



2. Testing procedure

The connectors and the conductors were pre-conditioned until they reached the test temperature of $(-25 \pm 3)^{\circ}\text{C}$, before they were assembled. Electrical continuity was measured between the main and branch cables. The tightening was carried out in a deep freezer at a rate of approximately 1 full turn in 8 seconds. The torque at which continuity was achieved was recorded. Two sample were tests for each of the following conductor combinations.

Main	Branch
Max.	Max.
Min.	Min.
Min.	Max.

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]
	Main	Branch	
1	BLL-T 157	BLL-T 157	25
2	BLL-T 157	BLL-T 157	24
3	BLL-T 50	BLL-T 50	20
4	BLL-T 50	BLL-T 50	20
5	BLL-T 50	BLL-T 157	22
6	BLL-T 50	BLL-T 157	24

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.



ВЯРНО С ОРИГИНАЛА



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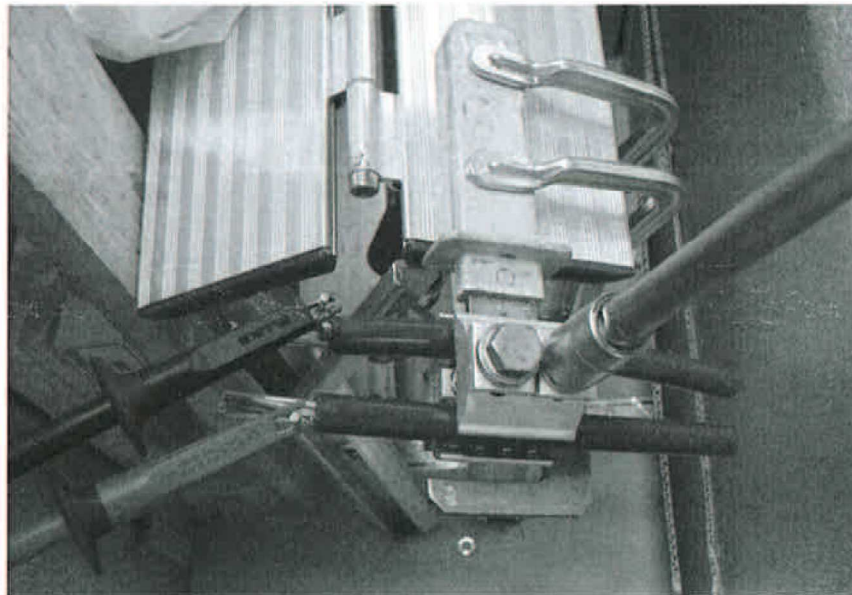
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4. Pictures



Picture 2: Test setup in freezer

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L42	Thermometer	2455 16	Temperature measurements
L56	Torque wrench	BDS – 80 E	Torque adjustment
L60	Multimeter	Fluke 87	Voltage drop measurements
L33	Deep freezer	ALK 30	Climate testing

6. Test Id

740

7. Revision history

A





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LABORATORY REPORT

No.: 1962S

Revision: A

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Date of Test: 28.1.2010

Test object:

Waterproof insulation piercing connector SLW25.2.

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 connector passed the test at -25 °C.



Picture 1: Tested connector SLW25.2

ENSTO
UTILITY NETWORKS
LABORATORY

Date of Report: 10.11.2010


Tested by: Patrick Ekholm


Reviewed by: Janne Lappalainen


Witnessed by: Sami Hakonen / SGS Fimko

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

Ensto Utility Networks Laboratory
Ensto Finland Oy

Ensto Mietusenkatu 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



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1. Test objects

Connectors:

Type:	Waterproof insulation piercing connector SLW25.2
Connector class:	B
Batch number:	0-series
Main conductor range:	50 – 157 mm ²
Branch conductor range:	50 – 157 mm ²
Tightening torque:	40Nm
No of pcs:	6

Conductors:

Type:	SAX-W 50
Used cross-sections:	50 mm ²
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	12,7 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





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2. Testing procedure

The connectors and the conductors were pre-conditioned until they reached the test temperature of $(-25 \pm 3)^{\circ}\text{C}$, before they were assembled. Electrical continuity was measured between the main and branch cables. The tightening was carried out in a deep freezer at a rate of approximately 1 full turn in 8 seconds. The torque at which continuity was achieved was recorded. Two sample were tests for each of the following conductor combinations.

Main	Branch
Max.	Max.
Min.	Min.
Min.	Max.

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]
	Main	Branch	
7	SAX-W 150	SAX-W 150	20
8	SAX-W 150	SAX-W 150	20
9	SAX-W 50	SAX-W 50	18
10	SAX-W 50	SAX-W 50	17
11	SAX-W 50	SAX-W 150	18
12	SAX-W 50	SAX-W 150	18

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.





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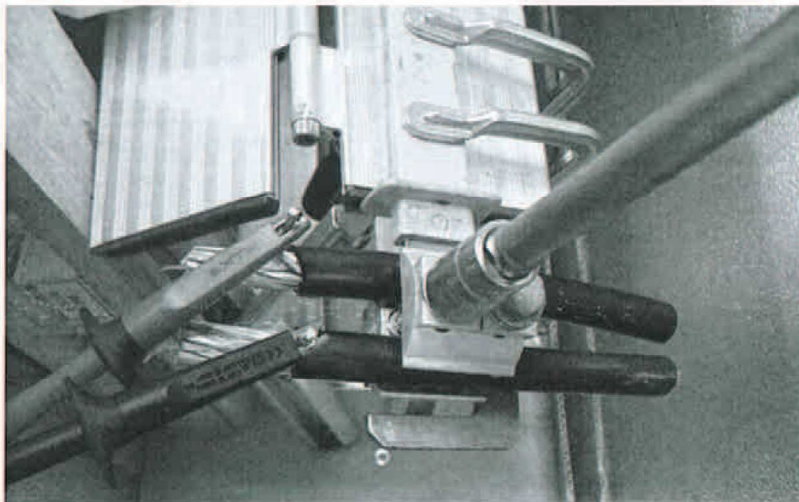
LABORATORY REPORT

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4. Pictures



Picture 2: Test setup in freezer

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L42	Thermometer	2455 16	Temperature measurements
L56	Torque wrench	BDS – 80 E	Torque adjustment
L60	Multimeter	Fluke 87	Voltage drop measurements
L33	Deep freezer	ALK 30	Climate testing

6. Test Id

740

7. Revision history

A



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Date of Test: 4-5.5.2010

Test object:

Waterproof insulation piercing connector SLW25.2.

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 connector passed the test.



Picture 1: Tested connector SLW25.2

ENSTO
UTILITY NETWORKS
LABORATORY

Date of Report: 11.11.2010

Tested by: Patrick Ekholm

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

Ensto 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



ВЯРНО С ОРИГИНАЛА



LABORATORY REPORT

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1. Test objects

Connectors:

Type:	Waterproof insulation piercing connector SLW25.2
Connector class:	B
Batch number:	0-series
Main conductor range:	50 – 157 mm ²
Branch conductor range:	50 – 157 mm ²
Tightening torque:	40Nm
No of pcs:	6

Conductors:

Type:	BLL-T 50
Used cross-section:	50 mm ²
Manufacturer/Country:	AMO Kraft AB / Sweden
Insulation thickness:	2,5 mm
Total diameter:	14,2 – 15,2 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



ВЕРНО С ОРИГИНАЛА



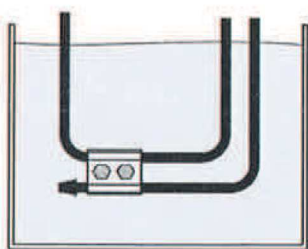
2. Testing procedure

The connectors were installed onto the conductors according to manufactures instructions. The ends of the conductor were bent so that they rose over the water surface. The connectors were immersed in the water at a depth of 200mm. The connectors were kept in the water for 48 hours. Three samples were tested for each of the following conductor combinations.

Main Branch

Max. Min.

Min. Min.



Requirement:

No water shall penetrate the conductor.

