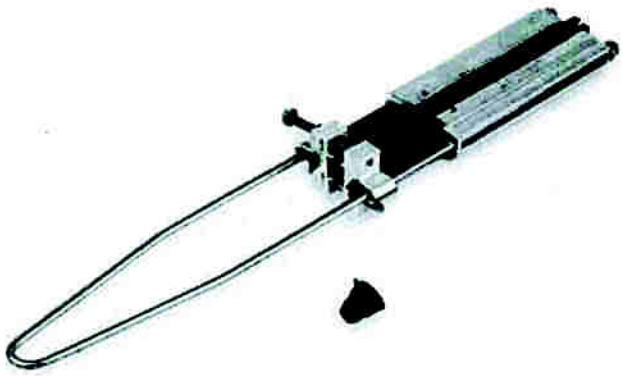
Tension clamp SO256.

Purpose of the test and relevant standards:

Part of type test.
Tensile test for tension clamp at low temperature according to EN 50397-2:2009 clause 7.4.8.

Conclusion:

The clamp passed the test.



Picture 1: Tested clamp SO256

ENSTO
UTILITY NETWORKS
LABORATORY

Date of Report: 1.3.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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ВЕРНО С ОРИГИНАЛА
АКЦИОНЕРНО ДРУЖЕСТВО ФИЛКАБ

1. Test objects

Clamp:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40Nm
SMFL:	30kN (AlMgSi), 20kN (FeAl)
No of pcs:	6

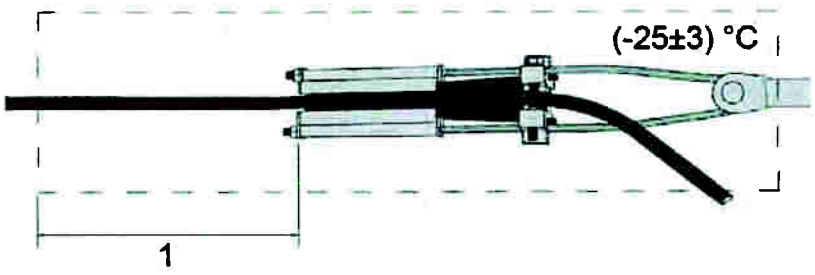
Conductors:

Type:	BLL-T 99
Used cross-section:	99 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	17,8 – 18,8 mm
Number of strands:	7
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Conductor MBL:	25,3 kN
Refer to standard:	EN50397-1

Type:	BLL-T 157
Used cross-section:	157 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	21,3 – 22,3 mm
Number of strands:	19
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Conductor MBL:	43,7 kN
Refer to standard:	EN50397-1

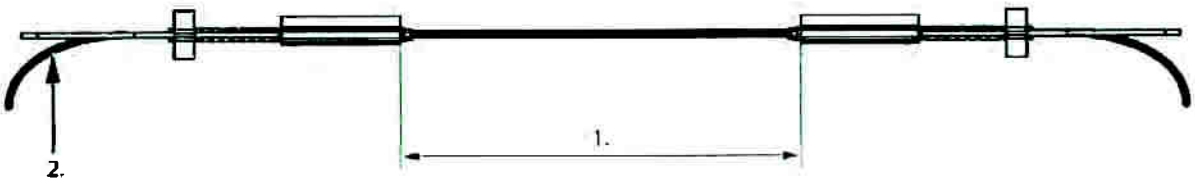
2. Testing procedure

Three tension clamps were tested in low temperature zone, see Picture 2. The clamp and 300 mm of conductor [1] was cooled down to (-25±3) °C.



Picture 2

Tension clamps were installed in each end of the conductor, see Picture 3. The distance between clamps [1] was approximately 100 x core diameter and the length of the tails [2] was approximately 500mm. The clamping pieces of the clamps were tightened to the nominal tightening torque. Two arrangements were installed into a tensile test machine. The load of the arrangements was increased to 70% of conductor MBL. Three clamps were cooled down to (-25±3) °C in one hour and kept there for one hour. The tension was the released. After the pre-tensioning the clamps were subjected to a 24h tensile test in low temperature, (-25±3) °C. Before starting the test the load of the arrangements was increased to 20% of the specified minimum slip load. Then the conductor was marked at the end of the wedges. After marking the load was increased gradually until it reaches the specified minimum slip load and kept there for 24h.



Picture 3

Requirement:

The test is passed if the movement of the conductor relative the clamp is less than 3 mm at or below specified minimum slip load. Also no damage shall occur which could affect the correct function of the clamp.

3. Test results

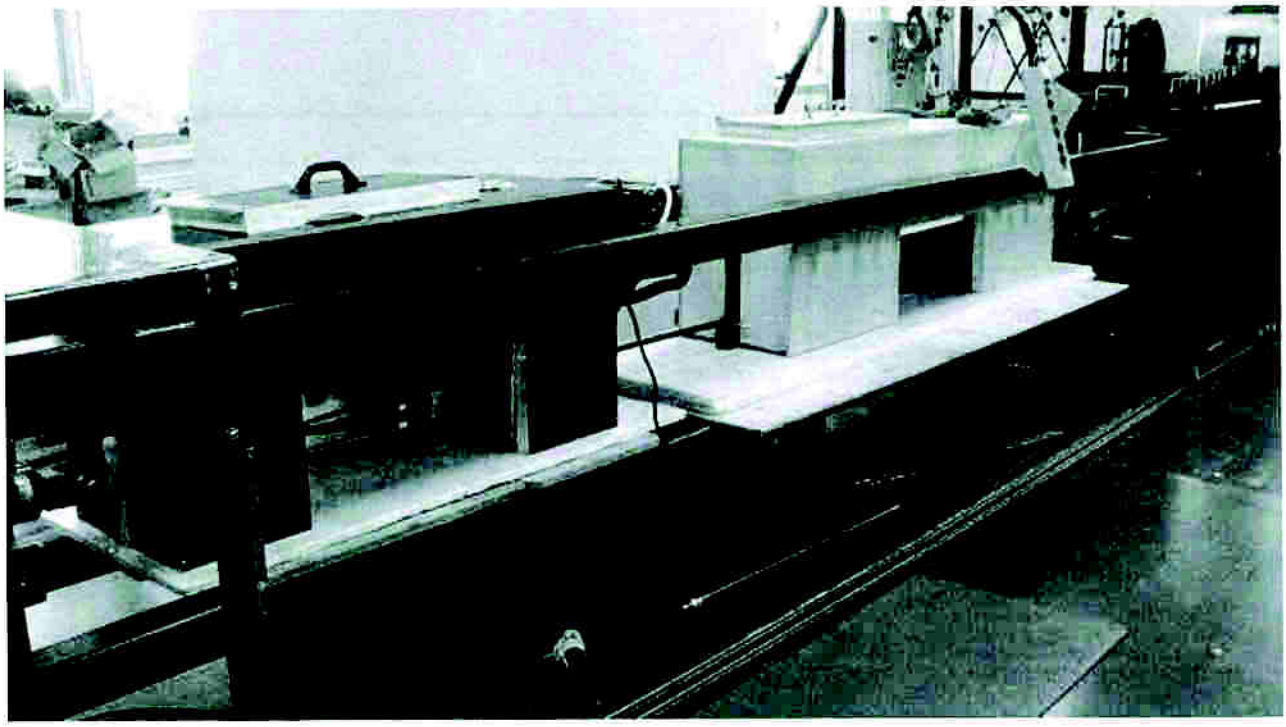
Sample	Conductors	MBL [kN]	70% of MBL [kN]	20% of SMSL [kN]	SMSL [kN]	Result
7	BLL-T 99	25,3	17,7	3,2	15,8	No slippage
8	BLL-T 99	25,3	17,7	3,2	15,8	No slippage
9	BLL-T 99	25,3	17,7	3,2	15,8	No slippage
10	BLL-T 157	43,7	30,6	5,5	27,3	No slippage
11	BLL-T 157	43,7	30,6	5,5	27,3	No slippage
12	BLL-T 157	43,7	30,6	5,5	27,3	No slippage

Table 1: Test data

Specified minimum slip load (SMSL) = MBL / 1,6

Summary:
All samples fulfilled standard requirements.

4. Pictures



Picture 4: Test setup in tensile test machine

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L14	Torque wrench	BDS 80 E	Torque adjustment
L110	Tensile test machine	50 kN	Tensile tests
C1	Cooling device -25°C	Ensto	Tensile test
C2	Cooling device -25°C	Ensto	Tensile test

6. Test Id

846

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 2089S
Revision: A

Date of Test: 16.11, 24.11 and 21.12.2010

Test object:

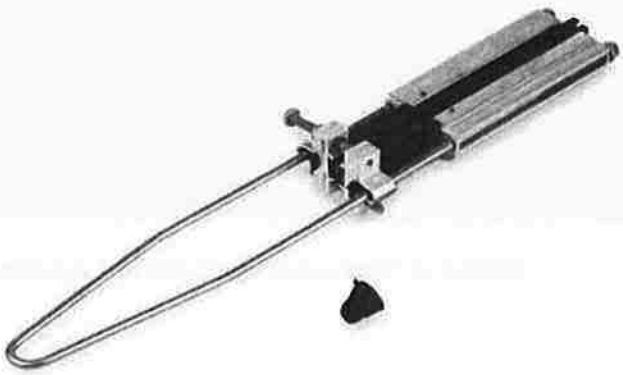
Tension clamp SO256.

Purpose of the test and relevant standards:

Part of type test.
Tensile test for tension clamp at low temperature according to EN 50397-2:2009 clause 7.4.8.

Conclusion:

The clamp passed the test.



Picture 1: Tested clamp SO256

ENSTO UTILITY NETWORKS LABORATORY

Date of Report: 1.3.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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Reg. Office: Porvoo

1. Test objects

Clamp:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40Nm
SMFL:	30kN (AlMgSi), 20kN (FeAl)
No of pcs:	9

Conductors:

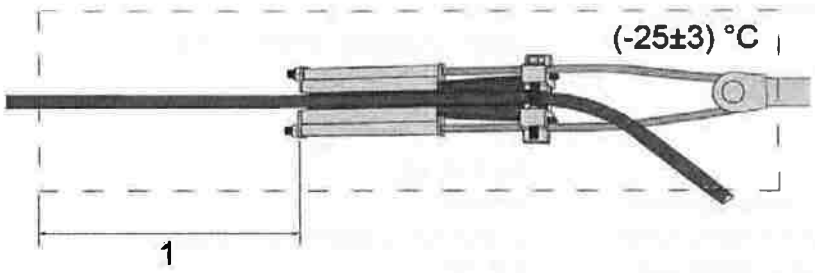
Type:	PAS-W 95
Used cross-sections:	95 mm^2
Manufacturer/Country:	Draka NK Cables Oy / Finland
Insulation thickness:	2,8 mm
Total diameter:	17 mm
Number of strands:	7
Insulation material:	XLPE
Conductor material:	AlMgSi
Conductor MBL:	27,9 kN
Refer to standard:	EN50397-1

Type:	SAX-W 120
Used cross-sections:	120 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	17,6 mm
Number of strands:	19
Insulation material:	XLPE
Conductor material:	AlMgSi
Conductor MBL:	38 kN
Refer to standard:	EN50397-1

Type:	SAX-W 150
Used cross-section:	150 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	18,9 mm
Number of strands:	19
Insulation material:	XLPE
Conductor material:	AlMgSi
Conductor MBL:	47,3 kN
Refer to standard:	EN50397-1

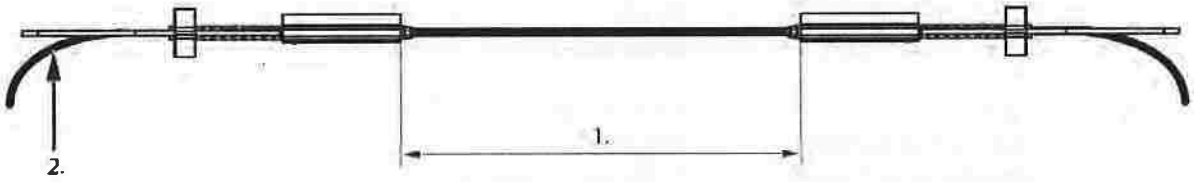
2. Testing procedure

Three tension clamps were tested in low temperature zone, see Picture 2. The clamp and 300 mm of conductor [1] was cooled down to (-25±3) °C.



Picture 2

Tension clamps were installed in each end of the conductor, see Picture 3. The distance between clamps [1] was approximately 100 x core diameter and the length of the tails [2] was approximately 500mm. The clamping pieces of the clamps were tightened to the nominal tightening torque. Two arrangements were installed into a tensile test machine. The load of the arrangements was increased to 70% of conductor MBL. Three clamps were cooled down to (-25±3) °C in one hour and kept there for one hour. The tension was the released. After the pre-tensioning the clamps were subjected to a 24h tensile test in low temperature, (-25±3) °C. Before starting the test the load of the arrangements was increased to 20% of the specified minimum slip load. Then the conductor was marked at the end of the wedges. After marking the load was increased gradually until it reaches the specified minimum slip load and kept there for 24h.



Picture 3

Requirement:

The test is passed if the movement of the conductor relative the clamp is less than 3 mm at or below specified minimum slip load. Also no damage shall occur which could affect the correct function of the clamp.

3. Test results

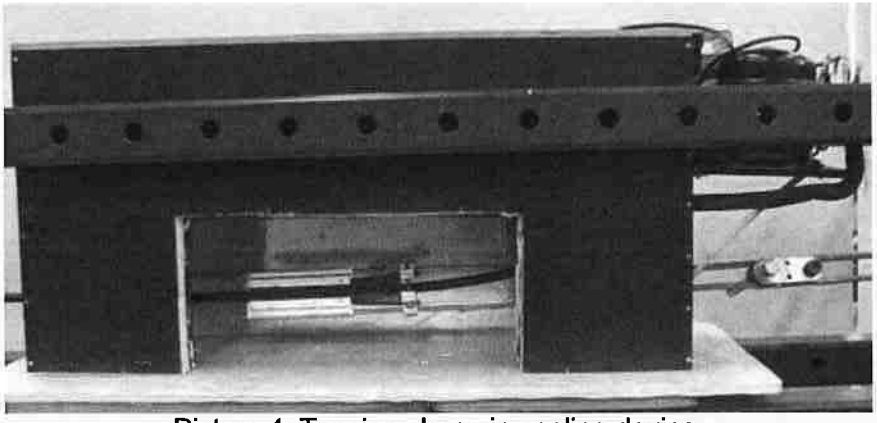
Sample	Conductors	MBL [kN]	70% of MBL [kN]	20% of SMSL [kN]	SMSL [kN]	Result
1	PAS-W 95	30,4	21,3	3,8	19	No slippage
2	PAS-W 95	30,4	21,3	3,8	19	No slippage
3	PAS-W 95	30,4	21,3	3,8	19	No slippage
13	SAX-W 120	38	26,6	4,75	23,75	No slippage
14	SAX-W 120	38	26,6	4,75	23,75	No slippage
15	SAX-W 120	38	26,6	4,75	23,75	No slippage
4	SAX-W 150	47,3	30*	5,9	29,56	No slippage
5	SAX-W 150	47,3	30*	5,9	29,56	No slippage
6	SAX-W 150	47,3	30*	5,9	29,56	No slippage
*The tensile force is restricted to clamp SMFL = 30kN						

Table 1: Test data

Specified minimum slip load (SMSL) = MBL / 1,6

Summary:
All samples fulfilled standard requirements.

4. Pictures



Picture 4: Tension clamp in cooling device

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L14	Torque wrench	BDS 80 E	Torque adjustment
L110	Tensile test machine	50 kN	Tensile tests
C1	Cooling device -25°C	Ensto	Tensile test
C2	Cooling device -25°C	Ensto	Tensile test

6. Test Id

846

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 2091S
Revision: A

Date of Test: 17.6 – 12.7 and 19.8 – 12.9.2010

Test object:

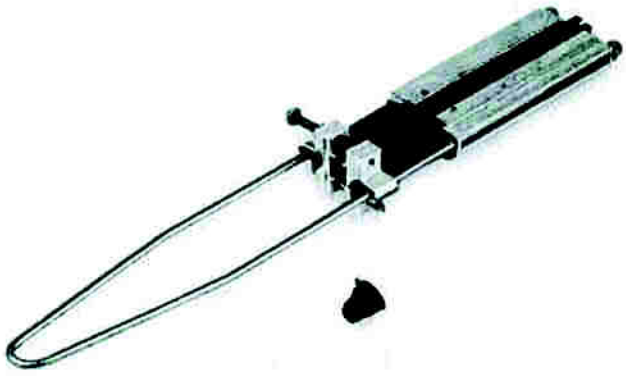
Tension clamp SO256.

Purpose of the test and relevant standards:

Part of type test.
Tensile test for tension clamp at high temperature according to EN 50397-2:2009 clause 7.4.9.

Conclusion:

The clamp passed the test.



Picture 1: Tested clamp SO256

ENSTO
UTILITY NETWORKS
LABORATORY

Date of Report: 1.3.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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Business ID: 0130215-8
Reg Office: Porvoo

1. Test objects

Clamp:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40Nm
SMFL:	30kN (AlMgSi), 20kN (FeAl)
No of pcs:	4

Conductors:

Type:	BLL-T 99
Used cross-section:	99 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	17,8 – 18,8 mm
Number of strands:	7
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Conductor MBL:	25,3 kN
Refer to standard:	EN50397-1

Type:	BLL-T 157
Used cross-section:	157 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	21,3 – 22,3 mm
Number of strands:	19
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Conductor MBL:	43,7 kN
Refer to standard:	EN50397-1

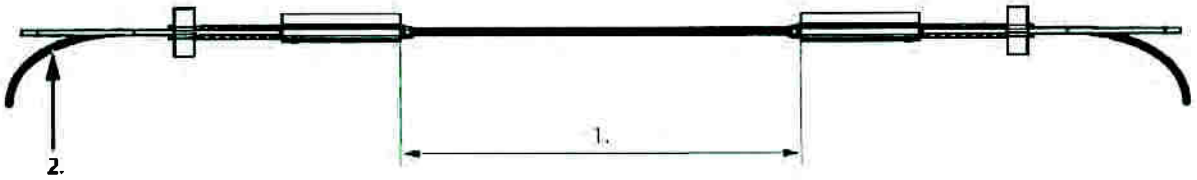
2. Testing procedure

The test was made with the maximum operating temperature of the conductor. Two tension clamps were tested. The test arrangement is shown in picture 2. The arrangement was installed in a horizontal test bench. A constant mechanical load was maintained throughout the test. The test load was 10% or 15% of conductor MBL. The test load was stabilised at ± 10 % and maintained for a period of at least 6 hours at ambient temperature. After the pre-tightening the test consisted of 100 heat cycles at a rate of maximum four cycles per day.

The heat cycle conditions:

- The conductor temperature was gradually increased to the maximum operating temperature of the conductor ± 5 K, in less than 2 hours.
- The high temperature was maintained for 4 hours.
- The test arrangement was allowed to cool down to ambient temperature naturally.

The heating of the conductor was made with an AC transformer. The temperature of the conductor was measured underneath the covering with a thermocouple. The thermocouple was placed under the strands of the outer layer on the conductor.



Picture 2

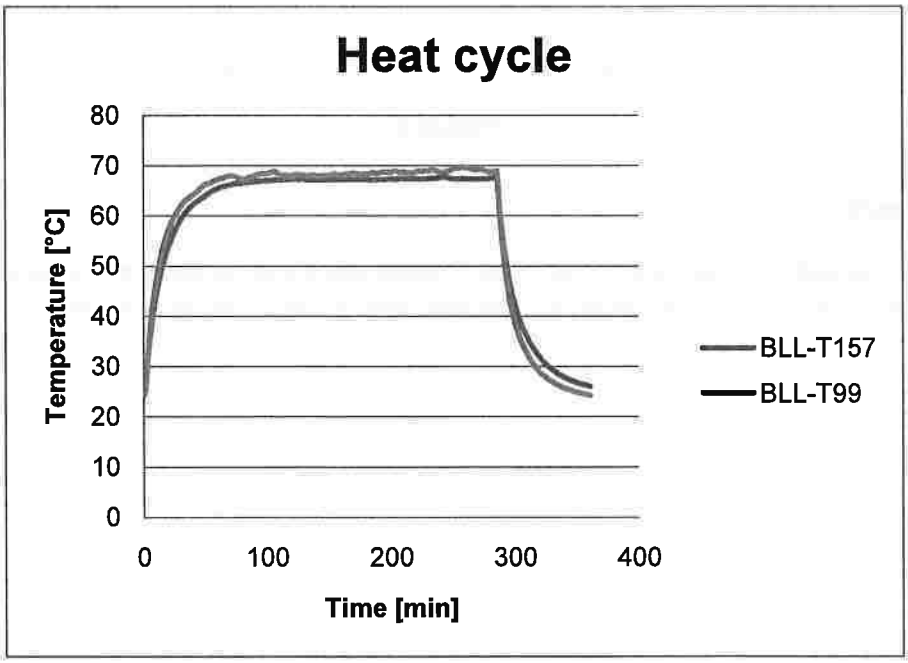
Requirement:

The test is passed if no damage occurs which could affect the correct function of the clamp. Also no damage shall occur on the covering. The slippage of the covering shall be less than 20 mm.

