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NECTOR* M-Line, 5-, 6-, 7-Position Standard Connectors

1. SCOPE

1.1. Content

This specification covers the performances, tests and quality requirements for NECTOR M-Line 3-Position C connectors, a system for flexible power wiring applications:

- Electrical power distribution in building installations
- Lighting distribution

1.2. Qualification

When tests are performed on the subject product line, procedures specified in Figure 2 shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.

2. APPLICABLE AND REFERENCED DOCUMENTS

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the latest edition of the document applies. In the event of conflict between requirements of this specification and the product inspection drawing, the Product Inspection Drawing shall take precedence. In the event of conflict between requirements of this Specification and referenced documents, this specification shall take precedence.

2.1. TE Connectivity Documents

- [114-32150](#): NECTOR M Standard Connector Assembly, 3 Positions and 5/6/7 Positions Connectors
- [107-20294](#): Packaging Specification
- DEKRA Attestation of Conformity 2156440.01 (Test Groups A through I)
- 501-TBD: Qualification Test Report (Test Groups J through L)
- 501-TBD: Qualification Test Report NECTOR M Sealed (Groups A-L for AWG Contacts)

2.2. Industry Documents

- EIA-364: Electrical Connector/Socket Test Procedures Including Environmental Classifications
- IEC 61535-1: Installation Couplers Intended for Permanent Connection in Fixed Installations
- IEC 60060-2-32: Basic Environment Testing Procedures
- IEC 60695-2-11: Glowing/Hot-wire Based Test Methods
- IEC 60998-1: Connecting Devices for Low-Voltage Circuits For Household and Similar Purposes
- IEC 60512-1-1: Connectors for Electronic Equipment – Tests and Measurements

2.3. Reference Documents

- [109-197](#): Test Specification (Tyco Electronics Test Specifications vs EIA and IEC Test Methods)

3. REQUIREMENTS

3.1. Design and Construction

Product shall be of design, construction and physical dimensions specified on the applicable product drawings.

3.2. Materials

Materials used in the construction of this product shall be as specified on the applicable product drawing.

3.3. Ratings

- Voltage: 400 V AC max
- Current: rating according to the table shown in Figure 1:

CONTACT PART NUMBER	WIRE CONDUCTOR SIZE	MAXIMUM RATED CURRENT	
		SINGLE-PHASE	MULTI-PHASE
293476-2 (Pin), 293475-2 (Socket)	1.5 mm ²	11 A■	10 A
2213657-2 (Pin), 2213656-2 (Socket)	1.5 mm ²	16 A	10 A
1-293476-2 (Pin), 1-293475-2 (Socket)	2.5 mm ²	14 A■	14 A
1-2213657-2 (Pin), 1-2213656-2 (Socket)	2.5 mm ²	20 A	16 A
1-2213266-2 (Pin), 1-2213265-2 (Socket)	18 AWG	7 A	7 A
1-2213266-2 (Pin), 1-2213265-2 (Socket)	16 AWG	10 A	10 A
2213266-5 (Pin), 2213265-5 (Socket)	14 AWG	15 A	15 A

■ Max operating temperature: installation couplers are suitable for use at ambient temperatures not normally exceeding +40°C, where the average temperature over a period of 24 hours does not exceed +35°C

Figure 1

3.4. Performance and Test Description

Product is designed to meet the electrical, mechanical and environmental performance requirements specified in Figure 1. Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

3.5. Test Requirements and Procedures Summary – IEC Standard Based

Plug connectors are tested when not engaged with the installation receptacle connector. Receptacle connector is only tested when engaged with its mating counterpart, in accordance to tests shown in Figure 2.

Parts are tested and meet the requirements of IEC 61535, attestation of conformity available upon request. To receive the full certification of conformity for IEC 61535, production of cable assemblies needs to be audited.