3. Test results

Sample	Conductors		Tightening torque [Nm]	Result
	Main	Branch		
13	BLL-T 50	BLL-T 50	40	OK
14	BLL-T 50	BLL-T 50	40	OK
15	BLL-T 50	BLL-T 50	40	OK
16	BLL-T 157	BLL-T 50	40	OK
17	BLL-T 157	BLL-T 50	40	OK
18	BLL-T 157	BLL-T 50	40	OK

Table 1: Test data

Summary:

All connectors fulfilled standard requirements.





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4. Pictures



Picture 2: Test setup

5. Test equipment

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

6. Test Id

1023

7. Revision history

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Revision: A

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Date of Test: 21-22.4.2010

Test object:

Waterproof insulation piercing connector SLW25.2.

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 connector passed the test.



Picture 1: Tested connector SLW25.2

ENSTO
UTILITY NETWORKS
LABORATORY

Date of Report: 11.11.2010


Tested by: Patrick Ekholm


Reviewed by: Janne Lappalainen


Witnessed by: Sami Hakonen / SGS Fimko

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

Ensto Utility Networks Laboratory
Ensto Finland Oy

Ensto 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



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1. Test objects

Connectors:

Type:	Waterproof insulation piercing connector SLW25.2
Connector class:	B
Batch number:	0-series
Main conductor range:	50 – 157 mm ²
Branch conductor range:	50 – 157 mm ²
Tightening torque:	40Nm
No of pcs:	6

Conductors:

Type:	SAX-W 50
Used cross-sections:	50 mm ²
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	12,7 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



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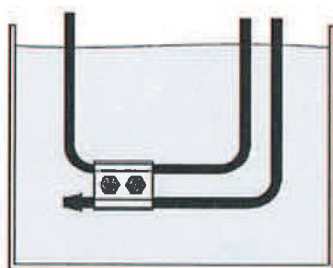
2. Testing procedure

The connectors were installed onto the conductors according to manufactures instructions. The ends of the conductor were bent so that they rose over the water surface. The connectors were immersed in the water at a depth of 200mm. The connectors were kept in the water for 48 hours. Three samples were tested for each of the following conductor combinations.

Main Branch

Max. Min.

Min. Min.



Requirement:

No water shall penetrate the conductor.

3. Test results

Sample	Conductors		Tightening torque [Nm]	Result
	Main	Branch		
7	SAX-W 50	SAX-W 50	40	OK
8	SAX-W 50	SAX-W 50	40	OK
9	SAX-W 50	SAX-W 50	40	OK
10	SAX-W 150	SAX-W 50	40	OK
11	SAX-W 150	SAX-W 50	40	OK
12	SAX-W 150	SAX-W 50	40	OK

Table 1: Test data

Summary:

All connectors fulfilled standard requirements.



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4. Pictures



Picture 2: Test setup

5. Test equipment

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

6. Test Id

1023

7. Revision history

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Date of Test: 28.1 – 16.3.2010

Test object:

Waterproof insulation piercing connector SLW25.2.

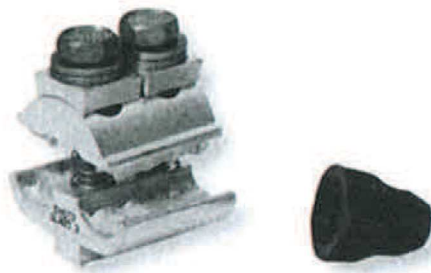
Purpose of the test and relevant standards:

Part of type test.

Electrical ageing test according to EN 50397-2:2009 clause 7.7.

Conclusion:

The connector passed the test.



Picture 1: Tested connector SLW25.2

ENSTO
UTILITY NETWORKS
LABORATORY

Date of Report: 11.11.2010


Tested by: Patrick Ekholm


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

Ensto 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



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1. Test objects

Connectors:

Type:	Waterproof insulation piercing connector SLW25.2
Connector class:	B
Batch number:	0-series
Main conductor range:	50 – 157 mm ²
Branch conductor range:	50 – 157 mm ²
Tightening torque:	40Nm
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 operating temp.:	70 °C
Max short circuit temp.:	200 °C
Refer to standard:	EN50397-1



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ВЯРНО С ОРИГИНАЛА



2. Testing procedure

There were six connectors subjected to the ageing test acc. to standard EN50483-5:2009 class B. Connectors were installed to conductors according to installation instructions. The connectors were tightened to 90% of the nominal manufacturer's declared torque. The equalizing points on the conductor were welded. Thermocouples for temperature measurements were installed into a hole drilled in the middle of the lower body. In the reference conductor the thermocouple was installed under the strands.

A 1500A AC-transformer controlled the ageing test. Resistances were measured from the equalizer points with a micro-ohm meter. Temperatures were measured with a temperature logger. During the heating period the reference conductor was warmed up to maximum operating temperature $\Theta_N^{+5K} - \Theta_N^{+10K}$. After the warming period a cooling period was applied during which the connectors and conductors cooled down to below 35 °C.

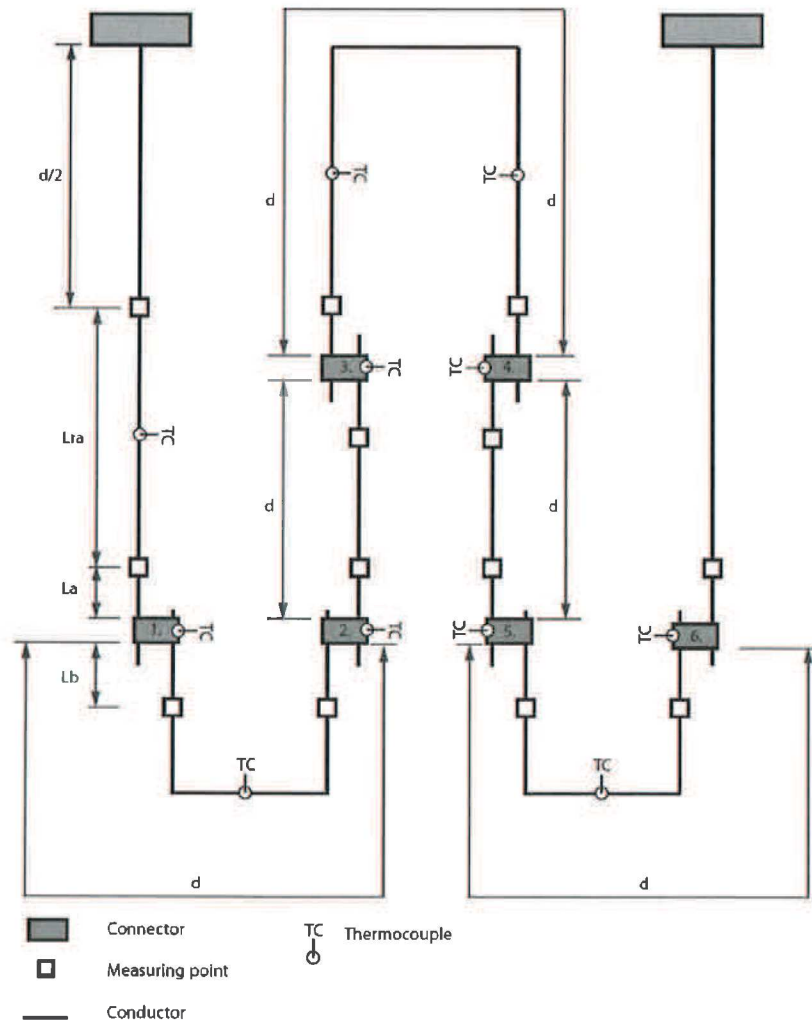
Test settings:

Total number of cycles:	1000 cycles
Heating period duration:	t1: 14min, t2: 30min
Heating period current:	I1: 537A, I2: 442A
Cooling period duration:	20 min
Cooling period type:	accelerated, using fans

Distances between equalizer points and connectors were measured. Reference conductor lengths are l_a . Distance before and after the connector is marked with l_a (main) and l_b (branch). The connector resistance can be calculated by using these lengths and the measured resistances between the equalizer points.