3. Test results

Sample	Conductors	MBL [kN]	15% of MBL [kN]	Measured test load [kN]	Max operating temperature [°C]	Test current [A]	Result
7	BLL-T 99	25,3	3,8	3.95	70	343	Ok
8	BLL-T 99	25,3	3,8	3,95	70		
Sample	**Conductors**	**MBL [kN]**	**10% of MBL [kN]**	**Measured test load [kN]**	**Max operating temperature [°C]**	**Test current [A]**	**Result**
9	BLL-T 157	43,7	6,6	4,37	70	425	Ok
10	BLL-T 157	43,7	6,6	4,37	70		

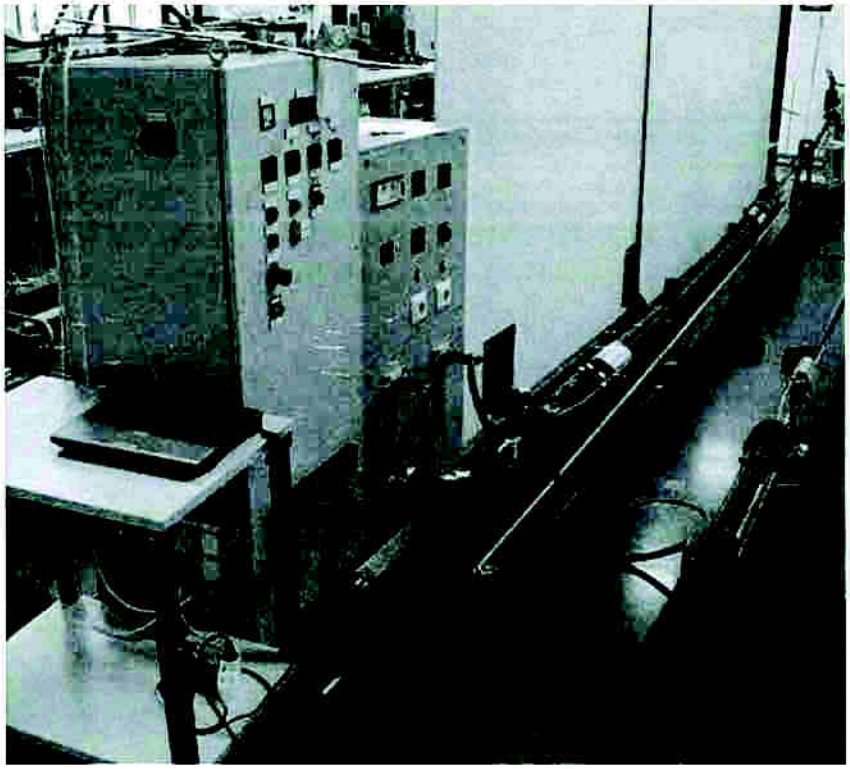
Table 1: Test data



Graph 1: One heat cycle

Summary:
All samples fulfilled standard requirements.

4. Pictures



Picture 3: Test arrangement in vertical test bench

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L14	Torque wrench	BDS 80 E	Torque adjustment
L56	Torque wrench	BDS 80 E	Torque adjustment
HT5	Test bench	Ensto	High temperature tests
HT6	Test bench	Ensto	High temperature tests
M1	AC Transformer	0 - 1000 A	AC-supply for heating
M12	AC Transformer	0 – 1500 A	AC-supply for heating

6. Test Id

849

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 2092S
Revision: A

Date of Test: 19.8 – 12.9, 19.9 – 26.10 and 5.10 – 6.11.2010

Test object:

Tension clamp SO256.

Purpose of the test and relevant standards:

Part of type test.
Tensile test for tension clamp at high temperature according to EN 50397-2:2009 clause 7.4.9.

Conclusion:

The clamp passed the test.

Picture 1: Tested clamp SO256

ENSTO UTILITY NETWORKS LABORATORY

Date of Report: 1.3.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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Business ID: 0130215-6
Reg. Office Porvoo

1. Test objects

Clamp:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40Nm
SMFL:	30kN (AlMgSi), 20kN (FeAl)
No of pcs:	6

Conductors:

Type:	SAX-W 95
Used cross-sections:	95 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	16,1 mm
Number of strands:	7
Insulation material:	XLPE
Conductor material:	AlMgSi
Conductor MBL:	30,4 kN
Refer to standard:	EN50397-1

Type:	SAX-W 120
Used cross-sections:	120 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	17,6 mm
Number of strands:	19
Insulation material:	XLPE
Conductor material:	AlMgSi
Conductor MBL:	38 kN
Refer to standard:	EN50397-1

Type:	SAX-W 150
Used cross-section:	150 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	18,9 mm
Number of strands:	19
Insulation material:	XLPE
Conductor material:	AlMgSi
Conductor MBL:	47,3 kN
Refer to standard:	EN50397-1

ВЯРНО С ОРИГИНАЛА

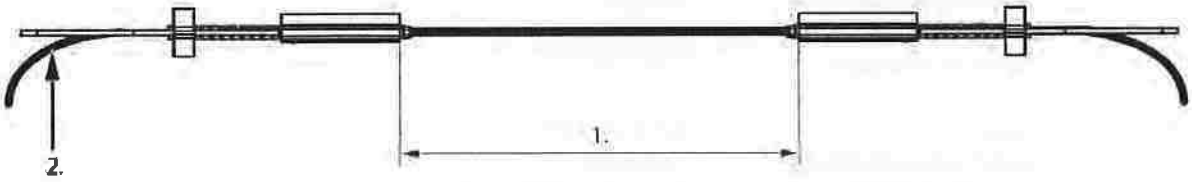
2. Testing procedure

The test was made with the maximum operating temperature of the conductor. Two tension clamps were tested. The test arrangement is shown in picture 2. The arrangement was installed in a horizontal test bench. A constant mechanical load was maintained throughout the test. The test load was 15% of conductor MBL. The test load was stabilised at ± 10 % and maintained for a period of at least 6 hours at ambient temperature. After the pre-tightening the test consisted of 100 heat cycles at a rate of maximum four cycles per day.

The heat cycle conditions:

- The conductor temperature was gradually increased to the maximum operating temperature of the conductor ± 5 K, in less than 2 hours.
- The high temperature was maintained for 4 hours.
- The test arrangement was allowed to cool down to ambient temperature naturally.

The heating of the conductor was made with an AC transformer. The temperature of the conductor was measured underneath the covering with a thermocouple. The thermocouple was placed under the strands of the outer layer on the conductor.



Picture 2

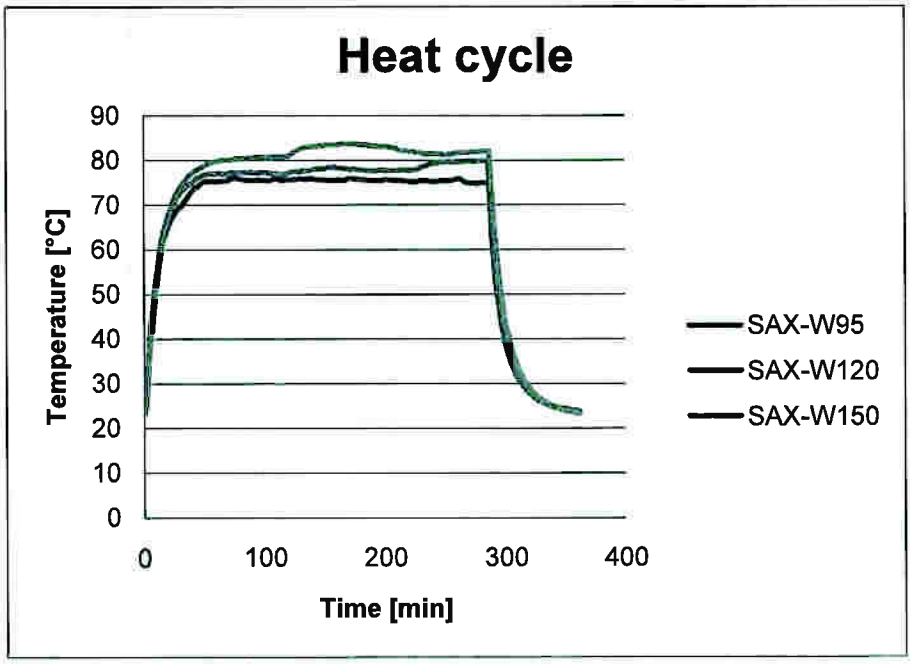
Requirement:

The test is passed if no damage occurs which could affect the correct function of the clamp. Also no damage shall occur on the covering. The slippage of the covering shall be less than 20 mm.

3. Test results

Sample	Conductors	MBL [kN]	15% of MBL [kN]	Measured test load [kN]	Max operating temperature [°C]	Test current [A]	Result
1	SAX-W 95	30,4	4,6	4,517	80	338	Ok
2	SAX-W 95	30,4	4,6	4,517	80		
3	SAX-W 120	38	5,7	5,7	80	380	Ok
4	SAX-W 120	38	5,7	5,7	80		
5	SAX-W 150	47,3	7,1	7,1	80	402	Ok
6	SAX-W 150	47,3	7,1	7,1	80		

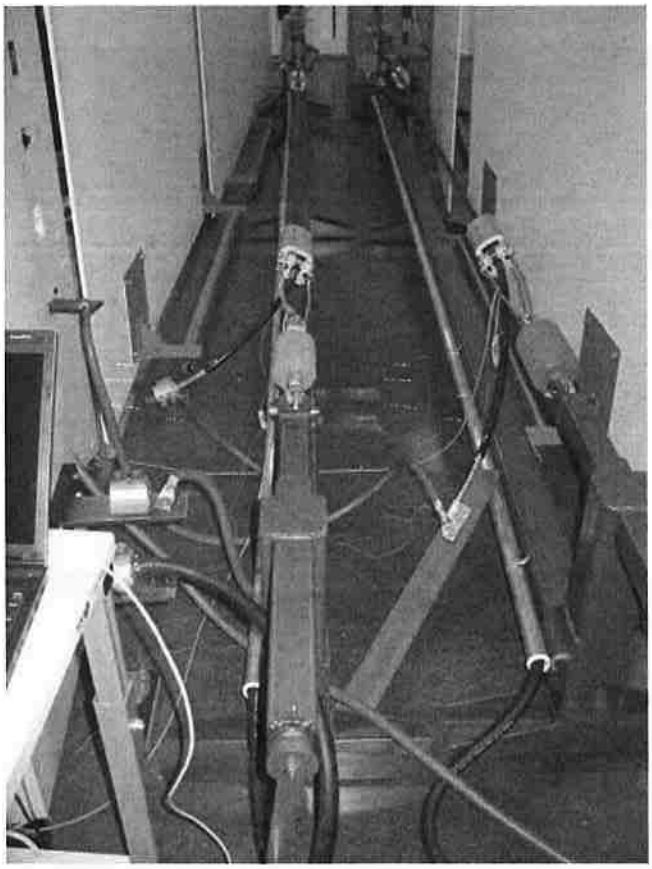
Table 1: Test data



Graph 1: One heat cycle

Summary:
All samples fulfilled standard requirements.

4. Pictures



Picture 3: Test arrangement in vertical test bench

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L14	Torque wrench	BDS 80 E	Torque adjustment
L56	Torque wrench	BDS 80 E	Torque adjustment
HT5	Test bench	Ensto	High temperature tests
HT6	Test bench	Ensto	High temperature tests
M1	AC Transformer	0 - 1000 A	AC-supply for heating
M12	AC Transformer	0 – 1500 A	AC-supply for heating

6. Test Id

849

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 2094S
Revision: A

Date of Test: 8.6.2010

Test object:

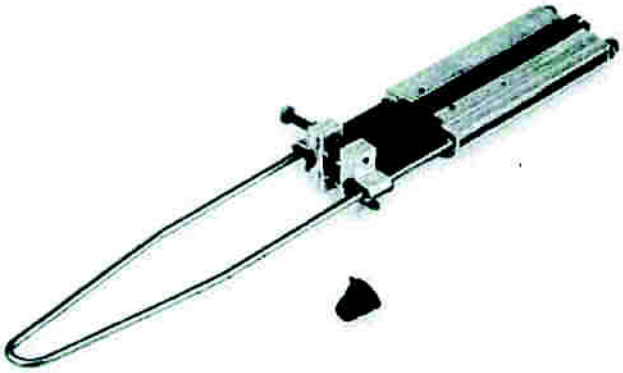
Tension clamp SO256.

Purpose of the test and relevant standards:

Part of type test.
Clamp bolt tightening test for tension clamp according to EN 50397-2:2009 clause 7.4.10.1 with deviation.

Conclusion:

The clamp passed the test.



Picture 1: Tested clamp SO256

ENSTO UTILITY NETWORKS LABORATORY

Date of Report: 18.5.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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Reg Office: Porvoo

ВЕРНО С ОРИГИНАЛА

1. Test objects

Clamp:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40Nm
No of pcs:	2

Conductors:

Type:	BLL-T 99
Used cross-section:	99 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	17,8 – 18,8 mm
Number of strands:	7
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Refer to standard:	EN50397-1

Type:	BLL-T 157
Used cross-section:	157 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	21,3 – 22,3 mm
Number of strands:	19
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Refer to standard:	EN50397-1

2. Testing procedure

Two clamps were tested. The clamp was installed on to the covered conductor. The tightening torque was increased to 1,1 x the specified installation torque. The clamp was checked for any damages. Then the tightening continued until breaking occurred. Breaking torque was recorded.

Deviation

Standard says that clamp shall be tightened and loosened 10 times to 1,1 x the specified installation torque. The clamps in test are tightened only ones because the clamps are not allowed to be re-used.

Requirement

No damage shall occur during tightening which could affect the correct function of the clamp or it's nuts.

3. Test results

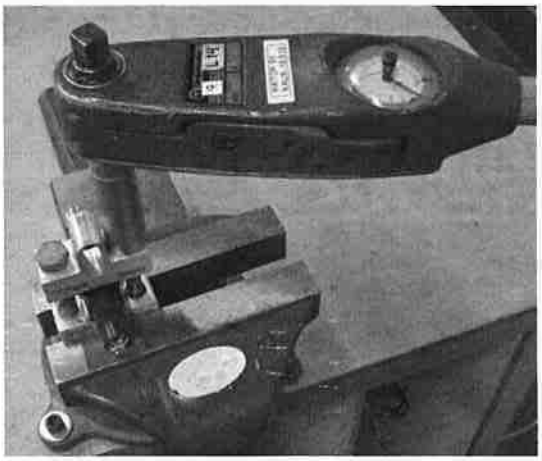
Sample	Conductors	Tigtening torque 44Nm [Nm]	Damage torque [Nm]
1	BLL-T 157	No damage	No damage at 100 Nm
2	BLL-T 99	No damage	No damage at 100 Nm

Table 1: Test data

Summary:
All samples fulfilled standard requirements.

ВЯРНО С ОРИГИНАЛА

4. Pictures



Picture 2: Test setup

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L73	Torque wrench	Norbar 200	Torque adjustment
L14	Torque wrench	BDS – 80 E	Torque adjustment
L73	Torque wrench	Norbar 200	Torque adjustment

6. Test Id

852

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 2095S
Revision: A

Date of Test: 8.6.2010

Test object:

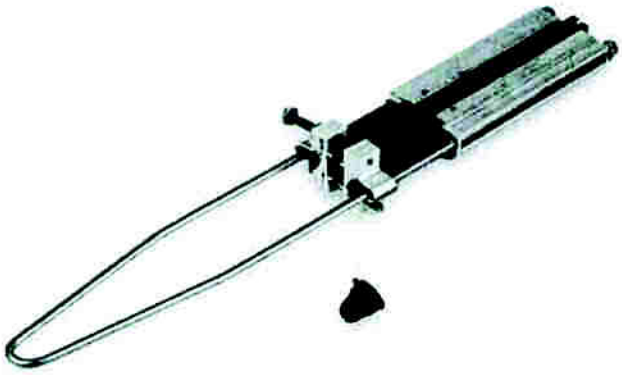
Tension clamp SO256.

Purpose of the test and relevant standards:

Part of type test.
Clamp bolt tightening test for tension clamp according to EN 50397-2:2009 clause 7.4.10.1 with deviation.

Conclusion:

The clamp passed the test.



Picture 1: Tested clamp SO256

ENSTO
UTILITY NETWORKS
LABORATORY

Date of Report: 18.5.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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Business ID: 0130215-8
Reg Office: Porvoo

1. Test objects

Clamp:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40Nm
No of pcs:	2

Conductors:

Type:	SAX-W 95
Used cross-sections:	95 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	16,1 mm
Number of strands:	7
Insulation material:	XLPE
Conductor material:	AlMgSi
Refer to standard:	EN50397-1

Type:	SAX-W 150
Used cross-section:	150 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	18,9 mm
Number of strands:	19
Insulation material:	XLPE
Conductor material:	AlMgSi
Refer to standard:	EN50397-1

2. Testing procedure

Two clamps were tested. The clamp was installed on to the covered conductor. The tightening torque was increased to 1,1 x the specified installation torque. The clamp was checked for any damages. Then the tightening continued until breaking occurred. Breaking torque was recorded.

Deviation

Standard says that clamp shall be tightened and loosened 10 times to 1,1 x the specified installation torque. The clamps in test are tightened only ones because the clamps are not allowed to be re-used.

Requirement

No damage shall occur during tightening which could affect the correct function of the clamp or it's nuts.

3. Test results

Sample	Conductors	Tigtening torque 44Nm [Nm]	Damage torque [Nm]
3	SAX-W 150	No damage	No damage at 100 Nm
4	SAX-W95	No damage	No damage at 100 Nm

Table 1: Test data

Summary:
All samples fulfilled standard requirements.

4. Pictures

Picture 2: Test setup

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L73	Torque wrench	Norbar 200	Torque adjustment
L14	Torque wrench	BDS – 80 E	Torque adjustment
L73	Torque wrench	Norbar 200	Torque adjustment

6. Test Id

852

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 2097S
Revision: A

Date of Test: 17.6.2010

Test object:

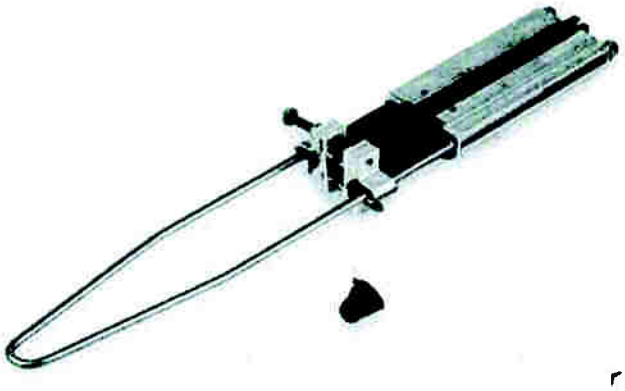
Tension clamp SO256.

Purpose of the test and relevant standards:

Part of type test.
Low temperature assembly test according to EN 50397-2:2009 clause 7.4.14.

Conclusion:

The clamp passed the test at -25 °C.



Picture 1: Tested clamp SO256

ENSTO UTILITY NETWORKS LABORATORY

Date of Report: 18.5.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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Business ID: 0130215-8
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ВЯРНО С ОРИГИНАЛА

1. Test objects

Clamp:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40Nm
No of pcs:	4

Conductors:

Type:	BLL-T 99
Used cross-section:	99 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	17,8 – 18,8 mm
Number of strands:	7
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Refer to standard:	EN50397-1

Type:	BLL-T 157
Used cross-section:	157 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	21,3 – 22,3 mm
Number of strands:	19
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Refer to standard:	EN50397-1

2. Testing procedure

The clamps and the conductors were pre-conditioned in a deep freezer until they reached the test temperature of (-25 ±3)°C. The clamps were removed from the deep freezer and immediately tightening was carried out in a bench vice at a rate of approximately 1 full turn in 8 seconds. Electrical continuity was measured between the main and branch cables. The torque at which continuity was achieved was recorded. Two samples were tested for both minimum and maximum conductors.

