E-TEST LABORATORY
WAGO Kontakttechnik GmbH
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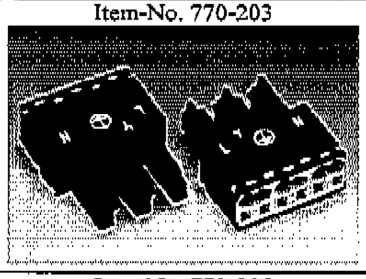
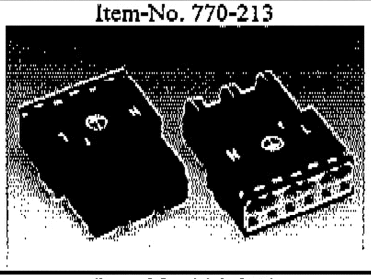
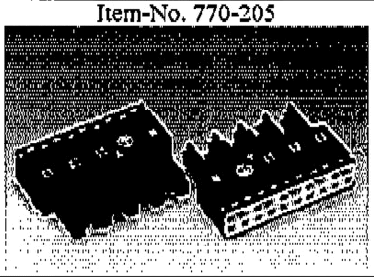
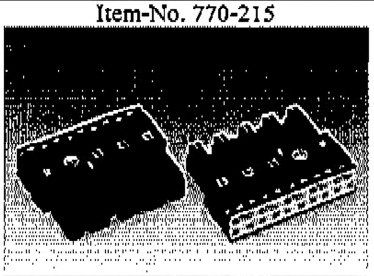
LABORATORY TEST REPORT

Re: Vibration test, damp heat test and salt mist test carried out on *WINSTA*® connectors, Series 770

Requirements acc. to DET NORSKE VERITAS Certification Notes - No. 2.4, April 2001

Specifications applied: DET NORSKE VERITAS Certification Notes - No. 2.4, April 2001; IEC 60068-2-6:1995; IEC 60068-2-30:1980; IEC 60068-2-52:1996; IEC 60998-1:1990; IEC 60999-1:1999

Tested connectors 3- and 5-pole, 2-conductor, Series 770:

	Socket	Plug
3-pole, without strain relief housing	Item-No. 770-203 	Item-No. 770-213 
5-pole, without strain relief housing	Item-No. 770-205 	Item-No. 770-215 

Technical data:	3-pole connector	5-pole connector
Rated cross section:	4 mm²	4 mm²
Cross section area:	2x 0.5 mm² - 4 mm²	2x 0.5 mm² - 4 mm²
Rated voltage:	250 V	400 V
Rated surge voltage:	4 kV	6 kV
Pollution degree:	3	3
Rated current:	25 A	25 A

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* Document created by EDP. Valid without signature.

