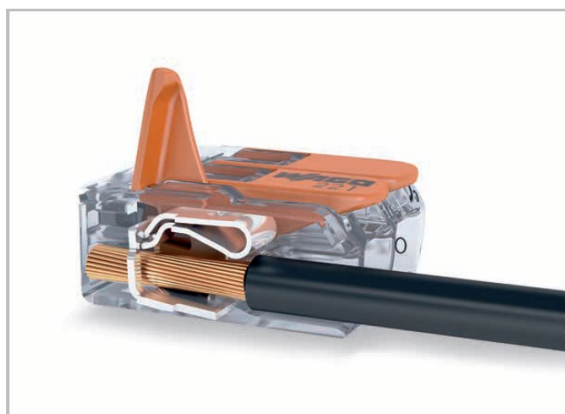


# TEST REPORT

## No: 28542

### 221-41x Series COMPACT Splicing Connectors for All Conductor Types



### Mechanical, electrical and climatic tests

Result of test(s):



passed



failed



Assessment by customer

This test result refers only to the test object. Parts of this test report may only be copied with our approval in writing.

approved by:

A. Bauer  
Head of Electrotechnical Laboratory  
Standardization and Approvals

tested/released by:

J. Olbrich  
Test engineer





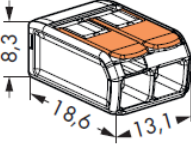
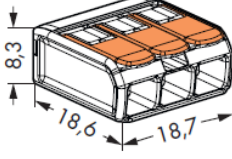
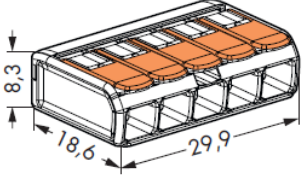
Test location: Electrotechnical Laboratory  
 – Accredited laboratory for electrical and mechanical tests  
 on terminal blocks and connectors, as well as environmental simulation –  
 Hansastraße 27 • D-32423 Minden / Germany

Customer: WAGO Kontakttechnik GmbH & Co. KG  
 Hansastraße 27 • 32423 Minden  
 – Sales International –

Kind of test: Product test

Input date: 2013-03-26 (Laboratory examination no. 24081)  
 2013-07-02 (Laboratory examination no. 24373)  
 2013-07-02 (Laboratory examination no. 24384)  
 2013-07-19 (Laboratory examination no. 24454)  
 2017-06-12 (Test report)

Equipment under test:

<b>COMPACT splicing connectors for all conductor types,</b> with operating levers, maximum ambient temperature of use 85 °C			
	2-conductor connector	3-conductor connector	5-conductor connector
			
Item no:	221-412	221-413	221-415
Test sample no:	24081-xx, 24373-xx, 24384-xx, 24454-xx (Allocation see test results)		
Status of production:	2013-03-26 (Test sample 24081-xx, 3-conductor connector) 2014-01-15 (Test sample 24373-xx, 5-conductor connector) 2013-07-01 (Test sample 24384-xx, 5-conductor connector) 2013-04-16 (Test sample 24454-xx, 5-conductor connector)		
Technical data:	<div> <div> <b>0.2 ... 4 mm<sup>2</sup> "s+st"</b>  <b>0.14 ... 4 mm<sup>2</sup> "f-st"</b>  <b>450 V/4 kV/2 ①</b>  <b>I<sub>N</sub> 32 A</b>   <b>11 mm / 0.43 inch</b> </div> <div> <b>24 ... 12 AWG</b> </div> <div> <b>"s+st" solid and stranded</b>  <b>"f-st" flexible</b> </div> </div> <div> <p>① in grounded power lines            450 V = rated voltage            4 kV = rated surge voltage            2 = pollution degree</p> </div> <div>    </div> <div> <b>Dimensions in mm</b> </div>		



Condition of the test specimen(s) before the test(s):

<b>X</b>	no noticeable problems		Noticeable problems at the test specimen(s)
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Start of test(s): 2013-07-02

Completion of test(s): 2014-06-05

Test engineer: J. Olbrich, J. Kuhlmann

Content of test report	Assessment	Page	
1. Short-time withstand current test <i>according to EN 60947-7-1:2009</i>	<b>P</b>	4	X
2. Rotating test <i>according to EN 60998-2-2:2004</i>	<b>P</b>	6	X
3. Pull-out test / Conductor retention force <i>according to EN 60998-2-2:2004</i>	<b>P</b>	8	X
4. Salt mist test (sodium chloride solution) <i>according to EN 60068-2-11:1999</i>	<b>P</b>	10	X
5. Ageing test sequence			
5.1. Ageing test in sulphur dioxide SO <sub>2</sub> with general condensation of moisture (accelerated simulation of application in an industrial atmosphere) <i>following EN ISO 6988:1994</i>	<b>P</b>	14	X
5.2. Current cycling ageing test at ambient temperature carried out with the previous aged test samples of Test 5.1 <i>following EN 60998-2-2:2004</i>	<b>P</b>	18	X
6. Additional information	–	21	
 Examination marked with "X" is part of the scope of accreditation			

Possible test case assessments			
<b>N/A</b> not applicable	<b>P</b> passed	<b>F</b> failed	<b>I</b> informative

Remark(s): Throughout this report a comma is used as the decimal separator.

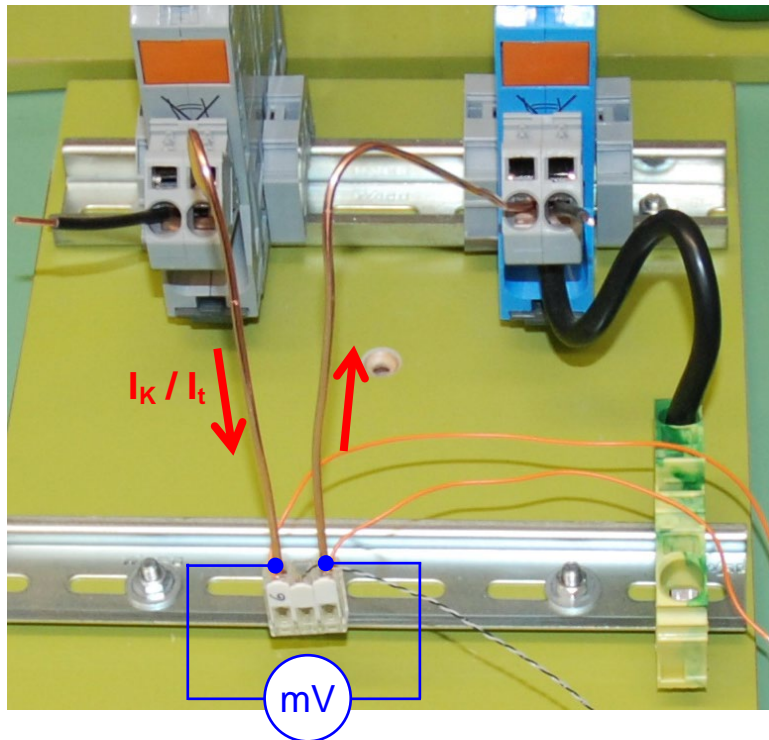
## 1. Short-time withstand current test

following EN 60947-7-2:2009, Clause 8.4.6

Deviation(s)/additional requirement(s) from/to the standard:

- The short circuit current is applied to the through connection of a 3-conductor connector;
- Test samples wired with solid and flexible conductors of the rated cross-section.

