

**Solder Sleeve Devices Specification  
For Commercial Wire Splices**Table of Contents

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## **1.0 General Requirements**

1.1 Design of the Electrical Connections - Reminder Concerning the Approval Procedure.  
The Specification RB 109 is a general specification regarding electrical stub splices requirements. Products corresponding to the present specification may undergo additional tests in compliance with the customer's standards or specifications prior to receiving the customer's approval.

### 1.2 Supplier's Responsibility

The specific requirements of a customer may apply to all or part of the present specification after approval by both Tyco Electronics and the customer(s).

## **2.0 Definition of the Test Specimens**

### 2.1 Introduction

Because of the large number of possible configurations for each splice, two types of test specimens shall be prepared (a minimum and a maximum) which shall represent the minimum and maximum cross-sectional areas applicable for each splice. These test specimens shall consist of a SOLDER-SLEEVE DEVICE and usually two 200mm maximum length standard conductors with identical cross-sectional areas. However, a third wire can be added if necessary in order to approach as closely as possible the desired cross-sectional area. The qualification shall be obtained using: either the customer's wire or a common wire clearly designated

### 2.2 Definition of the Conductor Cross-Sectional Area

For each test specimen, a standard conductor shall be used for which the doubling of the cross-sectional area is as close as possible to the cross-sectional area specified in a detail specification; a third and smaller wire may be added if necessary to reach the desired cross-sectional area. However, in order to have test specimens which represent the authentic conditions, the cross-sectional area of the conductor should not be greater than  $3\text{mm}^2$ .

### 2.3 Big Cross-Sectioned Test Specimens (sections greater than $6\text{mm}^2$ ).

If the cross-sectional area of the so-defined test specimen is greater than  $3\text{mm}^2$ , a standard conductor for which the cross-sectional multiple is as close as possible to the specified cross-sectional area shall be used. In each specific case, every measurement shall be taken on two marked conductors.

**3.0 Environmental Conditions for the Connections on Vehicles**

They are submitted to variable parameters of temperature, vibration, humidity or exposure to various types of fluids depending on the position of the connections in the vehicles.

**3.1 Temperature Classification**

Four classes of environmental temperature have been determined for the connections in consideration of the raw materials involved.

Class	Environmental temperature (TS)	Test temperature (TE)
1	-40°C to +85°C	-40°C to +100°C
2	-40°C to +100°C	-40°C to +125°C
3	-40°C to +125°C	-40°C to +150°C
4	-40°C to +150°C	-40°C to +175°C

**3.2 Vibration Classification**

Two classes of vibration have been determined:

- Class 1 (body): from 10 to 55 Hz, constant amplitude  $\pm 0.75\text{mm}$  from 55 to 500 Hz, with a constant acceleration of 10g.
- Class 2 (engine): from 10 to 55 Hz, constant amplitude  $\pm 1.5\text{mm}$  from 55 to 500 Hz, with a constant acceleration of 20g.

**3.3 Sealing Classification**

Three classes of sealing have been determined:

- Class 0: unsealed
- Class 1: sealed when sprinkled
- Class 2: sealed when immersed
- See paragraph 8 for further details.

**4.0 Normal Atmospheric Test Conditions**

- The normal atmospheric conditions are defined in the French standard register number NF C 20-600.
- The standard range of atmospheric conditions applicable to the tests and measurements of the present specification is the following:

Temperature (°C)	Relative humidity (%)	Atmospheric Pressure Pa (m bar)
$23 \pm 5$	$45 < \text{HR} < 75$	$860 < \text{Pa} < 1060$