Requirement:

Electrical continuity shall be achieved at a torque value less than, or equal to, 70 % of the manufacturer's specified minimum installation torque.

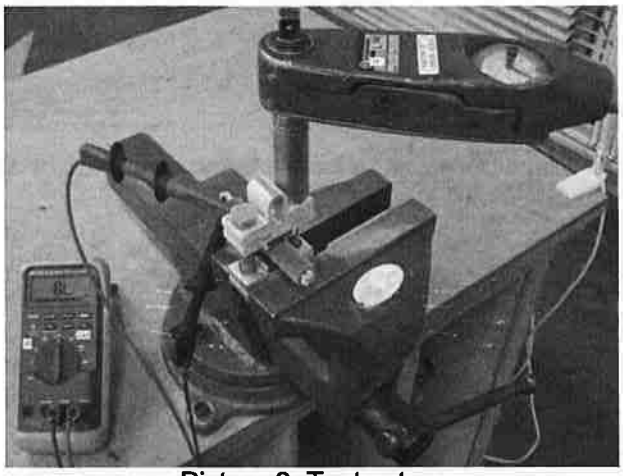
3. Test results

Sample	Conductors	Contact torque [Nm]
1	BLL-T 157	20
2	BLL-T 157	18
4	BLL-T 99	20
5	BLL-T 99	22

Table 1: Test data

Summary:
All samples fulfilled the requirement of the standard as none exceeded 28 Nm which is 70 % of the connectors tightening torque of 40 Nm.

4. Pictures



Picture 2: Test setup

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L42	Thermometer	2455 16	Temperature measurements
L14	Torque wrench	BDS – 80 E	Torque adjustment
L60	Multimeter	Fluke 87	Voltage drop measurements
L33	Deep freezer	ALK 30	Climate testing

6. Test Id

1083

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 2098S
Revision: A

Date of Test: 17.6.2010

Test object:

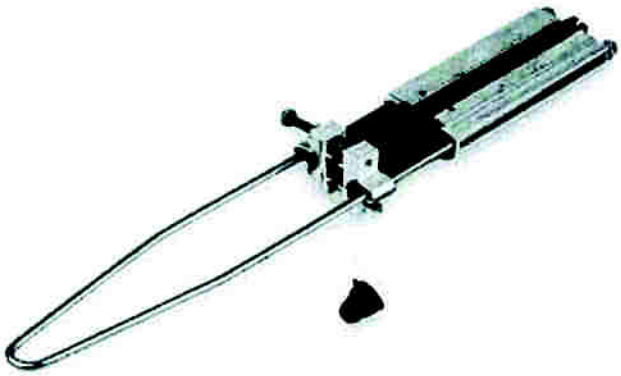
Tension clamp SO256.

Purpose of the test and relevant standards:

Part of type test.
Low temperature assembly test according to EN 50397-2:2009 clause 7.4.14.

Conclusion:

The clamp passed the test at -25 °C.



Picture 1: Tested clamp SO256

Date of Report: 18.5.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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Business ID: 0130215-8
Reg. Office: Porvoo

1. Test objects

Clamp:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40Nm
No of pcs:	4

Conductors:

Type:	SAX-W 95
Used cross-sections:	95 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	16,1 mm
Number of strands:	7
Insulation material:	XLPE
Conductor material:	AlMgSi
Refer to standard:	EN50397-1

Type:	SAX-W 150
Used cross-section:	150 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	18,9 mm
Number of strands:	19
Insulation material:	XLPE
Conductor material:	AlMgSi
Refer to standard:	EN50397-1

2. Testing procedure

The clamps and the conductors were pre-conditioned in a deep freezer until they reached the test temperature of (-25 ±3)°C. The clamps were removed from the deep freezer and immediately tightening was carried out in a bench vice at a rate of approximately 1 full turn in 8 seconds. Electrical continuity was measured between the main and branch cables. The torque at which continuity was achieved was recorded. Two samples were tested for both minimum and maximum conductors.

Requirement:

Electrical continuity shall be achieved at a torque value less than, or equal to, 70 % of the manufacturer's specified minimum installation torque.

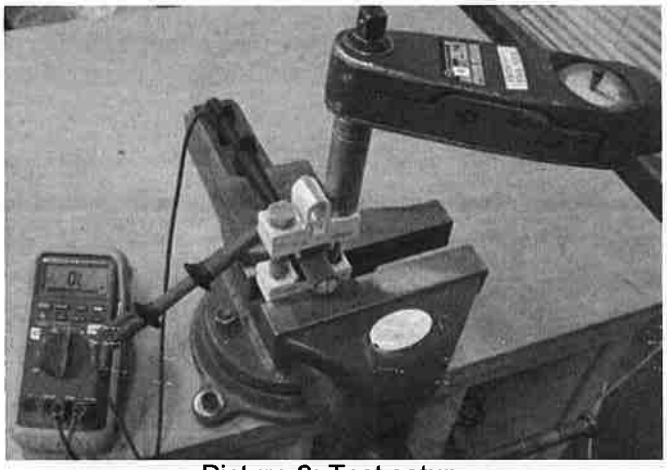
3. Test results

Sample	Conductors	Contact torque [Nm]
7	SAX-W 150	22
8	SAX-W 150	18
10	SAX-W 95	18
11	SAX-W 95	16

Table 1: Test data

Summary:
All samples fulfilled the requirement of the standard as none exceeded 28 Nm which is 70 % of the connectors tightening torque of 40 Nm.

4. Pictures



Picture 2: Test setup

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L42	Thermometer	2455 16	Temperature measurements
L14	Torque wrench	BDS – 80 E	Torque adjustment
L60	Multimeter	Fluke 87	Voltage drop measurements
L33	Deep freezer	ALK 30	Climate testing

6. Test Id

1083

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 2100S
Revision: A

Date of Test: 28 - 29.9.2010

Test object:

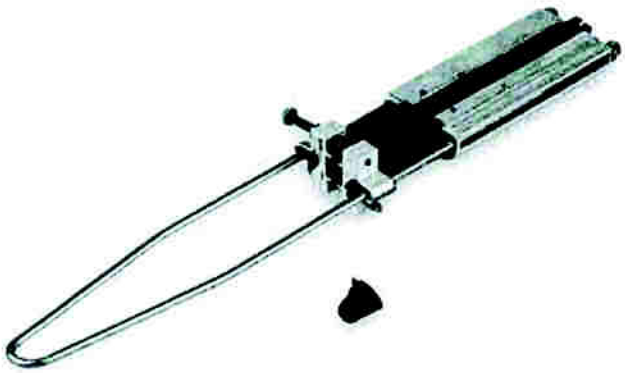
Tension clamp SO256.

Purpose of the test and relevant standards:

Part of type test.
Water tightness test according to EN 50397-2:2009 clause 7.6.

Conclusion:

The clamp passed the test.



Picture 1: Tested clamp SO256

Date of Report: 18.5.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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Business ID: 0130215-8
Reg Office: Porvoo

1. Test objects

Clamp:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40Nm
No of pcs:	6

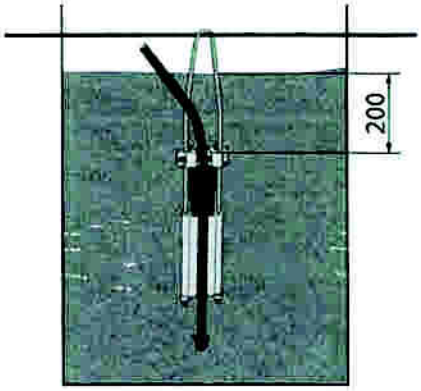
Conductors:

Type:	BLL-T 99
Used cross-section:	99 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	17,8 – 18,8 mm
Number of strands:	7
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Refer to standard:	EN50397-1

Type:	BLL-T 157
Used cross-section:	157 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	21,3 – 22,3 mm
Number of strands:	19
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Refer to standard:	EN50397-1

2. Testing procedure

The clamps were installed onto the conductors according to manufactures instructions. One end rose over the water surface and the other end was plugged with an end cap. The clamps piercing parts were immersed in the water at a depth of 200mm. The clamps were kept in the water for 48 hours. Three samples were tested for minimum and maximum conductors.



Requirement:

No water shall penetrate to the conductor.

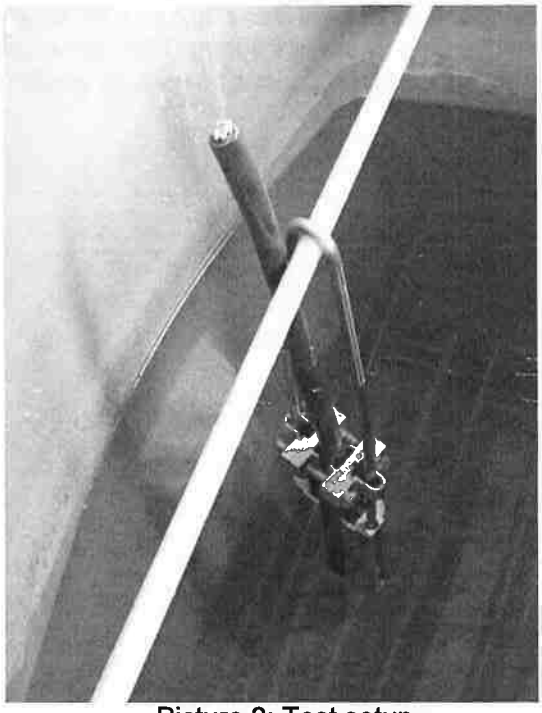
3. Test results

Sample	Conductors	Tightning torque [Nm]	Results
1	BLL-T 99	40	Ok
2	BLL-T 99	40	Ok
3	BLL-T 99	40	Ok
4	BLL-T 157	40	Ok
5	BLL-T 157	40	Ok
6	BLL-T 157	40	Ok

Table 1: Test data

Summary:
All samples fulfilled standard requirements.

4. Pictures



Picture 2: Test setup

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L56	Torque wrench	BDS 80 E	Torque adjustment

6. Test Id

855

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 2101S
Revision: A

Date of Test: 15-16.8 and 31.8-1.9.2010

Test object:

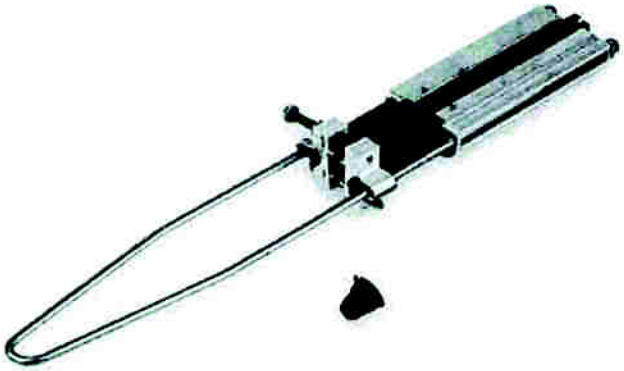
Tension clamp SO256.

Purpose of the test and relevant standards:

Part of type test.
Water tightness test according to EN 50397-2:2009 clause 7.6.

Conclusion:

The clamp passed the test.



Picture 1: Tested clamp SO256

ENSTO UTILITY NETWORKS LABORATORY

Date of Report: 18.5.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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Business ID: 0130215-8
Reg Office: Porvoo

ВЯРНО С ОРИГИНАЛА

1. Test objects

Clamp:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40Nm
No of pcs:	6

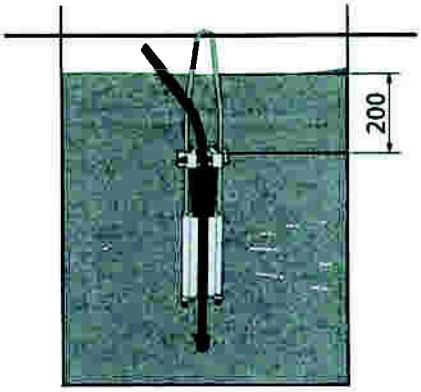
Conductors:

Type:	SAX-W 95
Used cross-sections:	95 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	16,1 mm
Number of strands:	7
Insulation material:	XLPE
Conductor material:	AlMgSi
Refer to standard:	EN50397-1

Type:	SAX-W 150
Used cross-section:	150 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	18,9 mm
Number of strands:	19
Insulation material:	XLPE
Conductor material:	AlMgSi
Refer to standard:	EN50397-1

2. Testing procedure

The clamps were installed onto the conductors according to manufactures instructions. One end rose over the water surface and the other end was plugged with an end cap. The clamps piercing parts were immersed in the water at a depth of 200mm. The clamps were kept in the water for 48 hours. Three samples were tested for minimum and maximum conductors.



Requirement:

No water shall penetrate to the conductor.

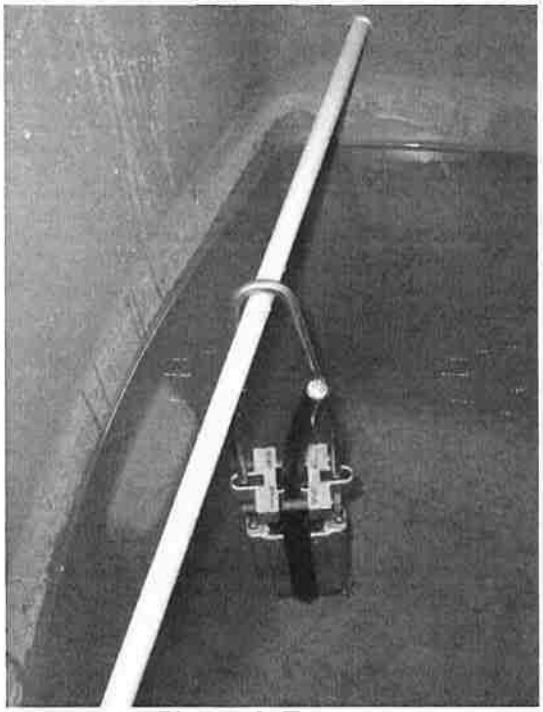
3. Test results

Sample	Conductors	Tightning torque [Nm]	Results
7	SAX-W 95	40	Ok
8	SAX-W 95	40	Ok
9	SAX-W 95	40	Ok
10	SAX-W 150	40	Ok
11	SAX-W 150	40	Ok
12	SAX-W 150	40	Ok

Table 1: Test data

Summary:
All samples fulfilled standard requirements.

4. Pictures



Picture 2: Test setup

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L56	Torque wrench	BDS 80 E	Torque adjustment

6. Test Id

855

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 2103S
Revision: A

Date of Test: 29.9.2010

Test object:

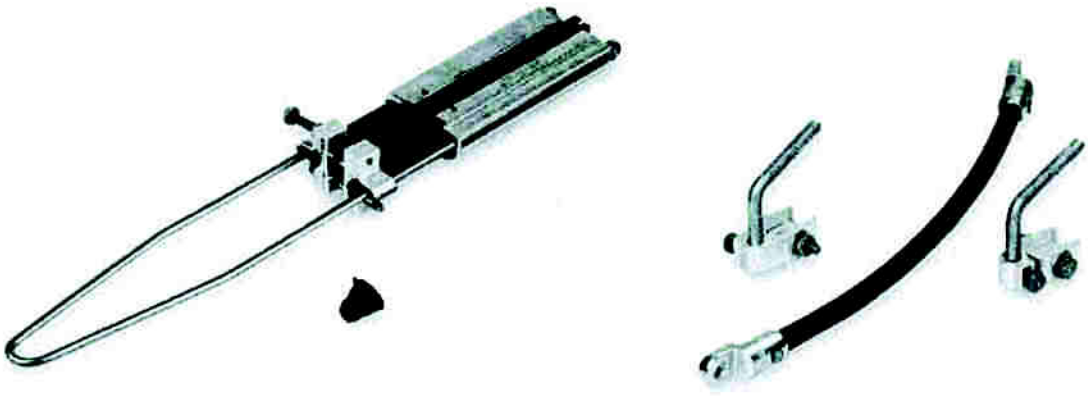
Tension clamp SO256 and power arc device SDI27.1.

Purpose of the test and relevant standards:

Part of type test.
Short-circuit test according to EN 50397-2:2009 clause 7.8.

Conclusion:

The clamp and power arc device passed the test.



Picture 1: Tested clamp SO256 and power arc device SDI27.1

Date of Report: 1.3.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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Reg. Office: Porvoo

1. Test objects

Clamps:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40Nm
SMFL:	30kN (AlMgSi), 20kN (FeAl)
No of pcs:	6

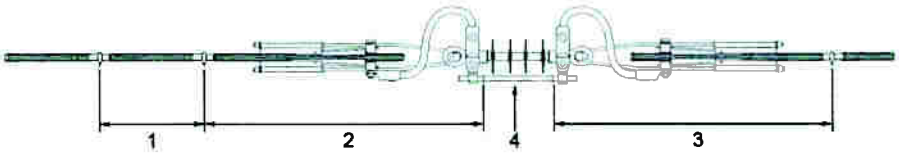
Type:	Power arc device SDI27.1
Batch number:	0-series
Tightening torque:	44Nm
No of pcs:	6

Conductors:

Type:	BLL-T 157
Used cross-section:	157 mm^2
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	21,3 – 22,3 mm
Number of strands:	19
Insulation material:	HDPE+PE
Conductor material:	AlMgSi
Max. short circuit current:	15,3 kA (+50°C >> +250°C)
Refer to standard:	EN50397-1

2. Testing procedure

Three test arrangements shall be tested. The test arrangement is subjected to one 10kA pulse of over-current for 1s. The test arrangement is shown in Picture 2. For this test the earthing rod will be replaced by a straight piece of the same cross-section, shape and material as the earthing rod. The test arrangement is made of two clamps installed on maximum conductor and combined with a test rod. The resistances are measured over reference conductor and the connectors before and after the test.



1 Resistance measurement reference conductor
2 Resistance measurement clamp
3 Resistance measurement clamp
4 Test rod twice the length of earthing rod

Picture 2: Test arrangement

Requirement:
The change of resistance before and after short circuit shall be less than 50 %. No visible damage shall be observed on the connector or on the cable.

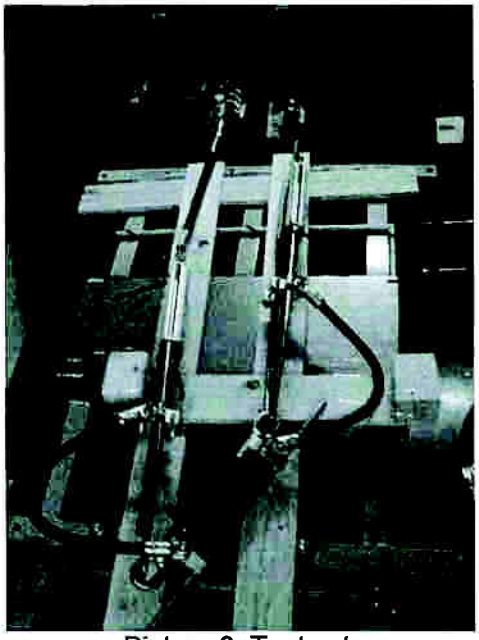
3. Test results

Sample	Lenght [mm]		Resistance before [μΩ]			Resistance after [μΩ]			Change in resistance	Over-current
	Reference	Clamp	Reference	Between measuring points	Clamp	Reference	Between measuring points	Clamp		
7	541	439	114	295	202	113	273	181	**-10 %**	10,9 kA
8	541	440	114	302	209	113	272	180	**-14 %**	10,9 kA
9	519	440	108	290	198	107	271	180	**-9 %**	10,9 kA
10	519	453	108	323	229	107	286	193	**-16 %**	10,9 kA
11	484	429	97	299	213	97	269	183	**-14 %**	10,9 kA
12	484	425	97	291	206	97	274	189	**-8 %**	10,9 kA

Table 1: Test data

Summary:
All samples fulfilled standard requirements.