Test set-up:



The connector shall be capable of withstanding three applications of 1 s duration each of the short-time withstand current which corresponds to 120 A/mm<sup>2</sup> of its rated cross-section.

Short circuit current  $I_K$ : 480 A

Test current  $I_t$  for  
voltage drop measurement: 1/10 rated current (DC) of the conductor

**Rated current of the conductor according to EN 60947-7-1:2009, Table 4 for metric wire sizes:**

Cross-section in mm <sup>2</sup>	0,2	0,34	0,5	0,75	1	1,5	2,5	4	6	10	16	25	35
Test current in A	4	5	6	9	13,5	17,5	24	32	41	57	76	101	125

Ambient temperature:

Specified value (20 ± 5) °C	Actual value 23 °C
-----------------------------	--------------------

#### Acceptance criteria:

- Maximum permissible voltage drops
  - before the test: 3,2 mV per through connection according to EN 60947-7-1:2009, Clause 8.4.4 at 1/10 rated current of the conductor.
  - after the test:  $\leq 150\%$  of the values measured before the test.
- Continuity shall exist on the test sample assembly and the connector shall not show any cracking, breakage or other critical damage.

Test result: (derived from laboratory examination no. 24081)

#### **Short-time withstand current test**

Connector	Conductor cross-section “s” solid “f” flexible	Test sample no.	Duration of test	Short-circuit current I <sub>k</sub> (DC)		Assessment /	
				Set value	Actual value	Function / circuit continuity	Visual inspection after the test
Item no.	mm <sup>2</sup>	24081		A	A		
221-413	4 “s”	-05	3x 1 s	480	480	P	P
					480		
	4 “f”	-06			480	P	P
					408		

#### **Voltage drop test**

Connector	Conductor cross-section "s" solid "str" stranded	Test current $I_t$ (DC)	Test sample no.	Voltage drop per through connection			
Item no.	mm <sup>2</sup>	A	24081	in state of delivery	1 <sup>st</sup>	after the test 2 <sup>nd</sup>	3 <sup>rd</sup>
221-413	4 "s"	3,2	-05	1,25	1,11	1,10	1,12
	4 "f"		-06	1,65	0,95	0,80	0,80

Result: The test is **passed**.

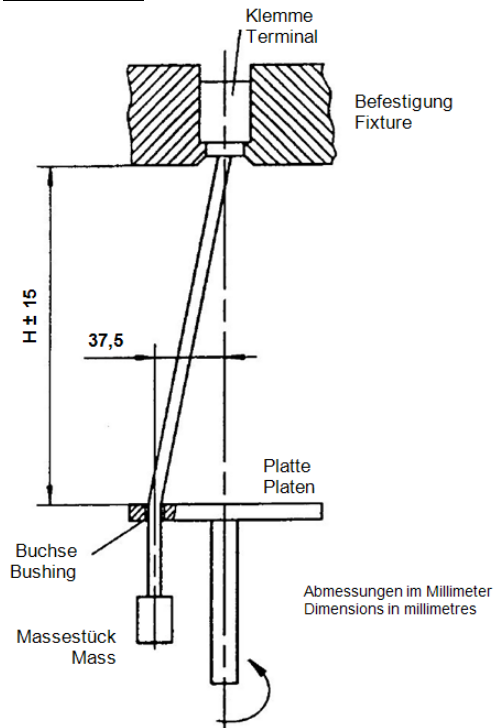
## 2. Rotating test

according to EN 60998-2-2:2004, Clause 10.105

Deviation(s)/additional requirement(s) from/to the standard:

- The test is carried out on each 5 new clamping units per specified test conductor.

Test set-up:



Length of the test conductor: 75 mm longer than the height (H) specified in Table 102 of EN 60998-2-2

Mass for conductor: Specified values according to Table 102 of EN 60998-1:2004

Revolutions:  $(10 \pm 2)$  r.p.m.

Duration of test: 15 minutes

Figure 101 of IEC 60998-2-2:2002

Three new clamping units shall be connected with new conductors of number, cross-sectional area and type (flexible and/or rigid stranded) specified by the manufacturer in the test apparatus.

The following tests shall be carried out using new samples for each of the following:

- Conductors of the smallest cross-sectional area;
- Conductors of the largest cross-sectional area.

**Relationship between mass, height and cross-sectional area of conductors according to EN 60998-2-2:2004, Table 102:**

according to EN 60502-2:2004, Table 102.			
Conductor cross-section	Diameter of bushing hole	Height $H$ ( $\pm 15$ mm)	Mass
mm <sup>2</sup>	mm	mm	kg
0,2	6,4	260	0,2
0,34	6,5		0,3
0,5			0,4
0,75			0,4
1,0	9,5	280	0,7
1,5			0,9
2,5			1,4
4,0			2,0
6,0	13,0	300	2,9
10			4,5
16			6,8
25			
35	14,5		

After the rotation test, each conductor under test shall passed the pull-out test according to Clause 10.106.

Ambient temperature: 

Specified value (20 ± 5) °C	Actual value 23,6 °C
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**Acceptance criteria:**

During the rotating test, the conductor

- shall neither slip out of the clamping unit, nor break near the clamping unit.
- shall not be damaged in such a way as to render it unfit for further use.