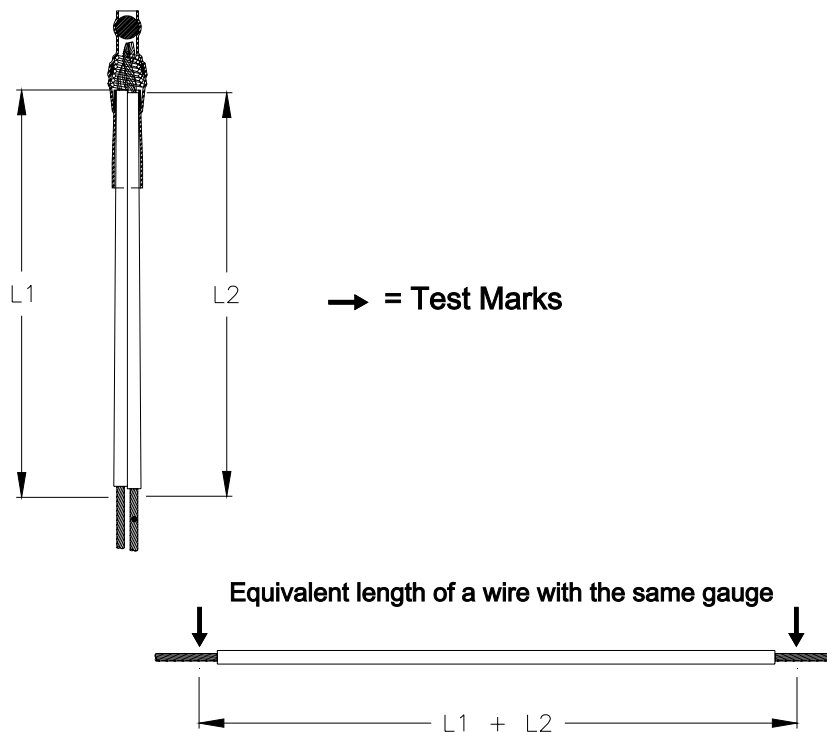
- Should it be impossible to carry out the tests in the above conditions, the atmospheric conditions that are actually used must be indicated in the test report.

The relative humidity and the pressure may be omitted in the test report if they do not influence the results. The temperature and humidity must remain constant during the entire series of test.

## 5.0 Electrical Tests

### 5.1 Contact Resistances

The test is done with the electrical circuit described in this section. The resistance of the wire employed is deducted from the value measured. Method for measuring length and comparative equivalent lengths.



$R_e$  = the resistance of the specimen  $\implies U_e$  = the voltage drop of the specimen  
 $R_f$  = the resistance of an equivalent length of wire  $\implies U_f$  = the voltage drop of an equivalent wire  
 $R_c$  = the contact resistance  $\implies U_c$  = the drop due to the connection  
 $R_c U_c = R_e - R_f \implies U_e - U_f$

#### 5.1.1 Test method according to millivolt level

The voltage employed must be in compliance with the following characteristics:

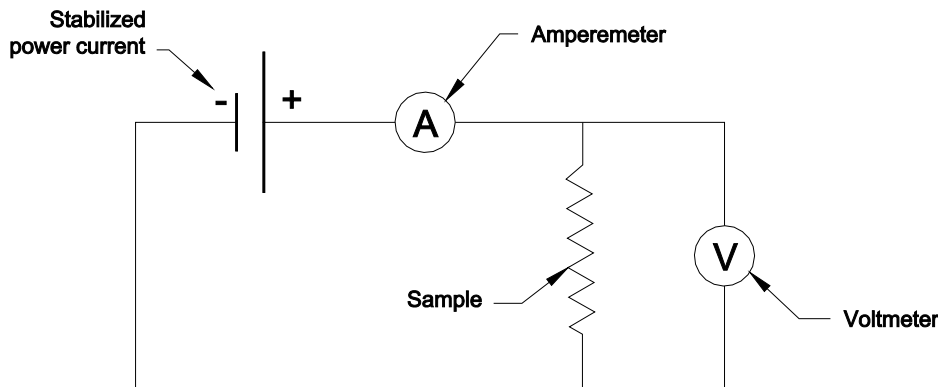
- open circuit voltage < 20 mV D.C.
- short circuit intensity set at 100 mA.

The contact resistance value ( $R_c$ ) is the difference between the specimen resistance ( $R_e$ ) and the resistance of an equivalent length of wire ( $R_f$ ).

*Requirement:* Two measurements per specimen shall be registered by inverting the direction of the current. The average value of these two measurements of contact resistance shall not be greater than 4 mOhms.

5.1.2 Test method using specified test current

The electromotive force of the current is less than 15 V DC. Unless specified otherwise in a customer specification, the short circuit intensity shall be set at  $7 \text{ A/mm}^2$  per wire cross-section used (the actual cross-section calculated according to the measure of each strand  $\pm 0.01 \text{ mm}$ ).