TEST DESCRIPTION	REQUIREMENT	PROCEDURE
Visual and dimensional examination	Meets requirements of product drawings	Acc. to IEC 60512-1-1
Durability of marking	Markings shall be durable and easily legible	Acc. to IEC 61535 part 8
Polarization and dangerous compatibility	The installation coupler shall not engage in any unintended configuration using a force of 80 N	Acc. to IEC 61535 part 9
Protection against electrical shock	An engaged installation coupler shall comply with the requirements of IP20. (See Paragraph 5.1)	Acc to IEC 61535 part 10.1 Test probed acc. to IEC 61032
Terminals and terminations	Compliance check by inspection	Acc. to IEC 61535 part 11 Measurement and Test acc. to IEC 61535 part 22

Figure 2 (cont'd)

TEST DESCRIPTION	REQUIREMENT	PROCEDURE
Construction	An engaged installation coupler shall comply with the requirements of IP20. (See Paragraph 5.2)	Acc. to IEC 61535 part 12.1 Acc. to IEC 61535 part 12.8 Acc. to IEC 61535 part 12.10
Cables and their connection	Cable axial pull force: -for cable H05VV-F, 2.5 mm ² : 80 ±2 N - other cables: 60 ±2 N Torque of 0.25 Nm applied to the cable for 1 min. The displacement shall be ≤2 mm. Torque of 0.25 Nm applied to the cable for 1 min. the distortion shall be ≤45° (See Paragraphs 5.3 and 5.4)	Acc. to IEC 61535 part 19.4
Contact mechanical strength	No contact shall have been displaced in the body of the installation coupler by more than 1 mm	Acc. to IEC 61535 part 12.3 Pre-ageing 70°C for 1 hr. 40 N applied to each contact in both direction consecutively
Protection against harmful ingress of solid foreign objects	Minimum rating is IP20	Acc. to IEC 61535 part 13.1
Insulation resistance and dielectric strength	Dielectric withstanding voltage (50/60 Hz) is applied for 1 min. 1500 V between parts of different polarity. 3000 V between all parts connector together and the body	Acc. to IEC 61535 part 14
Construction of contacts	Contacts resistance wire-to-wire ≤1mΩ Contact resistance measured across the clamping units of the installation coupler	Acc. to IEC 61535 part 15
Temperature rise	Test current = 1.25 x rated current ΔT max = 45°C for single-phase and 50°C for multi-phase	Acc. to IEC 61535 part 16 Wire length 1 m. Test 1 energizes L,N with TCs on L, N (socket) and L (pin). Test 2 energizes L, PE with TCs on L,PE (socket) and PE (pin)
Breaking capacity	After the test apply dielectric withstanding voltage at 1500 V. No flashover shall occur and contact parts shall not become loose	Acc. to IEC 61535 part 17 100 mating cycles without load and 50 mating cycles with load. Max current rating in a circuit with cosφ = 0.6. Speed rate 0.8m/s 0.1m/s (ref. 15 strokes/min)
Force for disconnection	Pull out after the last cycle ≤80N	Acc. to IEC 61535 part 18 10 mating cycle without locking device
Ageing of thermoplastic material	No samples damaged in a manner that would lead to non-compliance to other requirements of IEC 61535	Acc. to IEC 61535 part 21.4 70°C ±2°C for 240 hour

Figure 2 (cont'd)

TEST DESCRIPTION	REQUIREMENT	PROCEDURE
Mechanical strength	Part shall not be accessible with test probe. No visual cracks.	Acc. to IEC 61535 part 20 Fall test acc. to IEC 60068-2-32 Probes acc. to IEC 61032
Current cycling test	Voltage drop <22.5mV or 1.5 times the value after the 24 th cycle	Acc. to IEC 61535 part 21.5 384 cycled at rated current (30 min with current and 30 min without current) T ambient: 23°C
Glow wire test	850°C for contact carrying parts 650°C for covers Additional glow wire test: 750°C no flame	Acc to IEC 61535 part 24.1 Acc. to IEC 60695-2-11
PTI/CTI	No flashover or breakdown between electrodes (material plates)	Acc. to IEC 61535 part 24.2 Acc. to IEC 60112 test A, 400 V on material plates
Ball pressure test	The diameter of impression caused by the ball shall not exceed 2 mm (material plates)	Acc. to IEC 61535 part 21.3 Acc. to IEC 60998-1 Temperature 125°C for 1 hour
Heat resistance	The specimens shall not undergo any change in impairing their future use	Acc. to IEC 61535 Part 21.2 Samples for 1 hour in a heating cabinet at a temperature of 100°C ±2°C
Corrosion test	After 24 hours, sample surface shall show no signs of rust	Acc. to IEC 61535 part 25 All grease removed, parts are immersed for 10 min in a 10% solution of ammonium chloride, placed for 10 min in a box containing air saturated (20°C ±5°C), dried for 10 min in a heating cabinet at a temperature of 100°C ±5°C