**Test result:** (derived from laboratory examination no. 24373)

Connector	Test sample No.	Clamp- ing unit	Test conductor solid "s" stranded "str" flexible "f"	slipped out of the clamping unit	Test conductor broke off near the clamping unit	inadmissi- ble dam- aged	Assess- ment
Item no.	24373-		mm <sup>2</sup>	yes / no	yes / no	yes / no	
221-415	S5_01	1 2 3 4 5	0,14 "f"	no	no	no	P
	S5_02	1 2 3 4 5	0,2 "f"	no	no	no	P
	S5_03	1 2 3 4 5	0,2 "s"	no	no	no	P
	S6_01	1 2 3 4 5	4,0 "s"	no	no	no	P
	S6_02	1 2 3 4 5	4,0 "f"	no	no	no	P
	S6_03	1 2 3 4 5	4,0 "str"	no	no	no	P

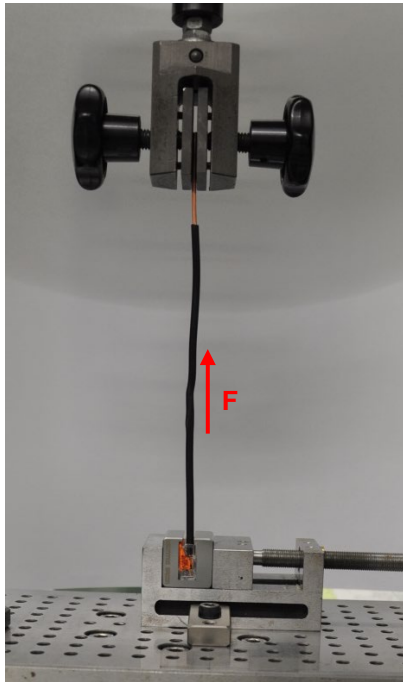
**Result:** The test is **passed**.

### 3. Pull-out test / Conductor retention force

according to EN 60998-2-2:2004, Clause 10.106

The pull-out test is carried out with the unchanged connectors/clamping units of the previous rotating test Clause 5.

Test set-up:



The pull force  $F$  shall be applied without jerks for 1 min., in the direction of the axis of the conductor.

**Specified values of the conductor retention forces according to EN 60998-2-2:2004, Table 103:**

Cross-section in mm <sup>2</sup>	0,2	0,34	0,5	0,75	1,0	1,5	2,5	4,0	6,0	10	16	25	35
Pull force in N	10	15	20	30	35	40	50	60	80	90	100	135	190

Ambient temperature:

Specified value (20 ± 5) °C	Actual value 23,6 °C
-----------------------------	----------------------

#### **Acceptance criteria:**

During the test, the conductor shall not come out of the terminal.



Test result: (derived from laboratory examination no. 24373)

Connector  Item no.	Test conductor solid "s" stranded "str" flexible "f"  mm <sup>2</sup>	Test sample <sup>a)</sup>		Conductor retention force	
		No.	Clamping unit	Specified value (1 min.)  N	Actual value (1 min.)  N
221-415	0,14 "f"	S5_01	1	10	10
			2		
			3		
			4		
			5		
	0,2 "f"	S5_02	1	10	10
			2		
			3		
			4		
			5		
	0,2 "s"	S5_03	1	10	10
			2		
			3		
			4		
			5		
	4,0 "s"	S6_01	1	60	60
			2		
			3		
			4		
			5		
	4,0 "f"	S6_02	1	60	60
			2		
			3		
			4		
			5		
	4,0 "str"	S6_03	1	60	60
			2		
			3		
			4		
			5		

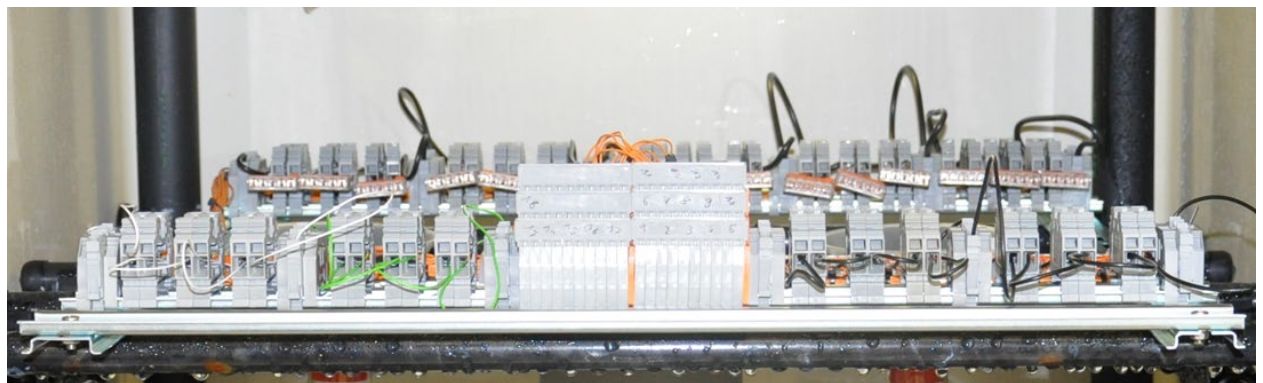
<sup>a)</sup> Unchanged connectors of the previous rotating test item 2.

**Result:** The test is **passed**.

#### 4. Salt mist test (sodium chloride solution) according to EN 60068-2-11:1999

##### Test set-up:

Orientation of the test specimens in the chamber



(Test arrangement in horizontal placement)

The test shall be performed in a closed heating cabinet with pressure compensation at a constant testing temperature of  $(35 \pm 2) ^\circ\text{C}$ .