4. Pictures



Picture 3: Test setup

5. Test equipment

ID	TYPE	MODEL	PURPOSE
SM3	Short-circuit transformer	230 kVA	Supply for s-c test
L160	Analog input/output module	cFP-AIO-610	DC-current measurement
L163	Thermocouple module	cFP-TC-125	Voltage drop measurements
L164	Thermocouple module	cFP-TC-125	Voltage drop measurements
L56	Torque wrench	BDS 80 E	Torque adjustment
L68	Scopemeter	105B	Short-circuit characteristics

6. Test Id

856

7. Revision history

A

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО * ФИЛКАБ 16 * ПЛОВДИВ

Saves Your Energy

LABORATORY REPORT
No.: 2104S
Revision: A

Date of Test: 29.9.2010

Test object:

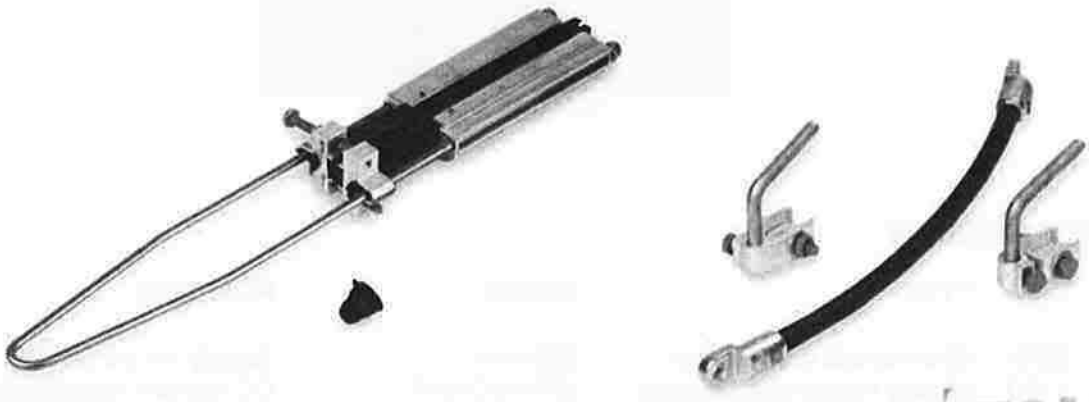
Tension clamp SO256 and power arc device SDI27.1.

Purpose of the test and relevant standards:

Part of type test.
Short-circuit test according to EN 50397-2:2009 clause 7.8.

Conclusion:

The clamp and power arc device passed the test.



Picture 1: Tested clamp SO256 and power arc device SDI27.1

Date of Report: 1.3.2011

Tested by: Patrick Ekholm

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

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Business ID: 0130215-8
Reg. Office Porvoo

1. Test objects

Clamps:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40Nm
SMFL:	30kN (AlMgSi), 20kN (FeAl)
No of pcs:	6

Type:	Power arc device SDI27.1
Batch number:	0-series
Tightening torque:	44Nm
No of pcs:	6

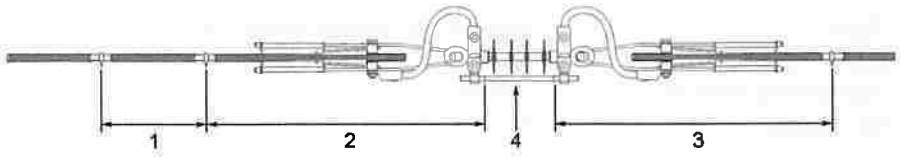
Conductors:

Type:	SAX-W 150
Used cross-section:	150 mm^2
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	18,9 mm
Number of strands:	19
Insulation material:	XLPE
Conductor material:	AlMgSi
Max. short circuit current:	13,5 kA (+40°C >> +200°C)
Refer to standard:	EN50397-1

ВЯРНО С ОРИГИНАЛА ФИЛКАБ 16

2. Testing procedure

Three test arrangements shall be tested. The test arrangement is subjected to one 10kA pulse of over-current for 1s. The test arrangement is shown in Picture 2. For this test the earthing rod will be replaced by a straight piece of the same cross-section, shape and material as the earthing rod. The test arrangement is made of two clamps installed on maximum conductor and combined with a test rod. The resistances are measured over reference conductor and the connectors before and after the test.



1 Resistance measurement reference conductor
2 Resistance measurement clamp
3 Resistance measurement clamp
4 Test rod twice the length of earthing rod

Picture 2: Test arrangement

Requirement:
The change of resistance before and after short circuit shall be less than 50 %. No visible damage shall be observed on the connector or on the cable.

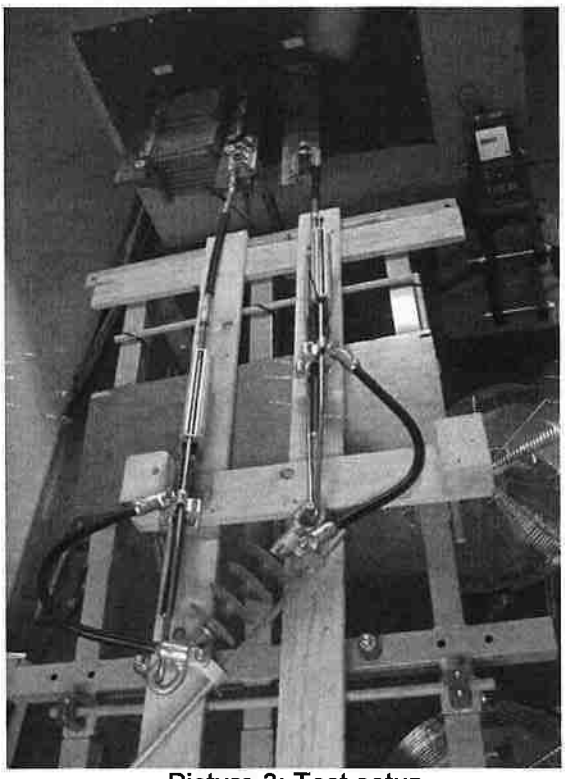
3. Test results

Sample	Lenght [mm]		Resistance before [µΩ]			Resistance after [µΩ]			Change in resistance	Over-current
	Reference	Clamp	Reference	Between measuring points	Clamp	Reference	Between measuring points	Clamp		
1	505	445	112	279	180	113	277	177	-2 %	10,2 kA
2	505	450	112	283	183	113	280	179	-2 %	10,2 kA
3	507	436	112	283	187	113	277	180	-4 %	10,2 kA
4	507	434	112	302	206	113	287	190	-8 %	10,2 kA
5	513	448	113	300	201	113	275	176	-12 %	10,2 kA
6	513	428	113	287	193	113	275	181	-6 %	10,2 kA

Table 1: Test data

Summary:
All samples fulfilled standard requirements.

4. Pictures



Picture 3: Test setup

5. Test equipment

ID	TYPE	MODEL	PURPOSE
SM3	Short-circuit transformer	230 kVA	Supply for s-c test
L160	Analog input/output module	cFP-AIO-610	DC-current measurement
L163	Thermocouple module	cFP-TC-125	Voltage drop measurements
L164	Thermocouple module	cFP-TC-125	Voltage drop measurements
L56	Torque wrench	BDS 80 E	Torque adjustment
L68	Scopemeter	105B	Short-circuit characteristics

6. Test Id

856

7. Revision history

A

Venus Greenhouse Test

Customer:

Ensto Sekko Oy
Janne Lappalainen
P.O. Box 51
FI-06101 Porvoo

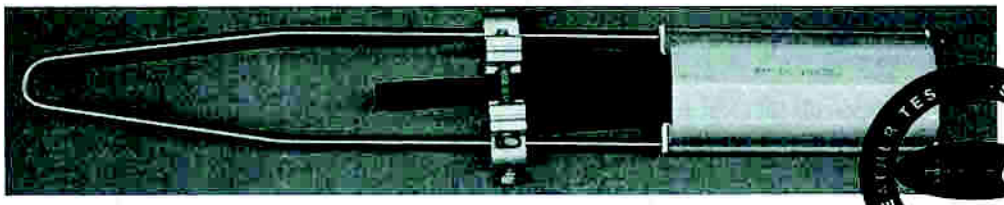
Research Contract:

EnstoSekkoLappalainenso171209HS.pdf
Ensto Test Id: 841 / 14.5.2010

Target:

Test item	Code	Manufacturer	Q'ty
Tension clamp	SO256	Ensto UN	2

Picture of the tested sample has been taken before the test.



Testing time:

The start of the test: 24th of June, 2010
The end of the test: 5th of August, 2010
Total test time 1000 hours

Purpose of the test:

To test the withstand of the samples to prohesion mist spray.

Test method:

The strain of the test is made according to the standard EN 50483-6 8.4.2.2 Gas atmosphere (Method 2). The test is a prohesion test. The test cycle consists of 0.05 % NaCl and 0.35 % $(NH_4)_2SO_4$ salt mist at the ambient temperature of 25 ± 3°C for one hour and one hour long drying time at the ambient temperature of 35°C. This test cycle is repeated for 500 times.

Validation of test method:

The test method was defined according to the requirements of the customer.

The test is used for comparative test of materials. The test conditions have some correlation with the real life conditions because the salt concentration is not very high. However, at the end of the drying period the concentration of the salt solution is very high.

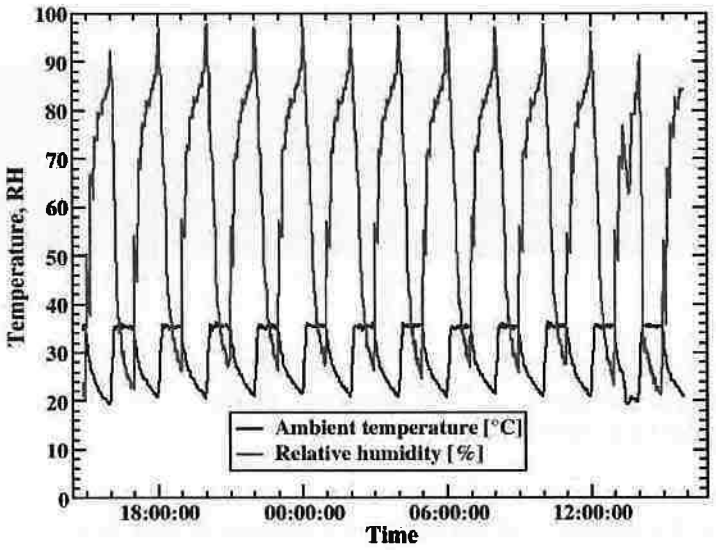
Actions done:

The samples were attached to a test casing after which the samples were placed into a prohesion mist chamber. The prohesion liquid solution was made to a purified water by using pro analysi sodium chloride and pro analysi ammonium sulphate. The amount of total impurities in the used salts was max. 0.5 % (in the standard 0.3 %). The pH of the solution was measured with a pH-meter to be 5.4. On a separate test a collecting receptacle with a collecting surface of 80 cm² collected 2 ml of prohesion solution per hour averaged over a period of 16 hours.

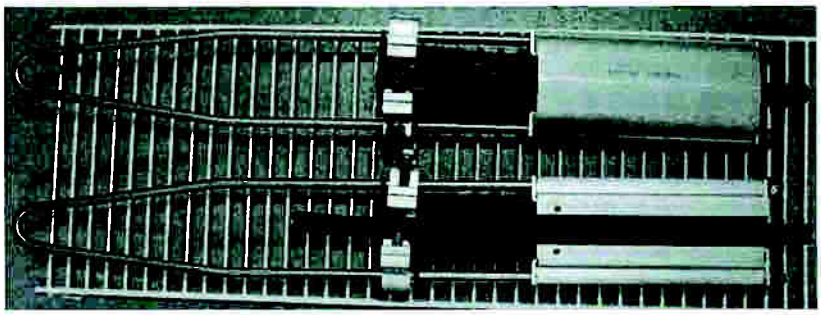
The samples were attached with plastic cable ties to the sample stand. The angle of the sample stand was 60° from horizontal. The sample was situated into a test chamber and the test lasted for 1000 hours.

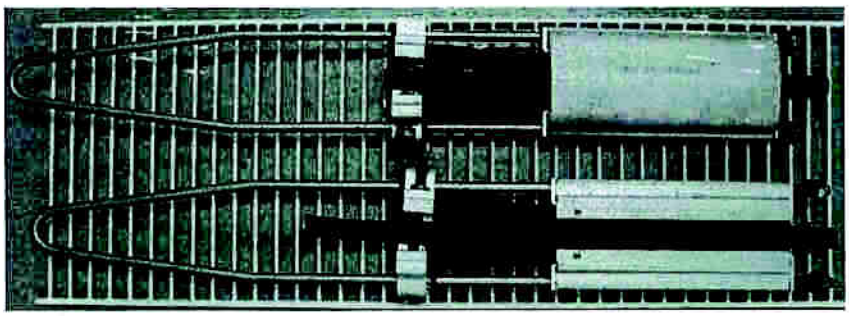
The samples were photographed at an interval of one test week. After the test the samples were washed in running tap water for five minutes. The temperature of the tap water was 30°C. After that the samples were rinsed in distilled water and then dried with an air blast.

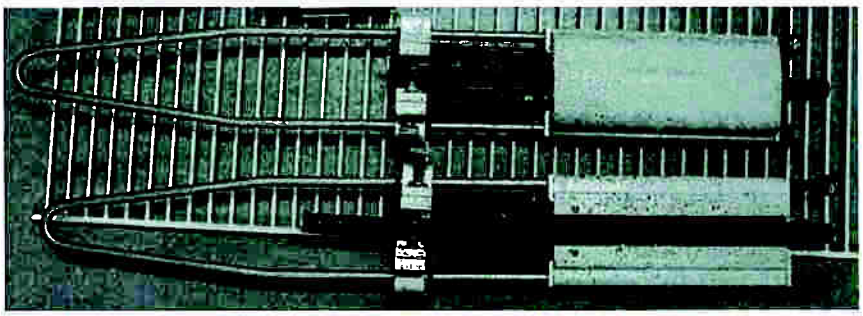
The ambient temperature and relative humidity in the test chamber during 12 test cycles is presented in the figure.

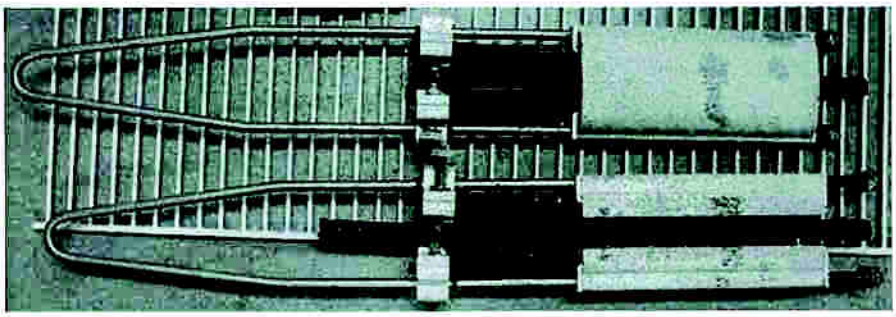


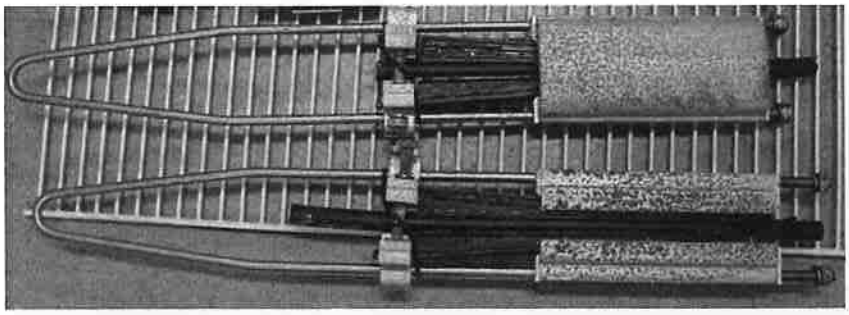
Tension clamp, SO256, Samples A and B, Ensto UN (Pictures of the sample were taken: From top: before the test, after one week, after two weeks, after three weeks, after four weeks, after five weeks, after the test and after washing the sample.)

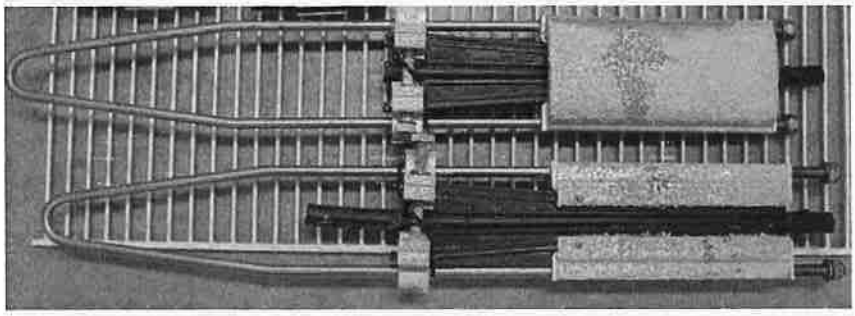


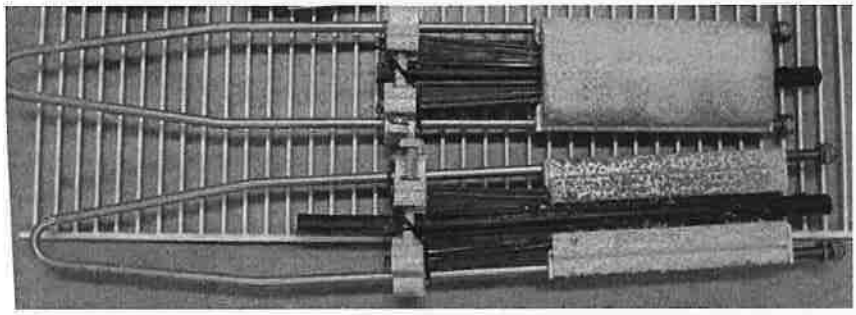


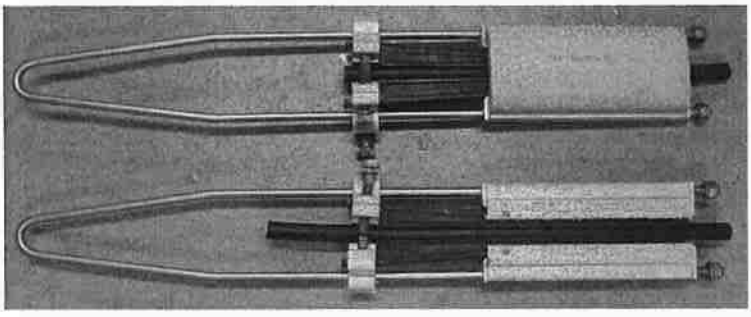












Conclusions:

The strain for the samples was prohesion mist.

The degradation in the samples was restricted only to the top layers of the cover parts of the samples.

The **SO256** samples made by Ensto UN passed the visual test.

Analysis:

-

Remarks:

Samples were photographed at an interval of one test week. The photographs were sent by email to the customer.

Used measuring equipment:
Prohesion chamber, No. 22
Temperature: No. 42 / Ch4_T1, calibrated 28th June, 2010, calibration is valid
Humidity: No. 42 / RH_AUX, calibrated 28th June, 2010, calibration is valid
pH: Fastech FT11, calibrated 28th June, 2010, calibration is valid

Actions, operations and reporting are in accordance with IEC/ISO 17025 'General requirements for the competence of testing laboratories'.

Signatures:

Timo Oksa
Littoinen, 5th of August, 2010

WEATHER TESTED • SÄÄTESTATTU
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CORROSION

ВЯРНО С ОРИГИНАЛА
АКЦИОНЕРНО ДРУЖЕСТВО ФИЛКАБ 16 ПЛОВДИВ

Venus Greenhouse Test

Customer:

Ensto Finland Oy
Janne Lappalainen
P.O. Box 51
FI-06101 Porvoo

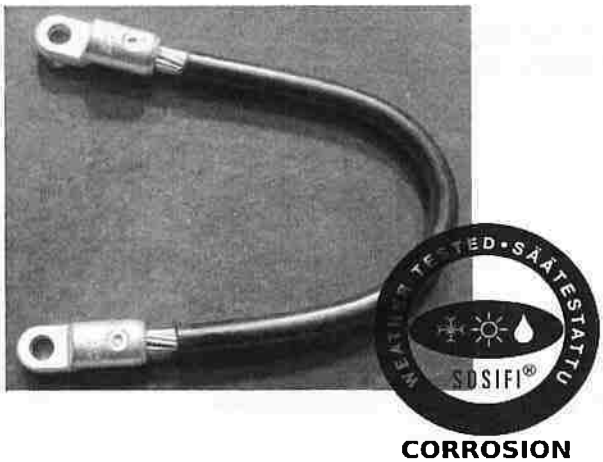
Research Contract:

EnstoSekkoLappalainenso171209HS.pdf
Ensto Test Id: 1012, 20.10.2010

Target:

Test item	Code	Manufacturer	Q'ty
Conductor with cable lugs for arc protection kit	SDI27.1	Ensto UN	1

Picture of the tested sample has been taken before the test.



