



Q16003

# QUALIFICATION ACCORDING TO APTA & AAR

## MU27P connector

PRJ-14-000003352

D	General update			19FEB2018	M.BONNIN
C	Add translation			06JUN2017	M.BONNIN
B	Add some modifications + add dummy receptacle			04MAR2017	M.BONNIN
A	CREATION			07MAR2016	M.BONNIN
LTR	Revision record			Date	Author
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## 1 INTRODUCTION

### 1.1 AIM OF THE TESTS

The aim of the type tests is to qualify the connector MU27P according to the standard APTA (PR-E-S-001-98, PR-E-RP-019-99, PR-E-RP-002-98) and AAR S512

This connector is designed to be used with a rated voltage of 600V according to the standard EN50124-1/A2 (mated connector), taking into account a pollution degree PD2 and overvoltage category of OV3.

### 1.2 APPLICABLE DOCUMENTS

➤ Standards:

- EN60068-1:1995 – Environmental tests - Part 1: Generality and guidance
- EN60068-2-2/A2:1995 - Environmental tests - Part 2: Tests - Tests B: Dry heat
- EN60068-2-11:1999 - Environmental tests - Part 2: Tests - Tests ka: Salt spray
- EN60068-2-14:2009 - Environmental tests - Part 4: Tests - Tests N: Temperature variation
- EN60068-2-78:2002 - Environmental tests - Part 2-78: Tests - Test Cab: Continuous damp heat
- EN60529/A1:2000 – Degree of protection provided by enclosures (IP code)
- EN61373:2000 - Railway applications – Rolling stock – Chocks and vibrations tests
- ISO1431-1:2012 – Rubber, vulcanized or thermoplastic materials – Resistance to ozone cracking – Part 1: Tests under static and dynamic stretching
- NFF61-030:1992 - Railway rolling stock – Electrical connectors - Generalities
- NFC93-400/A1:1988 – Electronic components – Connection devices – Test procedures and measuring methods – List of tests
- NFC93-422:1977 - Electronic components – Connection devices – Cylindrical multicontacts connectors – General requirements
- APTA PR-E-S-001-98 – Standard for insulation integrity
- APTA PR-E-RP-002-98 – Recommended Practice for Wiring of Passenger Equipment
- APTA RP-E-017-99 - Recommended Practice for 27-Point Jumper and Receptacle Hardware for Locomotives and Locomotive-Hauled Equipment
- APTA PR-E-RP-019-99 – Recommended Practice for 27-Point Jumper and Receptacle Hardware for Locomotives and Locomotive-Hauled Equipment
- AAR-S-512 – Locomotives and locomotive interchange equipment

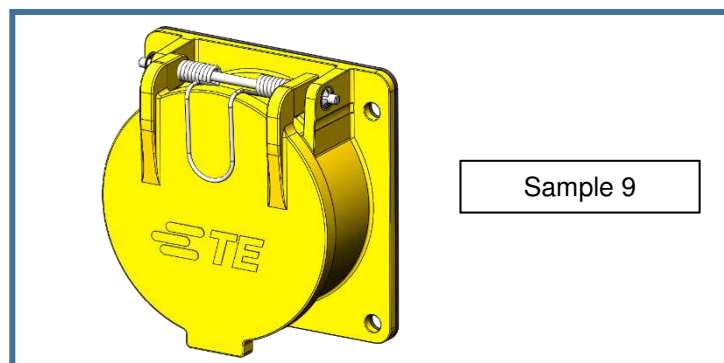
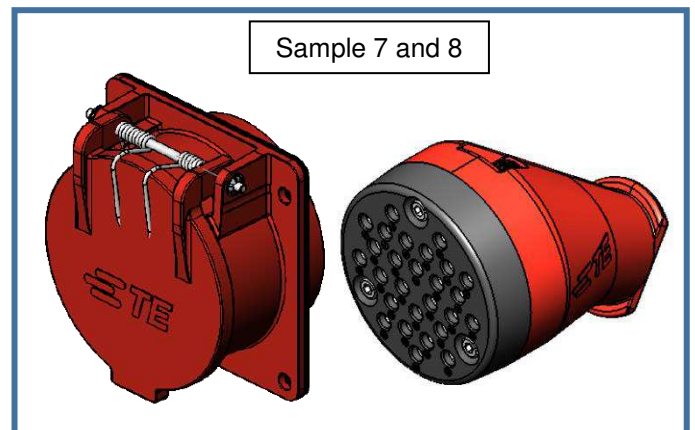
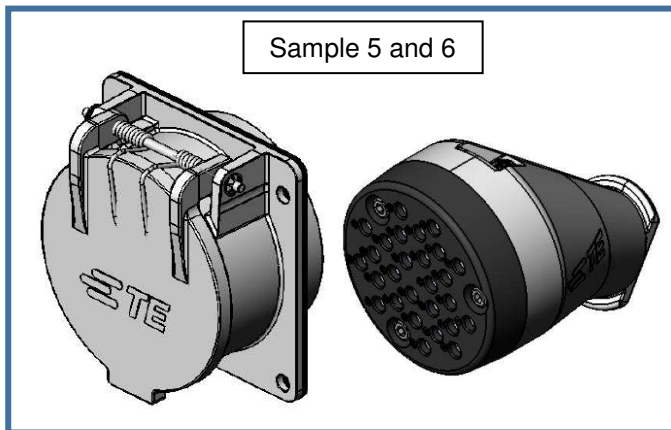
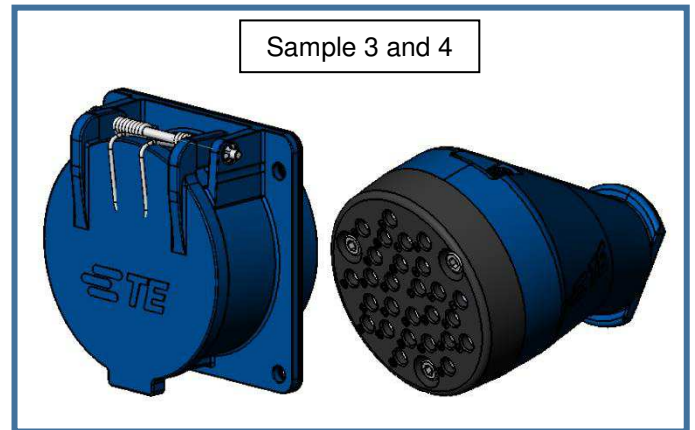
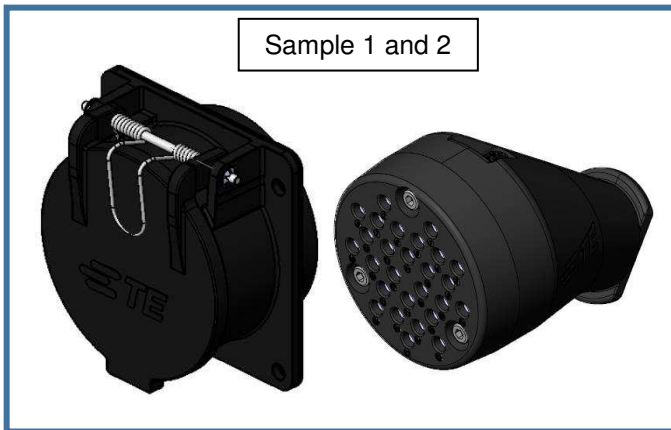
➤ Assembly drawings (see appendices):

- 211942\_DEUTSCH: MU CONTROL RECEPTACLE
- 211943\_DEUTSCH: COMMUNICATION RECEPTACLE
- 211944\_DEUTSCH: DUMMY RECEPTACLE
- 212085\_DEUTSCH: TYPICAL AEM-7 RECEPTACLE
- 212086\_DEUTSCH: COMMUNICATION COMMUTER RECEPTACLE
- 212075\_DEUTSCH: MU CONTROL PLUG
- 212093\_DEUTSCH: COMMUNICATION PLUG
- 212094\_DEUTSCH: TYPICAL AEM-7 PLUG
- 212095\_DEUTSCH: COMMUNICATION COMMUTER PLUG



1.3 SAMPLING

Sample No.	Sample BOM	Quantity per sample	Description	Cables
1 and 2	YE-UC-211942A-0000 YE-UC-212075A-0000	1	MU CONTROL RECEPTACLE MU CONTROL PLUG	See §1.5
3 and 4	YE-UC-211943A-0000 YE-UC-212093A-0000	1	COMMUNICATION RECEPTACLE COMMUNICATION PLUG	
5 and 6	YE-UC-212085A-0000 YE-UC-212094A-0000	1	TYPICAL AEM-7 RECEPTACLE TYPICAL AEM-7 PLUG	
7 and 8	YE-UC-212086A-0000 YE-UC-212095A-0000	1	COMMUNICATION COMMUTER RECEPTACLE COMMUNICATION COMMUTER PLUG	
9	YE-UC-211944C-0000	1	DUMMY RECEPTACLE	N/A





## 1.4 TEST SEQUENCE

Test sequence is the one described by the NFF61030, added to specific tests from the APTA and AAR standards.