ВЯРНО С ОРИГИНАЛА



Picture 2: Test loop

	Conn 1	Conn 2	Conn 3	Conn 4	Conn 5	Conn 6	l_{ra}
l_a [mm]	250	253	234	245	250	252	490
l_b [mm]	248	245	238	252	253	258	-

Table 1: Measuring point distances



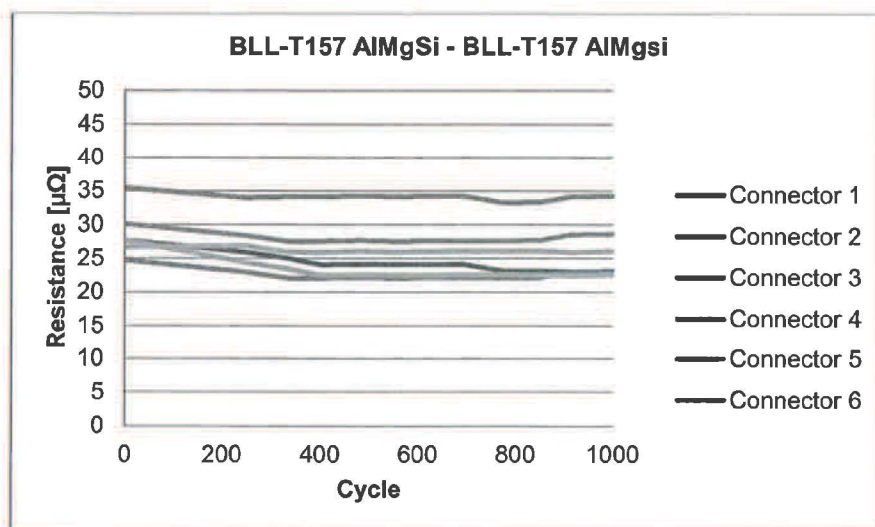
ВЯРНО С ОРИГИНАЛА



3. Test results

BLL-T157 AlMgSi - BLL-T157 AlMgsi						
Resistances referred to 20 °C [$\mu\Omega$]						
Cycle	Connector					
	1	2	3	4	5	6
0	28	25	30	35	27	28
248	26	23	28	34	27	24
334	25	22	28	34	26	23
400	24	22	28	34	26	22
485	24	22	28	34	26	23
550	24	22	28	34	26	23
625	24	22	28	34	26	23
692	24	22	28	34	26	23
775	23	22	28	33	26	23
850	23	22	28	33	26	23
916	23	23	29	34	26	22
1000	23	23	29	34	26	23
Mean value	24	22	28	34	26	23
Resistance stability	12,2 %	4,8 %	4,0 %	3,0 %	3,5 %	8,6 %

Table 2: Connector resistances

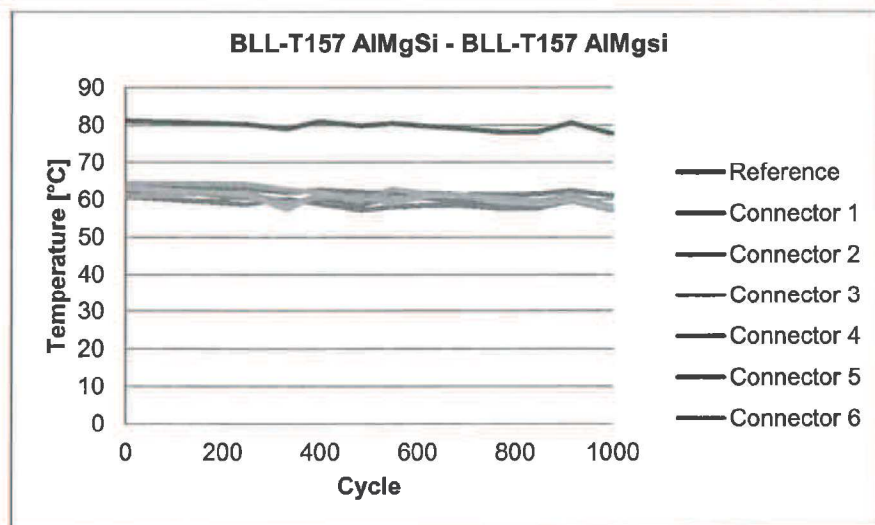


Graph 1: Connector resistances



BLL-T157 AlMgSi - BLL-T157 AlMgSi							
Maximum temperature [°C]							
Cycle	Reference Main	Connector					
		1	2	3	4	5	6
1	81	64	61	62	64	61	63
248	80	63	59	61	64	62	61
334	79	62	60	60	63	59	57
400	81	63	59	60	62	61	62
485	80	62	57	59	60	61	61
550	80	62	58	60	63	60	59
625	80	62	58	60	61	61	61
692	79	61	58	59	61	61	61
775	78	61	58	59	59	60	59
850	78	61	58	60	59	60	59
916	80	62	60	60	61	61	60
1000	78	61	57	58	58	58	58
Max value	81	64	61	62	64	62	63

Table 3: Connector temperatures



Graph 2: Connector temperatures







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BLL-T157 AlMgSi - BLL-T157 AlMgSi		
Parameter	Results	Requirements
	Value	Maximum value
Initial Scatter δ	0,2	0,3
Mean Scatter β	0,3	0,3
Assessment of resistance stability	12 %	15 %
Max Resistance ratio factor λ	1	2
Maximum connector temperature θ_{\max}	64	81
Maximum reference temperature $\theta_{R\max}$	81	
Temperature stability $\Delta\theta_j$	-2,28 / 1,97	$\overline{\Delta\theta_j} - 10 \leq \Delta\theta_j \leq \overline{\Delta\theta_j} + 10$

Table 4: Test results

Summary:

All samples fulfilled standard requirements.





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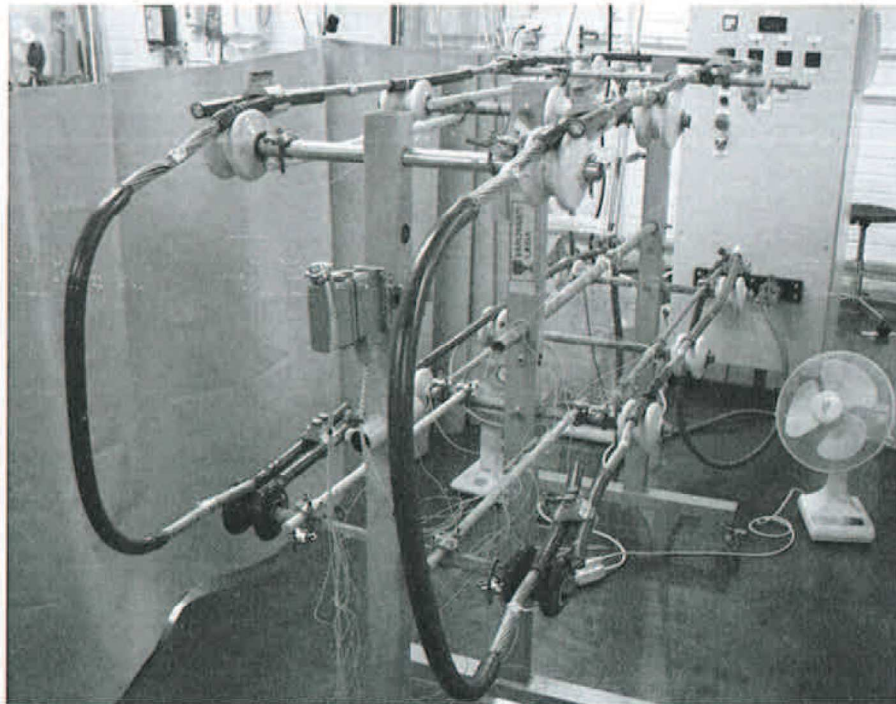
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4. Pictures



Picture 3: Test setup

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L56	Torque wrench	BDS – 80 E	Torque adjustment
L12	Micro-ohmmeter	D203	Resistance measurements
L141	Temperature logger	TC-08	Temperature measurements
M12	AC Transformer	0 – 1500 A	AC-supply for heating
L171	Clamp on multimeter	LH 2040	Control of AC current

6. Test Id

736

7. Revision history

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Date of Test: 28.1 – 29.3.2010

Test object:

Waterproof insulation piercing connector SLW25.2.