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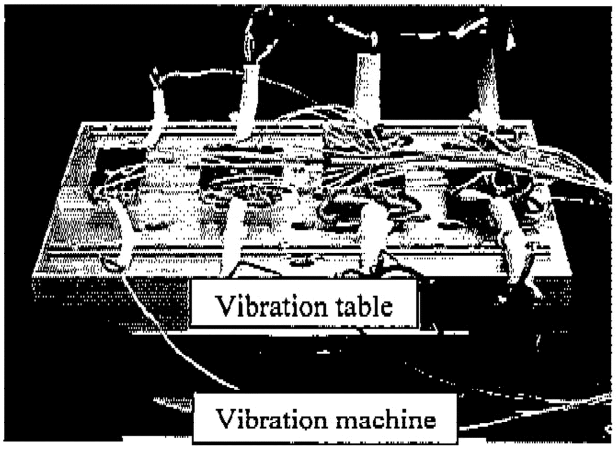
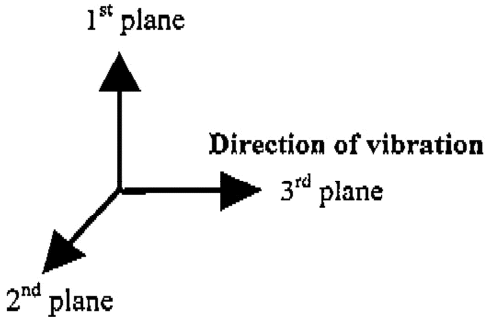
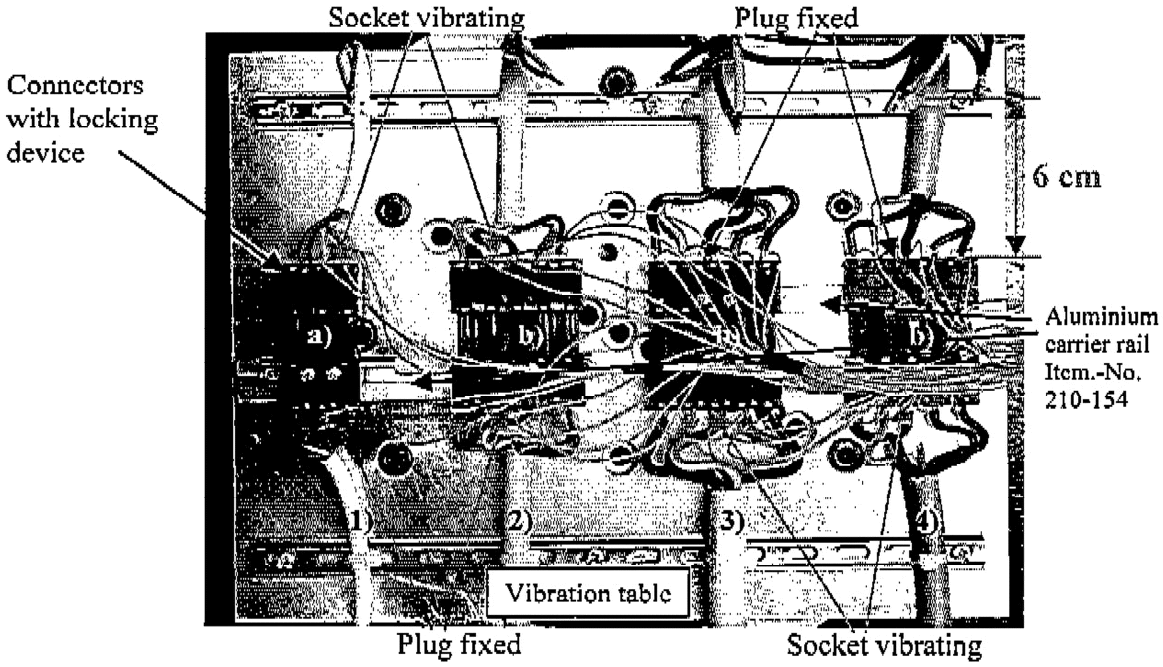
1. Vibration test "sweep sine test" according to DET NORSKE VERITAS Certification Notes - No. 2.4, April 2001, clause 3.6.2

Basis: IEC 60068-2-6:1995, Test FC

Test arrangement:







Connectors:
a) 3-pole socket 770-203 with plug 770-213 (without strain relief housing)
b) 5-pole socket 770-205 with plug 770-215 (without strain relief housing)

Cables:		*(conductor)*
1)	H05VV	3 x ***0.75 mm² flexible***
2)	NYM	5 x ***1.5 mm² solid***
3)	NYM	5 x ***4 mm² solid***
4)	YSLY	5 x ***4 mm² flexible***

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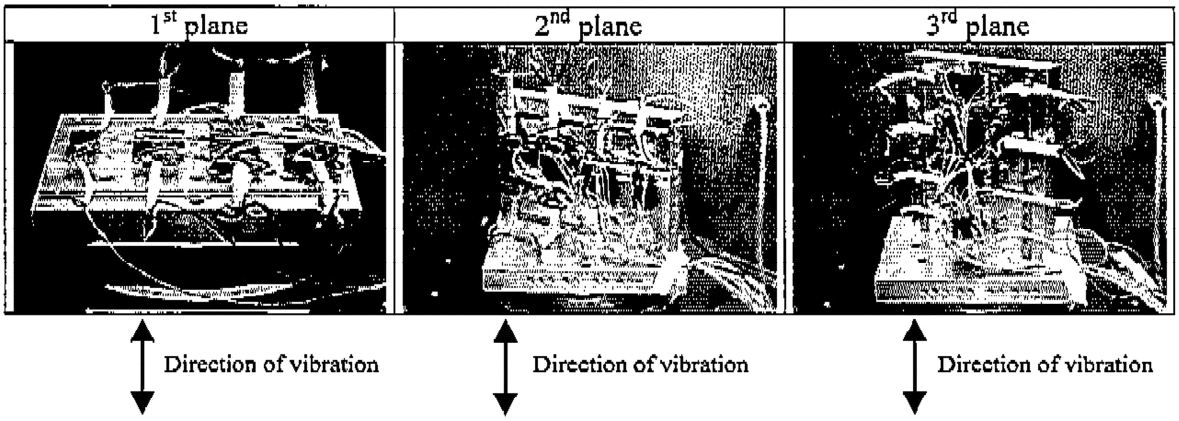


The equipment is to be mounted on the vibration table through its normal points of attachment, and in its normal orientation with respect to the vertical.