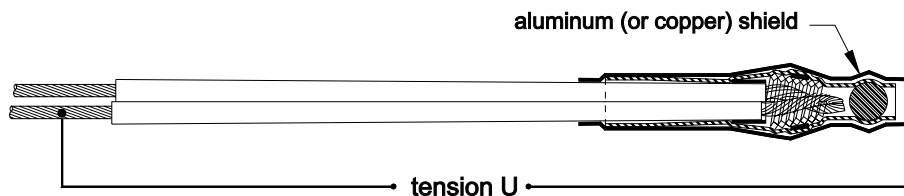
The measurements shall be made after thermal stabilization.

*Requirement:* The voltage drop value ( $U_c$ ) - in mV - is the difference between the voltage drop of the specimen ( $U_e$ ) and the voltage drop of the equivalent length of wire ( $U_f$ ). The calculated value:  $RC = U_c \div I$ , shall not be greater than 4 mOhms.

5.2 Insulation Resistance

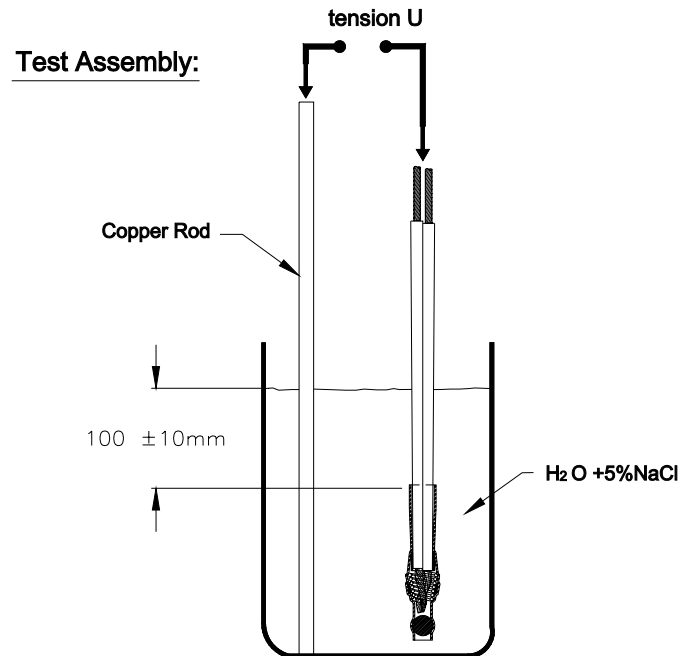
5.2.1 Unsealed connections

**Test Assembly:**



A sheet of aluminum, which is connected to one of the ends of the measuring apparatus, is rolled around the connection in order to form a common framework. One of the wires is connected to the other end of the apparatus.

### 5.2.2 Sealed connections



### 5.2.3 Measurement conditions

The measurement shall be done at  $100 \pm 15$  V DC.

- Unsealed connection: test assembly in compliance with paragraph 5.2.1. The insulation resistance value can be recorded once a steady reading is obtainable. If a steady reading is not obtainable, the insulation resistance shall be recorded at the 60th s  $\pm 5$  s after the current is applied.
- Sealed connections: test assembly in compliance with paragraph 5.2.2. The resistance value shall be recorded after immersion in the specified aqueous solution for 1 minute.

*Requirement:* insulation resistance should be  $\geq$ : than  $10^2 \Omega$ .

### 5.3 Dielectric Withstanding Voltage

- The test assemblies for the sealed sleeves and the unsealed sleeves shall be the same as those in paragraph 5.2.1.
- A test voltage of 2000 V R.M.S. at 50 Hz is applied for 60s  $\pm 5$ s between one of the connection wires and the framework.
- There should not be any signs of flash-over, crackling, blow-out, beginning of arcing, or leakage current more than 1 mA.