Purpose of the test and relevant standards:

Part of type test.

Electrical ageing test according to EN 50397-2:2009 clause 7.7.

Conclusion:

The connector passed the test.



Picture 1: Tested connector SLW25.2

ENSTO
UTILITY NETWORKS
LABORATORY

Date of Report: 26.11.2010


Tested by: Patrick Ekholm


Reviewed by: Janne Lappalainen


Witnessed by: Sami Hakonen / SGS Fimko

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

Ensto Utility Networks Laboratory
Ensto Finland Oy

Ensto Mietusen 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



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1. Test objects

Connectors:

Type:	Waterproof insulation piercing connector SLW25.2
Connector class:	B
Batch number:	0-series
Main conductor range:	50 – 157 mm ²
Branch conductor range:	50 – 157 mm ²
Tightening torque:	40Nm
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 operating temp.:	80 °C
Max short circuit temp.:	200 °C
Refer to standard:	EN50397-1



ВЯРНО С ОРИГИНАЛА



2. Testing procedure

There were six connectors subjected to the ageing test acc. to standard EN50483-5:2009 class B. Connectors were installed to conductors according to installation instructions. The connectors were tightened to 90% of the nominal manufacturer's declared torque. The equalizing points on the conductor were welded. Thermocouples for temperature measurements were installed into a hole drilled in the middle of the lower body. In the reference conductor the thermocouple was installed under the strands.

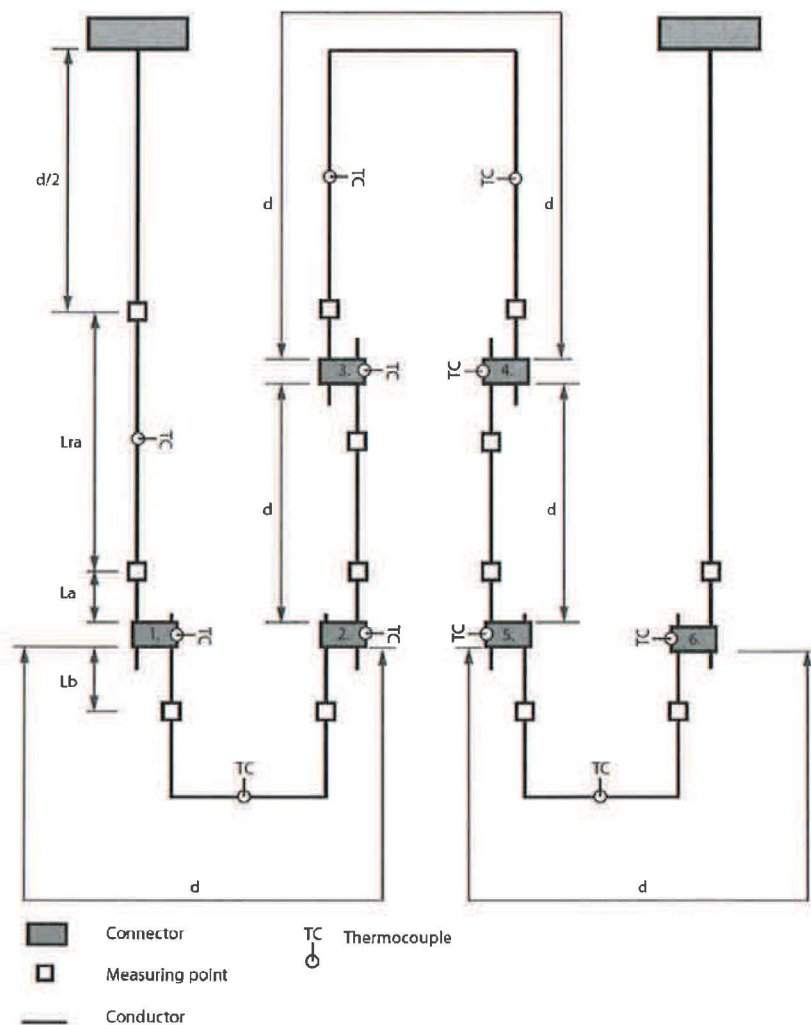
A 1000A AC-transformer controlled the ageing test. Resistances were measured from the equalizer points with a micro-ohm meter. Temperatures were measured with a temperature logger. During the heating period the reference conductor was warmed up to maximum operating temperature $\Theta_N^{+5K} - \Theta_N^{+10K}$. After the warming period a cooling period was applied during which the connectors and conductors cooled down to below 35 °C.

Test settings:

Total number of cycles:	1000 cycles
Heating period duration:	t1: 11min, t2: 40min
Heating period current:	I1: 532A, I2: 423A
Cooling period duration:	20 min
Cooling period type:	accelerated, using fans

Distances between equalizer points and connectors were measured. Reference conductor lengths are l_a . Distance before and after the connector is marked with l_a (main) and l_b (branch). The connector resistance can be calculated by using these lengths and the measured resistances between the equalizer points.





Picture 2: Test loop

	Conn 1	Conn 2	Conn 3	Conn 4	Conn 5	Conn 6	l_{ra}
l_a [mm]	248	251	236	246	248	250	497
l_b [mm]	230	252	248	245	265	250	-

Table 1: Measuring point distances



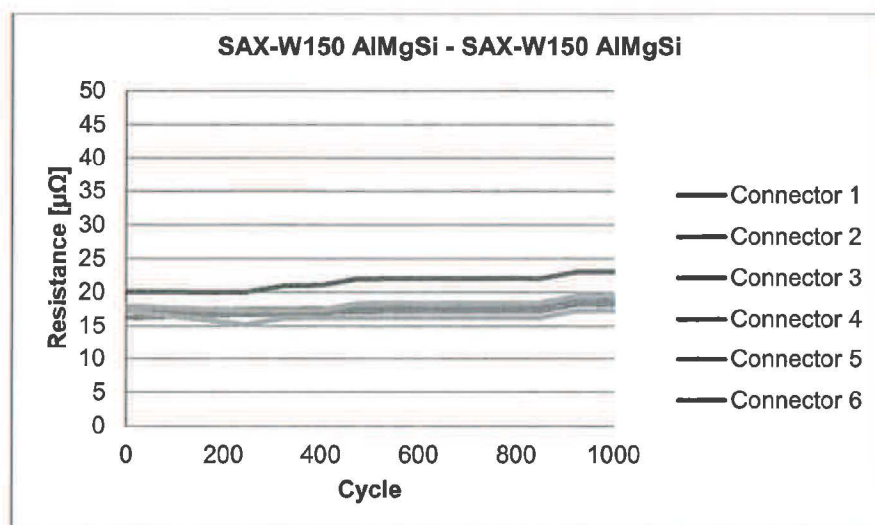

ВЕРНО С ОРИГИНАЛА



3. Test results

SAX-W150 AlMgSi - SAX-W150 AlMgSi						
Resistances referred to 20 °C [$\mu\Omega$]						
Cycle	Connector					
	1	2	3	4	5	6
0	20	18	16	17	18	17
246	20	18	17	17	17	15
325	21	17	17	17	17	16
400	21	18	17	17	17	16
475	22	18	18	17	18	16
560	22	18	18	17	18	16
625	22	18	18	17	18	16
700	22	18	18	17	18	16
785	22	18	18	17	18	16
850	22	18	18	17	18	16
925	23	19	19	18	19	17
1000	23	19	19	18	19	17
Mean value	22	18	18	17	18	16
Resistance stability	14,0 %	6,2 %	11,7 %	6,2 %	11,7 %	12,8 %