CORROSION

Testing time:

The start of the test: 22nd of October, 2010
The end of the test: 3rd of December, 2010
Total test time 1000 hours

Purpose of the test:

To test the withstand of the samples to prohesion mist spray.

Test method:

The strain of the test is made according to the standard EN 50483-6, 8.4.2.2 Gas atmosphere (Method 2). The test is a prohesion test. The test cycle consists of 0.05 % NaCl and 0.35 %

$(NH_4)_2SO_4$ salt mist at the ambient temperature of 24 ± 3°C for one hour and one hour long drying time at the ambient temperature of 35°C. This test cycle is repeated for 500 times.

Validation of test method:

The test method was defined according to the requirements of the customer.

The test is used for comparative test of materials. The test conditions have some correlation with the real life conditions because the salt concentration is not very high. However, at the end of the drying period the concentration of the salt solution is very high.

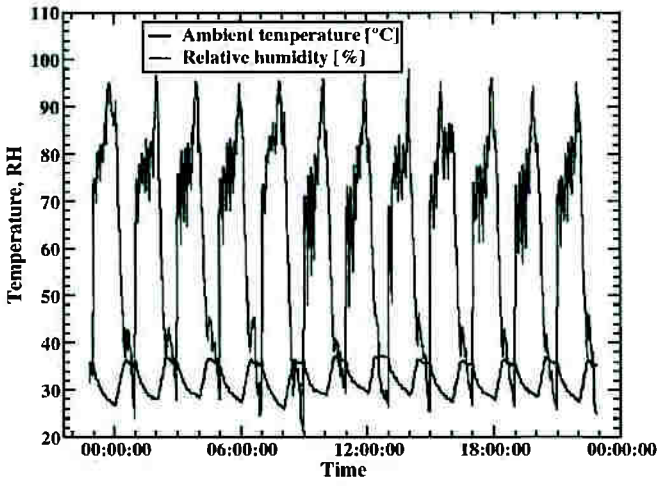
Actions done:

The samples were attached to a test casing after which the samples were placed into a prohesion mist chamber. The prohesion liquid solution was made to a purified water by using pro analysi sodium chloride and pro analysi ammonium sulphate. The amount of total impurities in the used salts was max. 0.5 % (in the standard 0.3 %). The pH of the solution was measured with a pH-meter to be 5.4. On a separate test a collecting receptacle with a collecting surface of 80 cm² collected 2 ml of prohesion solution per hour averaged over a period of 16 hours.

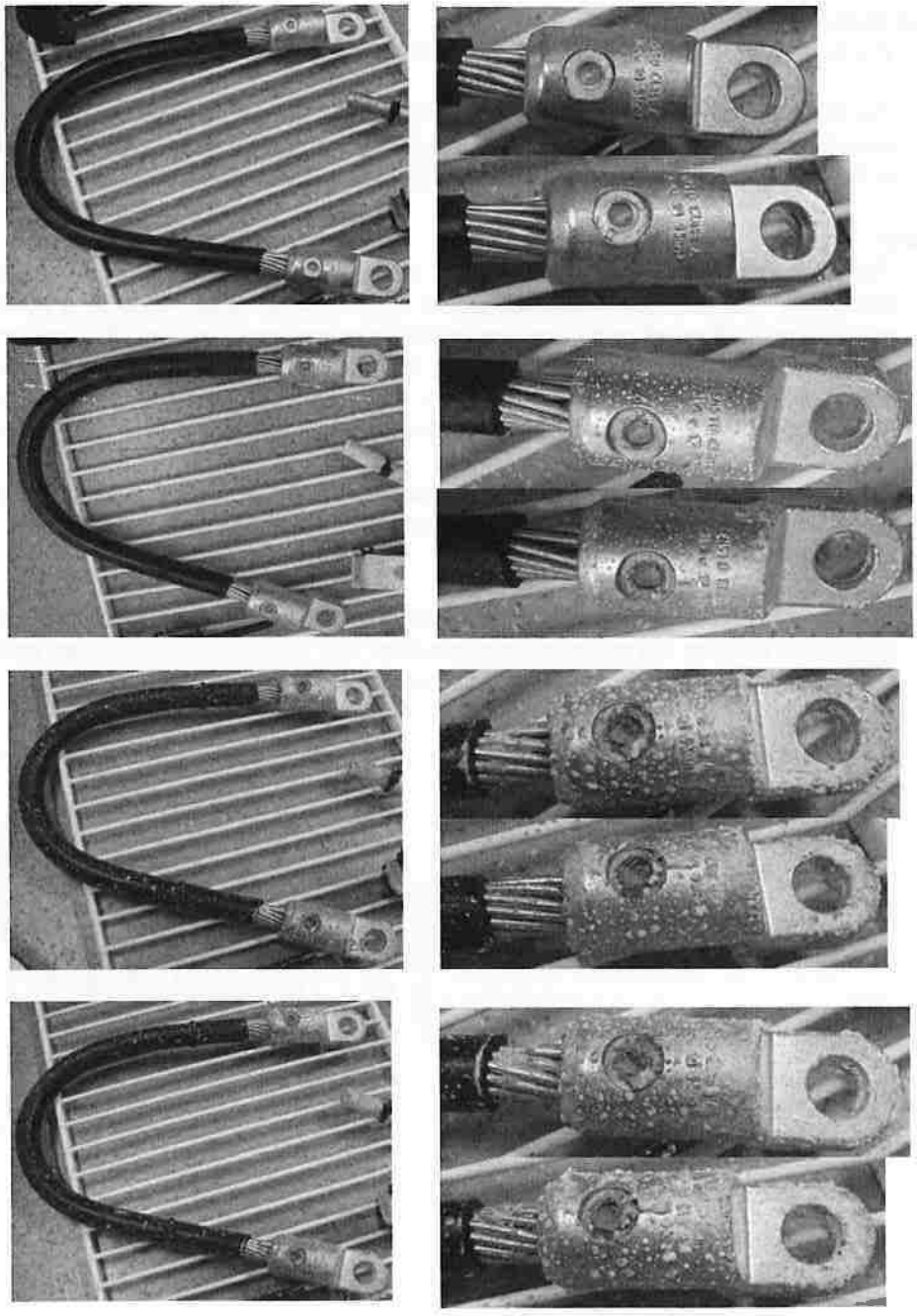
The samples were attached with plastic cable ties to the sample stand. The angle of the sample stand was 60° from horizontal. The sample was situated into a test chamber and the test lasted for 1000 hours.

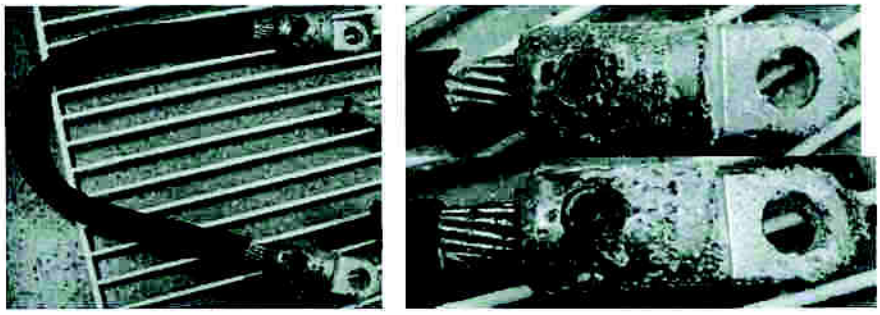
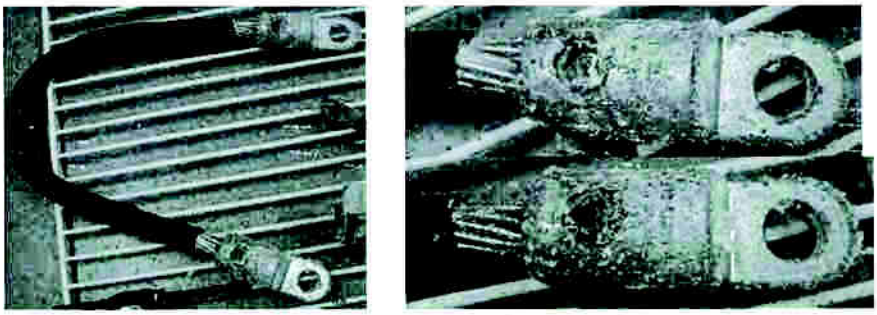
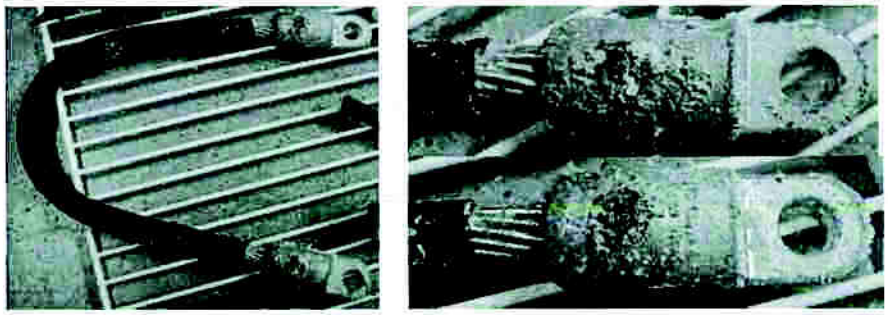
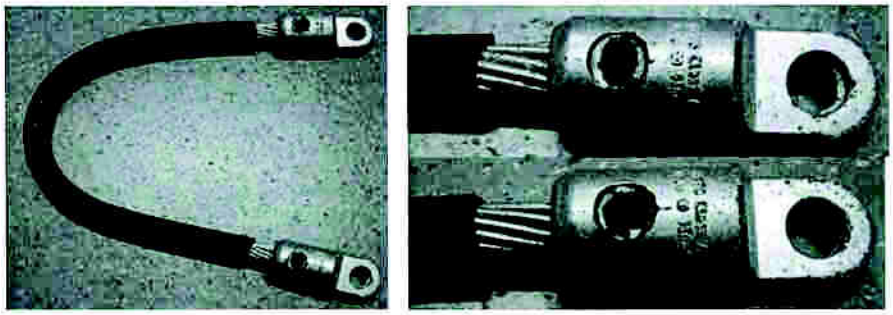
The samples were photographed at an interval of one test week. After the test the samples were washed in running tap water for five minutes. The temperature of the tap water was 30°C. After that the samples were rinsed in distilled water and then dried with an air blast.

The ambient temperature and relative humidity in the test chamber during a cycle of 24 hours is presented in the figure.



Conductor with cable lugs for arc protection kit SDI27.1, Ensto UN (Pictures of the sample were taken: From top till bottom row: before the test, after one week, after two weeks, after three weeks, after four weeks, after five weeks, after the test and after washing the sample.)



Conclusions:

The strain for the samples was 1000 h of prohesion mist.

There was minor degradation observed in the cable lugs.The **SDI27.1** passed the visual test.

Analysis:

-

Remarks:

Samples were photographed at an interval of one test week. The photographs were sent by email to the customer.

Used measuring equipment:
Prohesion chamber, No. 22
Temperature: No. 42 / Ch4_T1, calibrated 28th June, 2010, calibration is valid
Humidity: No. 42 / RH_AUX, calibrated 28th June, 2010, calibration is valid
pH: No. 41, Fastech FT11, calibrated 28th June, 2010, calibration is valid

Actions, operations and reporting are in accordance with IEC/ISO 17025 'General requirements for the competence of testing laboratories'.

Signatures:

Timo Oksa
Littoinen, 7th of December, 2010

WEATHER TESTED • SÄÄTESTATTU
SOSIFI®
CORROSION

Venus Greenhouse Test

Customer:

Ensto Finland Oy
Janne Lappalainen
P.O. Box 51
FI-06101 Porvoo

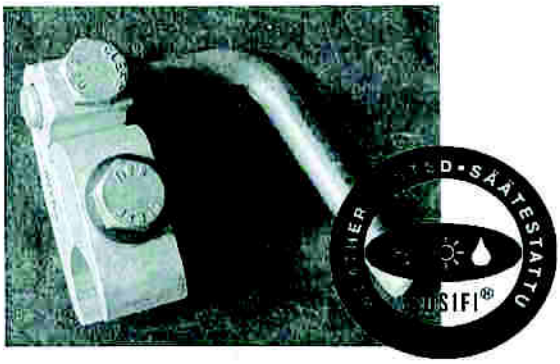
Research Contract:

EnstoFinlandLappalainen__ta141210HS.pdf
2828_001 / 14.12.2010
Ensto Test Id: 1080, 4.1.2011

Target:

Test item	Code	Q'ty	Manufacturer
Power arc device	SDI10.2	2	Ensto UN

Picture of one of the tested samples has been taken before the test.



CORROSION

Testing time:

The start of the test: 5th of January, 2011
The end of the test: 16th of February, 2011
Total test time 1000 hours

Purpose of the test:

To test the withstand of the samples to prohesion mist spray.

Test method:

The strain of the test is made according to the standard EN 50483-6, 8.4.2.2 Gas atmosphere (Method 2). The test is a prohesion test. The test cycle consists of 0.05 % NaCl and 0.35 % $(NH_4)_2SO_4$ salt mist at the ambient temperature of 24 ± 3°C for one hour and one hour long drying time at the ambient temperature of 35°C. This test cycle is repeated for 500 times.

ВЯРНО С ОРИГИНАЛА

Validation of test method:

The test method was defined according to the requirements of the customer.

The test is used for comparative test of materials. The test conditions have some correlation with the real life conditions because the salt concentration is not very high. However, at the end of the drying period the concentration of the salt solution is very high.

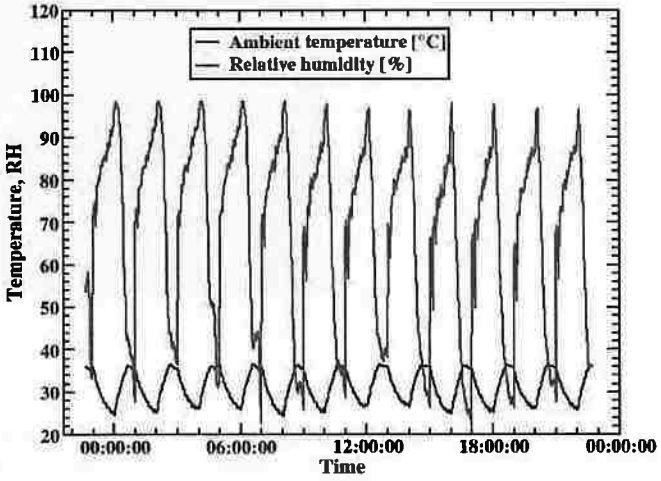
Actions done:

The samples were attached to a test casing after which the samples were placed into a prohesion mist chamber. The prohesion liquid solution was made to a purified water by using pro analysi sodium chloride and pro analysi ammonium sulphate. The amount of total impurities in the used salts was max. 0.5 % (in the standard 0.3 %). The pH of the solution was measured with a pH-meter to be 5.5. On a separate test a collecting receptacle with a collecting surface of 80 cm² collected 2 ml of prohesion solution per hour averaged over a period of 16 hours.

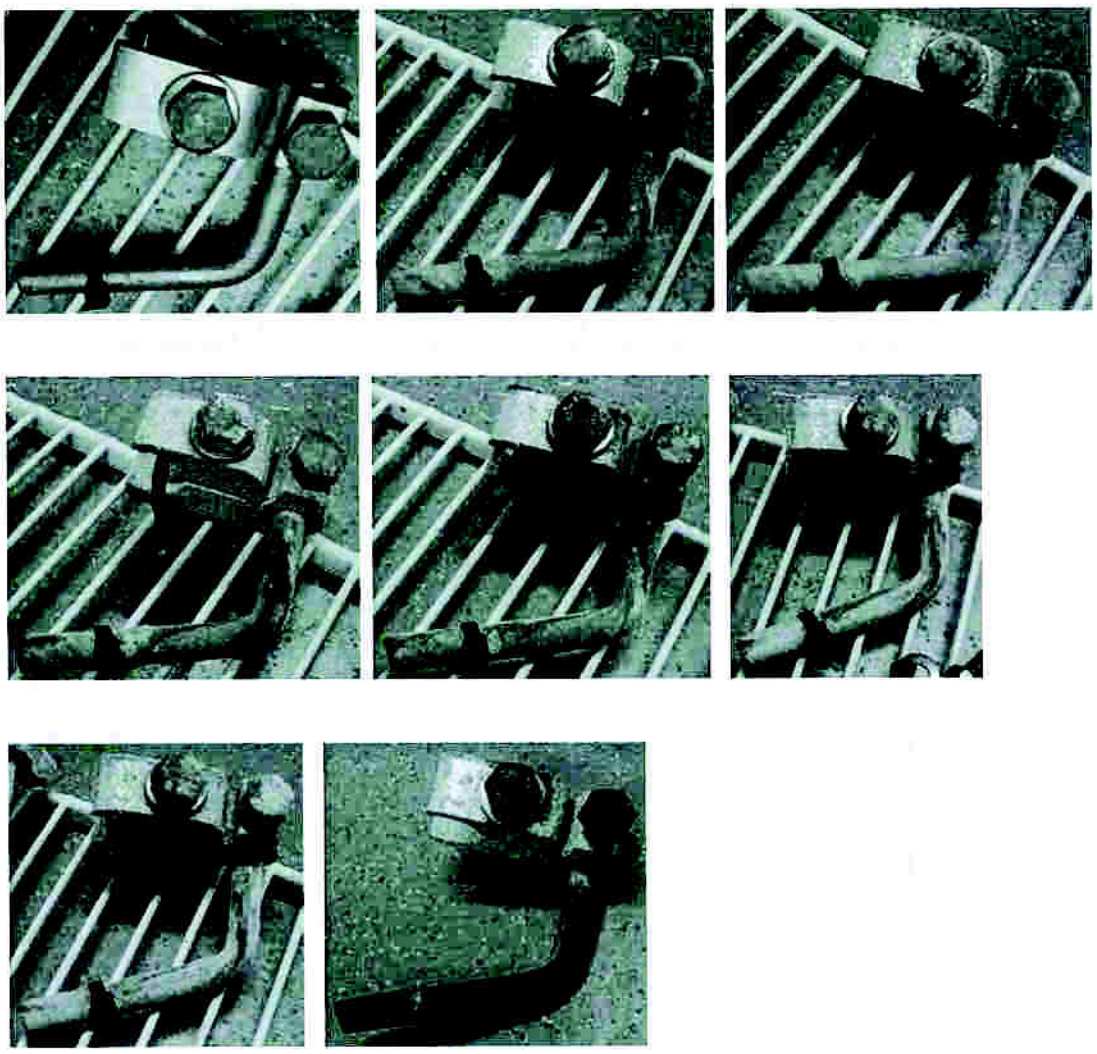
The samples were attached with plastic cable ties to the sample stand. The angle of the sample stand was 60° from horizontal. The sample stand was situated into a test chamber and the test lasted for 1000 hours.

The samples were photographed at an interval of one test week. After the test the samples were washed in running tap water for five minutes. The temperature of the tap water was 30°C. After that the samples were rinsed in purified water and then dried with an air blast.