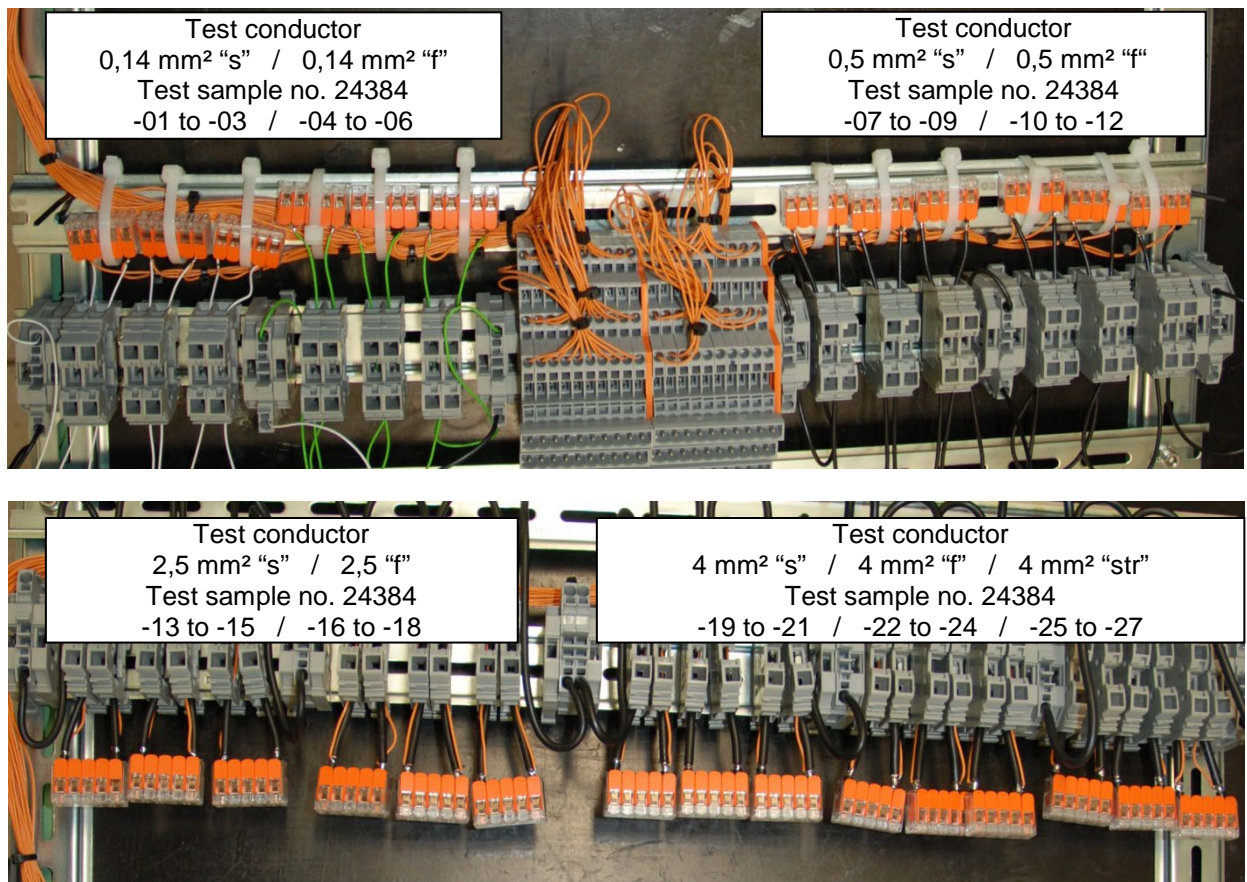
Test solution: 5 % hydrous sodium chloride solution

Duration of test: 96 h (Selected value according to Clause 7.6 of EN 60068-2-11:1999)

The wired test samples shall be tested in their normal operating position.

Functional tests/Verifications before and after the test in salt mist atmosphere (NaCl)

Overview/Arrangement of the test samples:

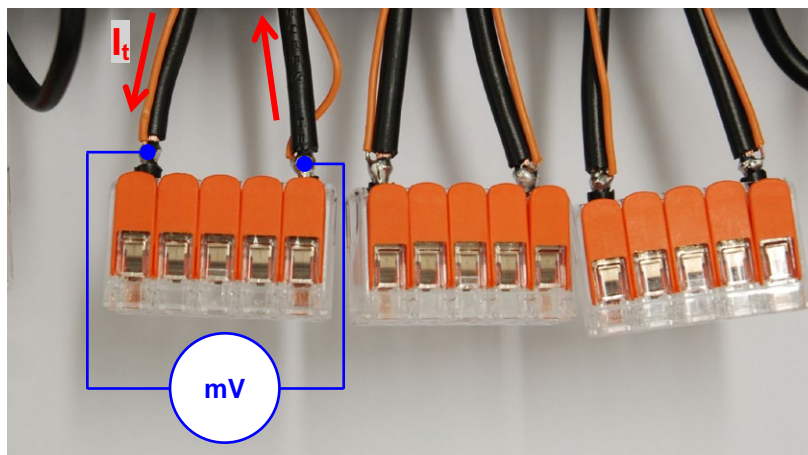


### Voltage drop measurement following EN 60999-1:2000, Clause 9.8

Deviation(s)/additional requirement(s) from/to the standard:

- Without 1 hour current load before the voltage drop measurement;
- Voltage drop measurement with 1/10 rated current.

Measuring points of the voltage drop measurement:



Test current  $I_t$  for voltage drop measurement: 1/10 rated current of the conductor

**Rated current of the conductor according to  
EN 60998-1:2004, Table 2 / EN 60947-7-1:2009, Table 4 / EN 60352-7:2002, Table 4:**

EN 60050-1:2004, Table 27/EN 60047-1:2000, Table 47/EN 60052-1:2002, Table 4:													
Conductor size mm²		≥0,08	0,2	0,34	0,5	0,75	1	1,5	2,5	4	6	10	16
Test current A	60998-1	-	4	5	6	9	13,5	17,5	24	32	41	57	76
	60947-7-1												
	60352-7	1											
Assumed value for conductor size <b>0,14 mm²: 2 A</b>													

**Acceptance criteria:**

- Maximum permissible voltage drops
  - before the test: 1,5 mV each clamping unit (respectively 3 mV per through connection) following EN 60999-1:2000, Clause 9.8 at 1/10 rated current of the conductor
  - after the test: ≤ 150 % of the values measured before the test
- No changes impairing further use such as cracks, deformations or the like on the test samples

**Test sequence:**

	Specified value	Actual value
• Initial measurements	Visual inspection and functional test, see test result	
• Pre-conditioning	in compliance with the relevant specification	not required
• Duration of conditioning	Selected value according to Clause 7.6 of EN 60068-2-11	96 h
• Recovery	-	
- unless otherwise specified by the relevant specification	Small specimens shall be washed and dried according Clause 8 of EN 60068-2-11	
- Climate for recovery	(Standard recovery conditions)	
- Duration	minimum 1 h, maximum 2 h	1,5 h
- Temperature	between 15 °C to 35 °C	23 °C
- Relative humidity	25 % to 75 %	57 %
- Air pressure	860 mbar to 1060 mbar	1030 mbar
• Final measurement	Visual inspection and functional test, see test result	

**Test result:** (derived from laboratory examination no. 24384)

Connector	Conductor cross-section “s” solid “str” stranded “f” flexible	Test current I <sub>t</sub>	Test sample no.	Voltage drop per through connection	
Item no.	mm <sup>2</sup>	A	24384-	before the test mV	after the test mV
221-415	0,14 “s”	0,2	01	0,93	0,92
			02	0,94	0,93
			03	1,00	0,99
	0,14 “f”		04	0,84	0,72
			05	1,05	0,85
			06	0,99	0,84
	0,5 “s”	0,6	07	0,92	0,75
			08	0,92	0,75
			09	0,91	0,75
	0,5 “f”		10	1,11	0,75
			11	1,08	0,71
			12	0,94	0,67