Figure 2 (end)

3.6. Clearances and Creepage Distances - IEC Standard Based (Figure 3)

BETWEEN	CLEARANCE (mm)	CREEPAGE (mm) ⁽³⁾
Live parts of different polarity	3.0	4.0
Live parts and :		
-accessible external surface ⁽¹⁾	5.5	6.4
-inaccessible external surface or the like	3.0	3.2
Parts of the earthing circuit and:		
-live parts	3.0	3.2
-accessible screws or the like ⁽²⁾	3.0	3.2
-inaccessible external screws or the like	1.5	1.5

⁽¹⁾The accessible external surface includes a foil in contact with the external surfaces of insulation material

⁽²⁾Accessible external screws are those that can be touched with the probe B of IEC 61032

⁽³⁾Values for creepage distances are adapted to clearances because they cannot be smaller than corresponding clearances

Figure 3

3.7. Additional Test Requirements and Procedures Summary – TE Qualification (Figure 4)

TEST DESCRIPTION	REQUIREMENT	PROCEDURE
Low Level Contact Resistance (LLCR)	10 mOhm maximum initial 20 mOhm maximum final	EIA-364-23 Subject specimens to 100 mA maximum and 20 mV maximum open circuit voltage
Insulation resistance	1000 MOhm minimum initial 100 MOhm minimum final	EIA 364-21 500 V DC, 2 minute hold. Test between adjacent contacts of mated specimen
Withstanding voltage	1 min. hold with no breakdown or flashover	EIA-364-20, Condition I. 1800 V AC at sea level
Temperature rise vs. current	45°C max temperature rise at product rated current (10A, 16A, or 20A accordingly)	EIA-364-70, Method 1 Stabilize at a single current level until 3 readings at 5 min. intervals are within 1°C.
Sinusoidal vibration	No discontinuities of 1 microsecond or longer duration Shall meet "VISUAL INSPECTION" requirements	EIA-364-28, Condition I Subject mated specimens to 10Hz to 55Hz traversed in 1 minute with 1.5 mm maximum total excursion. Two hours in each of 2 out of 3 mutually perpendicular planes
Mechanical shock	No discontinuities of 1 μ s or longer duration	EIA-364-27, Condition A Subject mated specimens to 50 G's half-sine shock pulses of 11 ms duration. 3 shocks in each direction applied along 3 mutually perpendicular planes, 18 total shocks
Crimp tensile strength	200 N max for 1.5 mm ² wire size 400 N max for 2.5 mm ² wire size	EIA-364-8B Measure force necessary to remove wire from specimens at a max rate of 25.0 mm/min
Connector mating force	40 N max	EIA-364-8B Measure force necessary to mate a 5-positions and a 7-positions connector assembly at a max rate of 12.7 mm/min
Durability	Shall meet visual requirements, shown no physical damage and meet requirements of additional tests as specified in the Product Qualification and Re-qualification Test Sequence shown in Figure 5	EIA-364-9 Mate and un-mate specimens for 10 cycles at a maximum rate of 500 cycles per hour
Thermal shock	Shall meet visual requirements, shown no physical damage and meet requirements of additional tests as specified in the Product Qualification and Re-qualification Test Sequence shown in Figure 5	EIA-364-32, Test Condition I. Subject unmated specimens to 25 cycles between -40°C and +105°C with 30 min. dwells at temperature extremes and 1 min transition between temperatures

Figure 4 (cont'd)