The connectors are successively submitted to the tests corresponding to the groups defined here-after:

Group	Test description	Required by standard	Sample number
0	Visual examinations (appearance & marking)	APTA PR-E-RP-019-99	Each sample
	Geometrical checking	APTA PR-E-RP-019-99 AAR S-512	Sample 1 and 9
	Mass checking	NF F 61-030	Each sample
	Withstand voltage	APTA PR-E-S-001-98	Each sample
	Insulation resistance	APTA PR-E-S-001-98	except sample 9
	Contact resistance	NF F 61-030	Sample 2 and 7
	Connector insertion force	APTA PR-E-RP-019-99	Sample 1,3,5 and 7
	Contact insertion force	APTA PR-E-RP-019-99	Sample 1
1	Continuous test in damp heat	APTA PR-E-RP-019-99	1
	Vibration test	NF F 61-030	2
	Resistance to fluids	APTA PR-E-RP-019-99 NF F 61-030	2, 4, 6 et 8
2	Rapid variations of temperature	APTA PR-E-RP-002-98	3
	Mechanical endurance	APTA PR-E-RP-002-98	3
	Jumper head retention	APTA PR-E-RP-019-99	3
3	Temperature rise	APTA PR-E-RP-019-99	7
	Corrosion	NF F 61-030	5
	Shocks	NF F 61-030	5
4	Dry heat	NF F 61-030	7
	Mechanical resistance to impact (drop test)	NF F 61-030	7
5	Traction test (crimped connection)	NF F 61-030	10 pairs of contacts

Note:

- A full version of this table included severity and checking tests to be performed is in appendix



## 1.5 SAMPLES IMPLEMENTATION

Each sample for testing is a pair of connectors composed of:

- 1 male receptacle equipped of 27 male contacts caliber 8 with 3 contacts in AWG 10 and 24 contacts in AWG12-14
- 1 female plug equipped of 27 female contacts caliber 8 with 3 contacts in AWG 10 and 24 contacts in AWG12-14

The retention between the plug and the receptacle made by a form in the cover and in the plug.



The contacts and cables used for this qualification are the following:

Receptacle:

CONTACTS					RECEPTACLE	
Caliber (mm)	Type	Cable used	Reference	Index	No. of contacts	Contact localization in insulator
8	Male contact 10AWG	10 AWG	YS-UC-211946A-AA1A	C	3	Randomly
8	Male contact 12-14 AWG	12 AWG	YS-UC-211945A-AA1A	C	12	Randomly
8	Male contact 12-14 AWG	14 AWG	YS-UC-211945A-AA1A	C	12	Randomly

Cable section	Cable designation	Selector position of the crimping tool
10 AWG	UL1015-10-105 RD	DANIELS CRIMPING HAND CRIMPER HX4 WITH Y543 DIES or DANIELS PNEUMATIC CRIMPER HX23 WITH Y543 DIES
12 AWG	UL1015-12-65 GN	
14 AWG	UL1015-14-41 BU	



Plug:

CONTACTS					RECEPTACLE	
Caliber (mm)	Type	Cable used	Reference	Index	No. of contacts	Contact localization in insulator
8	Female contact 10AWG	10 AWG	YS-UC-212073A-AA1A	C	3	Identical to receptacle
8	Female contact 12-14 AWG	12 AWG	YS-UC-212072A-AA1A	C	12	Identical to receptacle
8	Female contact 12-14 AWG	14 AWG	YS-UC-212072A-AA1A	C	12	Identical to receptacle

Cable section (mm <sup>2</sup> )	Cable designation	Selector position of the crimping tool
10 AWG	LXE-10-600V	DANIELS CRIMPING HAND CRIMPER HX4 WITH Y543 DIES or DANIELS PNEUMATIC CRIMPER HX23 WITH Y543 DIES
12 AWG	M16878/2-BLE-0	
14 AWG	M16878/2-BKE-09	





## 1.6 TESTS DEVICES

Description	TE No.
Coating measurement Instrument	6428
Smartscope MVP 300	6616
Radius gauge (indicator)	/
Digital CX1/DX1	5420
Digital caliper MITUTOYO	6131
Digital caliper MITUTOYO	2401
Scale KERN CXP	5435
Dielectric strength tester SEFELEC PR 12 PF	1589
Insulation tester MEGGER BM25	2231
Ohmmeter MEGGER DLRO600	6701
Traction / compression machine ADAMEL LHOMARGY DY36	1118
Climatic chamber CLIMATS 320H60-1-5	1574
Climatic chamber FRANCE ETUVES XU250	6019
Climatic chamber CERADEL SNOL 970/350	7292
Climatic chamber CLIMATS EX5424	6185
Data acquisition unit AGILENT 34970A	1868
Current power supply ZENONE model GI2000GL	7054
AC current probe CHAUVIN ARNOUX MA100	7570
Salt spray chamber DYCOMETAL type SSC-400	7574
Micro-cuts detection device	7344-0001-03-002
Driver station	7161-0001-05-002
Sensor signal conditioner model 488C series	7161-0001-26-001
Accelerometer	7161-0001-28-001
Shower + Flowmeter PIUISI instrument (indicator)	/



## 2 GROUP 0 TESTS

### 2.1 VISUAL EXAMINATIONS

#### Sampling

- All the samples of the qualification

#### Samples implementation

- Connectors equipped with contacts.

#### Test devices

- None

#### 2.1.1 Identification by mechanical interlocking (according to APTA PR-E-RP-019-99, §4.1)

Receptacle housings and mating jumper cable plugs for different services (MU, car communication, etc) should be mechanically interlocked to prevent a jumper being inserted into a different service receptacle. This should be achieved by a combination of two techniques:

##### 2.1.1.1 Keyways (according to APTA PR-E-RP-019-99, §4.1.1)

A master key on the metal jumper head and corresponding keyway in the metal receptacle housing to provide plug orientation in the receptacle.

#### Methodology

- Contacts are mounted in each receptacle and each plug but not cabling
- The 3 screws of the insulators are tightened at 10 Nm

#### Reference documents

- Assembly drawings (set in appendix)
  - 211942\_DEUTSCH : MU CONTROL RECEPTACLE
  - 211943\_DEUTSCH : COMMUNICATION RECEPTACLE
  - 211944\_DEUTSCH : DUMMY RECEPTACLE
  - 212085\_DEUTSCH : TYPICAL AEM-7 RECEPTACLE
  - 212086\_DEUTSCH : COMMUNICATION COMMUTER RECEPTACLE
  - 212075\_DEUTSCH : MU CONTROL PLUG
  - 212093\_DEUTSCH : COMMUNICATION PLUG
  - 212094\_DEUTSCH : TYPICAL AEM-7 PLUG
  - 212095\_DEUTSCH : COMMUNICATION COMMUTER PLUG

#### Requirements

Requirements	
Visual inspection of the bodies	All samples must be able to mate



**2.1.1.2 Rotate contact block (according to APTA PR-E-RP-019-99, §4.1.2)**

Rotating the contact block into one of three positions, relative to the housing, to provide unique keying of the mating. (The contact block itself is the same for all applications.)