Connector	Conductor cross-section “s” solid “str” stranded “f” flexible	Test current I <sub>t</sub>	Test sample no.	Voltage drop per through connection	
				before the test	after the test
Item no.	mm <sup>2</sup>	A	24384-	mV	mV
221-415	2,5 “s”	2,4	13	1,74	1,59
			14	1,59	1,39
			15	1,44	1,36
	2,5 “f”		16	1,67	1,15
			17	1,93	1,13
			18	1,95	1,16
	4 “s”	3,2	19	1,59	1,57
			20	1,54	1,49
			21	1,54	1,47
	4 “f”		22	1,90	1,25
			23	1,93	1,21
			24	2,24	1,26
	4 “str”		25	1,64	1,44
			26	1,67	1,38
			27	1,48	1,31

Test sample no. 24384	Assessment / Visual inspection	
	before the test	after the test
-01 to -27	<b>P</b> no damages	<b>P</b> no damages

**Result:** The test is **passed**.

Annex to the salt mist test:

*Salt concentration and pH value (actual values)*

Verification of the salt concentration and pH value during the "trial run" immediately <b>before the test</b>					
„Duration of trial run“  (Set value: 16 – 24 h)	Measurements carried out with the sprayed salt solution				
	collected amount (Set value: 16 – 32 ml) Receptacle		pH value (Set value: 6,5 – 7,2)	Salt concentration Verification by conductivity measurement (Set value: 62 – 89 mS/cm)	Temperature during the measurements (Set value: 35 °C ±2 °C)
	1	2			
16 h	21 ml	27 ml	6,73	80,1 mS/cm	34,7 °C
Verification/Check of the temperature of test chamber and the flow rate corresponding the monitoring protocol					

Verification of the salt concentration and pH value <b>during the test</b>					
Duration of test	Measurements carried out with the sprayed salt solution				
	collected amount (Set value: 1 – 2 ml) Receptacle		pH value (Set value: 6,5 – 7,2)	Salt concentration Verification by conductivity measurement (Set value: 62 – 89 mS/cm)	Temperature during the measurements (Set value: 35 °C ±2 °C)
	1	2			
96 h	125 ml	160 ml	6,63	79,3 mS/cm // %	34,6 °C
Verification/Check of the temperature of test chamber and the flow rate corresponding the monitoring protocol					

## 5. Ageing test sequence

### 5.1. Ageing test in sulphur dioxide SO<sub>2</sub> with general condensation of moisture (accelerated simulation of application in an industrial atmosphere)

following EN ISO 6988:1994

Variation(s)/additional requirement(s) from/to the standard:

- Filling of the test chamber with demineralised water and sulphur dioxide
- Evaluation of test results following to the relevant specification / product standard
- Total exposed surface area of the test specimens <0,5 m<sup>2</sup>
- Horizontal orientation of the test set-up in the test chamber
- Dry phase of the second cycle >16 hours (approximately 48 h)

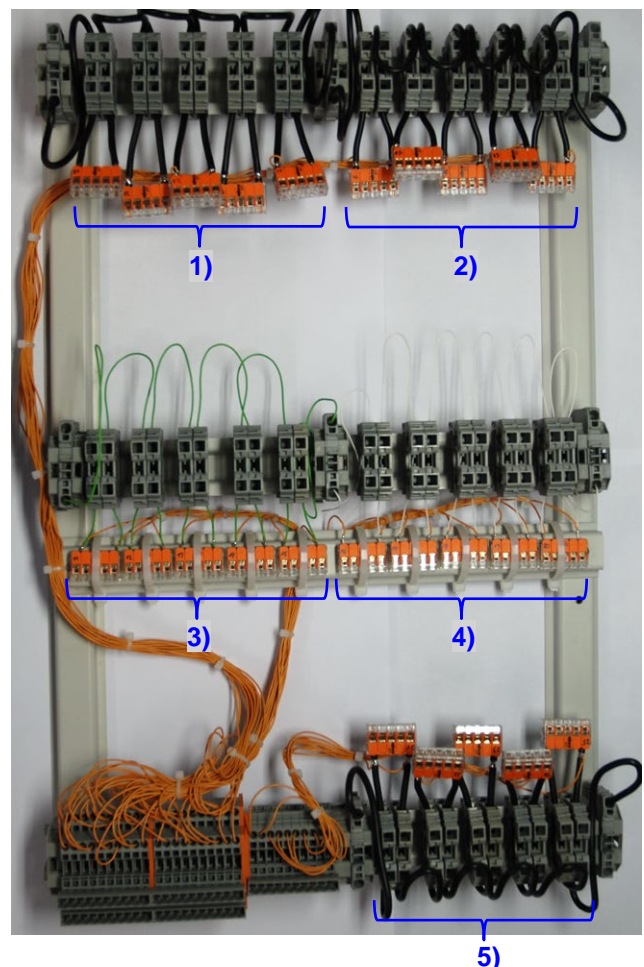
#### Test set-up:

- Orientation of the test samples in the chamber
- Test arrangement, view from above



Example:  
Test arrangement  
in horizontal placement

- 1) Test conductor 4 mm<sup>2</sup> flexible "f", test sample no. 24454-01 to -05
- 2) Test conductor 4 mm<sup>2</sup> solid "s", test sample no. 24454-06 to -10
- 3) Test conductor 0,14 mm<sup>2</sup> flexible "f", test sample no. 24454-11 to -15
- 4) Test conductor 0,14 mm<sup>2</sup> solid "s", test sample no. 24454-16 to -20
- 5) Test conductor 4 mm<sup>2</sup> stranded "str", test sample no. 24454-21 to -25



Number of test cycles: 2

- 1 cycle ➤ Humid phase: 8 hours including the warming up to (40 ± 3) °C in condensing sulphurous humidity, relative air humidity 100 %  
(Before each humid phase the test chamber is filled with 2 dm<sup>3</sup> ± 0,2 dm<sup>3</sup> demineralised water and 0,2 dm<sup>3</sup> sulphur dioxide.)
- Dry phase: 16 hours including the cooling down at opened respectively ventilated test chamber to room temperature (23 ± 5) °C, relative air humidity under 75 %

The test samples are during the test in non-operating conditions.