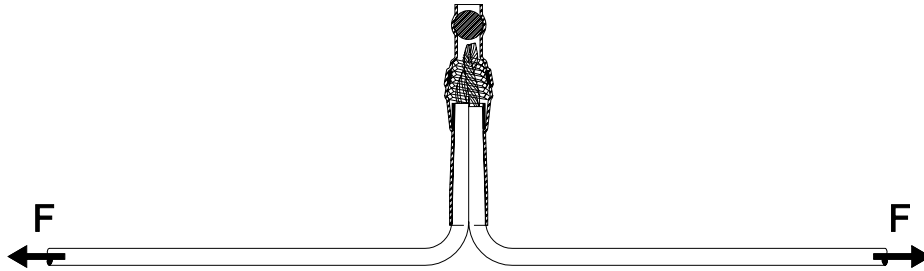
**6.0 Mechanical Tests****6.1 Tensile Strength**

The tensile test consists of pulling the two free ends of the assembled wires or two of the wires among the bundle installed if the specimen contains more than 2 wires.

The test shall be done with the heat-shrinkable sleeve installed.

The moveable clamp of the traction machine must move at a constant speed of 50mm/minute.

Assembly: force perpendicular to sample axis (or peeling)



The maximum force measured must be within the limits indicated in the table below:

wire section in mm <sup>2</sup>	mini rupture in Newton
0.35	60
0.6	100
1	140
1.4	180
2	220
3	280

**6.2 Abrasive Wear**

The abrasive wear resistance of the insulation shall be in compliance with Standard BS G 195.

**7.0 Aging and Endurance Tests****7.1 Vibrations on the Connection.**

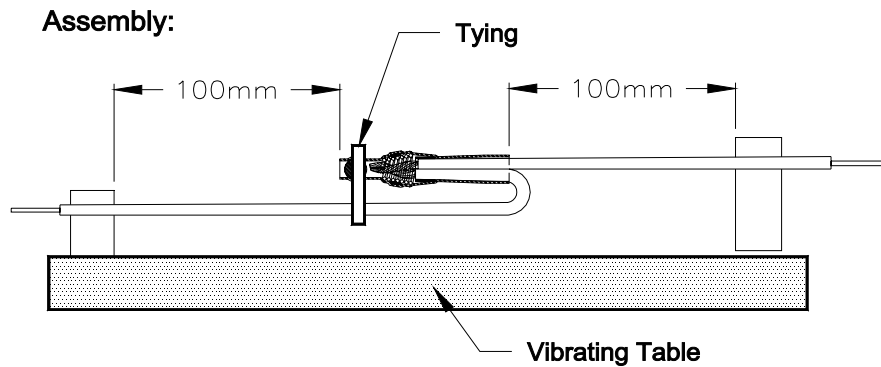
The vibration class, selected among those defined in paragraph 3.2. Is indicated in the SCD.

A voltage drop test is conducted through the splice (s) in order to detect any eventual micro cut-offs.

The connection is attached to the plate of the vibrating system for a total duration of 6 hours, divided into periods of 2 hrs. For each of the 3 axes (2 of which are horizontal, cf. figure below). The wires shall be slightly tight in order to eliminate any slackness.



A test configuration of both the minimal and maximal cross-sections compatible with the splice shall be tested.



The variation in frequency is done by logarithmic scanning of one octave per minute. No micro cut-off longer than 1  $\mu$ s must appear during the test.

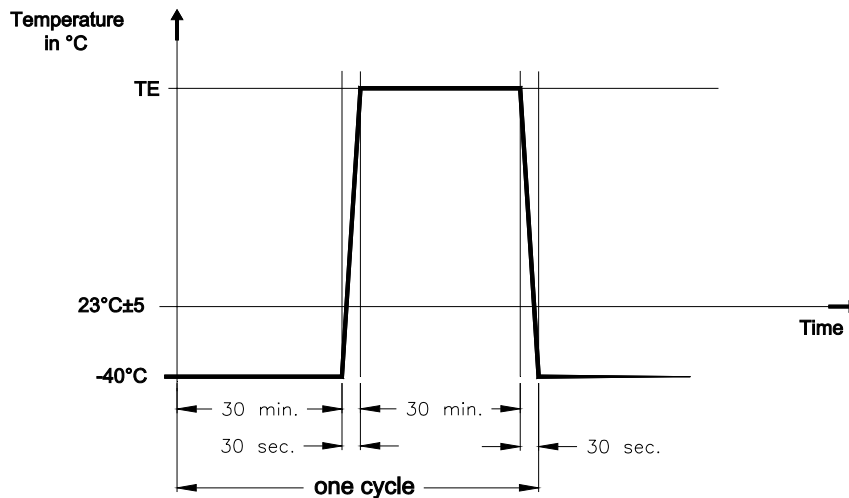
7.2

Thermal Shocks:

Test temperature (TE) is selected among those defined in paragraph 3.1., according to the temperature class application.