**Methodology**

- Connector unmated and dummy receptacle not used
- Visual checking of the position of the insulators into receptacles and plug

**Reference documents**

- Assembly drawings (set in appendix)
  - 211942\_DEUTSCH : MU CONTROL RECEPTACLE
  - 211943\_DEUTSCH : COMMUNICATION RECEPTACLE
  - 212085\_DEUTSCH : TYPICAL AEM-7 RECEPTACLE
  - 212086\_DEUTSCH : COMMUNICATION COMMUTER RECEPTACLE

**Requirements**

Requirements		
Sample number	Position	
<b>Visual inspection of the insulator position</b>	1 and 2	0°
	3 and 4	42°
	5 and 6	77,5°
	7 and 8	0°

**2.1.2 Identification by color coded (according to APTA PR-E-RP-019-99, §4.2)**

Receptacles and plugs should be color-coded according to the Figure 3 in the APTA PR-E-RP-019-99

**Methodology**

- Connector unmated

**Reference documents**

- Assembly drawings (set in appendix)
  - 211942\_DEUTSCH : MU CONTROL RECEPTACLE
  - 211943\_DEUTSCH : COMMUNICATION RECEPTACLE
  - 211944\_DEUTSCH : DUMMY RECEPTACLE
  - 212085\_DEUTSCH : TYPICAL AEM-7 RECEPTACLE
  - 212086\_DEUTSCH : COMMUNICATION COMMUTER RECEPTACLE
  - 212075\_DEUTSCH : MU CONTROL PLUG
  - 212093\_DEUTSCH : COMMUNICATION PLUG
  - 212094\_DEUTSCH : TYPICAL AEM-7 PLUG
  - 212095\_DEUTSCH : COMMUNICATION COMMUTER PLUG



**Requirements**

		Requirements	
		Sample number	Color
Visual inspection of the bodies		1 and 2	Black
		3 and 4	Blue
		5 and 6	White
		7 and 8	Red
		9	Yellow

**2.1.3 Housing, cover and head of plug (according to APTA PR-E-RP-019-99, §5.2.1 and §6.2)**

**Housing and cover:**

The receptacle housing and its cover should be of an aluminum alloy or an equivalent corrosion resistant material. The cover should open a minimum of 90 degrees to allow easy insertion of the jumper plug.

**Plug:**

The heads should be of an aluminum alloy or approved equal corrosion resistant material.

**Methodology**

- Connector unmated

**Reference documents**

- Assembly drawings (set in appendix)
  - 211942\_DEUTSCH : MU CONTROL RECEPTACLE
  - 211943\_DEUTSCH : COMMUNICATION RECEPTACLE
  - 211944\_DEUTSCH : DUMMY RECEPTACLE
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**Requirements**

		Requirements
Visual inspection of the housing and cover		Material sheet of receptacle and dummy receptacle body in Aluminum
		Material sheet of cover body in Aluminum
		Material sheet of plug body in Aluminum
		Minimum opening = 90°



**2.1.4 Cover spring and hinge (according to APTA PR-E-RP-019-99, §5.2.2)**

The cover spring and hinge pin should be stainless steel or an equivalent corrosion resistant material.

**Methodology**

- Connector unmated

**Reference documents**

- Assembly drawings (set in appendix)
  - 211942\_DEUTSCH : MU CONTROL RECEPTACLE
  - 211943\_DEUTSCH : COMMUNICATION RECEPTACLE
  - 211944\_DEUTSCH : DUMMY RECEPTACLE
  - 212085\_DEUTSCH : TYPICAL AEM-7 RECEPTACLE
  - 212086\_DEUTSCH : COMMUNICATION COMMUTER RECEPTACLE

**Requirements**

	Requirements
<b>Visual inspection of the cover spring and hinge pin</b>	Material sheet of the cover spring in Stainless steel
	Material sheet of the hinge pin in Stainless steel

**2.1.5 Cover gasket (according to APTA PR-E-RP-019-99, §5.2.3)**

A durable, long-life gasket, secured with compatible adhesive, should be provided on the inside face of the cover to provide a weatherproof seal when the cover is closed.

**Methodology**

- Connector unmated

**Reference documents**

- Assembly drawings (set in appendix)
  - 211942\_DEUTSCH : MU CONTROL RECEPTACLE
  - 211943\_DEUTSCH : COMMUNICATION RECEPTACLE
  - 211944\_DEUTSCH : DUMMY RECEPTACLE
  - 212085\_DEUTSCH : TYPICAL AEM-7 RECEPTACLE
  - 212086\_DEUTSCH : COMMUNICATION COMMUTER RECEPTACLE

**Requirements**

	Requirements
<b>Visual inspection of the cover gasket</b>	Each cover gasket in each sample is correctly fixed



**2.1.6 Flange seal (according to APTA PR-E-RP-019-99, §5.2.4)**

According to the APTA, a durable, long-life seal, secured with compatible adhesive, should be provided on the mounting flange to provide a waterproof seal between the receptacle and the surface to which it is mounted. To give more flexibility to the customer, the seal is attached on the receptacle with plastic fasteners.

**Methodology**

- Connector unmated

**Reference documents**

- Assembly drawings (set in appendix)
  - 211942\_DEUTSCH : MU CONTROL RECEPTACLE
  - 211943\_DEUTSCH : COMMUNICATION RECEPTACLE
  - 211944\_DEUTSCH : DUMMY RECEPTACLE
  - 212085\_DEUTSCH : TYPICAL AEM-7 RECEPTACLE
  - 212086\_DEUTSCH : COMMUNICATION COMMUTER RECEPTACLE

**Requirements**

Requirements	
Visual inspection of the flange seal	Each flange seal is correctly fixed with plastic fasteners on the receptacle

**2.1.7 Replacement considerations (according to APTA PR-E-RP-019-99, §5.2.5)**

A slot should be provided in the housing to make it possible to pass the rear insulator disk of the contact block, in a fully wired condition, through the housing without disconnecting any wiring. This is to allow a damaged housing to be replaced on a vehicle without having to disconnect any wiring.

**Methodology**

- Connector unmated and dummy receptacle not used

**Reference documents**

- Assembly drawings (set in appendix)
  - 211942\_DEUTSCH : MU CONTROL RECEPTACLE
  - 211943\_DEUTSCH : COMMUNICATION RECEPTACLE
  - 212085\_DEUTSCH : TYPICAL AEM-7 RECEPTACLE
  - 212086\_DEUTSCH : COMMUNICATION COMMUTER RECEPTACLE

**Requirements**

Requirements	
Visual inspection of the insulator disk	Housings of all receptacle assemblies shall have a clearance slot to pass the disk through the back



## 2.1.8 Contact block (according to APTA PR-E-RP-019-99, §5.3 and §6.3)

The contact block consists of a pair of insulator disks carrying the 27 contact pins, located in accordance with APTA PR-E-RP-019-99 (Figure 1). Each pin is crimped onto its respective wire and protected with a one piece molded grommet. This should provide:

- A resilient mount for the contact,
- Electrical insulation at the crimp,
- Mechanical support of the wire as it emerges from the contact.

### Housing:

Each contact cavity should be numbered per Figure 1 with raised characters a minimum of 3/32" (2.4 mm) high on the exposed face of the front and the wire side of the back-insulation disk. The contact block assembly should be secured to the housing with screws and suitable locking hardware of stainless steel or approve equal corrosion-resistant material.

### Plug:

The terminated contacts should be secured resiliently in the contact block to permit slight radial movement to allow for minor misalignment between plug and receptacle contacts. The front insulation disk should be molded from a durable, long-life, molded electrical grade elastomer suitable for the specified environment. It should have a high durometer rating which will prevent the contacts from being pulled out of the assembly when plugs are withdrawn from the receptacle under adverse conditions. The rear insulation disk should be molded from a shock resistant electrical grade plastic material and should have a low moisture absorption property. The contact block is keyed to the head so it can only be installed in the correct orientation. The same contact block is used regardless of the head keying. Each contact cavity should be numbered per Figure 4 with raised characters a minimum of 3/32" (2.4 mm) high on the exposed face of the front and the wire side of the back-insulation disk. The joints between the contact block and the head and contacts to contact block should be waterproof. The contact block assembly should be secured to the head with corrosion-resistant screws and suitable locking hardware.

### Methodology

- Connector unmated and dummy receptacle not used

### Reference documents

- Assembly drawings (set in appendix)
  - 211942\_DEUTSCH : MU CONTROL RECEPTACLE
  - 211943\_DEUTSCH : COMMUNICATION RECEPTACLE
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  - 212095\_DEUTSCH : COMMUNICATION COMMUTER PLUG



**Requirements**

		Requirements
Visual inspection of the contact block	Housing	Contact block provide in a pair of insulator disks carrying the 27 contacts pins
		Cavity numbered with raised characters a minimum of 2,4 mm
		Grommet is make in one-piece and is molded
		Contact block assembly with screws in stainless steel
	Plug	Front insulation disk is molded in elastomer with high hardness
		Cavity numbered with raised characters a minimum of 2,4 mm
		The rear insulation disk is molded in plastic
		Grommet is make in one-piece and is molded
		The contact block is keyed to the head so it can only be installed in the correct orientation
		Contact block assembly with screws in stainless steel

**2.1.9 Contact (according to APTA PR-E-RP-019-99, §5.4 and §6.4)**

Contacts should be fabricated from materials that meet or exceed the performance of copper alloy and should be silver-plated. The crimp barrel end of the contact should accept either # 10, 12 or 14 AWG wire.