Table 2: Connector resistances



Graph 1: Connector resistances



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LABORATORY REPORT

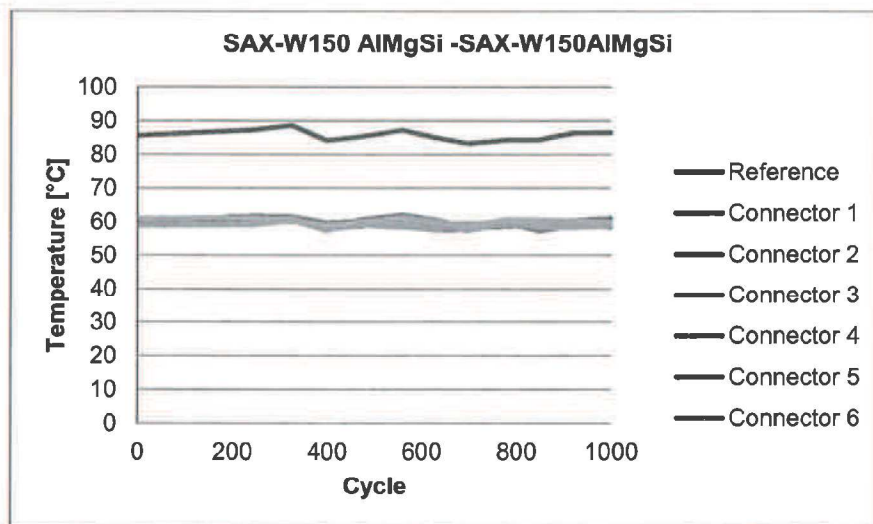
No.: 1978S

Revision: A

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SAX-W150 AlMgSi - SAX-W150 AlMgSi							
Maximum temperature [°C]							
Cycle	Reference Main	Connector					
		1	2	3	4	5	6
1	86	60	59	59	59	59	61
246	87	62	61	61	60	59	61
325	89	62	60	62	61	60	60
400	84	60	59	58	57	58	59
475	85	60	59	61	60	59	60
560	87	62	60	62	60	58	61
625	85	61	60	58	59	58	60
700	83	58	58	58	57	58	59
785	84	59	59	59	60	59	61
850	84	60	60	57	58	59	61
925	86	60	60	59	58	59	60
1000	86	61	59	59	59	59	60
Max value	89	62	61	62	61	60	61

Table 3: Connector temperatures



Graph 2: Connector temperatures



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ВЕРНО С ОРИГИНАЛА



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SAX-W150 AlMgSi - SAX-W150 AlMgSi		
Parameter	Results	Requirements
	Value	Maximum value
Initial Scatter δ	0,1	0,3
Mean Scatter β	0,2	0,3
Assessment of resistance stability	14 %	15 %
Max Resistance ratio factor λ	1	2
Maximum connector temperature θ_{\max}	62	89
Maximum reference temperature $\theta_{R\max}$	89	
Temperature stability $\Delta\theta_j$	-2,04 / 2,69	$\overline{\Delta\theta_j} - 10 \leq \Delta\theta_j \leq \overline{\Delta\theta_j} + 10$

Table 4: Test results

Summary:

All samples fulfilled standard requirements.





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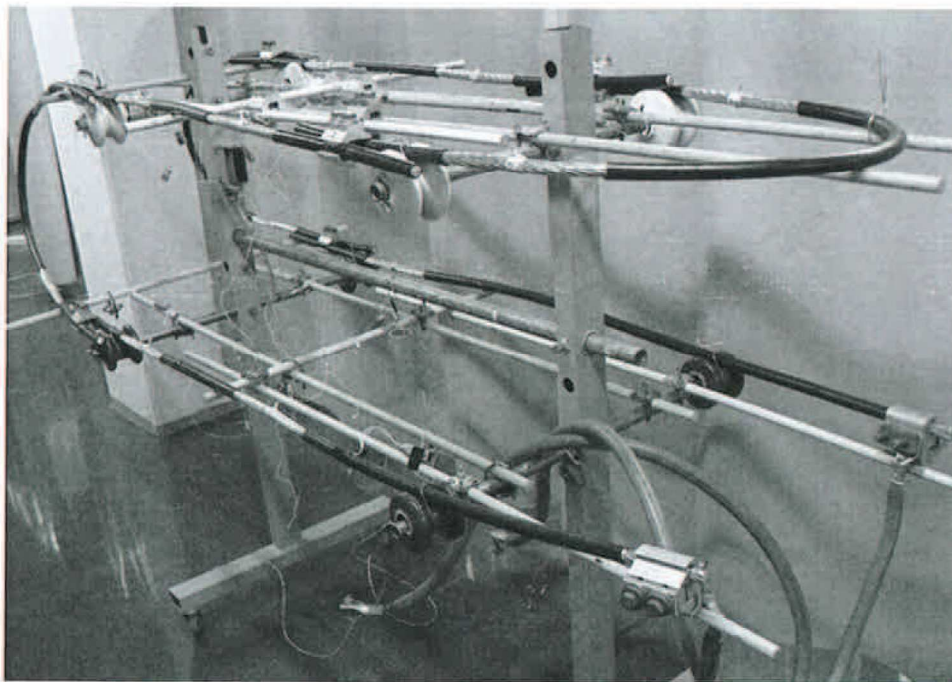
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4. Pictures



Picture 3: Test setup

5. Test equipment

ID	TYPE	MODEL	PURPOSE
L56	Torque wrench	BDS – 80 E	Torque adjustment
L12	Micro-ohmmeter	D203	Resistance measurements
L121	Temperature logger	TC-08	Temperature measurements
M1	AC Transformer	0 - 1000 A	AC-supply for heating
L171	Clamp on multimeter	LH 2040	Control of AC current

6. Test Id

737

7. Revision history

A



● Venus Greenhouse Test

Customer:



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

Research Contract:

EnstoSekkoLappalainenso171209HS.pdf
Ensto Test Id: 1009, 20.10.2010

Target:

Test Item	Code	Manufacturer	Q'ty
Waterproof insulation piercing connector	SLW25.2	Ensto UN	2

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 %




Keskiläntie 5
FI-20660 Littoinen

Tel. +358 (0)2 474 1600
Fax +358 (0)2 474 1629

ID 1045853-3
www.solarsimulator.com

ВЕРНО С ОРИГИНАЛА



Solar Simulator

Solar Simulator Finland Ltd.

**Test Report
Confidential**

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ref.no.: SLW25_2_EnstoFinlandLappalainen__tr221010TO.pdf

(NH₄)₂SO₄ 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.

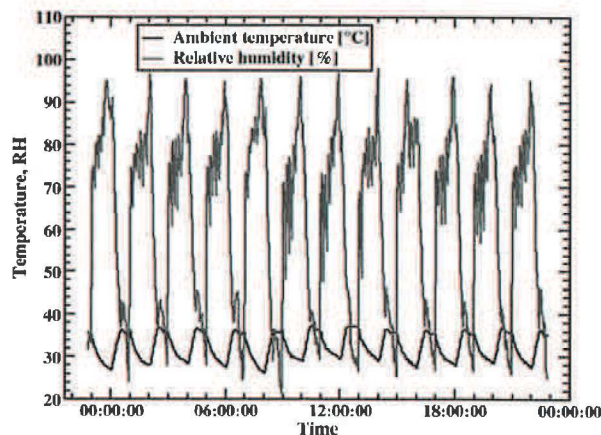
Actions done:

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.



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ВЕРНО С ОПИШНАТА



Solar Simulator

Solar Simulator Finland Ltd.