The splice undergoes 5 cycles as defined hereafter (also see following figure):

- a) Maintain the temperature in the test chamber at  $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$  for 30 minutes.
- b) Raise the temperature in the test chamber to  $\text{TE}^{\circ}\text{C} \pm 2^{\circ}\text{C}$  in a maximum of 30s.
- c) Maintain the temperature in the test chamber at  $\text{TE}^{\circ}\text{C} \pm 2^{\circ}\text{C}$  for 30 minutes
- d) Return the temperature in the test chamber back to  $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$  in a maximum of 30s.



**Requirement:** The difference between the contact resistance value after conditioning and the initial contact resistance shall be less than 4 mOhms. However, this contact resistance shall never be greater than 6 mOhms.

N.B.: The voltage drop measurements before and after the climate test shall be in compliance with the procedure defined in paragraph 5.1.1.

SPECIAL REMARK: The measurement points on the specimen must be protected against corrosion in order to have reliable results.

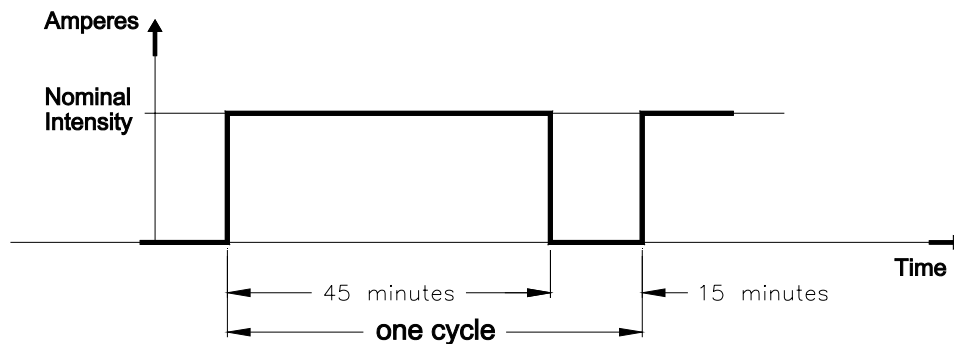
### 7.3 Periodic Current Intensive Test

The purpose of this test is to check the withstand strength of the splice when submitted to the current passage for which it is specified.

Definition of the nominal intensity of the splice:

-Splice nominal intensity is  $7 \text{ A/mm}^2$

-Since the cross-sectional area of the wires is sometimes slightly different from the theoretical cross-sectional area it is necessary to calculate the actual wire cross-sectional area according to the diameter of the individual strands.



Nominal intensity =  $7 \text{ A} \times$  the cross-sectional area of a strand multiplied by the number of strands measured  $\pm 0.01 \text{ mm}$ .

For the configurations of more than 2 wires only the 2 marked conductors shall be taken into consideration.

The length of the test shall be 500 of the above defined cycles.

*Requirement:* Cf. paragraph 7.2

### 7.4 Endurance (Temperature – Humidity)

The purpose of this test, divided into 2 parts, is to check the splice aptitude for voltage transmission in extreme environmental conditions.

The first part consists of a temperature test and the second a high relative-humidity test.

The procedure for the voltage periodic intensity test is identical to the one defined in paragraph 7.3; the test intensity is equal to 40% of the wire nominal intensity. The cross-sectional area of the conductor specimen (s) is defined in the S.C.D.

#### 7.4.1 Temperature endurance

- The connections are submitted to a 15 days voltage test (360 cycles) at the maximal environmental temperature.
- The temperature class selected among those indicated in paragraph 7.2 is found in the detail specification.