**Methodology**

- Connector unmated and dummy receptacle not used

**Reference documents**

- Assembly drawings (set in appendix)
  - 211942\_DEUTSCH : MU CONTROL RECEPTACLE
  - 211943\_DEUTSCH : COMMUNICATION RECEPTACLE
  - 212085\_DEUTSCH : TYPICAL AEM-7 RECEPTACLE
  - 212086\_DEUTSCH : COMMUNICATION COMMUTER RECEPTACLE
  - 212075\_DEUTSCH : MU CONTROL PLUG
  - 212093\_DEUTSCH : COMMUNICATION PLUG
  - 212094\_DEUTSCH : TYPICAL AEM-7 PLUG
  - 212095\_DEUTSCH : COMMUNICATION COMMUTER PLUG

**Requirements**

	Requirements
Visual inspection of the contact	Contacts accept either #10, 12 or 14 AWG wire
	Contacts material are made in copper alloy
	Contacts are silver-plated





**2.1.10 Marking checking (according to NFF61-030, §11.1)**

**Methodology**

- Appearance and labelling checking: visual checking
- Durability of the marking: to check by trying to rub out the inscription. Ten displacements, five in each direction, shall be carried out while applying a force of  $5 \pm 0.5$  N, on a surface area of about 1 cm<sup>2</sup> and at the rate of two displacements per second. This shall be done with a device using cotton wool that has absorbed its own mass of demineralized water.

**Reference documents**

- Assembly drawings (set in appendix)
  - 211942\_DEUTSCH : MU CONTROL RECEPTACLE
  - 211943\_DEUTSCH : COMMUNICATION RECEPTACLE
  - 211944\_DEUTSCH : DUMMY RECEPTACLE
  - 212085\_DEUTSCH : TYPICAL AEM-7 RECEPTACLE
  - 212086\_DEUTSCH : COMMUNICATION COMMUTER RECEPTACLE
  - 212075\_DEUTSCH : MU CONTROL PLUG
  - 212093\_DEUTSCH : COMMUNICATION PLUG
  - 212094\_DEUTSCH : TYPICAL AEM-7 PLUG
  - 212095\_DEUTSCH : COMMUNICATION COMMUTER PLUG

**Requirements**

	Requirements
<b>1. Appearance checking</b>	The parts shall not have any defect that would prevent them working properly
<b>2. Marking checking</b>	Name of the supplier
	Manufacture date
	Sample reference
	Contact locating numbers
<b>3. Durability of the marking</b>	The marking shall be legible at the end of the test



## 2.2 DIMENSIONS CHECKING (ACCORDING TO APTA PR-E-RP-019-99, §8.1, §8.2, §8.3, §8.4, §8.5 + AAR S-512, §6.0)

The test is achieved according to the test 1b from the standard NFC93-400 (IEC 60512-2) with the following procedure:

### Sampling

- Samples No.1 & No.9

### Samples implementation

- Connectors equipped with contacts, not cable

### Test devices

- Digital caliper MITUTOYO absolute digimatic No.2401
- Digital caliper MITUTOYO No.6131
- Smartscope MVP 300 No.6616
- Radius gauge (indicator)
- Digital CX1/DX1 No.5420

### Reference documents

- Assembly drawings (set in appendix)
  - 212502\_DEUTSCH : MIXED INSULATOR
  - 211942\_DEUTSCH : MU CONTROL RECEPTACLE
  - 212075\_DEUTSCH : MU CONTROL PLUG

### Requirements

		Drawing requirements (mm)			
		Item drawing	Dimension Inch mm	Item drawing	Dimension Inch mm
1. Checking general dimensions	212502 Insulator	1	1.631 41.43	15	1.507 38.28
		2	1.350 34.29	16	1.901 48.28
		3	1.006 25.55	17	0.344 8.74
		4	0.769 19.53	18	0.454 11.53
		5	0.667 16.94	19	0.801 20.35
		6	0.330 8.38	20	1.035 26.29
		7	0.959 24.36	21	1.145 29.08
		8	1.005 25.53	22	1.819 46.20
		9	1.084	23	0.501

Product specification



		10	27.53 1.630 41.40	24	12.73 0.405 10.29	
		11	0.127 3.23	25	0.755 19.18	
		12	0.252 6.40	26	0.284 7.21	
		13	0.848 21.54	27	45°	
		14	1.369 34.77	28	3/16 4.76	
	211942 Receptacle		1	5.79 147.06	9	6.88 174.75
			2	3.93 99.82	10	5.38 136.75
			3	2.41 61.21	11	2.94 74.67
			4	1.4 35.56	12	0.50 12.7
			5	0.12 3.04	13	0.50 12.7
			6	15/16MAX 13/16MIN 23.81 20.63	14	0.590 14.99
			7	6.88 174.75	15	7/16 11.11
			8	5.88 149.35		7/16 11.11
	212075 Plug		1	5 + 3/16 131.76	6	7/32 5.55
			2	5/32 3.97	7	0.907 23.04
			3	5/32 3.97	8	7/16 11.11
			4	2+5/35 54.77	9	3+3/16 80.96
			5	0.5 12.7		



### 2.3 MASS CHECKING (ACCORDING TO NFF61-030, §11.2)

Test realized according to the test 1b of the standard NFC93-400 (IEC 60512-2), with the following procedure:

#### Sampling

- All the samples of the qualification

#### Samples implementation

- Connectors equipped with contacts

#### Test devices

- Scale KERN CXP No.5435

#### Reference documents

- Assembly drawings (set in appendix)
  - 211942\_DEUTSCH : MU CONTROL RECEPTACLE
  - 211943\_DEUTSCH : COMMUNICATION RECEPTACLE
  - 211944\_DEUTSCH : DUMMY RECEPTACLE
  - 212085\_DEUTSCH : TYPICAL AEM-7 RECEPTACLE
  - 212086\_DEUTSCH : COMMUNICATION COMMUTER RECEPTACLE
  - 212075\_DEUTSCH : MU CONTROL PLUG
  - 212093\_DEUTSCH : COMMUNICATION PLUG
  - 212094\_DEUTSCH : TYPICAL AEM-7 PLUG
  - 212095\_DEUTSCH : COMMUNICATION COMMUTER PLUG

#### Requirements

SAMPLE 1 and 2	Requirements		
	Nominal	-5%	+5%
Plug	2032 g	1930 g	2134 g
Receptacle	2392 g	2272 g	2512 g

SAMPLE 5 and 6	Requirements		
	Nominal	-5%	+5%
Plug	2020 g	1919 g	2121 g
Receptacle	2392 g	2272 g	2512 g

SAMPLE 3 and 4	Requirements		
	Nominal	-5%	+5%
Plug	2025 g	1923 g	2126 g
Receptacle	2392 g	2272 g	2512 g

SAMPLE 7 and 8	Requirements		
	Nominal	-5%	+5%
Plug	2032 g	1930 g	2134 g
Receptacle	2392 g	2272 g	2512 g

SAMPLE 9	Requirements		
	Nominal	-5%	+5%
Receptacle	1417 g	1346 g	1487 g



## 2.4 WITHSTAND VOLTAGE (ACCORDING TO APTA PR-E-S-001-98, §4.6)

Test realized according to the 4a test, method A (type test), of the standard NFC93-400 (IEC 60512-2), with the following procedure:

### Sampling

- All the samples of the qualification except sample 9

### Samples implementation

- Connectors equipped with contacts and wired according to the §1.5 specifications

### Test devices

- Dielectric strength tester SEFELEC PR 12 PF No.1589

### Methodology

- Connectors unmated
- An alternative sinusoidal voltage of 50 Hz is applied:
  - ◆  $2,25 \times 600 + 2000 \text{ V} = 3350 \text{ V}$

Method A (type test):

- Voltage applied for  $60 \pm 5\text{s}$
- Measure on 50% of the contacts with a minimum of 2:
  - Between adjacent contacts which have the least distance between centers
  - Between contacts which have the least distance to the housing taken one after the other and the housing

Note:

- For the connectors without metallic housing, no voltage test can be realized between the contacts and the housing.