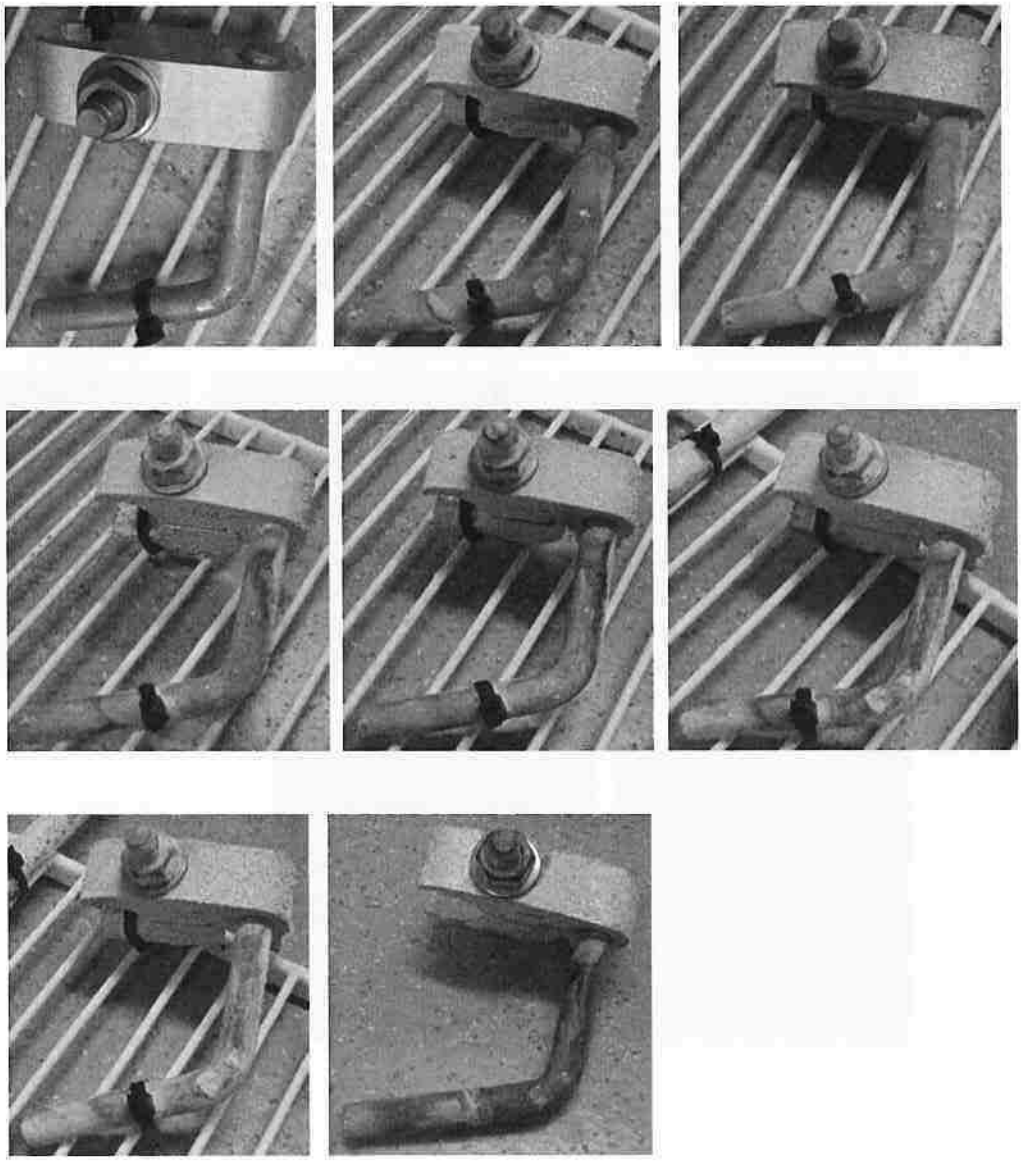
The ambient temperature and relative humidity in the test chamber during a cycle of 24 hours is presented in the figure.



Power arc device SDI10.2, Sample A (Pictures of the sample were taken: Top row: before the test, after one week and after two weeks, Middle row: after three weeks, after four weeks and after five weeks, Bottom row: after the test and after washing the sample.)



Power arc device SDI10.2, Sample B (Pictures of the sample were taken: Top row: before the test, after one week and after two weeks, Middle row: after three weeks, after four weeks and after five weeks, Bottom row: after the test and after washing the sample.)



Conclusions:

The strain for the samples was 1000 h of prohesion mist.

The power arc device **SDI10.2** passed the visual test.

Analysis:

-

Remarks:

Samples were photographed at an interval of one test week. The photographs were sent by email to the customer.

Used measuring equipment:
Prohesion chamber, No. 22
Temperature: No. 42 / Ch4_T1, calibrated 21st January, 2011, calibration is valid
Humidity: No. 42 / RH_AUX, calibrated 21st January, 2011, calibration is valid
pH: No. 41, Fastech FT11, calibrated 21st January, 2011, calibration is valid

Actions, operations and reporting are in accordance with IEC/ISO 17025 'General requirements for the competence of testing laboratories'.

Signatures:

Timo Oksa
Littoinen, 16th of February, 2011

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ВЯРНО С ОРИГИНАЛА
ФИЛКАБ 16

Saves Your Energy

LABORATORY REPORT
No.: 2191S
Revision: A

Date of Tests: 28.6.-9.8.2010

Test object:

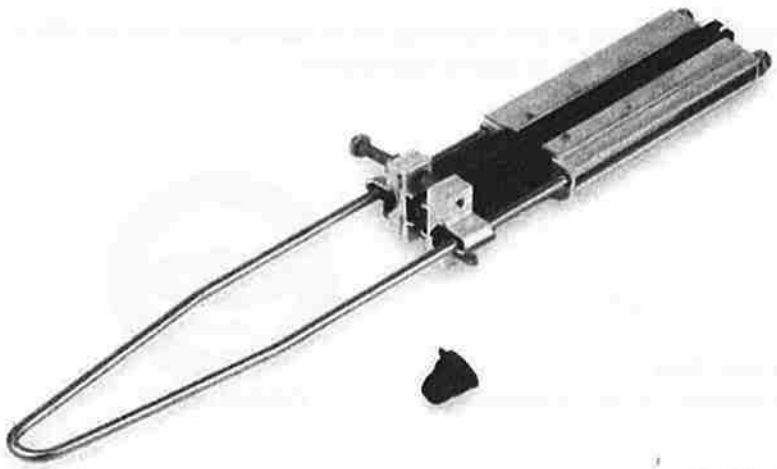
Tension clamp SO256.

Purpose of the test and relevant standards:

Part of type test.
Climatic ageing test, method 2 (UV-test), according to EN 50397-2:2009, clause 7.10.2.2.

Conclusion:

The tension clamp passed the test.



Picture 1: Tested product SO256.

ENSTO UTILITY NETWORKS LABORATORY

Date of Report: 8.6.2011

Tested by: Kari Malinen

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: V.Vilenius
Distribution: OHL PD-team

Ensto Utility Networks Laboratory
Ensto Finland Oy

Ensio Miettisen katu 2,
P.O.Box 77
06101 Porvoo, Finland

Tel. +358 204 76 21
Fax +358 204 76 2770

Business ID: 0130215-8
Reg. Office: Porvoo

1. Test object

Tension clamp:

Type:	Tension clamp SO256
Batch number:	0-series
Conductor range:	95 – 157 mm^2
Conductor diameter:	16,1 – 22,3 mm
Tightening torque:	40 Nm
Clamp SMFL:	30 kN
No of pcs:	2

2. Testing procedure

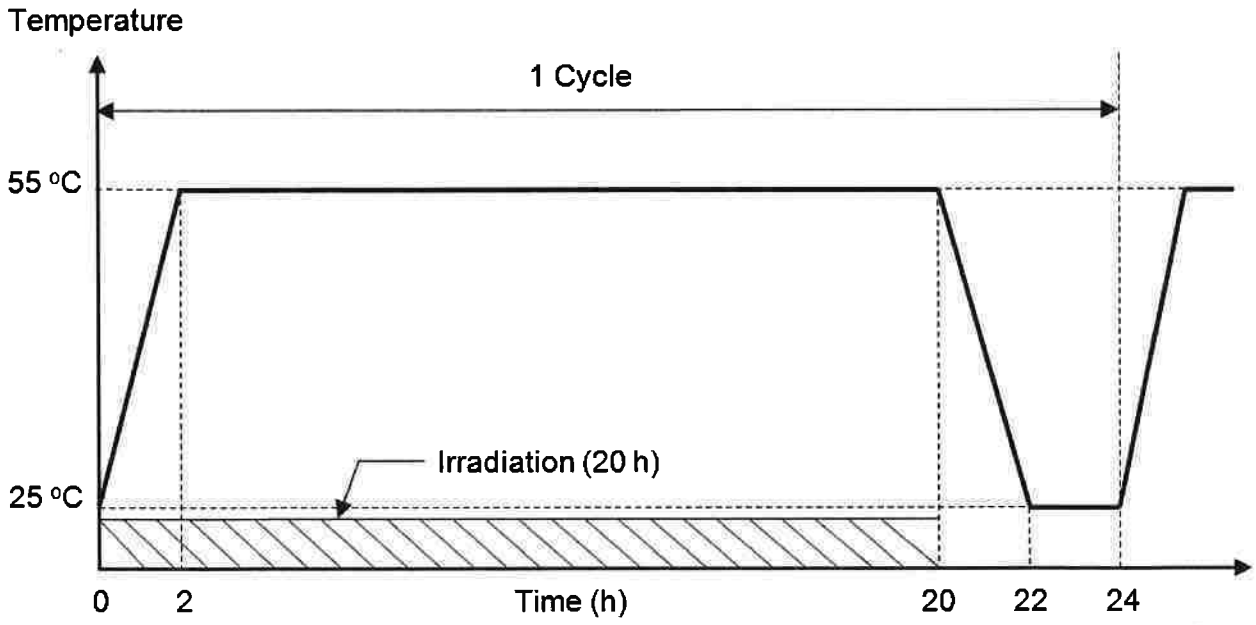
2.1 Simulated solar radiation test (UV-test)

The test was carried out in an enclosure, where an irradiance of 0, 83 kW/m^2 with the spectral distribution given in Table 1 was provided over an irradiation measurement plane of 900 mm x 900 mm. This value includes any radiation reflected from the test enclosure. The radiation was produced with 20 pcs of 300 W Ultra-Vitalux lamps of Osram with burning age (50%) 1000 h. The distance to the measurement plane was 700 mm.

The test consists of 56 daily cycles (8 weeks). Each cycle consist of 20 h irradiation and 4 h darkness, Picture 2. The temperature was maintained at 55±2 °C during the irradiation period and at 25±2 °C during the darkness period. The temperature was measured with a thermocouple in a point 40 mm below the measurement plane at half the distance between the specimen and the wall.

Spectral region	Ultra-violet B	Ultra-violet A	Visible			Infra-red
Bandwidth	0,28 µm - 0,32 µm	0,32 µm - 0,40 µm	0,40 µm - 0,52 µm	0,52 µm - 0,64 µm	0,64 µm - 0,78 µm	0,78 µm - 3,00 µm
Irradiance measured	9,1 W/m^2	47,3 W/m^2	53,0 W/m^2	105,1 W/m^2	33,3 W/m^2	578,6 W/m^2
Std. requirements Irradiance Tolerance	5 W/m^2 ±35 %	63 W/m^2 ±25 %	200 W/m^2 ±10 %	186 W/m^2 ±10 %	174 W/m^2 ±10 %	492 W/m^2 ±20 %

Table 1: Spectral energy distribution and permitted tolerances



Picture 2: Temperature-radiation-time relationships

Requirements

Simulated solar radiation test (UV-test)
The sample may not have any degradation, which could affect the normal function and the identification marking shall be legible.

Damage and failure load test
Regarding damage load, the test is passed if no permanent deformation, which can affect the proper function of the fitting, occurs at or below the specified mechanical minimum damage load.

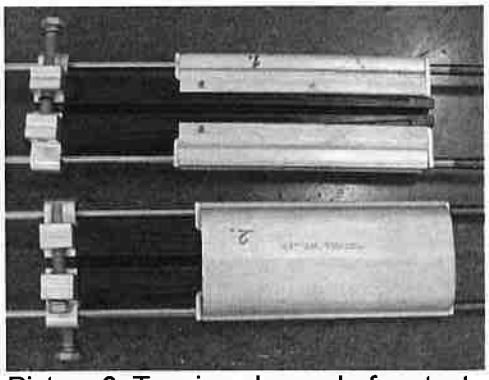
Regarding failure load, the test is passed if failure of the fitting does not occur at a load less than or equal to the specified minimum failure load.

3. Test results

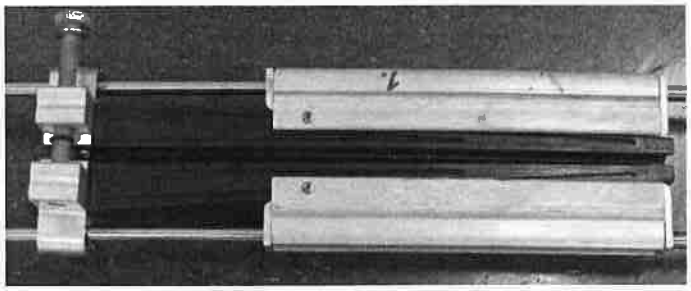
Test results for damage and failure load test can be founded in test report:
2106_SO256_Damage_and_failure_load_test_TR.pdf

Summary:
No visual degradation could be noticed. The markings are clearly legible.

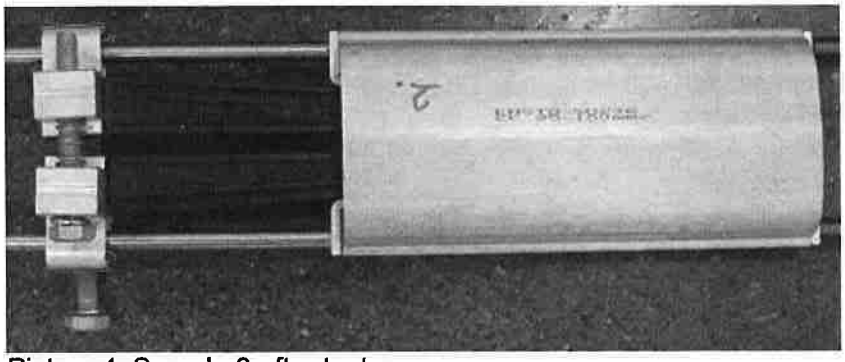
4. Pictures



Picture 2: Tension clamps before test.



Picture 3: Sample 1 after test.



Picture 4: Sample 2 after test.

5. Test equipment

ID	TYPE	MODEL	PURPOSE
UV1	UV-radiation chamber	Ensto	Climate testing
L112	Thermometer	Center 309	Temperature measurements

6. Test Id

882

7. Revision history

A

Saves Your Energy

LABORATORY REPORT
No.: 2170S
Revision: A

Date of Tests: 8.7.-1.9.2010

Test object:

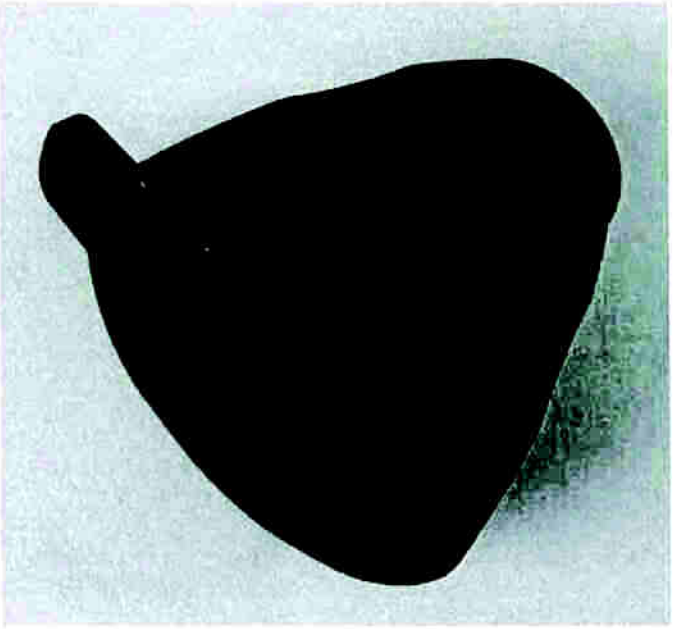
End cap ENSTO PMR2720.

Purpose of the test and relevant standards:

Part of type test.
Climatic ageing test, method 2 (UV-test), according to EN 50397-2:2009, clause 7.11.2.3.2.

Conclusion:

The end cap passed the test.



Picture 1: Tested product PMR2720.

ENSTO
UTILITY NETWORKS
LABORATORY

Date of Report: 23.5.2011

Tested by: Kari Malinen

Witnessed by: Sami Hakonen / SGS Fimko

Reviewed by: Janne Lappalainen

Ordered by: M.Salonen
Distribution: MSa, VV

Ensto Utility Networks Laboratory
Ensto Finland Oy

Ensto Mietisen katu 2,
P.O.Box 77
06101 Porvoo, Finland

Tel +358 204 76 21
Fax +358 204 76 2770

Business ID 0130215-8
Reg Office: Porvoo

1. Test object

End cap:

Product code:	PMR2720
Cross-section:	12,7 – 22,3 mm
No of pcs:	2

2. Testing procedure

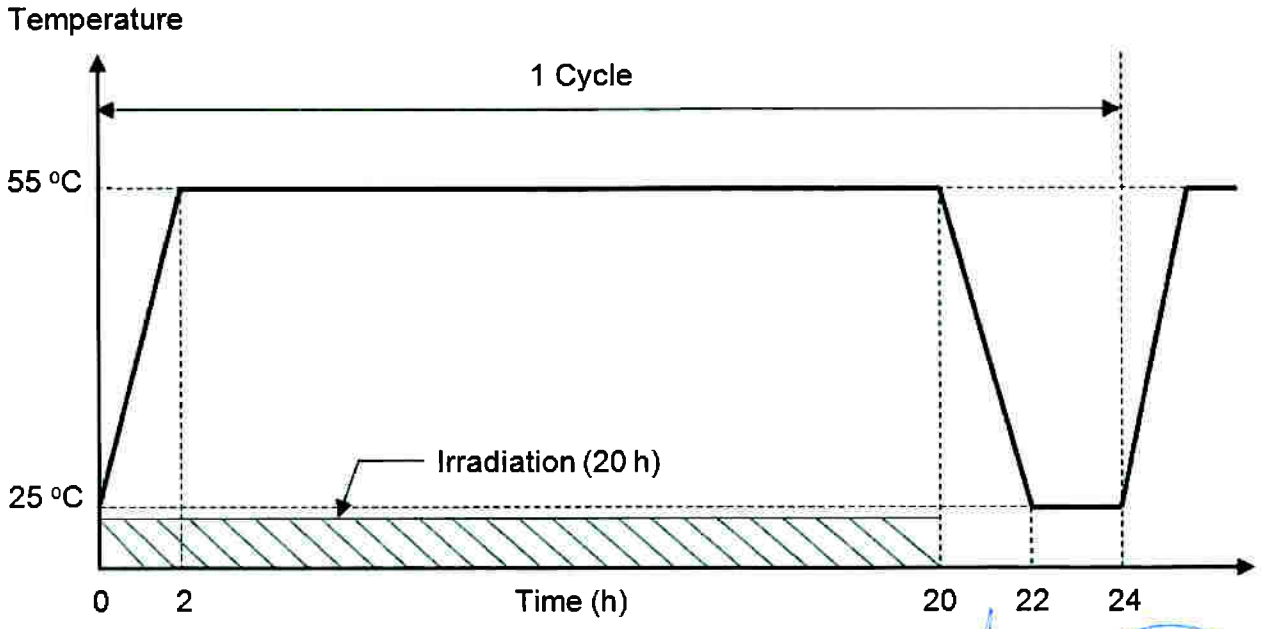
2.1 Simulated solar radiation test (UV-test)

The test was carried out in an enclosure, where an irradiance of 0, 83 kW/m^2 with the spectral distribution given in Table 1 was provided over an irradiation measurement plane of 900 mm x 900 mm. This value includes any radiation reflected from the test enclosure. The radiation was produced with 20 pcs of 300 W Ultra-Vitalux lamps of Osram with burning age (50%) 1000 h. The distance to the measurement plane was 700 mm.

The test consists of 56 daily cycles (8 weeks). Each cycle consist of 20 h irradiation and 4 h darkness, Picture 2. The temperature was maintained at 55±2 °C during the irradiation period and at 25±2 °C during the darkness period. The temperature was measured with a thermocouple in a point 40 mm below the measurement plane at half the distance between the specimen and the wall.