*Requirement:* Cf. paragraph 7.2

#### 7.4.2 Humidity endurance

The connections are submitted to 3 cycles defined as below:

- |         |   |
|---------|---|
| 1 cycle | <ul style="list-style-type: none"><li>(a) 24 hours voltage periodic intensity test (24 cycles) at <math>85^{\circ}\text{C} \pm 2^{\circ}\text{C}</math>, with 95 to 99% relative humidity.</li><li>(b) maintenance at <math>23^{\circ}\text{C} \pm 5^{\circ}\text{C}</math> for 24 hours without periodic intensity of current.</li></ul> |
|---------|---|

REMARKS: Only distilled water shall be used for this test.

*Requirement:* The difference between the contact resistance value after conditioning and the initial contact resistance shall be less than 6 mOhms. However, this contact resistance shall never be greater than 8 mOhms.

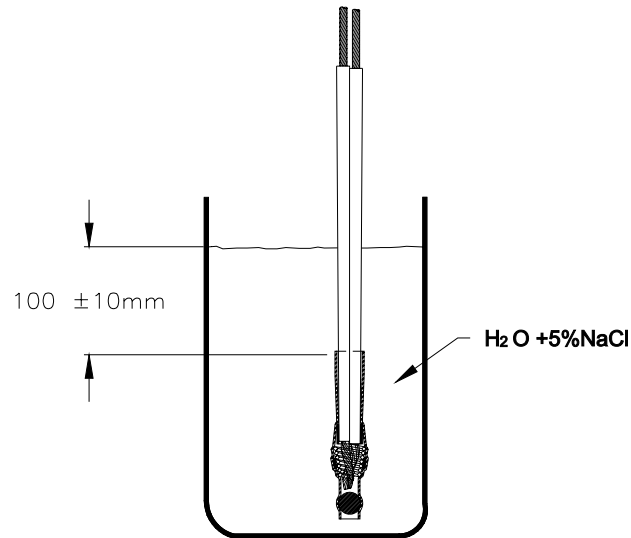
NB: The contact resistance measurements before and after the climate test shall be in compliance with the procedure defined in paragraph 5.1.1.

SPECIAL REMARK: The measurement points on the specimen must be protected against corrosion in order for the reading of the results to be reliable.

## 8.0 Sealing

### 8.1 Immersion (sealed splices Class 2 only).

- The assembled and cabled splices shall undergo 5 cycles of exposure.
- Each cycle consists of 30 minutes in dry air at temperature T, followed by 30 minutes of total immersion in a salt solution of 5% of the mass at  $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$  according to the following figure:



The transition time between the chamber and the bath does not exceed 30 seconds.

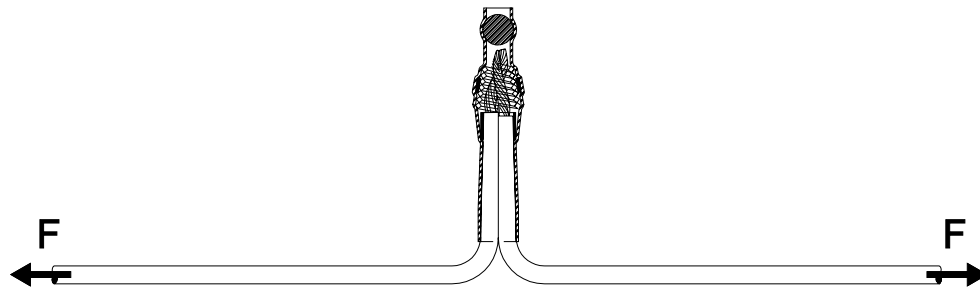
- The temperature class selected among those defined in paragraph 3.1 is indicated in the detail specification.
- At the end of the test the insulation resistance (cf. paragraph 5.2) shall be immediately measured on the specimens.

*Requirements:* identical to those defined in paragraphs 5.2.

NB: the sealing level required is equivalent to a withstanding of pressure and depression of 300 mbars.

## 8.2 Sealing after Bending. (Sealed splices Class 2)

- The test assembly shall be identical to the one defined in paragraph 6.1. The speed of the tensile machine shall be 50 mm/min.
- The tensile machine shall be stopped as soon as the limit of 50 N (Newton) or, for the smallest cross sectional area, 50% of the minimum stripping resistance specified in the § 6.1



*Requirement:* The specimen shall then undergo the test specified in paragraph 5.2.2.