### Requirements

	Requirements
Withstand voltage <i>Connectors unmated</i>	No disruptive breakdown, nor arcing
	Leakage current $\leq 2 \text{ mA}$ (rms value)



## 2.5 INSULATION RESISTANCE (ACCORDING TO APTA PR-E-S-001-98, §4.5)

The test shall be carried out in accordance with test 3a, method A (test de type), of the standard NFC93-400 (IEC 60512-2) with the following features:

### Sampling

- All the samples of the qualification except sample No.9

### Samples implementation

- Connectors equipped with contacts and wired according to the §1.5 specifications

### Test devices

- Insulation tester *MEGGER BM25* No.2231

### Methodology

- Connectors unmated
- Application of a DC voltage of 1000V
- Measure of the insulation resistance when a stable reading is obtained or if the stable conditions are not obtained, after  $60 \pm 5$  s voltage is applied.

Method A:

- Measure on 50% of the contacts with a minimum of 2:
  - Between adjacent contacts which have the least distance between centers
  - Between contacts which have the least distance to the casing taken one after the other and the housing

Note:

- For the connectors without metallic housing, no voltage test can be realized between the contacts and the housing.

### Requirements

	Requirements
Insulating resistance <i>Connectors unmated</i>	$IR \geq 5 \text{ M}\Omega$

## 2.6 CONTACT RESISTANCE (ACCORDING TO NFF61-030, §11.3.3)

### Sampling

- Samples No.2 & No.7

### Samples implementation

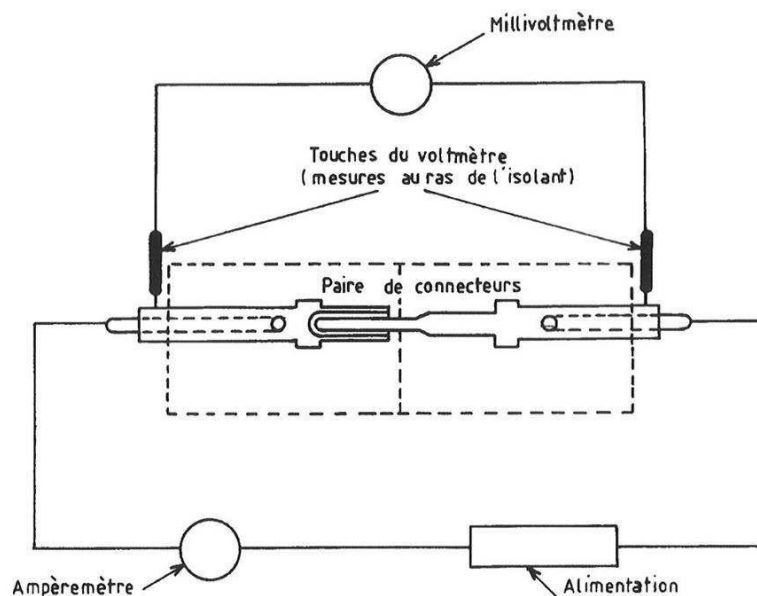
- Connectors equipped with contacts and wired according to the §1.5 specifications

### Test devices

- Ohmmeter MEGGER DLRO600 No.6701

### Methodology

- Connectors mated and locked
- Measurement with DC current
- Measurement points on the cables, each side of the contacts (voltage drop due to the crimping and to the cable resistance shall be deducted from the value measured)



- 10% of the total number of contacts with a minimum of five
- Measuring cycle: insertion of the contact, application of current, measurement, switching off of the current, removal of the contact
- 1 measure for each direction of current (without opening the contact)
- The contact resistance is the average of the measured values for each direction of current



Method A (low current for contact diameters  $\leq 1,6$  mm):

- Not applicable because contact diameters  $\geq 1,6$  mm

Method B (rated current):

- The test shall be carried out as specified in test 2b of the standard NFC93-400 (IEC 60512-2) and the values of §11.3.3.1 of the standard NFF61-030 with the following features:

Test voltage	$1 < U \text{ (V)} < 60$
Intensity of the rated current notified on the drawing	30 A

**Requirements**

	Contact nominal $\varnothing$	Requirements
Contact resistance	8 mm	$R_c \leq 0.35 \text{ m}\Omega$ (according to table 6 of the NFF61-030 standard)





## 2.7 CONNECTOR INSERTION FORCE (ACCORDING TO APTA PR-E-RP-019-99, §4.4)

The test shall be carried out in accordance with test 13a of standard NFC93-400 (IEC 60512-7) with the following features:

### Sampling

- Samples No.1, No.2, No.5 and No.7

### Samples implementation

- Connector equipped with contacts and wired according to the § 1.5 specifications

### Test devices

- Traction / compression machine ADAMEL LHOMARGY DY36 No.1118

### Methodology

Insertion force:

Test conducted according to the test 13b of NFC93-400 standard with the following conditions:

- Test at ambient temperature, without the addition of lubricant
- Insertion speed not higher than 5 mm/s
- Measuring the force needed to lock the connector

### Requirements

	Requirement According to APTA PR-E-RP-019-99, §4.4
Connector insertion force	195 N < Insertion force < 285 N



## 2.8 CONTACT INSERTION FORCE (ACCORDING TO APTA PR-E-RP-019-99, §4.3)

The test shall be carried out in accordance with test 13a of standard NFC93-400 (IEC 60512-7) with the following features:

### Sampling

- All contacts of sample No.1

### Samples implementation

- Contacts dismantled of the connector

### Test devices

- Traction / compression machine ADAMEL LHOMARGY DY36 No.1118

### Methodology

Insertion force:

Test conducted according to the test 13b of NFC93-400 standard with the following conditions:

- Test at ambient temperature, without the addition of lubricant
- Insertion speed not higher than 5 mm/s
- Measuring the force needed to lock the contact

### Requirements

	Requirements According to APTA PR-E-RP-019-99
Contact insertion force	2.2 N < Insertion force < 14.5 N



### 3 GROUP 1 TESTS

#### 3.1 CONTINUOUS DAMP HEAT (ACCORDING TO APTA PR-E-RP-019-99, §4.6)

The test shall be carried out as specified in test 11c of standard NFC93-400 (IEC 60512-6) with the following features:

##### Sampling

- Sample No.1

##### Samples implementation

- Connector equipped with contacts and wired according to §1.5 specifications
- The ends of the insulated conductors are sealed
- The connectors are mated and their principal axis shall be horizontal

##### Test devices

- Climatic chamber *CLIMATS 320H60-1-5* No.1574
- Insulation tester *MEGGER BM25* No.2231

##### Methodology

Test realized as specified in standard NFC93-400 (IEC 60068-2-3, HD 329-2-3S2) and according to the climatic category specified in clause 5.4.1:

- Preconditioning time is at least 1 hour
- Conditions in the climatic chamber: 40 ± 2 °C à 93 +2/-3 % of relative humidity
- Duration of the test: 21 days
- Before final measurements, the duration of the repeat shall be between 1 hour to 1h30 min (connector kept mated)

##### Requirements

	Requirements
1. Appearance checking	No defect that would prevent the connector working properly
2. Durability of the marking (according to §2.1.10)	Legible marking at the end of the test
3. Insulation resistance with 1000 V (according to §2.5, mated connector)	IR ≥ 5 MΩ



## 3.2 VIBRATIONS (ACCORDING TO NFF61-030, §11.5.2)

The test shall be done as specified in test 6d of standard NFC93-400 (IEC 60512-4) with the following features:

### **Sampling**

- Sample No.2

### **Samples implementation**

- Connector equipped with accessories and contacts, mated and wired according to §1.5 specifications
- The fixing on the vibration generator table shall be done by means of the normal fixing device of the connector
- The contacts are wired in serial with 30 cm cable length by contact

### **Test devices**

- Driver station No.7161-0001-05-002
- Sensor signal conditioner model 488C series No.7161-0001-26-001
- Accelerometer No.7161-0001-28-001
- Micro-cuts detection device No.7344-0001-03-002
- Traction / compression machine *ADAMEL LHOMARGY DY36* No.1118
- Shower + Flowmeter *PIUISI instrument (indicator)*

### **Methodology**

The test shall be carried out as specified in standard EN61373 (NFF60-002 cancelled):

- Category 1 (connectors mounted on the car)
- Class B
  - Random vibrations
  - Vertical: 7.9 m/s<sup>2</sup>; transverse: 3.5 m/s<sup>2</sup>; longitudinal: 5.5 m/s<sup>2</sup>
  - Frequency range: 5 up to 150 Hz
  - Endurance: 5 hours by axis in the 3 axis (15 hours)
- The four M8 screws of the receptacle are tightened at 20 N.m



Figures:



**Requirements**

Checks during the test:

	Requirements
Check the electrical continuity as specified in clause 9 of standard NFC93-050 (EN2591-201, method B)	No micro-cuts higher than 10 $\mu$ s