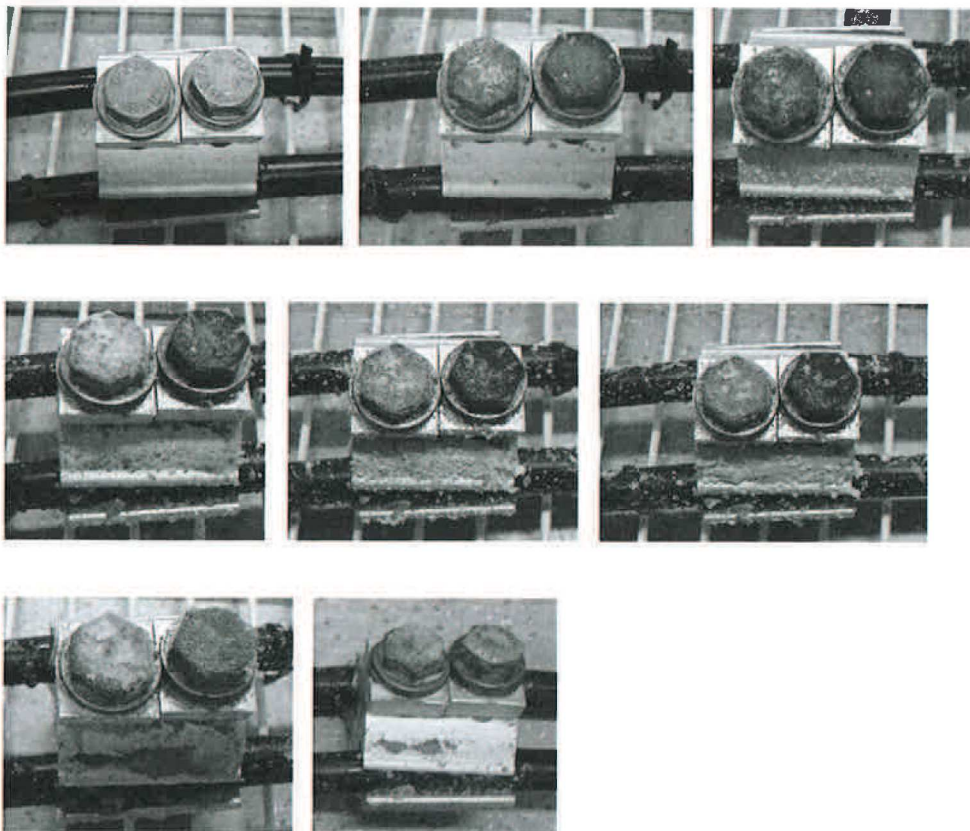
Test Report

Confidential

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ref.no.: SLW25_2_EnstoFinlandLappalainen__tr221010TO.pdf

Waterproof insulation piercing connector, SLW25.2, Sample A, Ensto UN (Pictures of the sample were taken: Top row: before the test, after one week and after two weeks 2nd row: after three weeks, after four weeks and after five weeks, Bottom row: after the test and after washing the sample.)



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ВЪРНО С ОРИГИНАЛА



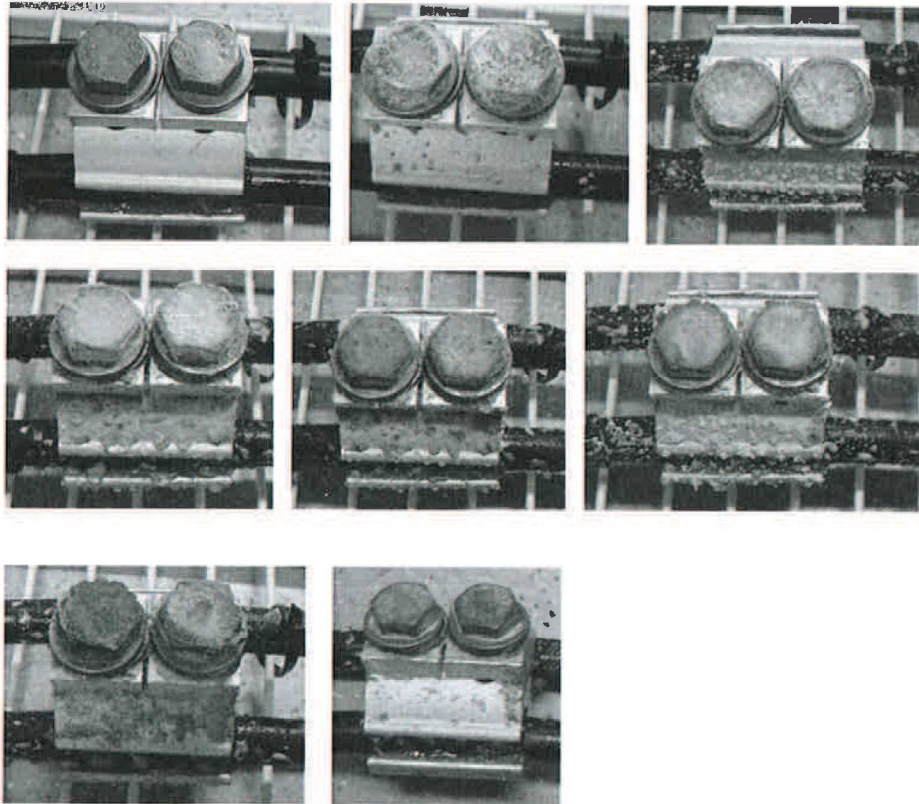
Solar Simulator
Solar Simulator Finland Ltd.

Test Report
Confidential

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ref.no.: SLW25_2_EnstoFinlandLappalainen_tr221010TO.pdf

Waterproof insulation piercing connector, SLW25.2, Sample B, Ensto UN (Pictures of the sample were taken: Top row: before the test, after one week and after two weeks 2nd row: after three weeks, after four weeks and after five weeks, Bottom row: after the test and after washing the sample.)



ВЯРНО С ОРИГИНАЛА

Conclusions:

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

There was some minor degradation in the samples. The **SLW25.2** 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 28th June, 2010, calibration is valid

Humidity: No. 42 / RH_AUX, calibrated 28th June, 2010, calibration is valid

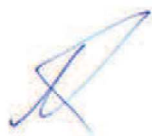
pH: No. 41, Fastech FT11, calibrated 28th June, 2010, calibration is valid

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



ВЯРНО С ОРИГИНАЛА



Saves Your Energy

LABORATORY REPORT

No.: 2138S

Revision: A

Page: 1/3

Date of Test: 21.12.2010

Test object:

Waterproof insulation piercing connector SLW25.2.

Purpose of the test and relevant standards:

Part of type test.

Opening torque test after gas atmosphere test (Method 2) done at Solar Simulator Finland acc. to EN 50397-2:2009 clause 7.11.1.3.2., test report: 071210_SLW25-2_prohesion_test_Solar_TR.pdf.

Conclusion:

The connector passed the test.



Picture 1: Tested connector SLW25.2

ENSTO
UTILITY NETWORKS
LABORATORY

Date of Report: 23.3.2011


Tested by: Patrick Ekholm


Reviewed by: Jänne Lappalainen


Witnessed by: Sami Hakonen / SGS Fimko

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

Ensto Utility Networks Laboratory
Ensto Finland Oy

Ensto Miettusen 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



ВЯРНО С ОРИГИНАЛА



1. Test objects

Connectors:

Type:	Waterproof insulation piercing connector SLW25.2
Connector class:	B
Batch number:	0-series
Main conductor range:	50 – 157 mm ²
Branch conductor range:	50 – 157 mm ²
Tightening torque:	40Nm
No of pcs:	2

Conductors:

Type:	SAX-W 50
Used cross-sections:	50 mm ²
Manufacturer/Country:	Prysmian / Finland
Insulation thickness:	2,4 mm
Total diameter:	12,7 mm
Number of strands:	7
Insulation material:	XLPE
Conductor material:	AlMgSi
Refer to standard:	EN50397-1

2. Testing procedure

The test procedure was according to the requirement in standard EN 50397-2:2009 clause 7.11.1.4. The connectors were opened with a torque wrench. The opening torque was recorded when the opening started.

Requirement:

For a connector designed without a shear-head it shall be able to be removed with a torque below, or equal to 1,1 x the manufacturer's specified nominal torque.