Spectral region	Ultra-violet B	Ultra-violet A	Visible			Infra-red
Bandwidth	0,28 µm - 0,32 µm	0,32 µm - 0,40 µm	0,40 µm - 0,52 µm	0,52 µm - 0,64 µm	0,64 µm - 0,78 µm	0,78 µm - 3,00 µm
Irradiance measured	9,1 W/m^2	47,3 W/m^2	53,0 W/m^2	105,1 W/m^2	33,3 W/m^2	578,6 W/m^2
Std. requirements Irradiance Tolerance	5 W/m^2 ±35 %	63 W/m^2 ±25 %	200 W/m^2 ±10 %	186 W/m^2 ±10 %	174 W/m^2 ±10 %	492 W/m^2 ±20 %

Table 1: Spectral energy distribution and permitted tolerances



Picture 2: Temperature-radiation-time relationships

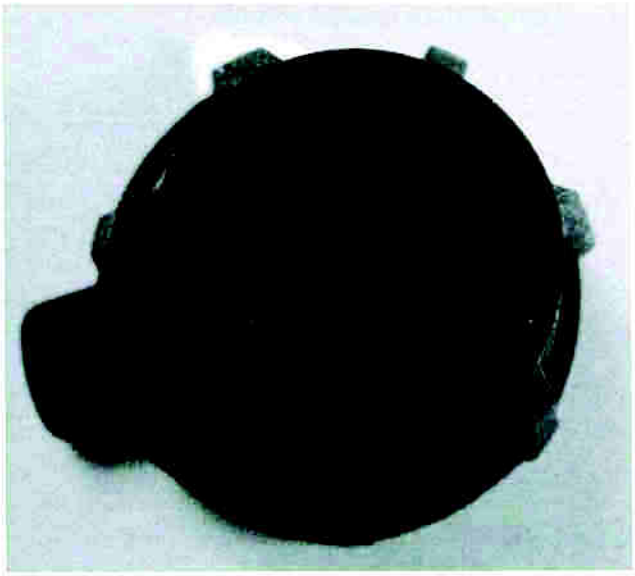
Requirements

Simulated solar radiation test (UV-test)
The sample may not have any degradation, which could affect the normal function and the identification marking shall be legible.

3. Test results

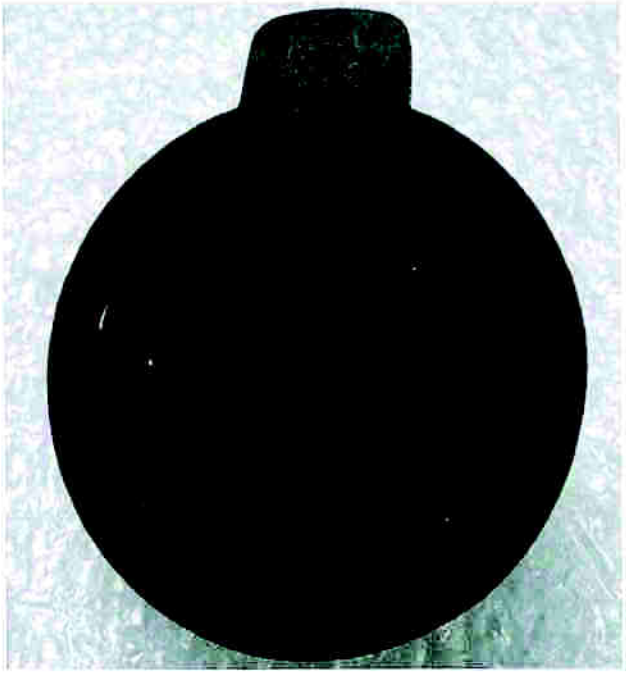
Summary:
The samples have small cracks on the upper surface, but in fact these have no influence to proper working of the end cap. The markings are clearly legible.

4. Pictures



Picture 2: End cap before UV-test.

Picture 3: End cap after Uv-test.



Picture 4: Markings on the end cap.

5. Test equipment

ID	TYPE	MODEL	PURPOSE
UV1	UV-radiation chamber	Ensto	Climate testing
L112	Thermometer	Center 309	Temperature measurements

6. Test Id

838

7. Revision history

A

TEST REPORT
IEC 61238-1
Compression and mechanical connectors for power cables
Part 1: Test method and requirements

Report

Reference No. ..... : **251420-1**

Compiled by (+ signature) ..... : **S.Hakonen**

Approved by (+ signature) ..... : **V.Haapaoja**

Date of issue ..... : **16.05.2008**

Contents ..... : **9 pages including Annex**

This report is based on a blank test report that was prepared by SGS Fimko.

Testing laboratory

Name ..... : **SGS Fimko Ltd.**

Address ..... : **P.O. Box 30, FIN-00211 HELSINKI, FINLAND**

Testing location ..... : **Särkiniementie 3, FIN-00210 HELSINKI, FINLAND**

Client

Name ..... : **Ensto Sekko**

Address ..... : **Ensio Miettisen katu 2**

..... : **FI-06100 PORVOO, FINLAND**

Test specification

Standard ..... : **IEC 61238-1:2003**

Test procedure ..... : **FI-Scheme**

Procedure deviation ..... : **N.A.**

Non-standard test method ..... : **N.A.**

Test Report Form / blank test report

Test Report Form No. ..... : **IEC 61238-1_SGS FIMKO**

TRF ..... : **SGS Fimko Ltd**

Test item description ..... : **Connector for power cables**

Trademark ..... : **ENSTO**

Manufacturer ..... : **Ensto Sekko**

Model and/or type reference ..... : **SML1.17**

Rating(s) ..... : **Al/Cu 10 – 95 mm²**

Copy of marking plate

ENSTO

SML1.17

Summary of testing and remarks

Connector SML1.17 fulfils requirements of the standard.

Heat cycle test made with Al 95 mm² conductor and d.c current.

General remarks

This test report shall not be reproduced except in full without the written approval of the testing laboratory.

The test results presented in this report relate only to the item tested.

"(see remark #)" refers to a remark appended to the report.

"(see appended table)" refers to a table appended to the report.

Throughout this report a comma is used as the decimal separator.

Test item particulars:	
Cross-sectional areas of conductors .....:	**10 – 95 mm²**
Conductor material(s) .....:	**Al / Cu**
Shape of conductors.....:	**Round**
Type of the conductor .....:	**Stranded**
Stranded conductors, if known:	
- hardness.....:	-
- type of plating.....:	-
- number and arrangement of strands.....:	-
- type of impregnation, water blocking, etc.....:	-
In case insulation piercing connectors:	
- material and thickness of insulation ...:	-
- type of insulation and installation temperature.....:	-
Connector class .....:	**A**
Tool for compressions.....:	-
Compression jaws.....:	-
Number of compressions.....:	-
Protection grease .....:	**SR 1**
Diameter of screws .....:	**12 mm**
Nominal tightening torque of screws.....:	**Shear-head bolt**
Preparation of contact surfaces.....:	**Brushed conductors**

Test case verdicts	
Test case does not apply to the test object .:	**N(.A.)**
Test item does meet the requirement.....:	**P(ass)**
Test item does not meet the requirement....:	**F(ail)**

IEC 61238-1:2003			
Clause	Requirement - Test	Result - Remark	Verdict
6	**ELECTRICAL TESTS**		
6.1	Installations		
	conductors of same cross-sectional area, taken from the same continuous core		P
	test shall be made with six specimens		P
	connectors assembled in accordance with manufacturers instruction		P
	insulation removed before assembly		P
	ambient temperature between 15 °C and 30 °C		P
	Insulation piercing connector (IPC):		
	- insulation retained under and at least 100 mm outside the connector		N
	- reference conductor with insulation including test loop		N
	- when assembling IPC, temperature 23±3°C		N
6.1.1	Through connectors and terminal lugs		
	test loop according to figure 1.....:	**Figure 1B**	P
	Terminal lugs:		
	- palm connected direct to palm		P
	- palms bolted to linking bars		N
	- palms bolted to plant terminal etc., agreement between parties		N
	Linking bars shall be, at the point of connection:		
	- same material as palm		N
	- same dimensions and thickness as palm		N
6.1.2	Branch connectors		
	when branch conductor immediately below, above or same as main, treated as through connector		N
	test loop according to figure 2		N
6.3	Heat cycle test		
6.3.1	First heat cycle		
	heating current (A)	**359 A**	P
	temperature of reference conductor (°C).....:	**140°C**	P
	temperature of median connector (°C).....:	**94°C**	P
	temperature of linking bars (°C).....:		N
	When tests of IPCs, maximum conductor temperature in normal use (°C).....:		N
6.3.2	Second heat cycle		

IEC 61238-1:2003			
Clause	Requirement - Test	Result - Remark	Verdict
	durations of heating (t_1) and cooling (t_2) periods (min):	**t_1 36 min; t_2 13 min**	**P**
6.3.3	Subsequent heat cycles		
	a total of 1000 heat cycles		**P**
	Maximum connectors temperature during heat cycles (°C)……:	**99 °C**	**P**
	Measurements at following cycles:		
	Class A connectors:		
	ΔU_1 ➔ before the first heat cycle ΔU_2 ➔ after the 200th ±10th heat cycles however before short circuits ΔU_3 ➔ after the short circuits ΔU_4 ➔ after the 250th ±10th heat cycle then every 75 cycles. (In total 14 measurements)	**Measuring results are in annex 1, Summary table of the test results.**	**P**
	measuring current (A)……:	**179 A**	**P**
	Class B connectors:		
	ΔU_1 ➔ before the first heat cycle ΔU_2 ➔ after the 250th ±10th heat cycle then every 75 cycles. (In total 12 measurements)		**N**
	measuring current (A)……:		**N**
6.3.4	Short-circuit tests (for class A connectors only)		
	six short-circuits applied after 200th cycles		**P**
	temperature raises from ≤35°C to between 250 °C and 270 °C ……:	**Max. 276°C**	**P**
	for IPC connectors, maximum permissible temperature of the insulation (°C)……:		**N**
	duration of short-circuit test (s)……:	**0,85 s**	**P**
	current in short-circuit test (A)……:	**Max. 13,3 kA**	**P**
6.5	Requirements		
	Six connectors shall comply with the requirements (Table 2):		
	- initial scatter δ ≤ 0,30……:	**0,04**	**P**
	- mean scatter β ≤ 0,30……:	**0,17**	**P**
	- change of resistance factor D ≤ 0,15……:	**0,05**	**P**
	- resistance factor ratio λ ≤ 2,0……:	**1,30**	**P**
	- connectors maximum temperature $\theta_{max} \leq \theta_{ref}$……:	**θ_{max} 99°C; θ_{ref} 142°C**	**P**

7	MECHANICAL TESTS		
7.1	Method		
	test shall be made with three additional specimens		**N**
	connectors assembled as for electrical test		**N**

IEC 61238-1:2003			
Clause	Requirement - Test	Result - Remark	Verdict
	connectors for different cross-section areas, the different connectors tested individually		**N**
	conductors length ≥ 500 mm.....:		**N**
	Tensile force for mechanical test (table 3):		
	- for aluminium conductors 40 N x A, max 20 kN		**N**
	- for copper conductors 60 N x A, max 20 kN		**N**
	load not exceed 10 N/mm²/s		**N**
	load maintained for 1 minute		**N**
	no slipping shall occur during the test		**N**

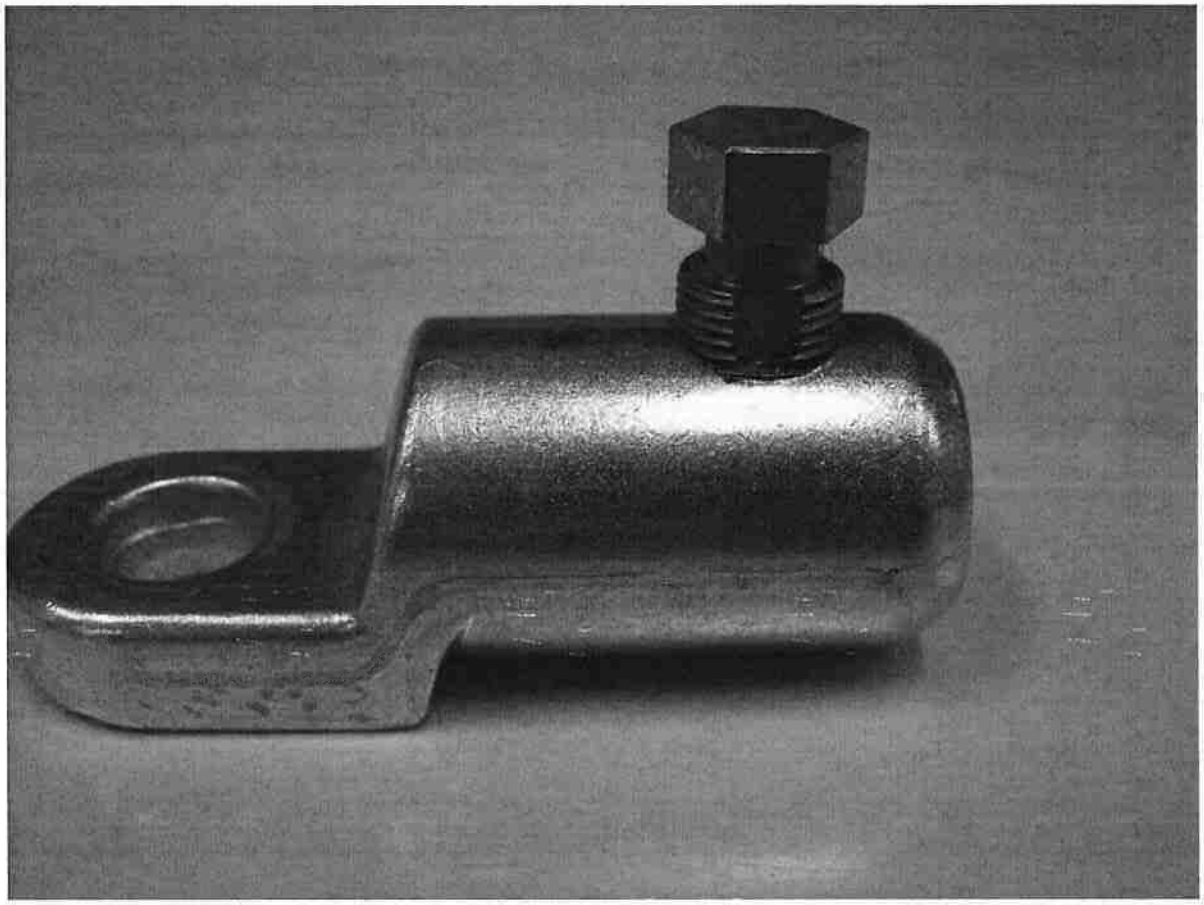
	SUMMARY TABLE OF THE TEST RESULTS	
	- connector type	**Screw cable lug**
	- cross-sectional areas of conductor(s)	**95 mm²**
	- connectors class	**A**
	- protection grease	**SR1**
	- tightening torque [Nm]	**17 Nm**
	- tool for compressing	**-**
	- jaws and number of compressions	**-**
	- conductors in heat cycle tests	**Al 95 mm²**
	- load current [dc]	**359 A**
	- measuring current [dc]	**179 A**
	- durations of heating (t_1) and cooling (t_2) periods [min]	**t_1 36 min; t_2 13 min**
	- short circuit test	
	- short circuit current [kA]	**Max. 13,3 kA**
	- time [s]	**0,85 s**
	- temperature [°C]	**Max. 276 °C**

Resistance values:

Cycle no.	Sample 1 [mΩ]	Sample 2 [mΩ]	Sample 3 [mΩ]	Sample 4 [mΩ]	Sample 5 [mΩ]	Sample 6 [mΩ]	Ref. conductor [mΩ]
0	0,0650	0,0656	0,0648	0,0648	0,0650	0,0656	0,1562
200th	0,0651	0,0656	0,0657	0,0651	0,0642	0,0658	0,1550
201st	0,0628	0,0646	0,0631	0,0624	0,0637	0,0644	0,1507
250th	0,0651	0,0665	0,0677	0,0652	0,0658	0,0679	0,1557
325th	0,0651	0,0658	0,0680	0,0651	0,0657	0,0680	0,1560
400th	0,0650	0,0657	0,0679	0,0649	0,0657	0,0680	0,1556
475th	0,0650	0,0656	0,0680	0,0648	0,0657	0,0680	0,1556
550th	0,0649	0,0656	0,0678	0,0645	0,0656	0,0679	0,1554
625th	0,0650	0,0657	0,0680	0,0646	0,0658	0,0681	0,1556
700th	0,0651	0,0659	0,0680	0,0646	0,0658	0,0681	0,1557
775th	0,0650	0,0658	0,0679	0,0645	0,0657	0,0680	0,1555
850th	0,0650	0,0657	0,0678	0,0645	0,0657	0,0680	0,1552
925th	0,0650	0,0657	0,0679	0,0646	0,0658	0,0681	0,1554
1000th	0,0651	0,0657	0,0679	0,0646	0,0658	0,0681	0,1553

Length of the measuring points

Sample 1 [mm]	Sample 2 [mm]	Sample 3 [mm]	Sample 4 [mm]	Sample 5 [mm]	Sample 6 [mm]	Ref. conductor [mm]
l_a 152 l_b 1	l_a 152 l_b 1	l_a 151 l_b 1	l_a 151 l_b 1	l_a 152 l_b 1	l_a 152 l_b 1	450



ВЯРНО С ОРИГИНАЛА

FINAS
Finnish Accreditation Service
T284 (EN ISO/IEC 17025)

Laboratory Report

No.: 3332S
Revision: A

Date of Test: 25.11.2015 – 23.1.2016

Test object:

Bird protector SP67.3.

Purpose of the test and relevant standards:

Test for markings.
Climatic ageing test according to EN 50397-2:2009 clause 7.10.2.2 and IEC 60068-2-5:2010 procedure B.

Conclusion:

The bird protector passed the test.

Picture 1: Bird protector SP67.3

Date of Report: 25.1.2016

Tested by: Ola Forsström

ENSTO
UTILITY NETWORKS
LABORATORY

Approved by: Janne Lappalainen

Ordered by: K. Gajewski
Distribution: KGa, PPu, SOr

ВЯРНО С ОРИГИНАЛА

ENSTO

Ensto Utility Networks Laboratory
Ensto Finland Oy
Ensio Miettisen katu 2,
P.O.Box 77
06101 Porvoo, Finland
Tel. +358 204 76 21
Fax +358 204 76 2770
Business ID: 1481990-6
Reg. Office: Porvoo

1. Test objects

Bird protector:

Type:	SP67.3 (PMR3007)
Manufacturer:	Ensto Finland Oy
Batch number:	11/2015
No of pcs:	2

2. Testing procedure

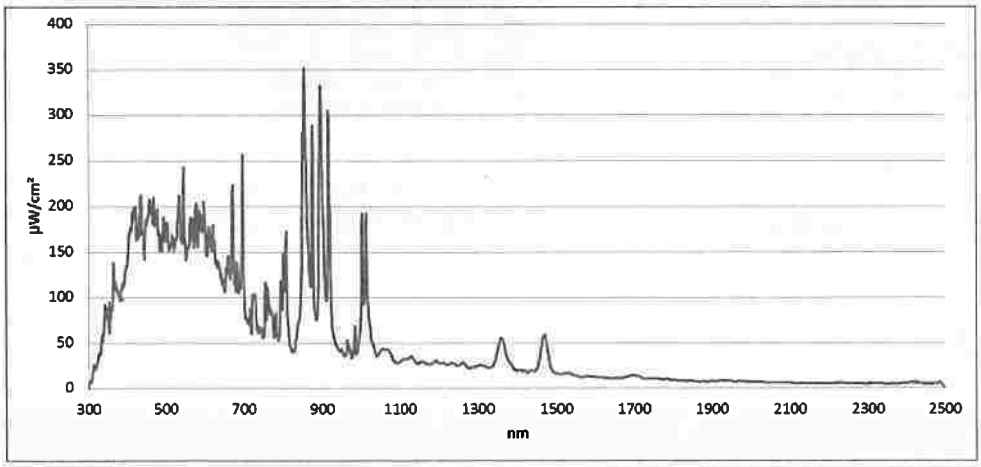
For the purpose of this test only the part of the bird protector containing markings was used.

The test was carried out in a solar environmental chamber, where an irradiance of 1090 W/m^2 ± 10 % with the spectral distribution given in Table 1 was provided over an irradiation measurement plane of 750 mm x 750 mm. This value includes any radiation reflected from the test chamber. The radiation was produced with one 4000 W Metal Halide Global lamp with a replacement interval of 1120 h. The lamp is pre-selected by the supplier to ensure compliance with the standard requirement regarding spectral distribution.