Checks at the end of the test:

	Requirements
1. Appearance checking	No defect that would prevent the connector working properly No splitting or fracture or play in the component parts No loosening of the locking system of the connector
2. Locking test (according to §2.7)	195 N < Insertion force < 285 N
3a. Watertightness test IPx4 according to the standard EN60529	No water trace on the actives parts
3b. Dust proof test IP5x according to the standard EN 60529	No dust trace on the actives parts

Note:

IP5x tests realized in an external laboratory approved and sanctioned by a certification report



### 3.3 RESISTANCE TO FLUIDS (ACCORDING TO APTA PR-E-RP-019-99, §4.6 + NFF61-030, §11.4.4)

The test shall be carried out as specified in standard NFC 93-422 with the following particular features:

#### 3.3.1 RESISTANCE TO GAS OIL

##### Sampling

- Sample No.2

##### Samples implementation

- Connectors equipped with contacts and wired according to the §1.5 specifications

##### Test devices

- Insulation tester *MEGGER MIT525* No.6898
- Dielectric strength tester *SEFELEC PR 12 PF* No.1589

##### Methodology

- Connectors not mated totally immersed for 5 minutes ± 30 seconds in some fuel for diesel powered vehicles (gas oil) (specified in document M15-007(IRM 903)), kept at the temperature of 50 ± 2°C. After, the connector is mated for at least 24 hours, at the ambient temperature of +15°C to +30°C with a relative humidity of between 30 and 70%
- The test consists of 3 cycles

##### Requirements

Without carrying out any cleaning or wiping:

	Requirements
<b>1. Appearance checking</b>	No cracking or dissolving of the insulation and the sealing system, no defect that would prevent the connector working properly
<b>2. durability of the marking</b> (according to §2.1.10)	The marking shall be legible at the end of the test

On the unmated assembly after 4 hours storing at a temperature of 70 ± 2 °C:

	Requirements
<b>Withstand voltage with 2350 V</b> (according to §2.4 and table 18 of the NFF61-030 standard, connectors unmated)	No disruptive breakdown, nor arcing Leakage current ≤ 2 mA (rms value)

	Requirement
<b>Insulating resistance with 1000 V</b> (according to §2.5 and table 18 of the NFF61-030 standard, connectors unmated)	IR ≥ 5 MΩ



**3.3.2 RESISTANCE TO MINERAL OIL**

**Sampling**

- Sample No.4

**Samples implementation**

- Connectors equipped with contacts and wired according to the §1.5 specifications

**Test devices**

- Insulation tester *MEGGER MIT525* No.6898
- Dielectric strength tester *SEFELEC PR 12 PF* No.1589

**Methodology**

- Connectors not mated, totally immersed for 5 minutes ± 30 seconds in mineral oil No.2 (IRM 902) kept at the temperature of 50 ± 2°C. After, the connector is mated for at least 24 hours, at the ambient temperature of +15°C to +30°C with a relative humidity of between 30 and 70%
- The test consists of 3 cycles

**Requirements**

Without carrying out any cleaning or wiping:

	Requirements
<b>1. Appearance checking</b>	No cracking or dissolving of the insulation and the sealing system, no defect that would prevent the connector working properly
<b>2. durability of the marking</b> (according to §2.1.10)	The marking shall be legible at the end of the test

On the unmated assembly after 4 hours storing at a temperature of 70 ± 2 °C:

	Requirements
<b>Withstand voltage with 2350 V</b> (according to §2.4 and table 18 of the NFF61-030 standard, connectors unmated)	No disruptive breakdown, nor arcing Leakage current ≤ 2 mA (rms value)

	Requirement
<b>Insulating resistance with 1000 V</b> (according to §2.5 and table 18 of the NFF61-030 standard, connectors unmated)	IR ≥ 5 MΩ



**3.3.3 RESISTANCE TO ACID AND BASE**

**Sampling**

- Sample No.6 for acid bath (normal solution of hydrochloric acid)
- Sample No.8 for base bath (normal solution of sodium hydroxide)

**Samples implementation**

- Connectors equipped with contacts and wired according to the §1.5 specifications

**Test devices**

- Insulation tester *MEGGER MIT525* No.6898
- Dielectric strength tester *SEFELEC PR 12 PF* No.1589

**Methodology**

- Connectors not mated totally immersed for 5 minutes ± 30 seconds in the acid and base baths, kept at the temperature of 23 ± 2°C. Two rinses are carried out. After, the connector is mated for 24 hours, at the ambient temperature of +15°C to +30°C with a relative humidity of between 30 and 70%
- The test consists of 3 cycles

**Requirements**

Without carrying out any cleaning or wiping:

	Requirements
<b>1. Appearance checking</b>	No cracking or dissolving of the insulation and the sealing system, no defect that would prevent the connector working properly
<b>2. durability of the marking</b> (according to §2.1.10)	The marking shall be legible at the end of the test

On the unmated assembly after 4 hours storing at a temperature of 70 ± 2 °C:

	Requirements
<b>Withstand voltage with 2350 V</b> (according to §2.4 and table 18 of the NFF61-030 standard, connectors unmated)	No disruptive breakdown, nor arcing Leakage current ≤ 2 mA (rms value)

	Requirement
<b>Insulating resistance with 1000 V</b> (according to §2.5 and table 18 of the NFF61-030 standard, connectors unmated)	IR ≥ 5 MΩ





## 4 GROUP 2 TESTS

### 4.1 RAPID TEMPERATURE VARIATION (ACCORDING TO APTA PR-E-RP-002-98, §4.6)

The test shall be done as specified in test 11d of the standard NFC93-400 (IEC 60512-6) with the following features:

#### Sampling

- Sample No.3

#### Samples implementation

- Connector equipped with accessories and contacts, wired according to §1.5 specifications
- Connector mated
- Preconditioning time at least 1 hour

#### Test devices

- Climatic chamber *CLIMATS EX5424* No.6185
- Climatic chamber *CERADEL SNOL 970-350* No.7292
- Insulation tester *MEGGER BM25* No.2231

#### Methodology

The test is carried out as specified in standard EN60068-2-14 test Na (instead of NFC20-714 which is removed):

- Low temperature  $T_A$ : -40 °C
- High temperature  $T_B$ : +100 °C
- Exposure time  $t_1$ : 30 minutes
- Transfer duration  $t_2$ : 2 to 3 minutes (< 30 s authorized if automatic transfer)
- 5 cycles
- Finales measurement after 1 hour to 1 h 30 min of storing (connector kept mated)

#### Requirements

	Requirements
<b>1. Appearance checking</b>	The parts shall not have any defect that would prevent them working properly
<b>2. Durability of the marking</b> (according to §2.1.10, connectors mated)	The marking shall be legible at the end of the test
<b>3. Insulating resistance with 1000 V</b> (according to §2.5, connectors mated)	$IR \geq 5 \text{ M}\Omega$



**4.2 MECHANICAL ENDURANCE (ACCORDING TO APTA PR-E-RP-002-98, §4.6)**

The test shall be done as specified in test 9a of the standard NFC93-400 (IEC 60512-5) with the following features:

**Sampling**

- Sample No.3

**Samples implementation**

- Connectors equipped with contacts and wired according to §1.5 specifications

**Test devices**

- Traction / compression machine *ADAMEL LHOMARGY DY36* No.1118
- Ohmmeter MEGGER DLRO600 No.6701

**Methodology**

- Mechanical endurance test without electrical load
- Connectors mated and unmated normally at a speed that does not exceed 5 cycles per minute
- Number of cycles: 500

**Requirements**

	Requirements
<b>1. Appearance checking</b>	No defect that would prevent the connector working properly No splitting or fracture or play in the component parts No loosening of the locking system of the connector
<b>2. Locking test</b> (according to § 2.7)	195 N < Insertion force < 285 N
<b>3. Contact resistance</b> (according to §2.6)	$R_c \leq 0.35 \text{ m}\Omega$ (according to table 6 of the NF F 61-030 standard)



### 4.3 JUMPER HEAD RETENTION (ACCORDING TO APTA PR-E-RP-019-99, §4.5)

#### **Sampling**

- Sample No.3

#### **Samples implementation**

- The plug is mated in the receptacle

#### **Test devices**

- Traction / compression machine *ADAMEL LHOMARGY DY36* No.1118

#### **Methodology**

- A force which increases (speed < 50 N/s) shall be applied to the plug
- Until the unmating

#### **Requirements**

	Requirements
Appearance checking after removing the force	No damage on receptacle and plug