TEST DESCRIPTION	REQUIREMENT	PROCEDURE
Humidity/temperature cycling	Shall meet "VISUAL INSPECTION" requirements	EIA-364-31, Method IV Subject mated specimens to 10 cycles (10 days) between 25°C and 65°C at 80% to 100% RH
Temperature life	Shall meet visual requirements, shown no physical damage and meet requirements of additional tests as specified in the Product Qualification and Re-qualification Test Sequence shown in Figure 5	EIA-364-17, Method A, Test Condition 4, Test Time Condition B. Subject mated specimens to 120° for 250 hours

Figure 4 (end)

3.8. Qualification and Re-qualification Test Sequence (Figure 5)

TEST	TEST GROUP												
	A	B	C	D	E	F	G	H	I	J	K	L	M□
	TEST SEQUENCE												
Visual and dimensional examination	1, 9	1, 3	1, 3	1, 5	1, 3	1, 4	1, 3	1, 3	1, 7	1, 9	1, 12	1, 10	1, 11
Durability of marking	2												
Polarization	3												
Protection against electrical shock	4												
Terminals and terminations	5												
Construction	6												
Cables and their connection	7												
Clearances and creepage distances	8												
Contacts mechanical strength		2											
Protection against harmful ingress of solid foreign objects			2										
Insulation resistance and dielectric strength				2									
Construction of contacts				3									
Temperature rise				4									
Breaking capacity					2								
Force for disconnection						2							
Ageing of thermoplastic material						3							
Mechanical strength							2						
Current cycling test								2					
Glow wire test									2				
PTI / CTI									3				
Ball pressure test									4				
Heat resistance									5				
Corrosion test									6				
Low level contact resistance										3, 7	2, 5, 7, 10	2, 7	2, 5, 7, 9
Insulation resistance												3, 8	
Withstanding voltage												4, 9	
Temperature rise vs. current											3, 8, 11		3, 8, 10
Sinusoidal vibration										5	9		9
Mechanical shock										6			
Crimp tensile strength										8			
Durability										4			
Connector mating force										2			
Thermal shock												5	
Humidity/temperature cycling											4	6	4
Temperature life											6		6

□For all data on AWG contacts groups A-L, refer to 501-TBD, for group M, refer to 501-TDB.

Figure 5

4. SAMPLE COMPOSITION AND PREPARATION (Figure 6)

Connectors are designed to meet the electrical, mechanical and environmental performance requirements according to specified test conditions.

The samples shall be prepared in accordance with product drawings, they shall be selected at random from current production.

TEST GROUP	QUANTITY (Mated Assemblies)
A	3 Pieces (For each kind of wire termination)
B	3 Pieces (For each kind of wire termination)
C	3 Pieces (For each kind of wire termination)
D	3 Pieces (For each kind of wire termination)
E	3 Pieces (For each kind of wire termination)
F	3 Pieces (For each kind of wire termination)
G	3 Pieces (For each kind of wire termination)
H	3 Pieces (For each kind of wire termination)
I	3 Pieces of metal plates where required (PTI/CIT, ball pressure test)
J	3 Pieces (For each kind of wire termination)
K	3 Pieces (For each kind of wire termination)
L	3 Pieces (For each kind of wire termination)
M	3 Pieces (For each kind of wire termination)

Figure 6

4.1. Re-Qualification Testing

If changes significantly affect fit, form or function are made to the product or the manufacturing process, of which negative influence of the product quality cannot be excluded, product assurance shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by development/product, quality and reliability engineering.

4.2. Quality Conformance Inspection

The applicable TE Connectivity quality inspection plan will specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification.

5. ADDITIONAL INFORMATION ON TEST REQUIREMENTS

5.1. Protection Against Harmful Ingress of Solid Foreign Objects (Figure 7)

Engaged installation couplers shall comply with the requirements of IP 20. For usage in readily accessible areas, they shall comply with IP 40 (IP 40 verification with test probe 1.0 mm diameter).



Figure 7

5.2. Force for Disconnection

The fully engaged installation coupler shall be subjected to an axial force of 80 N for 1 min. during which the locking device shall be fully engaged. See Figure 8.