The test specimen is to be vibrated in three mutually perpendicular planes unless otherwise stated in the relevant test programme. These planes are to be chosen so that faults are most likely to be revealed.

Test I Resonance search

The sweeping is to be logarithmic (with vibration machine continuous not possible), and the sweep rate is to be maximum one octave per minute.

Resonance search is to be run at the actual test level specified in table B) High Vibration Strain, Class B.

Table B) High Vibration Strain, Class B. ONE SWEEP

Frequency range	Displacement	Acceleration
5 Hz* to 25 Hz	1.6 mm (peak value)	
25 Hz to 100 Hz		4.0 g
Sweep rate	max. 1 octave/minute	

*min. frequency of the vibration machine

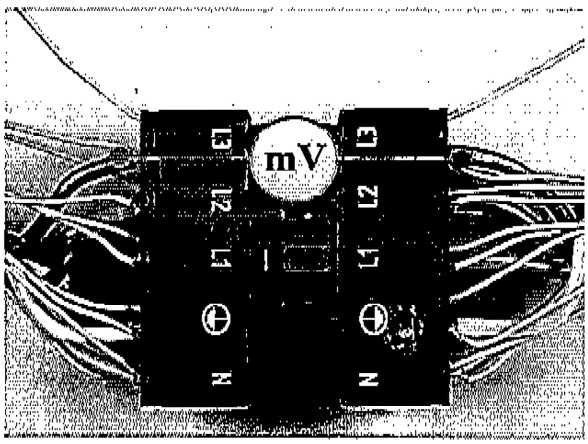
Should however resonance's occur, the amplification factors 'Q' are to be measured and recorded if 2 or above. Resonance's with mechanical amplification greater than 10 are not acceptable.

Test II Endurance test

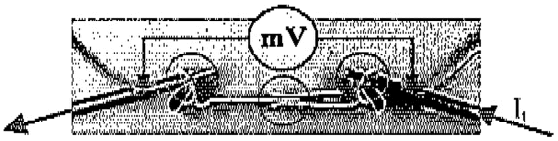
Endurance test is to be carried out for at least 90 minutes at all actual resonance frequencies (and at upper frequency if amplification factor is increasing with increasing frequency) where the amplification factor is greater than 2.
If the resonance frequency varies during the test, the control equipment is to be adjusted accordingly.
The test level is to be as in the sweep test.
If no amplification factor higher than 2 is found, the endurance test is to be performed at the frequency of the highest one.
If no resonance frequencies are found, the test is to be carried out at 30 Hz for Class A and B, and at 10 Hz for Class C.

Measuring of the voltage drop at each pole of the connector before the vibration test and after in each plane.

Test arrangement for the voltage drop measurement:



Connector through connection
(3 clamping units ⇒ max. 4.5 mV voltage drop)



Test current I_t:

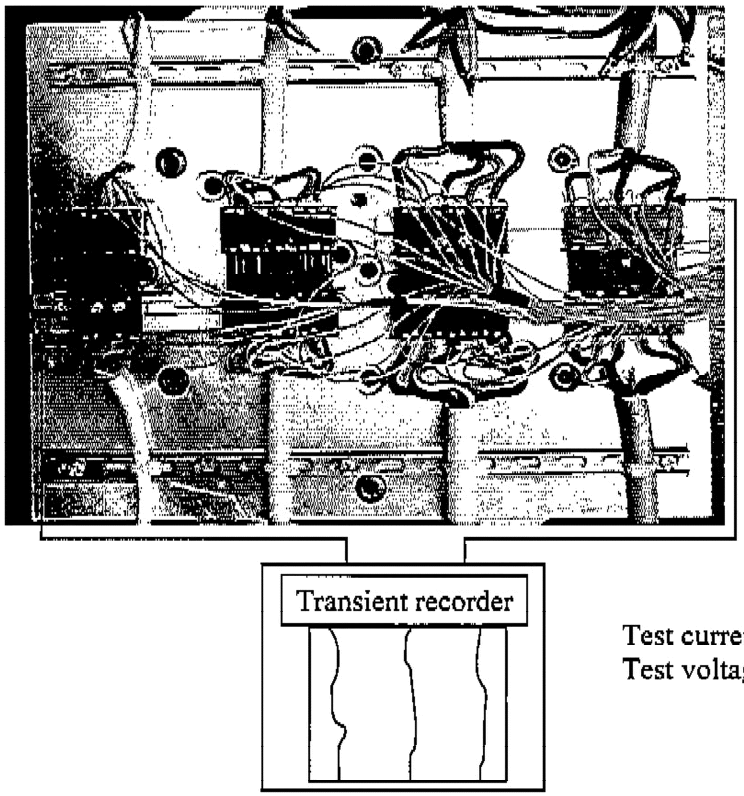
0.75 mm²	=	0.9 A	(1/10 rated current of the conductor)	acc. to IEC 60998-1:1990, Table 2
1.5 mm²	=	1.75 A	(1/10 rated current of the conductor)	
4 mm²	=	2.5 A	(1/10 rated current of the connector)	

During the vibration test, a voltage interruption test (interruptions > 20 ns) was carried out and the test specimens have been checked for excessive voltage drops.