## 5 GROUP 3 TESTS

### 5.1 TEMPERATURE RISE (ACCORDING TO APTA PR-E-RP-019-99, §4.3)

The test shall be done as specified in test 5a of the standard NFC93-400 (IEC 60512-3) with the following special features:

#### Sampling

- Sample No.7

#### Samples implementation

- Connectors equipped with contacts, mated and wired according to the §1.5 specifications
- The assembly is horizontal
- The measuring point are at the rear part of the stem

#### Test devices

- Current generator ZENONE GI2000GL model No.7054
- Datalogger AGILENT 34970A No.1868
- AC current probe CHAUVIN ARNOUX MA100 No.7570

#### Methodology

- Ambient temperature  $20 \pm 5$  °C
- Area protected of air flow

Method A, informative (contact):

- A single pair of contacts of the connector is wired with 3 sections (10,12 and 14 AWG)
- Application of an AC current of intensity 30 A (normative value)
- Measure of the contact temperature rise, after 15 minutes with a temperature variation  $\leq 1$  K

Method B (Mated connector):

- The contacts used for the tests method A are removed
- All the contacts are wired in serial with contacts in 10 AWG (biggest cross section)
- Application of an AC current of intensity 30 A (normative value)
- Measure of the contact temperature rise, after 15 minutes with a temperature variation  $\leq 1$  K

#### Requirements

		Requirements
Temperature rise	Method A	$\Delta T \leq 50$ K @ 30A
	Method B	$\Delta T \leq 50$ K @ 30A



## 5.2 CORROSION (SALT SPRAY) (ACCORDING TO NFF61-030, §11.4.3)

The test shall be done as specified in test 11f of the standard NFC93-400 (IEC 60512-6, PrEN60512-11-6) with the following special features:

### Sampling

- Sample No.5

### Samples implementation

- Connectors equipped with accessories and contacts, wired according to the §1.5 specifications
- Connectors unmated
- Preconditioning time at least 1 hour

### Test devices

- Salt spray chamber *Dycometal model SSC-400* No.7574
- Insulation tester *MEGGER BM25* No.2231

### Methodology

Test realized as specified in standard EN60068-2-11 (NFC20-711 removed):

- Salt solution with  $5 \pm 1\%$  in mass of sodium chloride with  $6.5 < \text{pH} < 7.2$
- Test chamber held at a temperature of  $35 \pm 2^\circ\text{C}$
- Duration of the test: 96 hours (normative value)
- Inquiry test: 120, 240 and 500 hours
- Period between test end and checking: 1 to 2 hours

### Requirements

	Requirements
<b>1. Appearance checking</b>	The parts shall not have any defect that would prevent them working properly
<b>2. Durability of the marking</b> (according to §2.1.10)	The marking shall be legible at the end of the test
<b>3. Insulating resistance with 1000 V</b> (according to §2.5, connectors unmated)	$IR \geq 5 \text{ M}\Omega$



### 5.3 SHOCKS (ACCORDING TO NFF61-030, §11.5.1)

The test shall be done as specified in test 6c of standard NFC93-400 (IEC 60512-4) with the following features:

#### **Sampling**

- Sample No.5

#### **Samples implementation**

- Connectors equipped with accessories and contacts, mated and wired according to §1.5 specifications
- The fixing on the vibration generator table shall be done by means of the normal fixing device of the connector
- The contacts are wired in serial wiring
- 30 cm cable length by contact (single core cables)

#### **Test devices**

- Driver station No.7161-0001-05-002
- Sensor signal conditioner model 488C series No.7161-0001-26-001
- Accelerometer No.7161-0001-28-001
- Micro-cuts detection device No.7344-0001-03-002
- Traction / compression machine ADAMEL LHOMARGY DY36 No.1118

#### **Methodology**

Severity level according to the standard EN 61373 (the standard NF F 20-727 is removed):

- Category 1 (mounted on the car)
- Class B
  - Vertical: 30 m/s<sup>2</sup>; transverse: 30 m/s<sup>2</sup>; longitudinal: 50 m/s<sup>2</sup>
  - Duration of every shock: 30 ms
  - Number of impacts: 3 positive shocks and 3 negative shocks in each of the 3 orthogonal plans

#### Figures



**Requirements**

Checks at the end of the test:

	Requirements
<b>1. Appearance checking</b>	No defect that would prevent the connector working properly No splitting or fracture or play in the component parts No loosening of the locking system of the connector
<b>2. Locking test (according to § 2.7)</b>	195 N < Insertion force < 285 N



## 6 GROUP 4 TESTS

### 6.1 DRY HEAT (ACCORDING TO NFF61-030, §11.6.2)

The test shall be done as specified in test 11i of standard NFC93-400 (IEC 60512-6, PrEN60512-11-3) with the following features:

#### Sampling

- Sample No.7

#### Samples implementation

- Connectors equipped with contacts, wired according to §1.5 specifications
- Connectors mated and placed in the chamber with its principal axis horizontally
- Preconditioning time at least 1 hour

#### Test devices

- Climatic chamber *FRANCE ETUVES XU250* No.6019
- Insulation tester *MEGGER BM25* No.2231
- Ohmmeter *MEGGER DLRO600* No.6701 (Measure of the voltage and the current so automatically calculate the resistance)

#### Methodology

Test carried out as specified in the standard EN60068-2-2 test Bb (NFC20-702 is removed):

- Test temperature:  $100 \pm 2$  °C
- Duration of the test: 96 hours

#### Requirements

During the test, after a period of 24 hours:

	Requirements
<b>Insulating resistance with 1000V</b> (according to §2.5, connectors mated)	$IR \geq 5 \text{ M}\Omega$

At the end of the test, after a period of at least 24 hours:

	Requirements
<b>1. Appearance checking</b>	The parts shall not have any defect that would prevent them working properly
<b>2. Contact resistance</b> (according to §2.6)	$R_c \leq 0.35 \text{ m}\Omega$ (according to §5.3.4 of the standard <i>NFF61-030</i> )
<b>3. Insulating resistance with 1000 V</b> (according to §2.5, connectors unmated)	$IR \geq 5 \text{ M}\Omega$





## 6.2 MECHANICAL RESISTANCE TO IMPACT (FREE FALL OF THE PLUG) (ACCORDING TO NFF61-030, §11.5.11)

The test shall be done as specified in test 7b of standard NFC93-400 (IEC 60512-5):

### Sampling

- Sample No.7

### Samples implementation

- The plug is equipped with its normal accessories, wired as for normal application

### Test devices

- Traction / compression machine *ADAMEL LHOMARGY DY36* No.1118

### Methodology

- The length of the cable: the back of the component is  $2250 \pm 10$  mm from the attachment point of the cable
- The sample can pivot freely from horizontal position to a vertical position
- The plug is placed in the horizontal position and loose on a steel plate 390 x 500 mm and 25 mm thick
- Height of fall: 1 m (according to the table 12 of the NFF61-030 standard)
- A mating test of the connector is realized after each fall
- This cycle is repeated 8 times
- After each test, the cable is rotated 90° around its axis and fixing point

### Requirements

	Requirements
1. Appearance checking	No defect of the parts that would harm their satisfactory operation
2. Locking test (according to § 2.7)	195 N < Insertion force < 285 N



## 7 GROUP 5 TESTS

### 7.1 PULLING RESISTANCE OF THE CRIMPING (ACCORDING TO NFF61-030, §11.5.7)

The test shall be carried out as specified in test 16d of NF C 93-400 (IEC 60512-8)

#### Sampling

- 10 pairs of contacts of each cable section cross-section:

CONTACT				CABLE CROSS-SECTION
Caliber (mm)	Type	Drum capacity	Reference	Diameter conductor
8	Male contact 10 AWG	10 AWG	YS-UC-211946A-AA1A	4,65 mm
8	Male contact AWG 12 and 14	12 AWG	YS-UC-211945A-AA1A	3,70 mm
8	Male contact AWG 12 and 14	14 AWG	YS-UC-211945A-AA1A	3,22 mm
8	Female contact 10 AWG	10 AWG	YS-UC-212073A-AA1A	4,57 mm
8	Female contact AWG 12 and 14	12 AWG	YS-UC-212072A-AA1A	4,01 mm
8	Female contact AWG 12 and 14	14 AWG	YS-UC-212072A-AA1A	3,71 mm

#### Samples implementation

- Each sample is formed of 2 male contacts or de 2 female contacts, crimped at each end of a conductor with the specified tools, according to the §1.5 description
- 5 pairs of male contacts are crimped with the minimal section of conductor that can be joined
- 5 pairs of female contacts are crimped with the maximal section of conductor that can be joined

#### Test devices

- Traction / compression machine *ADAMEL LHOMARGY DY36* No.1118

#### Methodology

- The ends of the test sample fixed between the jaws of the traction machine
- The jaws of the traction machine move at a constant speed of between 25 mm/min et 50 mm/min
- Application of a tensile force on the axis of the crimped connection until the conductor is torn out at one end or the other or until the conductor break

#### Requirements

	Requirements
Resistance to tension of the crimping According to APTA PR-E-RP-019-99, §5.4	F ≥ 180 N



## 8 CHECKING REPORT

At the end of the type tests, a detail report is written of all the tests realized and of the result.