REMARKS: In order to avoid exceeding the specified control point due to the rigidity of the specimen, a deadweight spring can be attached as a counterbalance to one of the machine clamps.

### 8.3 Sprinkling (class 1)

Six assembled and cabled splices shall be submitted to the sprinkling test to check the compliance with the degree IPX4 defined in the French standard register No. NFC 20-010.

The samples shall be submitted to the test of § 5.2.1 after conditioning.

## 9.0 Miscellaneous Tests

### 9.1 Resistance To Fluids

The connections shall be immersed for the specified period in the following fluids at the specified temperature:

- motor oil at 100°C (15 W 40 multigrade for gasoline and gas oil)	70 hrs
- manual transmission oil at 100°C (HP 90)	1 hr
- cooling fluid at 100°C (type C at 50% or BASF -G at 50%)	1 hr
- brake fluid at 70°C (type HD 55 or SHELL BS 38 or NEWLOOK 2001 BENDIX)	1 hr
- motor fuel N at 23°C (90% of fluid C (*) + 7% ethyl alcohol + 3% methyl alcohol)	24 hrs
- motor fuel O at 23°C (85% of fluid C (*) + 15% methyl alcohol)	24 hrs
- diesel fuel oil at 23°C (90% of ASTM No. 3 + 10% paraxylene)	24 hrs
- motor protection fluid at 23°C	1 hr

*Requirement:* After being wiped clean and 24 hrs at 23°C ± 5°C, the splices should show no sign of degradation, cracking, or sizeable swelling.

(\*) Fluid C: 50 % ISO OCTANE / 50 % Toluene

### 9.2 Vertical Combustion

Shall be in compliance with French standard NF C 32-070.

## 10.0 Visual Inspection

The specimen shall not show any significant defects, e.g.

- improper shrinkage
- overheated or underheated
- punctured or cracked
- solder flow hinders desired electrical performance, etc.
- missing or destroyed adhesive insert (in sealed product only).

**11.0 Test Sequence**GROUP 1

No.	Tests	Paragraph No.	Remarks
1	Visual inspection	10	minimum 4 splices per configuration
2	Contact resistance Rc (*1)	5.1.1.	
3	Contact resistance Rc (*2)	5.1.2.	
4	Voltage periodic intensity	7.3	
5	Contact resistance Rc (*1)	5.1.1.	Event. 5.1.2.
6	Visual inspection	10	

GROUP 2

No.	Tests	Paragraph No.	Remarks
1	Visual inspection	10	minimum 4 splices per configuration
2	Contact resistance Rc (*1)	5.1.1.	
3	Insulation resistance	5.2	
4	Vibration	7.1	
5	Visual inspection	10	
6	Thermal shocks	7.2	
7	Contact resistance Rc	5.1.1.	Event. 5.1.2.
8	Visual inspection	10	

(\*1) Method according to millivolt level

(\*2) Method using specified test current

GROUP 3

No.	Tests	Paragraph No.	Remarks
1	Visual inspection	10	minimum 4 splices per configuration
2	Contact resistance	5.1.1.	
3	Insulation resistance	5.2	
4	Withstand voltage	5.	
5	Temperature endurance	7.4.1.	
6	Contact resistance	5.1.1.	
7	Humidity endurance	7.4.2.	
8	Contact resistance	5.1.1.	5.1.2. if confirmation required
9	Insulation resistance	5.2	
10	Visual inspection	10	

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GROUP 4

No.	Tests	Paragraph. No.	Remarks
1	Visual inspection	10	minimum 4 splices per configuration
2	Insulation resistance	5.2	
3	Sealing in natural position	8.1	
4	Insulation resistance	5.2	
5	Visual inspection	10	
6	Sealing after bending	8.2	
7	Insulation resistance	5.2	

Tests Not Included In The Groups

Tests	Paragraph No.	Remarks
Tensile strength of the wire-to-wire connection	6.1	20 samples per cross-sectional area.
Resistance to fluids	9.1	1 connection per test fluid
Abrasive wear	6.2	According to BS G 195
Combustion	9.2	According to NF C 32-070