ВЯРНО С ОРИГИНАЛА



3. Test results

Sample	Conductor configuration Main-Branch	Opening torque [Nm]	Result
1	Min - Min	22, 26	OK
2	Min - Min	26, 23	OK

Table 1: Test results

Summary:

The opening test of the connector fulfilled the requirement of the standard as all results were below 1,1 x the manufacturer's specified nominal torque of 44 Nm.

4. Test equipment

ID	TYPE	MODEL	PURPOSE
L14	Torque wrench	BDS 80 E	Torque adjustment

5. Test Id

1009

6. Revision history

A





Saves Your Energy

LABORATORY REPORT

No.: 2170S

Revision: A

Page: 1/6

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

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

Business ID 0130213-5
Reg. Office: Porvoo



ВЯРНО С ОРИГИНАЛА



2. Testing procedure

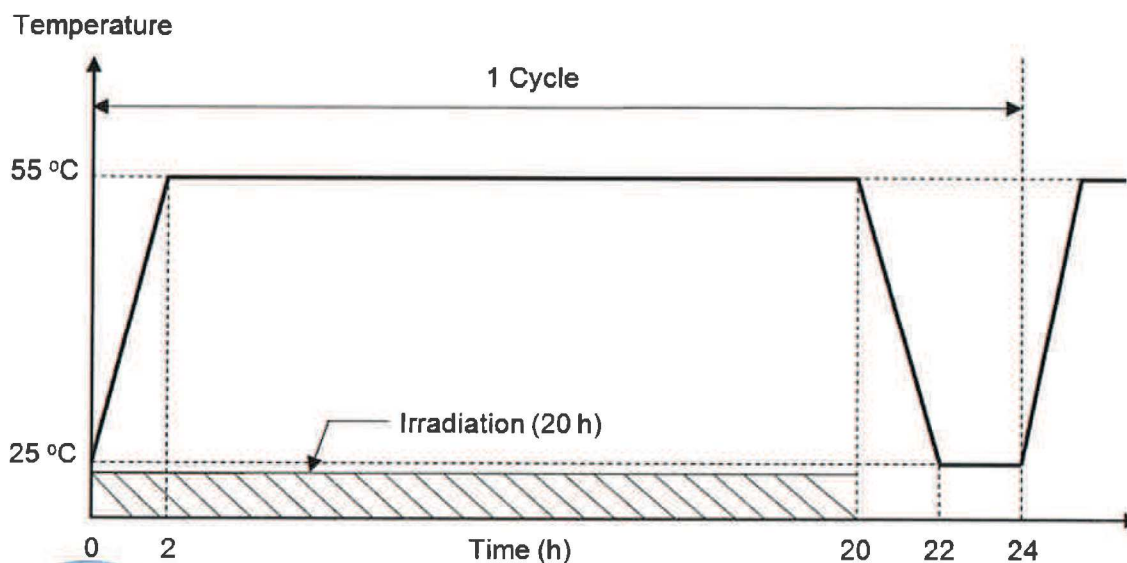
2.1 Simulated solar radiation test (UV-test)

The test was carried out in an enclosure, where an irradiance of $0,83 \text{ kW/m}^2$ with the spectral distribution given in Table 1 was provided over an irradiation measurement plane of $900 \text{ mm} \times 900 \text{ mm}$. 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 $55 \pm 2 \text{ }^\circ\text{C}$ during the irradiation period and at $25 \pm 2 \text{ }^\circ\text{C}$ 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	$0,28 \text{ } \mu\text{m} - 0,32 \text{ } \mu\text{m}$	$0,32 \text{ } \mu\text{m} - 0,40 \text{ } \mu\text{m}$	$0,40 \text{ } \mu\text{m} - 0,52 \text{ } \mu\text{m}$	$0,52 \text{ } \mu\text{m} - 0,64 \text{ } \mu\text{m}$	$0,64 \text{ } \mu\text{m} - 0,78 \text{ } \mu\text{m}$	$0,78 \text{ } \mu\text{m} - 3,00 \text{ } \mu\text{m}$
Irradiance measured	$9,1 \text{ W/m}^2$	$47,3 \text{ W/m}^2$	$53,0 \text{ W/m}^2$	$105,1 \text{ W/m}^2$	$33,3 \text{ W/m}^2$	$578,6 \text{ W/m}^2$
Std. requirements Irradiance Tolerance	$5 \text{ W/m}^2 \pm 35 \%$	$63 \text{ W/m}^2 \pm 25 \%$	$200 \text{ W/m}^2 \pm 10 \%$	$186 \text{ W/m}^2 \pm 10 \%$	$174 \text{ W/m}^2 \pm 10 \%$	$492 \text{ W/m}^2 \pm 20 \%$

Table 1: Spectral energy distribution and permitted tolerances



Picture 2: Temperature-radiation-time relationships



ВЯРНО С ОРИГИНАЛА



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4. Pictures



Picture 2: End cap before UV-test.



Picture 3: End cap after Uv-test.



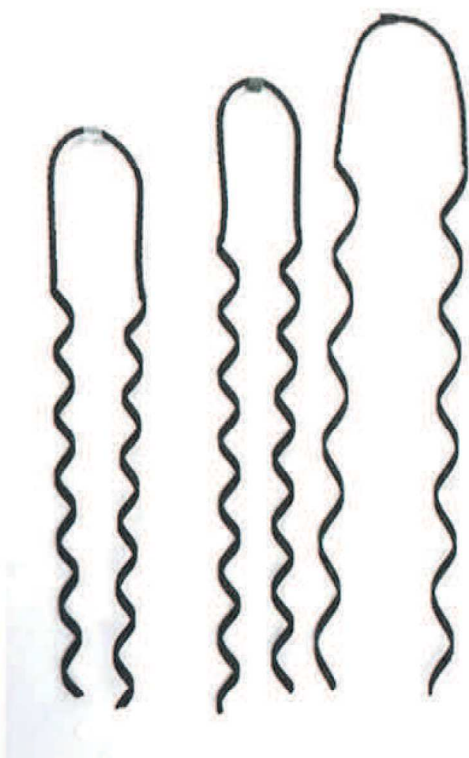
Picture 4: Markings on the end cap.



ВЯРНО С ОРИГИНАЛА

Test Reports

Helical ties (Suspension clamps)
CO35, CO70 and CO120



Test standard:
EN 50397-2:2009

ENSTO



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

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



ВЯРНО С ОРИГИНАЛА

Product: CO35, CO70 and CO120

Contents

Document no

1. Specification

CO35
CO70
CO120

2. Content

- 2.1. Slip test at ambient temperature
- 2.2. Slip test at low temperature
- 2.3. Lift load test at ambient temperature
- 2.4. Corrosion test
- 2.5. Climate ageing test

3552S
3553S
3551S
3569S
3586S





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PRODUCT SPECIFICATION

10/4/16



6418677409165

CO35

Helical tie

Code CO35
GTIN 6418677409165
Name Helical tie
 CC 35-50 mm², yellow
Description Used with covered conductors for tying the conductors to the insulators. Can be used as both top and side ties. Easy to install without tools. The tie is installed on the insulation of the covered conductor. The sets include 6 pcs ties (one set/cross arm). The right size is easy to recognize by the colour code. e.g. with the insulators SDI30 or SDI37. Insulator diameter 73-90 mm.



Technical specification

Dimensions

Weight: 0.53 kg
Covered conductors: 35 ... 50 mm²
Insulator neck: 85 mm

Colors

Color identifier: Yellow

Certificates

Standards: EN 50397-2

Specification

Use: For binding the covered conductor on the insulator top groove or side groove e.g. with the insulators SDI30 or SDI37.

Construction: Plastic covered, zinc coated steel wire.

Installation: Easy mounting without any special tools.
 Stripping of insulation is not necessary on covered conductors.