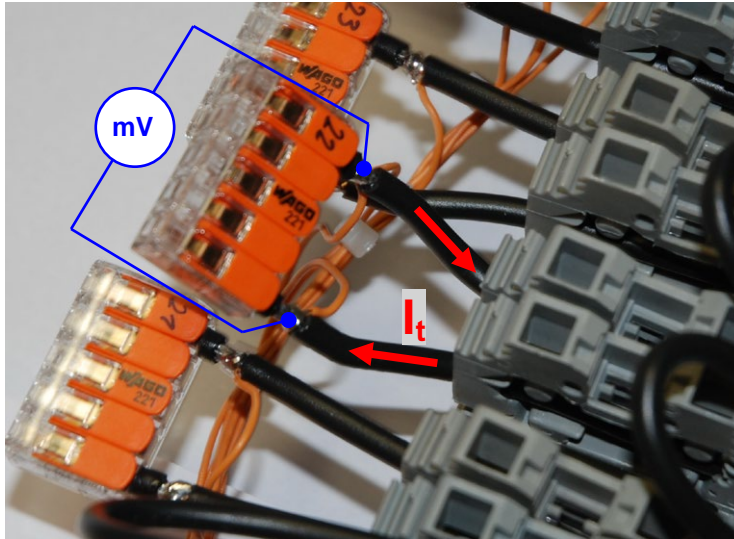
Verification of the contact quality before the test, after the 1<sup>st</sup> cycle and after the 2<sup>nd</sup> cycle in industrial atmosphere.

### Voltage drop measurement following EN 60999-1:2000, Clause 9.8

Deviation(s)/additional requirement(s) from/to the standard:

- Without 1 hour current load before the voltage drop measurement;
- Voltage drop measurement with 1/10 rated current.

Measuring points of the voltage drop measurement:



Test current  $I_t$  for the voltage drop measurement: 1/10 rated current of the conductor

Rated current of the conductor according to EN 60998-1:2004, Table 2 / EN 60947-7-1:2009, Table 4 / EN 60352-7:2002, Table 4:

Conductor size mm²		≥0,08	0,2	0,34	0,5	0,75	1	1,5	2,5	4	6	10	16
Test current A	60998-1	-	4	5	6	9	13,5	17,5	24	32	41	57	76
	60947-7-1												
	60352-7	1											-
Assumed value for conductor size <b>0,14 mm²: 2 A</b>													

### Acceptance criteria:

Maximum permissible voltage drops

- before the test: 1,5 mV each clamping unit (respectively 3 mV per through connection) following EN 60999-1:2000, Clause 9.8 at 1/10 rated current of the conductor
- after the test: ≤ 150 % of the values measured before the test

Test result: (derived from laboratory examination no. 24454)

Connector	Test conductor “S” solid “str” stranded “f” flexible	Test current I <sub>t</sub>	Test sample no.	Voltage drop per through connection		
Item no.	mm <sup>2</sup>	A	24454-	before the test	after the 1 <sup>st</sup> cycle	after the 2 <sup>nd</sup> cycle
221-415	0,14 “f”	0,2	11	0,97	0,79	0,79
			12	1,11	0,81	0,83
			13	1,00	0,83	0,84
			14	1,04	0,76	0,77
			15	1,01	0,78	0,81
	0,14 “s”		16	0,93	0,93	0,91
			17	0,83	0,86	0,82
			18	0,89	0,86	0,86
			19	0,84	0,83	0,83
			20	0,89	0,89	0,88
	4 “f”	3,2	01	2,00	1,56	1,57
			02	2,00	1,59	1,58
			03	2,10	1,59	1,58
			04	2,30	1,60	1,61
			05	1,88	1,57	1,56
	4 “s”		06	1,53	1,48	1,47
			07	1,80	1,67	1,67
			08	1,64	1,59	1,59
			09	1,54	1,47	1,46
			10	1,50	1,51	1,50
	4 “str”		21	1,21	1,39	1,21
			22	1,40	1,37	1,35
			23	1,68	1,43	1,45
			24	1,52	1,48	1,15
			25	1,85	1,80	1,80

**Result:** The test is **passed**.

Annex to the ageing test in sulphur dioxide:

Information about the conduct of the test according to EN ISO 6988:1994, Clause 10.2:		
a)	Specification of the basis material;	Copper
b)	Type and dimensions or description of parts;	5-conductor connector
c)	Preparation of the test specimens, cleaning treatments applied or protection given to special areas;	none
d)	Type of coating with an indication of its surface finish;	Tin
e)	Number of test specimens of each coating or product subjected to the test;	25
f)	Methods, if any, used to clean the test specimens after the test;	none
g)	Temperature readings within the exposure zone of the test cabinet;	Test cabinet with calibrated controlling system of temperature
h)	Duration of test;	2 test cycles
j)	Angle of inclination of the test specimens during exposure;	horizontal placement of the test specimens, see test set-up



Information about the conduct of the test according to EN ISO 6988:1994, Clause 10.2:		
k)	Character of any test panels placed in the cabinet expressly to check the correctness of the operating conditions;	none
m)	Statement, whether the test was continuous or discontinuous;	discontinuous
n)	Concentration of sulphur dioxide used;	Sulphur dioxide, liquid (100 percent)
p)	Results of all inspections;	see test result

Verification of the conductivity of the used demineralised water:		
Specified value	Actual value	Temperature of the water during measurement
$\leq 500 \mu\text{S/m}$ ( $\leq 5 \mu\text{S/cm}$ )	<ul style="list-style-type: none"> <li>• Cycle 1: <math>3,08 \mu\text{S/cm}</math></li> <li>• Cycle 2: <math>1,80 \mu\text{S/cm}</math></li> </ul>	<div>23 °C</div> <div>24 °C</div>

## 5.2 Current cycling ageing test at ambient temperature carried out with the previous aged test samples of Test 5.1

following EN 60998-2-2:2004, Clause 15.101

Variation(s)/additional requirement(s) from/to the standard:

- The test is carried out
  - with the unchanged test set-up of the “industrial atmosphere” test;
  - at an ambient temperature of  $(25 \pm 5) ^\circ\text{C}$ ;
  - on 5 test samples each kind of conductor and cross-section.
- Number of current load cycles > 192

Test set-up: Unchanged test set-up of the “industrial atmosphere” test, see item 5.1, page 14 and 15

Test conductor: 4 mm<sup>2</sup> solid, stranded and flexible  
0,14 mm<sup>2</sup> solid and flexible

Length of test conductor: 300 mm (conductor loop)

Number of current load cycles: 1008

1 current load cycle: 0,5 h test current „ON“ / 0,5 h test current „OFF“

Test current  $I_t$ : Rated current of the conductor according to EN 60998-1:2004, Table 2

**Rated current of the conductor according to EN 60998-1:2004, Table 2 / EN 60947-7-1:2009, Table 4 / EN 60352-7:2002, Table 4:**

EN 60060-1:2006, Table 27; EN 60060-1:2006, Table 27; EN 60060-1:2006, Table 27													
Conductor size mm²		≥0,08	0,2	0,34	0,5	0,75	1	1,5	2,5	4	6	10	16
Test current A	60998-1	-	4	5	6	9	13,5	17,5	24	32	41	57	76
	60947-7-1												
	60352-7	1											