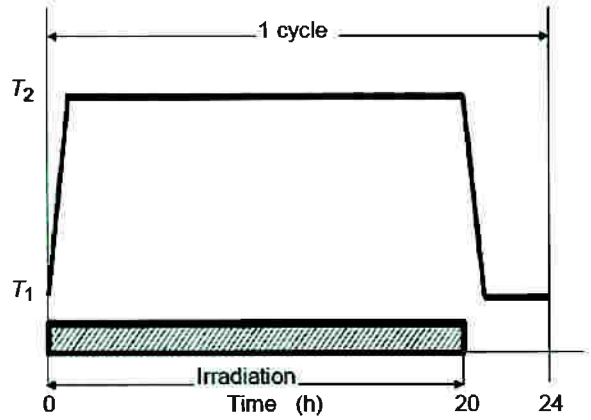
The test consists of 56 daily cycles (8 weeks). Each cycle consist of 20 h irradiation and 4 h darkness, as shown in Picture 3. During the irradiation period the temperature within the test chamber rises at approximately 1 °C/min to 55 ± 2 °C, and is thereafter maintained at this level. During the darkness period the temperatures falls at approximately 1 °C/min to 25 ± 2 °C, and is thereafter maintained at this level. Two RTDs (Pt100) placed 20 mm below the measurement plane at half the distance between the specimen and both side walls of the test chamber are used to monitor and control the temperature. Picture 4 shows measured temperature and relative humidity values for one daily cycle.

Spectral region	Ultra-violet B	Ultra-violet A	Visible	Infra-red	Total radiation
Bandwidth	300 nm – 320 nm	320 nm – 400 nm	400 nm – 800 nm	800 nm – 2450 nm	300 nm – 2450 nm
Irradiance, measured	2,8 W/m^2	68,2 W/m^2	563,8 W/m^2	455,2 W/m^2	1090 W/m^2
Irradiance, std. requirement	4,06 W/m^2	70,5 W/m^2	604,2 W/m^2	411,2 W/m^2	1090 W/m^2

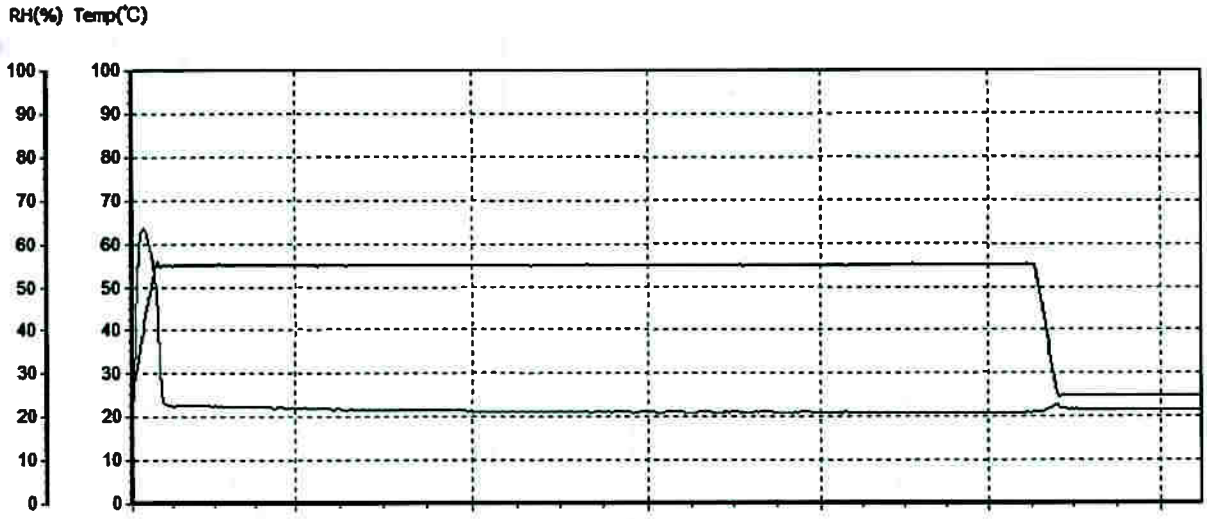
Table 1: Spectral energy distribution



Picture 2: Measured spectral distribution of irradiation intensity



Picture 3: Temperature-radiation-time relationships



Picture 4: Daily cycle plot of *T* and *RH%*

Requirements

Visual inspection shall be carried out to determine that there has been no degradation of the organic parts.

The sample's identification markings shall be legible when examined with normal or corrected vision without magnification.

No deterioration of the sample shall occur which would impair the normal function of the bird protector.

3. Test results

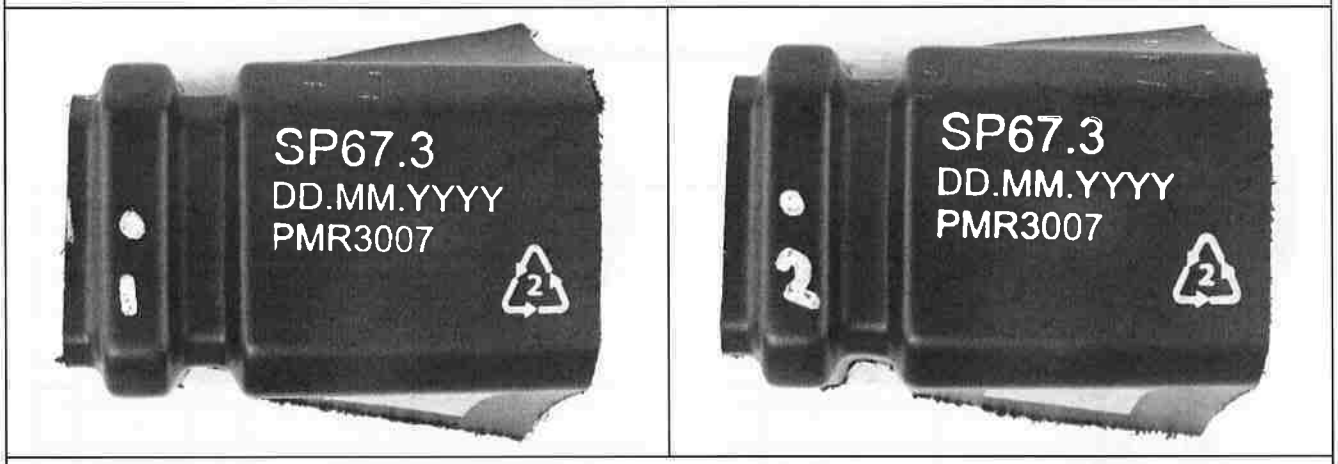
No visual degradation of the bird protector was observed after the simulated solar radiation test. The sample also withstood mechanical bending and twisting by hand. The markings were legible.

Summary

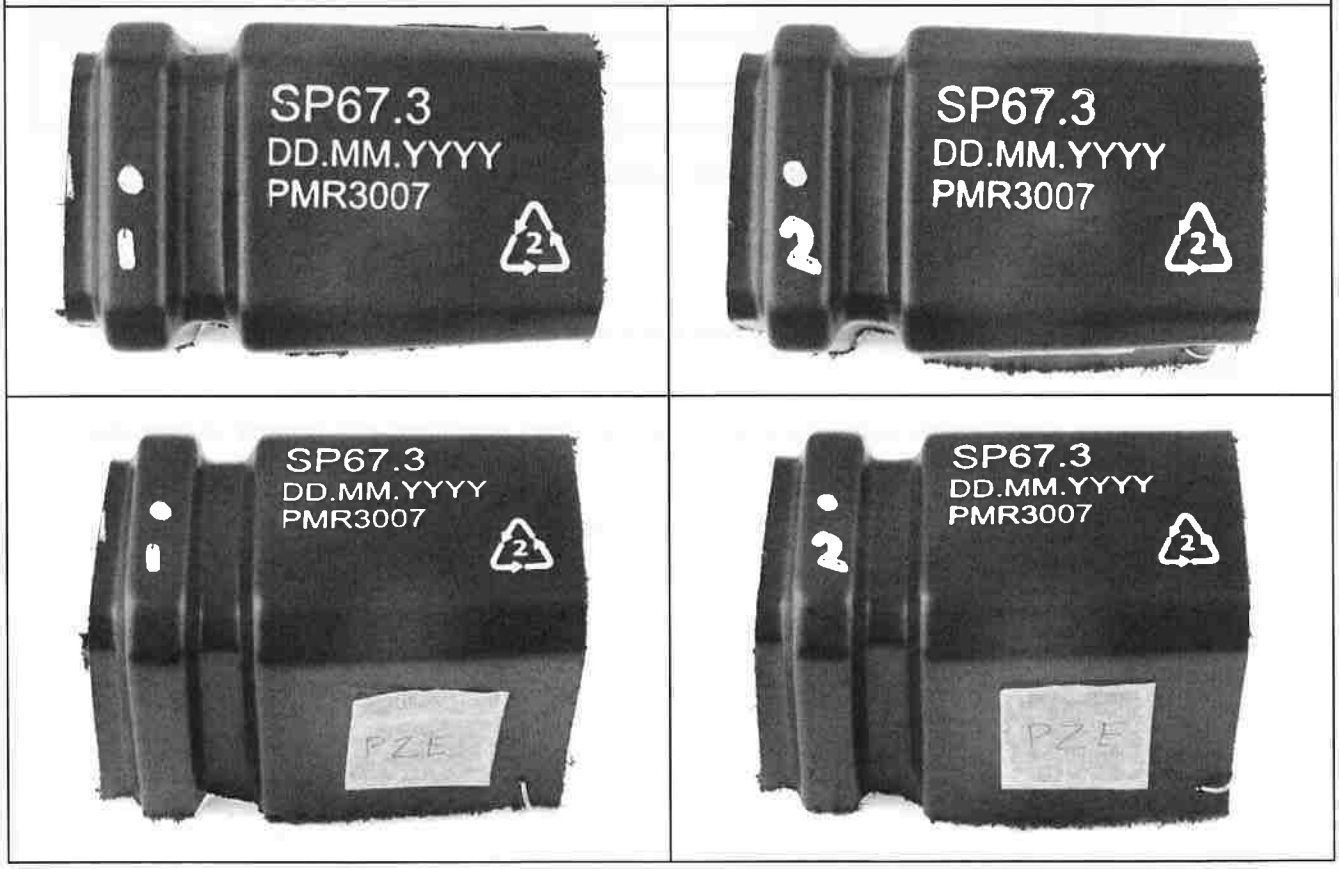
The bird protector fulfilled the test requirements.

4. Pictures

Before test



After test



Picture 5: Tested samples

5. Test equipment

ID	Type	Model	Purpose	Latest calibration
UV3	Climate chamber	SEC 1100	Climate testing	15.09.2014

6. Test Id

3543

7. Revision history

A

Our ref.: 59725

Certificate FILab/16001

The Testing facility

Ensto Finland Oy
Ensto Utility Networks

Ensio Miettisen katu 2
FI-06150 PORVOO
Finland

has been assessed and found out to meet the relevant requirements of

EN ISO/IEC 17025:2005

SGS Fimko has authorized the testing facility to test products as Customer Testing Facility (CTF) stage 2 and 3 in order to utilize the test results for FI-certifications issued by SGS Fimko Ltd according to the following standards (limitations apply):

IEC 61238-1 (ed.2)
EN 50397-1:2006 (table 2, 1.2)
EN 50397-2:2009
HD 605:2008 (item 3.2.2.2)
EN 50483-1, -2, -3, -4, -5, -6:2009
IEC 61284 (ed.2)

This certificate is valid three years from the date of issue provided that the testing facility fulfils the criteria for maintaining recognition for the relevant CTF stage and as defined in the applicable IECEE Operational Document.

Date of issue: 10th December 2015

Authorised by

Mika Richardt
SGS Fimko Ltd
Särkiniementie 3, FI-00210 Helsinki, Finland
Phone +358 (0)9 6963 61 - Fax +358 (0)9 692 5474 www.sgsfimko.com

FINAS
Finnish Accreditation Service

AKKREDITOINTITODISTUS

ACCREDITATION CERTIFICATE

ENSTO FINLAND OY

ENSTO UTILITY NETWORKS LABORATORY

PORVOO

T284

on FINAS-akkreditointipalvelun akkreditoima testauslaboratorio T284.
Akkreditointipäätös on voimassa 25.11.2018 asti.
Tiedot akkreditoinnin pätevyysalueesta ja voimassaolosta on esitetty verkkosivuilla www.finas.fi.

is testing laboratory No. T284 accredited by FINAS Finnish Accreditation Service.
The accreditation decision is valid until 25.11.2018.
Information about the scope and the current status of the accreditation is available on the web page www.finas.fi.

Toimielin täyttää seuraavan standardin vaatimukset:
The above body conforms to the requirements of the following standard:

SFS-EN ISO/IEC 17025:2005

Espoo 25.11.2014

Leena Tikkanen

Mika Penttinen

АКЦИОНЕРНО ДРУЖЕСТВО БИЛКАБ 16 ПЛОВДИВ

ВЯРНО С ОРИГИНАЛА

FINAS kuuluu European co-operation for Accreditation (EA) monenkeskiseen tunnustamissopimukseen (EA MLA).
FINAS is a signatory of the European co-operation for Accreditation (EA) Multilateral Agreement for accreditation.

PRODUCT CARD
8/4/2017

ENSTO

SO256.2

Tension clamp

Code	SO256.2
GTIN	6438100303839
ENumber	
Name	Tension clamp PAS/BLL-T 95-157 mm² AlMgSi hoist adapter
Description	Tension clamp for covered conductors (PAS/BLL AlMgSi). The insulation piercing contact part has silicone seal which prevents the moisture getting into the conductor. Clamps are equipped with an adapter for hoist hook.

Technical specification

Dimensions

Weight:	2.79 kg
Conductor diameter:	16.1 ... 22.3 mm

Features

For conductor size:	PAS / BLL 95-157 mm² AlMgSi

Mechanical

SMFL:	25 kN
Tightening torque:	40 Nm
SMDL:	22 kN

Certificates

Standards:	EN 50397-2

Specification

Construction:

ВЯРНО С ОРИГИНАЛА
ФИЛКАБ 16

Ensto Finland Oy
Ensio Miettisen katu 2
06100 Porvoo
Finland
email: ensto@ensto.com
phone: +358 204 76 21
www.ensto.com

Construction:

Component	Material
Body	Corrosion resistant aluminium alloy
Bolts	Hot-dip galvanised steel M10
Bail	Stainless steel
Plastic parts	Frost, heat and UV-radiation resistant plastic
Hoist adapter	Hot-dip galvanised steel

Installation: The clamp is opened and the conductor wire is inserted between the wedges. The locking connector is tightened. Tightening torque 40 Nm. The clamp is closed and strained.

Markings:

Markings:

ENSTO

SO256.2

95-157 mm²

40 Nm

week/year of manufacture

Packaging

Default package

Unit: PCS
Size: 3
Length: 1130 mm
Width: 150 mm
Height: 120 mm
Weight (net): 8.37 kg
Weight (brt): 8.43 kg
Volume: 0.0203

Pallet package

Unit: PCS
Size: 90
Length: 1200 mm
Width: 800 mm
Height: 860 mm
Weight (net): 251.1 kg

Weight (brt):	272 kg
Volume:	0.8256

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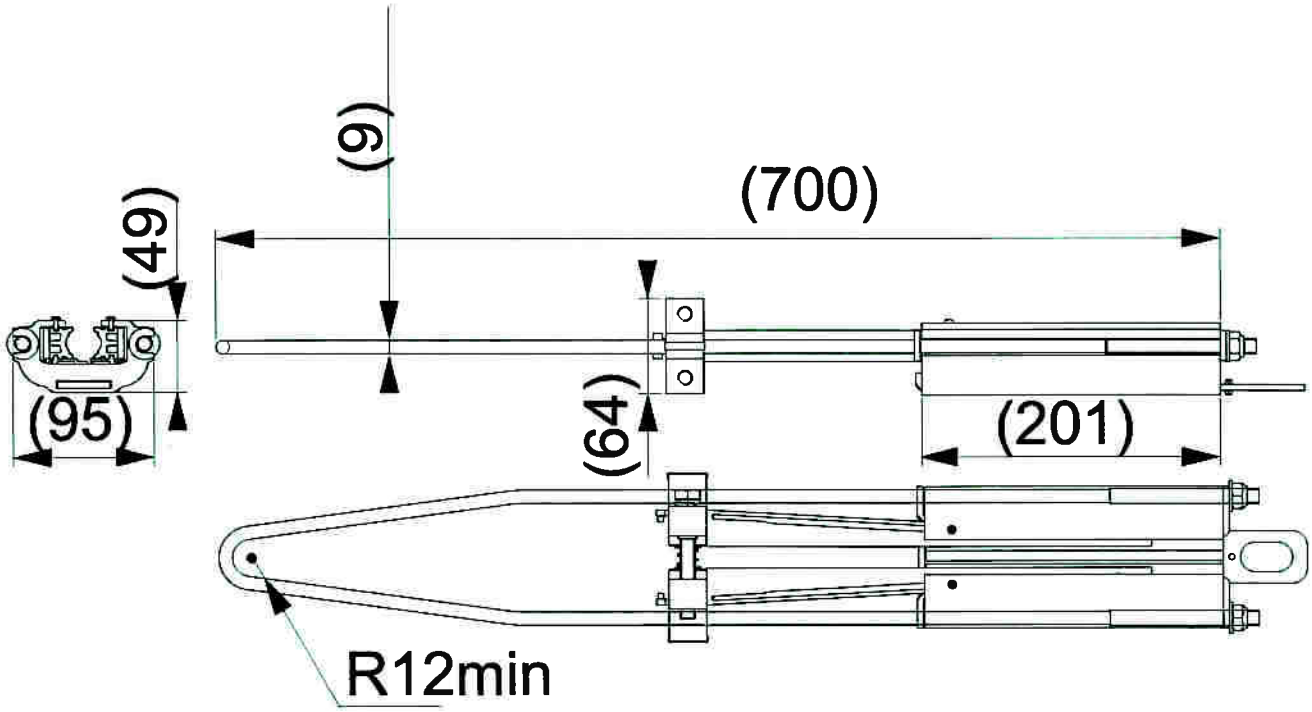

ВЯРНО С ОРИГИНАЛА

АКЦИОНЕРНО ДРУЖЕСТВО
ФИЛКАБ
16
ПЛОВДИВ

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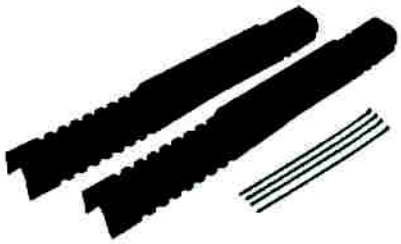
www.ensto.com

PRODUCT CARD
8/4/2017

ENSTO

SP67.3

Bird protector set



Code	SP67.3
GTIN	6438100322946
ENumber	
Name	Bird protector set For tension clamp SO256, set includes covers for three phases.
Description	SP67.3 is a bird protection set for tension clamp SO256. The products are manufactured of weather and UV-resistance thermoplastic material. The bird protectors prevent failures created by birds or other animals. Set includes covers for three phases.

Technical specification

Ratings

ETIM class: EC002976

Specification

Use: SP67.3 is a bird protection set for tension clamp SO256. The products are manufactured of weather and UV-resistance thermoplastic material. The bird protectors prevent failures created by birds or other animals

Construction:

Construction:

The SP67.3 delivery includes

Bird protector units	3 pcs
Cable tie	12 pcs

Installation: The SP 67.3 bird protector is mounted on SO256 tension clamp. Hole for the jumper cable is cut with a knife.

Tools required: Knife for jumper cable hole.

Markings: Ensto

Standard: EN 60068-2-5

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ETIM

ETIM

Insulated neck diameter:	81 mm

Packaging

Default package

Unit:	PCS
Size:	1

ЕРЮГ
EVN група

ЦЕНОВО ПРЕДЛОЖЕНИЕ

От: ……„Филкаб“ АД…… *(наименование на участника)*

По обществена поръчка за възлагане чрез събиране на оферти с обява

№ 368-ЕР-17-МР-Д-3 с предмет: Доставка на арматура за изолирана въздушна мрежа Ср.Н.

№	НАИМЕНОВАНИЕ	Мярка	Прогнозно коли-чество	Ед. цена лева, без вкл. ДДС	Стойност лева, без вкл. ДДС
1	Опъвателна клема за изолиран проводник за PAS 95 мм2	бр.	291	100,00	29 100,00
2	Изолация за опъвателна клема за PAS 95 мм2	бр.	97	240,60	23 338,20
Обща стойност, в лева, без включен ДДС[4]:					52 438,20

Посочените по-горе количества са прогнозни, необвързващи за Възложителя и служат за изготвяне на ценово сравнение между участниците.

Дата.25.08.2017

УЧАСТНИК: ……
(подпис и печат)

АКЦИОНЕРНО ДРУЖЕСТВО * ФИЛКАБ 16 * ПЛОВДИВ *

Атанас Танчев
Изпълнителен директор
Филкаб АД

[4] *При разминаване между единичните цени, предложени от участника и общата стойност, се взема предвид единичната цена.*