Figure 8

The locking device must be removable only with the aid of a tool (e.g. screwdriver), not easily by hand.

5.3. Cable Pull Test (Figure 9)

The cable shall not be damaged during the test. It shall not have been longitudinally displaced by more than 2 mm.

NOTE: Installation Socket Connector Shown for Reference Only



Figure 9

5.4. Torsion Test (Figure 10)

Apply a torque of 0.25 Nm for 1 min.; the distance between the cable clamp and the end of the installation coupler shall be equal to the cable diameter. Cable distortion less than 45°.

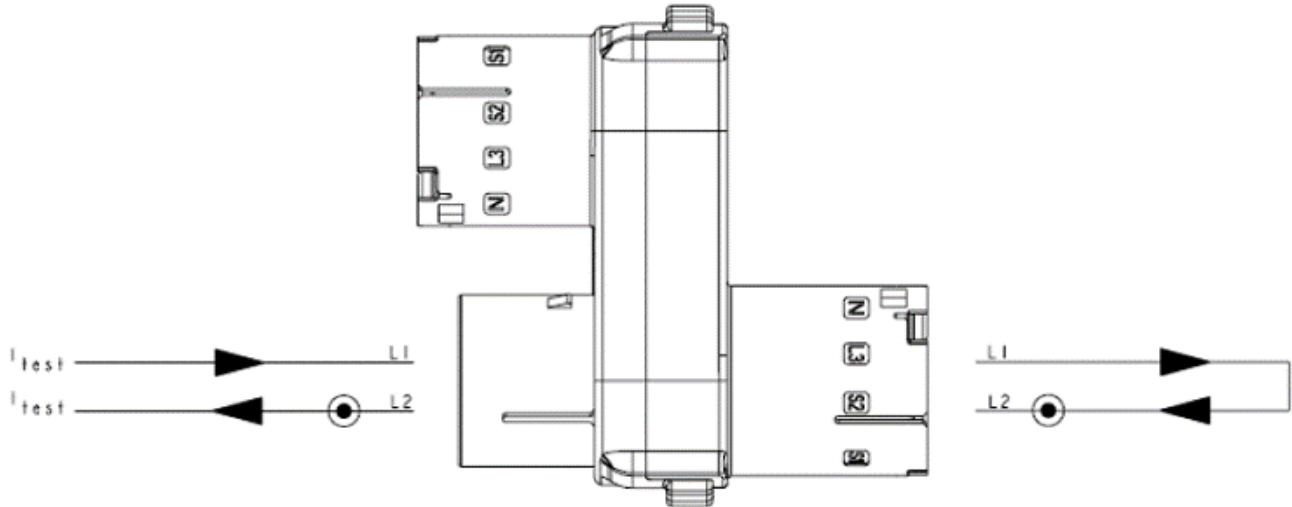


Figure 10

5.5. Temperature Rise (Figure 11)

- T-splitter 5+1 poles connector (multi-phase) – Test circuit schemes:

Direct Circuit – Test 1: L1+L2



Direct Circuit – Test 2: N+PE

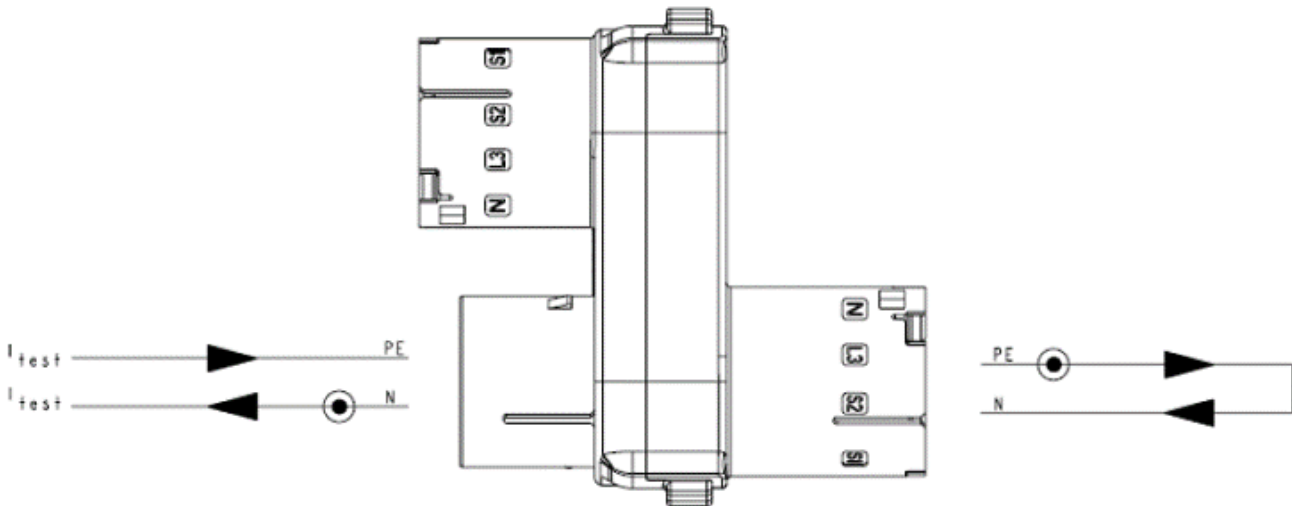
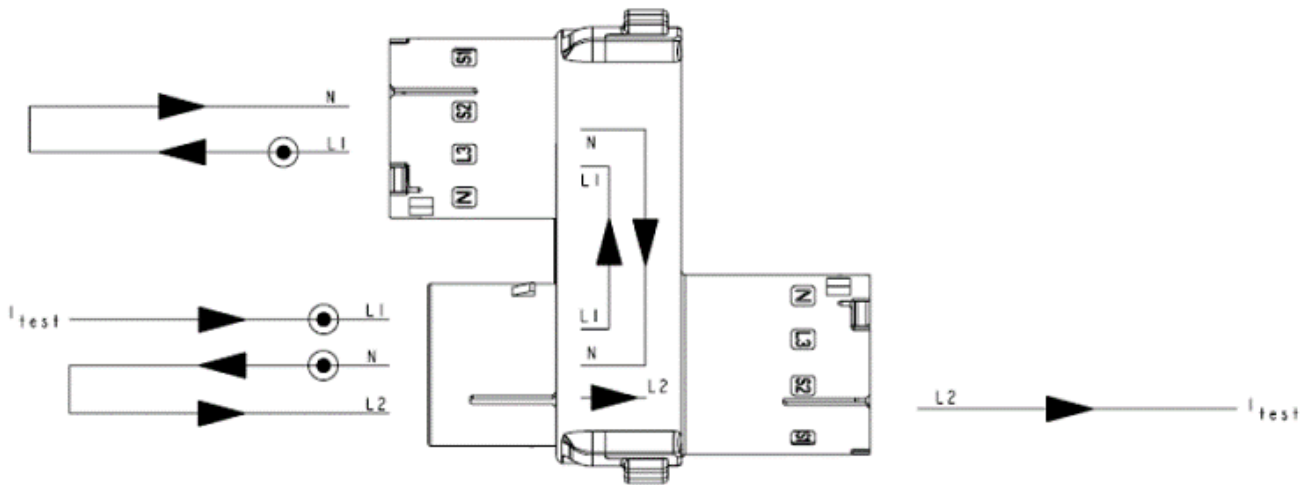


Figure 11 (cont'd)

Branch Circuit – Test 1: L1+N (+L2)



Branch Circuit – Test 2: L1+PE (+L2)