The voltage interruption test was carried out with a oscilloscope.

Test arrangement for monitoring the voltage drop:

All poles of the four connectors are connected in series.



Test current I_t: 1 A
Test voltage: 1 V (open-circuit voltage)

The test is considered to be successfully completed if

a) no resonance frequencies greater 10 occurred.

b) the voltage drop before the test shall not exceed 1.5 mV per clamping unit ⇒ 4.5 mV per through connection (3 clamping units) and after the test it shall not exceed 150 % of the value measured before the test.

c) during the vibration test there shall be no voltage interruption > 20 ns and no excessive changing of the voltage drop occurred.

d) no damage to the individual parts and the satisfactory operation of the disconnect terminal blocks is maintained.

After the test no conductor shall be damaged in such a way as to render it unfit for further use.

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Test result:

a) Resonance frequencies

Connector Series 770 Item-No.	Conductor cross section s = solid f = flexible [mm²]	Vibration environment	Direction of vibration	Result
3-pole 770-203 with 770-213	0.75 f	Frequency range: 5 Hz - 100 Hz Displacement: 1.6 mm (peak value) (5 Hz - 25 Hz) Acceleration: 4.0 g (25 Hz - 100 Hz)	1st plane	**no resonance frequencies occurred**
			2nd plane	**no resonance frequencies occurred**
			3rd plane	**no resonance frequencies occurred**
5-pole 770-205 with 770-215	1.5 s 4.0 s 4.0 f		1st plane	**no resonance frequencies occurred**
			2nd plane	**no resonance frequencies occurred**
			3rd plane	**no resonance frequencies occurred**

b) Voltage drop test similar to IEC 60999-1:1999, clause 9.8
- during the vibration environment

Connector Series 770 Item-No.	Conductor cross section s = solid f = flexible [mm²]	Test current I_t	**Course of the voltage drop** during the vibration test (1st plane, 2nd plane, 3rd plane)	**Voltage interruption test** during the vibration test (1st plane, 2nd plane, 3rd plane)
3-pole 770-203 with 770-213 5-pole 770-205 with 770-215	0.75 s 1.5 s 4.0 s 4.0 f	20 mA	steady	no interruptions measured

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- before and after the vibration environment

Connector Series 770 Item-No.	Conductor cross section s = solid f = flexible [mm²]	Test current I_t [A]	Direction of vibration	Test specimen No.	Pole	Voltage drop ΔU per through connection before the test *Resonance search* 5 Hz - 100 Hz - 5 Hz [mV]	after the test *Endurance test (Duration each plane: 90 minutes)* *** 30 Hz, 4 g** *(no resonance frequencies)* [mV]	***100 Hz, 4 g*** *(amplification factor < 2)* [mV]
3-pole 770-203 with 770-213	0.75 f	0.9	1st plane	1	N PE L1	1.30 1.45 1.45	1.35 1.50 1.40	
			2nd plane		N PE L1	1.45 1.80 2.00	1.30 1.75 1.90	
			3rd plane		N PE L1	1.65 1.50 1.65	1.65 1.50 1.65	
5-pole 770-205 with 770-215	1.5 s	1.75	1st plane	2	N PE L3 L2 L1	1.50 1.60 1.70 1.85 1.70	1.55 1.60 1.75 1.90 1.75	
			2nd plane		N PE L3 L2 L1	1.60 1.65 1.75 1.90 1.75	1.60 1.65 1.75 1.95 1.75	
			3rd plane		N PE L3 L2 L1	1.55 1.65 1.75 2.05 1.75	1.55 1.65 1.75 2.05 1.75	

* If no resonance frequencies are found, the test is to be carried out at 30 Hz for Class A and B.
** If no amplification factor higher than 2 is found, the endurance test is to be performed at the frequency of the highest one.