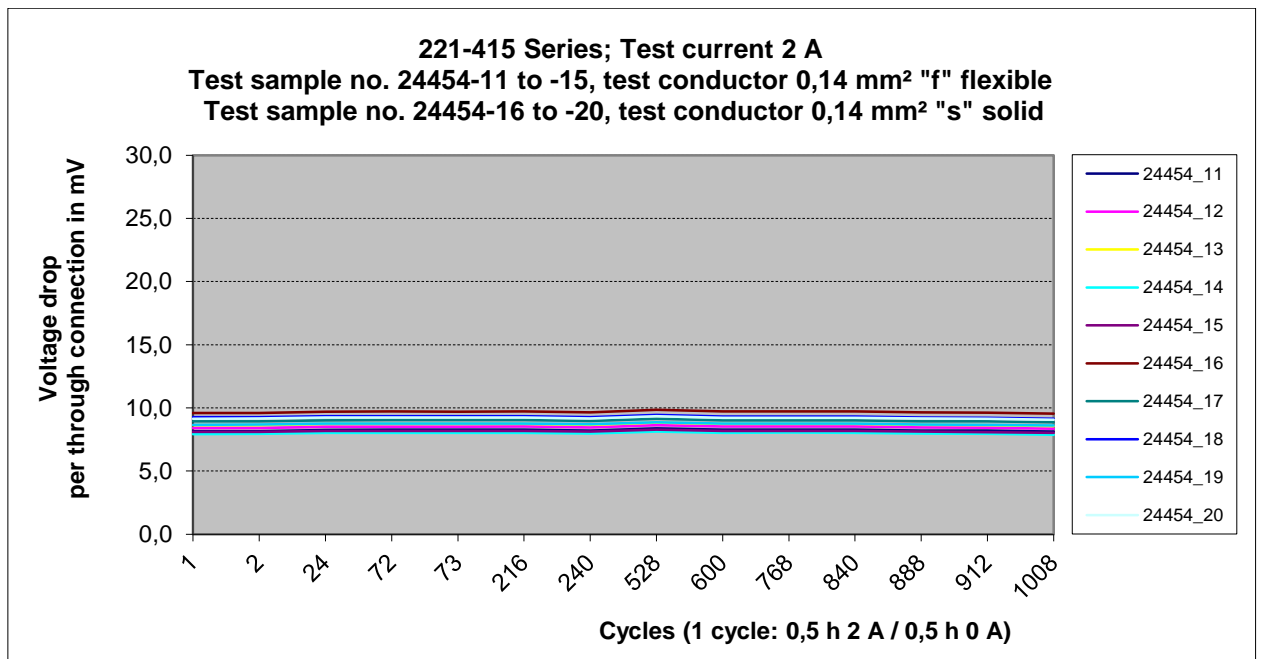
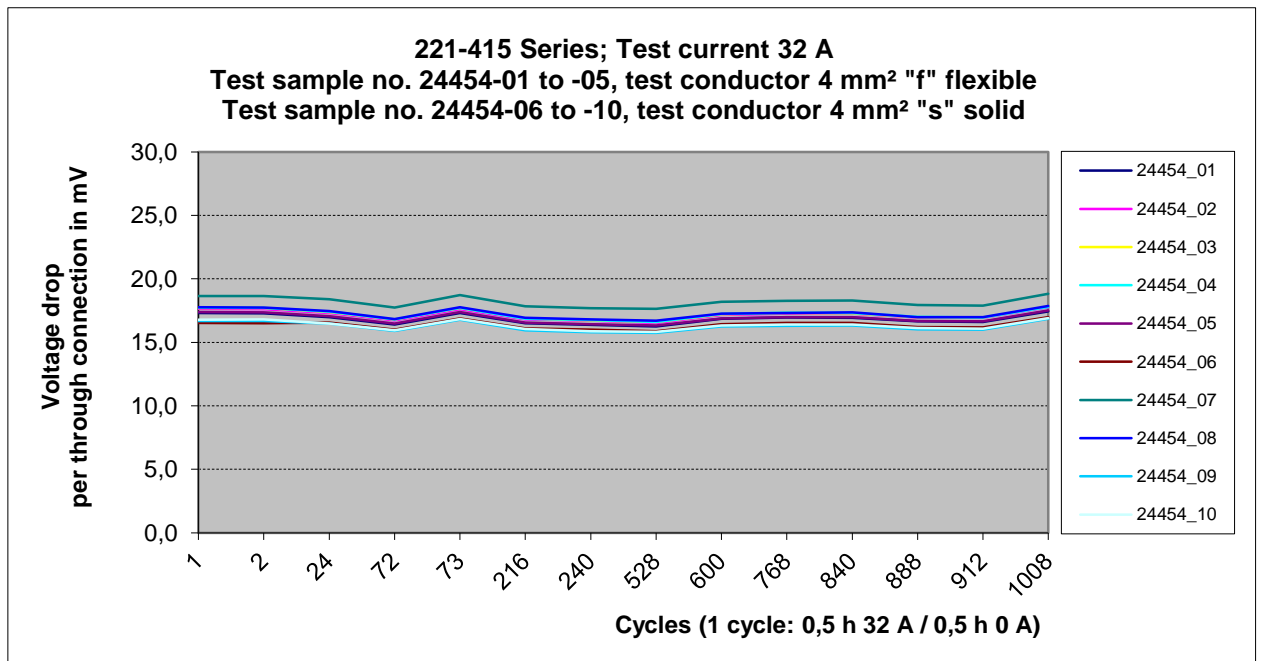
Assumed value for conductor size **0,14 mm²: 2 A**