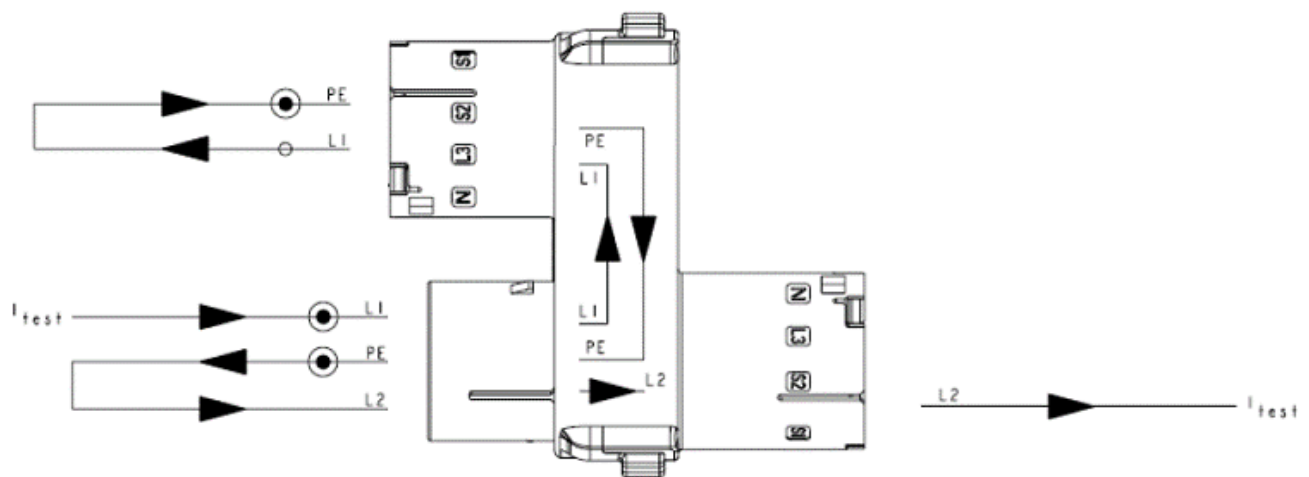
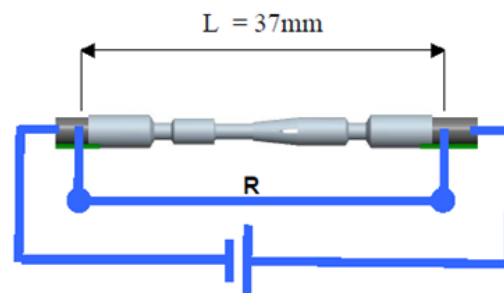


Figure 11 (end)

5.6. Contact Resistance (Wire-to-Wire) (Figure 12)



$R = 1.0 \text{ mOhm Max (Test Current } I - 1\text{A)}$

Figure 12

5.7. Glow Wire (Figure 13)

Thermal stabilization of specimens: 24 hours at 21-25°C and 30%-95% Rh. The extremity of the wire is positioned horizontally and brought into contact with the sample with a force of between 0.8N and 1.2N for a period of 30 ± 1 second:

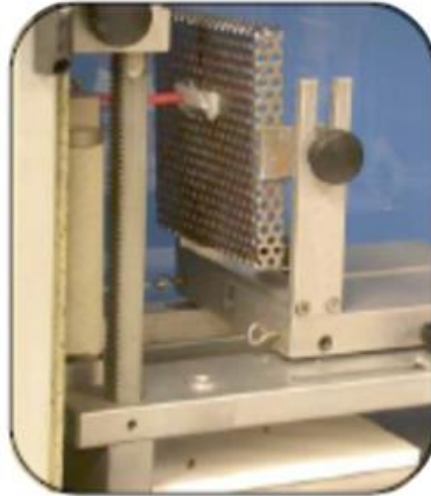


Figure 13

- For parts made of insulating material not intended to retain current-carrying parts: 650°C

$$T_i + T_e \leq T_a + 30sec$$

A flame must appear for 1-2 seconds when glow wire touches the specimen

- For parts made of insulating material intended to retain current-carrying parts: 850°C

$$T_i + T_e \leq T_a + 30sec$$

A flame must appear for 1-2 seconds when glow wire touches the specimen

- For parts made of insulating material intended to retain current-carrying parts: 750°C. No flame must develop

T_a : time of application of glow wire (30 seconds)

T_i : duration from the beginning of the tip application to the time at which the specimen of the layer below it ignites

T_e : duration from the beginning of ignition of the sample to the point at which the flames extinguish, either during or after the period of application