Connector Series 770 Item-No.	Conductor cross section s = solid f = flexible [mm²]	Test current I_t [A]	Direction of vibration	Test specimen No.	Pole	Voltage drop ΔU per through connection		
						before the test	after the test	
						Resonance search 5 Hz - 100 Hz - 5 Hz	*Endurance test (Duration each plane: 90 minutes)* * 30 Hz, 4 g *(no resonance frequencies)*	***100 Hz, 4 g*** *(amplification factor < 2)*
						[mV]	[mV]	[mV]
5-pole 770-205 with 770-215	4.0 s	2.5	1st plane	3	N	1.80	1.80	
					PE	1.60	1.65	
					L3	1.65	1.70	
					L2	1.75	1.80	
					L1	1.65	1.65	
			2nd plane		N	1.80	1.85	
					PE	1.65	1.65	
					L3	1.70	1.70	
					L2	1.85	1.85	
					L1	1.70	1.70	
			3rd plane		N	1.80	1.80	
					PE	1.65	1.65	
					L3	1.70	1.70	
					L2	1.80	1.80	
					L1	1.70	1.70	

* If no resonance frequencies are found, the test is to be carried out at 30 Hz for Class A and B.
** If no amplification factor higher than 2 is found, the endurance test is to be performed at the frequency of the highest one.

Connector Series 770 Item-No.	Conductor cross section s = solid f = flexible [mm²]	Test current I_t [A]	Direction of vibration	Test specimen No.	Pole	Voltage drop ΔU per through connection		
						before the test	after the test	
						Resonance search 5 Hz – 100 Hz - 5 Hz	*Endurance test (Duration each plane: 90 minutes)* * 30 Hz, 4 g *(no resonance frequencies)*	*100 Hz, 4 g* *(amplification factor < 2)*
						[mV]	[mV]	[mV]
5-pole 770-205 with 770-215	4.0 f	2.5	1st plane	4	N	1.65	1.70	
					PE	1.75	1.75	
					L3	1.70	1.70	
					L2	1.80	1.85	
					L1	1.65	1.65	
			2nd plane		N	1.75	1.75	
					PE	1.85	1.80	
					L3	1.75	1.75	
					L2	1.80	1.80	
					L1	1.70	1.70	
			3rd plane		N	1.70	1.70	
					PE	1.80	1.80	
					L3	1.75	1.75	
					L2	1.80	1.80	
					L1	1.70	1.70	

* If no resonance frequencies are found, the test is to be carried out at 30 Hz for Class A and B.
** If no amplification factor higher than 2 is found, the endurance test is to be performed at the frequency of the highest one.

c) Visual control of the test specimen after the test

Connector Series 770 Item-No.	Test specimen No.	**Visual control**
3-pole 770-203 with 770-213	1	**O.K.**
5-pole 770-205 with 770-215	2	**O.K.**
	3	**O.K.**
	4	**O.K.**

Test result:

No resonance frequencies greater 10 are occurred.

The maximum voltage drop of 1.5 mV per clamping unit ⇒ 4.5 mV per through connection (3 clamping units) is not exceeded.

The increase of voltage drop after the vibration test compared to the value before the vibration test is in all cases much less than 50 %.

During the vibration test neither interruptions ≥ 20 ns have occurred on the monitored transitions nor have the voltage drop changed in an inadmissible way.

There is no damage to the individual parts and the operation reliability of the connectors is maintained.

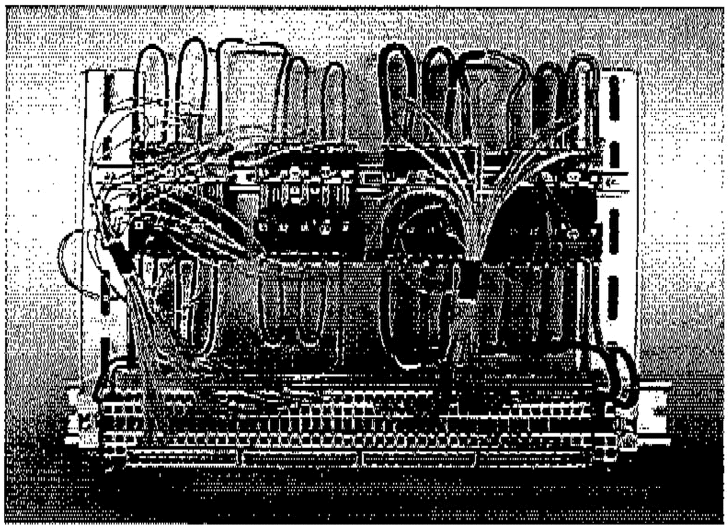
After the test no conductor is damaged in such a way as to render it unfit for further use.