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PRODUCT SPECIFICATION

10/7/16

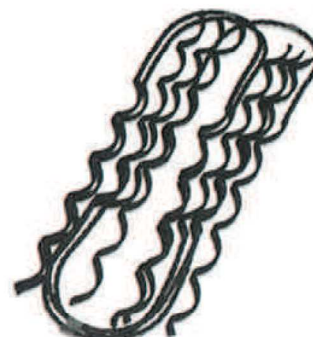


6418677409172

CO70

Helical tie

Code CO70
GTIN 6418677409172
Name Helical tie
 CC 70-95 mm², green
Description Used with covered conductors for tying the conductors to the insulators. Can be used as both top and side ties. Easy to install without tools. The tie is installed on the insulation of the covered conductor. The sets include 6 pcs ties (one set/cross arm). The right size is easy to recognize by the colour code. e.g. with the insulators SDI30 or SDI37. Insulator diameter 73-90 mm.



Technical specification

Dimensions

Weight: 0.65 kg
Covered conductors: 70 ... 95 mm²
Insulator neck: 85 mm

Colors

Color identifier: Green

Certificates

Standards: EN 50397-2

Specification

Use: For binding the covered conductor on the insulator top groove or side groove e.g. with the insulators SDI30 or SDI37.

Construction: Plastic covered, zinc coated steel wire.

Installation: Easy mounting without any special tools. Stripping of insulation is not necessary on covered conductors.



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PRODUCT SPECIFICATION

10/7/16

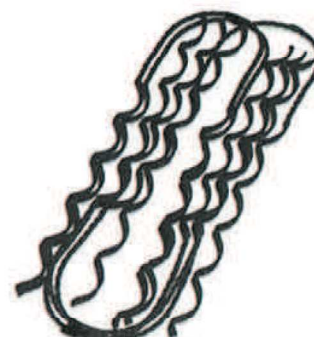


6418677409134

CO120

Helical tie spiral

Code CO120
GTIN 6418677409134
Name Helical tie spiral
 CC 120-150 mm², black
Description Used with covered conductors for tying the conductors to the Insulators. Can be used as both top and side ties. Easy to install without tools. The tie is installed on the insulation of the covered conductor. The sets include 6 pcs ties (one set/cross arm). The right size is easy to recognize by the colour code. e.g. with the insulators SDI30 or SDI37. Insulator diameter 73-90 mm.



Technical specification

Dimensions

Weight: 0.71 kg
Covered conductors: 120 ... 150 mm²
Insulator neck: 85 mm

Colors

Color identifier: Black

Certificates

Standards: EN 50397-2



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Revision: A

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Date of Test: 29.7.&10.8.2016

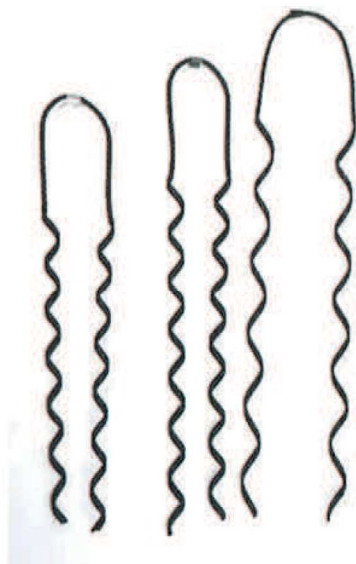
Test object:

Helical ties CO35, CO70 and CO120.

Purpose of the test and relevant standards:

Slip test at ambient temperature for suspension clamp according to EN 50397-2:2009 clause 7.4.2.

Conclusion:



Picture 1: CO35, CO70 and CO120

Date of Report: 11.8.2016

Tested by: Mika Karjalainen

Approved by: Janne Lappalainen

ENSTO
UTILITY NETWORKS
LABORATORY

Ordered by: P.Pulkkinen
Distribution: OHL PD-team

ENSTO



Laboratory Report

No.: 3552S

Revision: A

Page: 2/7

1. Test objects

Helical tie:

Type: CO35
Manufacturer: Ensto
Conductor size: 35-50
Insulator neck size: 73-85
Marking: Yellow
SMSL: 2
Batch number: 290116
No of pcs: 8

Type: CO70
Manufacturer: Ensto
Conductor size: 70-95
Insulator neck size: 73-85
Marking: Green
SMSL: 3
Batch number: 020216
No of pcs: 8

Type: CO120
Manufacturer: Ensto
Conductor size: 120
Insulator neck size: 73-85
Marking: Black
SMSL: 1
Batch number: 2012
No of pcs: 4

Conductors:

Type: SAX-W 35 AlMgSi
Used cross section: 35 mm²
Conductor material: AlMgSi
Number of strands: 7
Conductor diameter: 6,9 mm
Conductor construction: Compacted
Shape of conductor: Round
Insulation material: XLPE
Insulation thickness: 2,3 mm
Core diameter: 11,5 mm
Conductor MBL: 11,2 kN
Max operating temperature: 80 °C
Max short-circuit temperature: 200 °C
Manufacturer: Prysmian
Country: Finland
Refer to standard: SFS 5791, EN 50397-1
Conductor ID: 137



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Type: PAS-W 50
Used cross section: 50 mm²
Conductor material: AlMgSi
Number of strands: 7
Conductor diameter: 8,0 mm
Conductor construction: Compacted
Shape of conductor: Round
Insulation material: XLPE
Insulation thickness: 2,4 mm
Core diameter: 12,7 mm
Conductor MBL: 15,5 kN
Max operating temperature: 80 °C
Max short-circuit temperature: 200 °C
Manufacturer: Draka
Country: Finland
Refer to standard: SFS 5791, EN50397-1
Conductor ID: 64

Type: SAX-W 70 AlMgSi 12/20 kV, K2000
Used cross section: 70 mm²
Conductor material: AlMgSi
Number of strands: 7
Conductor diameter: 9,7 mm
Conductor construction: Compacted
Shape of conductor: Round
Insulation material: XLPE
Insulation thickness: 2,3 mm
Core diameter: 14,3 mm
Conductor MBL: 22,5 kN
Max operating temperature: 80 °C
Max short-circuit temperature: 200 °C
Manufacturer: Prysmian
Country: Finland
Refer to standard: SFS 5791, EN 50397-1
Conductor ID: 450

Type: SAX-W 95
Used cross section: 95 mm²
Conductor material: AlMgSi
Number of strands: 7
Conductor diameter: 11,3 mm
Conductor construction: Compacted
Shape of conductor: Round
Insulation material: XLPE
Insulation thickness: 2,4 mm
Core diameter: 16,1 mm
Conductor MBL: 30,4 kN
Max operating temperature: 80 °C
Max short-circuit temperature: 200 °C
Manufacturer: Prysmian
Country: Finland
Refer to standard: EN50397-1
Conductor ID: 210



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Type:	SAX-W 120 AlMgSi
Used cross section:	120 mm ²
Conductor material:	AlMgSi
Number of strands:	19
Conductor diameter:	12,8 mm
Conductor construction:	Compacted
Shape of conductor:	Round
Insulation material:	XLPE
Insulation thickness:	2,4 mm
Core diameter:	17,6 mm
Conductor MBL:	38 kN
Max operating temperature:	80 °C
Max short-circuit temperature:	200 °C
Manufacturer:	Prysmian
Country:	Finland
Refer to standard:	SFS 5791, EN 50397-1
Conductor ID:	140

2. Testing procedure

The covered conductor for which the clamp is intended was installed between the extremities of a tension machine and subject to a load of 15 % of the MBL. The clamp was then assembled on the covered conductor. Used torque was specified torque. The load was then reduced to zero and one end of the conductor was detached from the tension machine. The clamp was attached to the free extremity of the tension machine, see Picture 2. A load (T) of 20 % of specified minimum slip load (SMSL) was applied and the conductor was marked to detect movement relative the clamp. The load (T) was then gradually increased with a speed of 100 N/s to specified minimum slip load (SMSL) and kept there for 60 s. After that the load was gradually increased until slippage of the conductor inside the clamp occurred.



1 Static counter load (G)

2 Applied load (T)

Picture 2: Test arrangement

Requirements

No slippage greater than 5 mm shall occur at or below the specified minimum slip load. The fitting shall still be securely attached to the insulator despite any deformation that may take place.

The fitting shall be removed and the covering of the conductor examined. No tearing of the covering should have occurred.