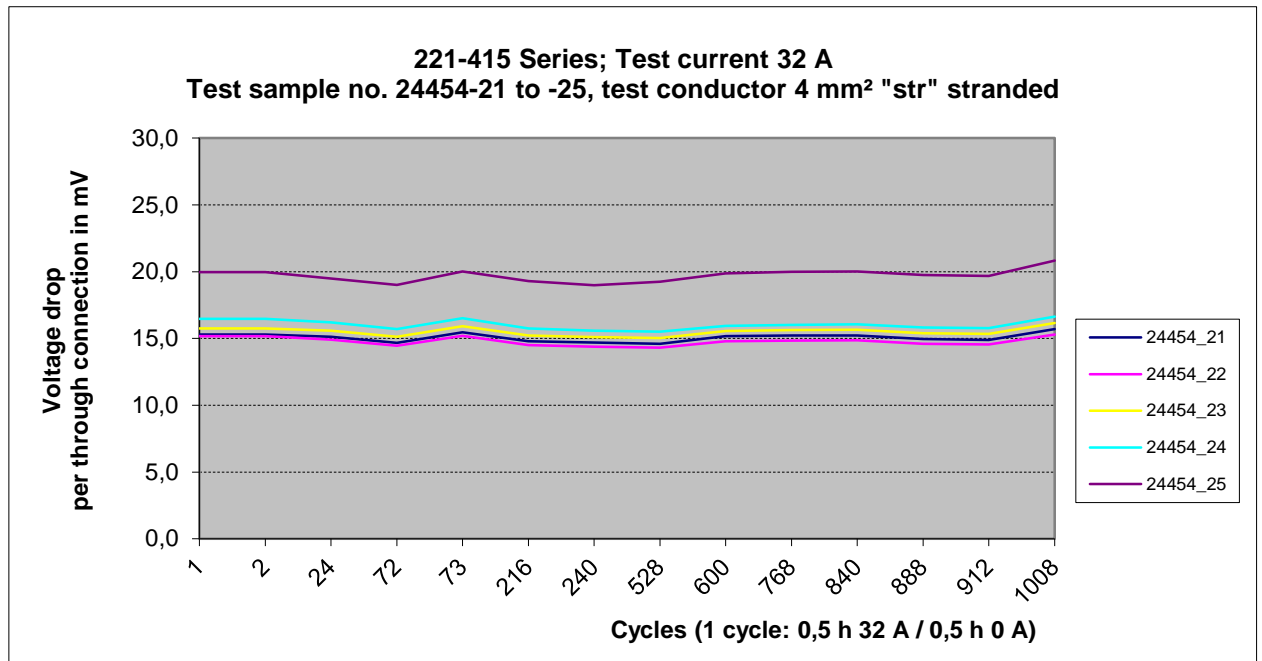
### Acceptance criteria:

- Max. permissible voltage drops
  - during and after the test: 22,5 mV per clamping unit (respectively 45 mV per through connection) following EN 60998-2-2:2004, Clause 15.101 at rated current of the terminal block  
or 1,5 times the value measured after the 24<sup>th</sup> cycle, whichever is lower  
(Voltage drop measurement always to the same time within the last third of an “ON” cycle)
- No changes impairing further use such as cracks, deformations or the like on the test samples

Test result: (derived from laboratory examination no. 25454)

Courses of the voltage drops during the current cycling ageing test:





Test sample no. 24454	Assessment / Visual inspection	
	before the test	after the test
-01 to -25	<b>P</b> no damages	<b>P</b> no damages

**Result:** The test is **passed**.

## 6. Additional information

### Test and measuring equipment

No.	Measured variable	Test and measuring equipment	Equipment no.	Calibration <sup>b)</sup>		used in test <sup>a)</sup> no.
				last	due	
1	Atmospheric pressure	Saveris U1	206475	04.09.2013	04.09.2014	1, 2, 3, 5.1, 5.2
2	Temperature / Humidity	Saveris H3	206470	02.09.2013	02.09.2014	
3	Voltage	Multimeter DMM2701	208259	15.07.2013	15.07.2014	1
4	Current	Power supply unit TOE8951-20	207471	19.06.2013	19.06.2014	
5	Current	Power supply unit GEN8-600 5000W	206456	28.06.2013	28.06.2014	2
6	Angle	Equipment for rotating test	204958	29.07.2013	29.07.2015	
7	Force	Universal test machine Erichsen 490	205021	05.02.2013	05.02.2014	3
8	Force	Force sensor 200N	205196	04.02.2013	04.02.2014	
9	Time	Stopwatch Quantum	207470	08.07.2013	08.07.2014	4
10	Atmospheric pressure	Saveris U1	206475	30.08.2012	30.08.2013	
11	Temperature / Humidity	Saveris H3	206470	24.08.2012	24.08.2013	
12	-	Salt mist test chamber SKB 400	206014	19.11.2012	19.11.2013	
13	Volume	Measuring cylinder 500ml	209120	21.02.2011	21.02.2015	
14	Volume	Measuring cylinder 50ml	209125	03.12.2008	03.12.2013	
15	Temperature	Magnetic stir bar RCT basic with controller	202600	23.08.2012	23.08.2013	
16	Conductivity /	Conductivity measuring device SevenGo Pro	207352	31.08.2012	31.08.2013	
17	Temperature		207304	31.08.2012	31.08.2013	
18	Weight	Balance Kern KB 6000-1	206732	29.08.2012	29.08.2013	
19	Temperature	Saveris H3	206483	08.05.2012	08.07.2013	
20	-	Demineralisation system salt mist	209204_INV	-	-	
21	-	Demineralisation system	209167_INV	-	-	
22	Current	Power supply unit TOE8951-20	207471	20.08.2012	20.08.2013	
23	Voltage	Multimeter DMM2700	206198	14.08.2012	14.08.2013	5.1
24	Atmospheric pressure	Saveris U1	206475	02.09.2013	02.09.2014	
25	Temperature / Humidity	Saveris H3	206470	04.09.2013	04.09.2014	
26	-	SO2 cabinet KB300	206197	19.11.2012	19.11.2013	
27	Volume	SO2 gas dosing system	205164	07.03.2013	07.03.2014	
28	Volume	Measuring cylinder 2000ml	209192	19.10.2009	19.10.2014	
29	Conductivity / Temperature	Conductivity measuring device SevenGo Pro	207304	17.07.2013	17.07.2014	
30	-	Demineralisation system	209167_INV	-	-	
31	-	Power supply unit TOE8951-20	207471	19.06.2013	19.06.2014	
32	Voltage	Multimeter DMM2700	206198	20.06.2013	20.06.2014	
33	Temperature	Thermo wire ø0,2mm	200062_INV	-	-	5.2
34	Current	Clamp-on ammeter Fluke 360	207662	17.07.2013	17.07.2014	
35	Voltage	Data Logger Si 35356 D	206759	20.06.2013	20.06.2014	
36	-	Power supply unit 10A/40A	206044_INV	-	-	
37	-		206822_INV	-	-	

<sup>a)</sup> Clause from table "Content of test report"

<sup>b)</sup> at the time of tests

Details to the estimated measurement uncertainty are available on request.

### Test engineer / Test period

Test <sup>a)</sup>	Test engineer	further test engineer(s)	Test period
1.	J. Olbrich	-	2014-06-05
2.	J. Olbrich	-	2014-01-30
3.	J. Olbrich	-	
4.	J. Olbrich	J. Kuhlmann	2013-07-02 to 2013-07-08
5.1.	J. Olbrich	-	2013-07-18 to 2013-07-22
5.2.	J. Olbrich	-	2013-07-22 to 2013-09-09

<sup>a)</sup> Clause from table "Content of test report"