The vibration test „sweep sine test" according to DET NORSKE VERITAS Certification Notes - No. 2.4, April 2001, clause 3.6.2, **is passed.**

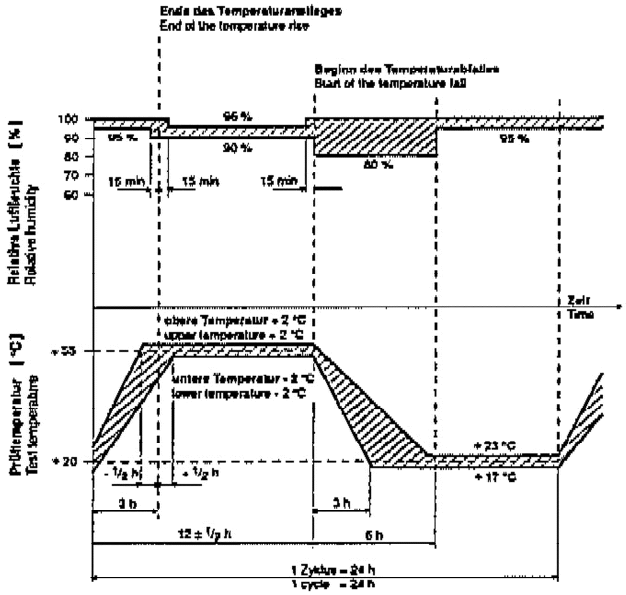
2. Damp heat test "cyclic"according to DET NORSKE VERITAS Certification Notes – No. 2.4, April 2001, clause 3.8.3

Test procedure: Basis IEC 60068-2-30:1980, test Db

Test arrangement:



Low test temperature:	20 °C ± 2 °C
High test temperature:	55 °C ± 2 °C
Relative air humidity:	93 % ± 3 %
1 cycle:	24 h ± 0.5 h
Number of cycles:	2



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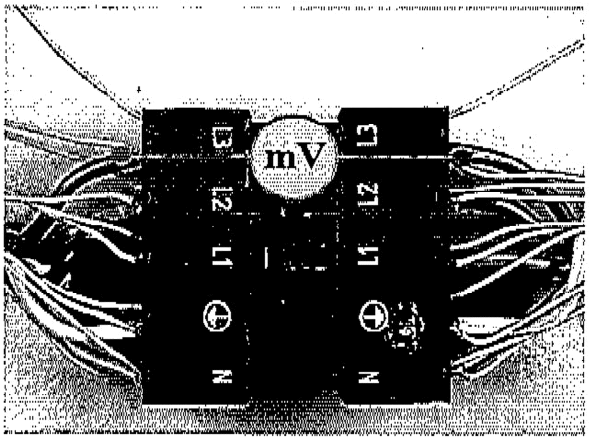
The equipment under test, is placed in the test chamber at room temperature and remains connected and switched on throughout the first test cycle.

During the second test cycle, the equipment under test is switched off.

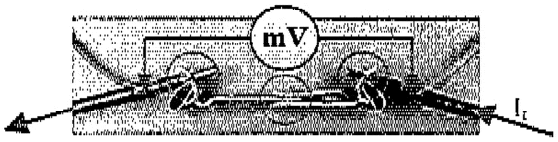
Current load during the first test cycle: 0.5 mm² = 6 A
4.0 mm² = 25 A

Before the test and after the test (within one hour at normal ambient humidity and temperature) a voltage drop test and an insulation resistance test is carried out.

Test arrangement for the voltage drop measurement:



Connector through connection
(3 clamping units ⇒ max. 4.5 mV voltage drop)



Test current I_t: 0.5 mm² = 0.6 A (1/10 rated current of the conductor acc. to IEC 60998-1:1990, Table 2)
4 mm² = 2.5 A (1/10 rated current of the connector)

The test is considered to be successfully completed if

a) the voltage drop before the test shall not exceed 1.5 mV per clamping unit ⇒ 4.5 mV per through connection (3 clamping units) and after the test it shall not exceed 150 % of the value measured before the test.

b) the insulation resistance at a test voltage of 500 V D.C. is not lower than 100 MΩ (before the test) and 10 MΩ (after the test).

c) no damage to the individual parts and the satisfactory operation of the connectors is maintained.

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Test result:

a) Voltage drop test similar to IEC 60999-1:1999, clause 9.8

Connector Series 770 Item-No.	Conductor cross section s = solid f = flexible [mm²]	Test current I_t [A]	Test specimen No.	Pole	Voltage drop ΔU per through connection before the test [mV]	Voltage drop ΔU per through connection after the test [mV]
5-pole 770-205 with 770-215	0.5 f	0.6	1	L1	1.60	1.90
				L2	1.40	1.40
				L3	1.25	1.40
				PE	1.75	1.70
				N	1.20	1.35
	0.5 s		2	L1	0.85	0.90
				L2	0.85	0.85
				L3	0.90	0.90
				PE	1.00	0.95
				N	0.90	0.90
	4.0 f	2.5	3	L1	2.15	2.05
				L2	1.70	1.80
				L3	1.80	1.85
				PE	1.85	1.80
				N	1.70	1.65
	4.0 s		4	L1	2.35	1.80
				L2	2.00	1.70
				L3	1.80	1.70
				PE	2.20	1.80
				N	1.80	1.95

b) Insulation resistance test

Connector Series 770 Item-No.	Test voltage D.C.	Test specimen No.	Insulation resistance between two adjacent poles before the test [Ω]	Insulation resistance between two adjacent poles after the test [Ω]
5-pole 770-205 with 770-215	500 V	1	$48 \times 10^{12} - 58 \times 10^{12}$	$14 \times 10^{9} - 55 \times 10^{9}$
		2	$50 \times 10^{12} - 65 \times 10^{12}$	$11 \times 10^{9} - 32 \times 10^{9}$
		3	$14 \times 10^{12} - 20 \times 10^{12}$	$23 \times 10^{8} - 44 \times 10^{8}$
		4	$12 \times 10^{12} - 16 \times 10^{12}$	$18 \times 10^{8} - 36 \times 10^{8}$
			between all poles connected together and the metal foil	
			before the test [Ω]	after the test [Ω]
		1	11×10^{11}	28×10^{8}
		2	10×10^{11}	35×10^{8}
		3	12×10^{11}	18×10^{8}
		4	11×10^{11}	17×10^{8}

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c) Visual control of the test specimen after the test

Connector Series 770 Item-No.	Test specimen No.	**Visual control**
5-pole 770-205 with 770-215	1	**O.K.**
	2	**O.K.**
	3	**O.K.**
	4	**O.K.**

Test result:

The maximum voltage drop of 1.5 mV per clamping unit ⇒ 4.5 mV per through connection (3 clamping units) is not exceeded.

The increase of voltage drop after the damp heat test compared to the value before the damp heat test is in all cases much less than 50 %.

The insulation resistance at a test voltage of 500 V D.C. is
- before the test > 100 MΩ and
- after the test > 10 MΩ.

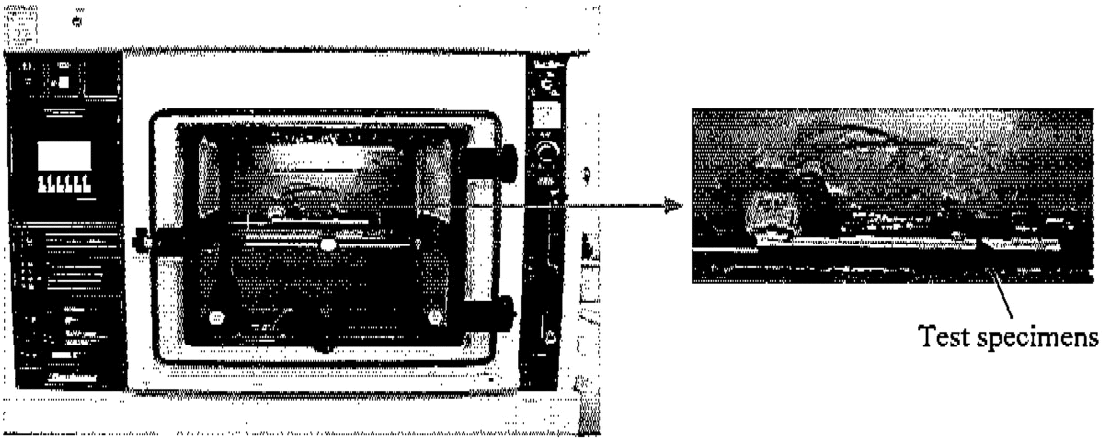
There is no damage to the individual parts and the operation reliability of the connectors is maintained.

The damp heat test "cyclic" acc. to DET NORSKE VERITAS Certification Notes - No. 2.4, April 2001, clause 3.8.3, **is passed.**

3. Salt mist test according to DET NORSKE VERITAS Certification Notes - No. 2.4, April 2001, clause 3.10

Test procedure: Basis IEC 60068-2-52:1996, test Kb

Test arrangement:



Test conditions:

Number of spraying:	4
Storage period in damp chamber:	7 days after each spraying, 28 days total
Spray duration:	2 hours
Temperature:	25 °C ± 10 °C
Saline solution:	5 % NaCl, pH 6,5 to 7.2 at 20 °C ± 2 °C
Storage temperature:	40 °C ± 2 °C
Humidity in chamber during storage:	≈ 100 %

Before commencing the test an insulation resistance test and a voltage drop test is carried out.

The test consists of 4 sprayings and 7 days storage in the damp chamber after each spraying.

On the 7th day of each storage period a voltage drop measurement is carried out (test arrangement see page 13).

The test is considered to be successfully completed if

a) the voltage drop before the test shall not exceed 1,5 mV per clamping unit ⇒ 4,5 mV per through connection and after the test it shall not exceed 150 % of the value measured before the test.

b) the insulation resistance at a test voltage of 500 V D.C. is not lower than 100 MΩ (before the test) and 10 MΩ (after the test).

c) no damage to the individual parts and the satisfactory operation of the connectors is maintained.

Test result:

a) Voltage drop test similar to IEC 60999-1:1999, clause 9.8

Connector Series 770 Item-No.	Conductor cross section s = solid f = flexible [mm²]	Test current I_t [A]	Test specimen No.	Pole	Voltage drop ΔU per through connection before the test (12.12.2001) [mV]	after the 7 days (1st storage period) (19.12.2001) [mV]	after the 14 days (2nd storage period) (26.12.2001) [mV]	after the 21 days (3rd storage period) (02.01.2002) [mV]	after the 28 days (4th storage period) (09.01.2002) [mV]
5-pole 770-205 with 770-215	0.5 f	0.6	1	L1	1.60	1.50	1.45	1.45	1.45
				L2	1.50	1.45	1.50	1.50	1.50
				L3	2.00	1.80	1.70	1.75	1.70
				PE	1.85	1.70	1.65	1.60	1.65
				N	1.30	1.35	1.35	1.30	1.30
	0.5 s		2	L1	0.95	0.95	0.90	0.90	0.90
				L2	0.90	0.90	0.85	0.90	0.85
				L3	1.05	1.00	0.95	0.95	0.95
				PE	1.00	1.05	1.05	1.00	0.95
				N	0.85	0.90	0.85	0.85	0.80
	4.0 f	2.5	3	L1	1.70	1.70	1.65	1.60	1.55
				L2	1.85	1.75	1.75	1.75	1.70
				L3	1.80	1.85	1.80	1.75	1.75
				PE	1.75	1.70	1.60	1.60	1.60
				N	2.00	1.90	1.80	1.85	1.85
	4.0 s		4	L1	2.20	1.95	1.90	1.85	1.80
				L2	1.70	1.85	1.95	1.95	1.95
				L3	1.65	1.70	1.70	1.75	1.70
				PE	2.15	2.00	1.80	1.70	1.65
				N	1.70	1.80	1.85	1.85	1.85

b) Insulation resistance test

Connector Series 770 Item-No.	Test voltage D.C.	Test specimen No.	Insulation resistance between two adjacent poles	
			before the test [Ω]	after the test [Ω]
5-pole 770-205 with 770-215	500 V	1	$45 \times 10^{12} - 56 \times 10^{12}$	$2.5 \times 10^{8} - 10 \times 10^{8}$
		2	$45 \times 10^{12} - 70 \times 10^{12}$	$4.0 \times 10^{8} - 45 \times 10^{8}$
		3	$10 \times 10^{12} - 15 \times 10^{12}$	$25 \times 10^{7} - 40 \times 10^{7}$
		4	$13 \times 10^{12} - 19 \times 10^{12}$	$15 \times 10^{7} - 45 \times 10^{7}$
			between all poles connected together and the metal foil	
			before the test [Ω]	after the test [Ω]
		1	12×10^{11}	32×10^{7}
		2	11×10^{11}	30×10^{7}
		3	11×10^{11}	21×10^{7}
		4	13×10^{11}	24×10^{7}

c) Visual control of the test specimen after the test

Connector Series 770 Item-No.	Test specimen No.	Visual control
5-pole 770-205 with 770-215	1	**O.K.**
	2	**O.K.**
	3	**O.K.**
	4	**O.K.**

Result:

The maximum voltage drop of 1.5 mV per clamping unit ⇒ 4.5 mV per through connection (3 clamping units) is not exceeded.

The increase of voltage drop after the salt mist test compared to the value before the salt mist test is in all cases less than 50 %.

The insulation resistance at a test voltage of 500 V D.C. is
- before the test > 100 MΩ and
- after the test > 10 MΩ.

There is no damage to the individual parts and the operation reliability of the connectors is maintained.

The salt mist test according to DET NORSKE VERITAS Certification Notes - No. 2.4, April 2001, clause 3.10, **is passed.**

Findings:

All test results are satisfactory.

NO.: 10576	DATE: 09.01.2002	FINDINGS: see above
SHEET-NO.: 19 / 19	TESTER: Kuhlmann	SGD.: * **authorized copy**

* Document created by EDP. Valid without signature.