## 9 SERIAL TESTS

The serial tests are to realize according to the requirements of the NFF61-030 standard.

## 10 APPENDICES

- Appendix 1: Synthesis of the type test and requirement tests
- Appendix 2: Assembly drawings of the test samples
- Appendix 3: Insulation coordination



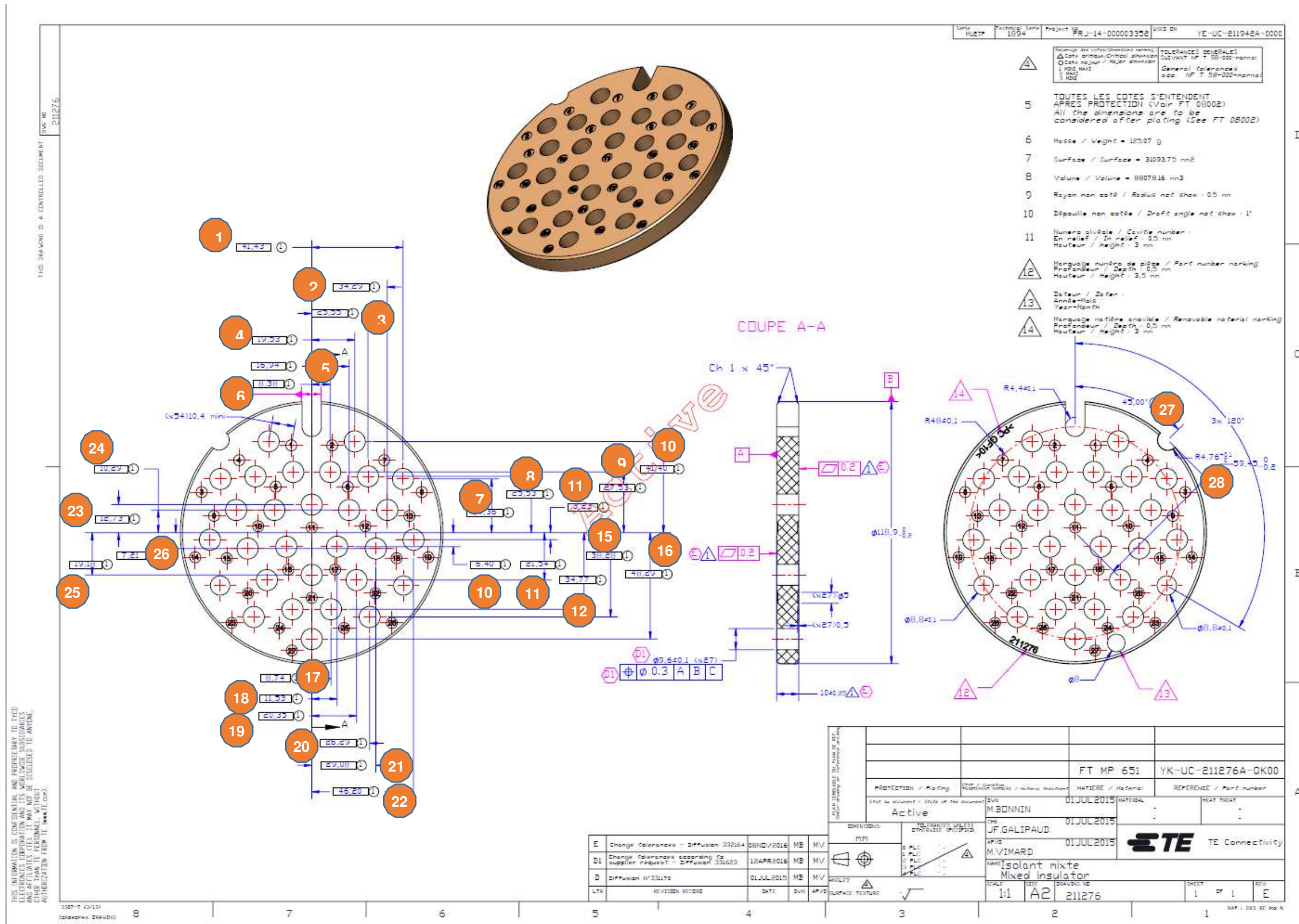
APPENDIX 1: TYPE TESTS SYNTHESIS AND TESTS REQUIREMENTS

Group	Test description	Severity or conditions	Type tests	Checking tests	No. of the test sample								
					1	2	3	4	5	6	7	8	9
0	<b>Visual examination (appearance &amp; marking)</b>	No damage	X										
	<b>Geometrical checking</b>		X										
	<b>Mass checking</b>	±5%	X										
	<b>Withstand voltage</b>	Leakage current ≤2mA	X										
	<b>Insulating resistance</b>	IR ≥5MΩ	X										
	<b>Contact resistance</b>	Rc≤0.35mΩ	X										
	<b>Connector insertion force</b>	195N<insertion force<285N	X										
1	<b>Contact insertion force</b>	2.2N<insertion force<14.5N	X										
	<b>Continuous test in damp heat</b>	-	X										
	<i>Visual examination (appearance &amp; marking)</i>	No damage		X									
	<i>Insulating resistance</i>	IR ≥5MΩ		X									
	<b>Vibration test</b>		X										
	<i>Visual examination (aspect)</i>	No damage		X									
	<i>Locking test</i>	195N<insertion force<285N		X									
	<i>Watertightness IPx4</i>	No water trace on actives parts		X									
	<i>Dust resistance IP5x</i>	No dust trace on actives parts		X									
	<b>Resistance to fluids</b>		X										
	<i>Visual examination (appearance &amp; marking)</i>	No defect – marking visible		X									
<i>Withstand voltage</i>	Leakage current ≤2mA		X										
<i>Insulating resistance</i>	IR ≥5MΩ		X										
2	<b>Rapid variations of temperature</b>		X										
	<i>Visual examination (appearance &amp; marking)</i>	No defect		X									
	<i>Insulating resistance</i>	IR ≥5MΩ		X									
	<b>Mechanical endurance</b>		X										
	<i>Visual examination (appearance)</i>	No damage		X									
	<i>Locking test</i>	195N<insertion force<285N		X									
	<i>Contact resistance</i>	Rc≤0.35mΩ		X									
<b>Jumper head retention</b>		X											
<i>Visual examination (appearance)</i>	No damage		X										
3	<b>Temperature rise</b>	>30A for 45°K	X										
	<b>Corrosion</b>		X										
	<i>Visual examination (appearance &amp; marking)</i>	No damage		X									
	<i>Insulating resistance</i>	IR ≥5MΩ		X									
	<b>Shocks</b>		X										
<i>Visual examination (appearance)</i>	No damage		X										
<i>Locking test</i>	195N<insertion force<285N		X										
4	<b>Dry heat</b>		X										
	<i>Visual examination (appearance &amp; marking)</i>	No damage		X									
	<i>Contact resistance</i>	Rc≤0.35mΩ		X									
	<i>Insulating resistance</i>	IR ≥5MΩ		X									
	<b>Mechanical resistance to impact (drop test)</b>		X										
<i>Visual examination (appearance)</i>	No damage		X										
<i>Locking test</i>	195N<insertion force<285N		X										
5	<b>Traction resistance of the crimped connection</b>	F≥180N	X		10 pairs of contacts of each cable section range								

	Test to realized
-	Test not to realized



APPENDIX 2: ASSEMBLY DRAWINGS OF THE TEST SAMPLES









THIS DRAWING IS A CONTROLLED DOCUMENT  
PART NO. E1894-212093

COUPE A-A  
Représentation avec les contacts et manchons  
A-A View  
Show with mounted contacts and sleeves

COUPE C-C  
VIEW C-C

COUPE B-B  
VIEW B-B

Vue isométrique - Echelle 1:2  
Isometric view - Scale 1:2

Vue isométrique - Echelle 1:2  
Isometric view - Scale 1:2

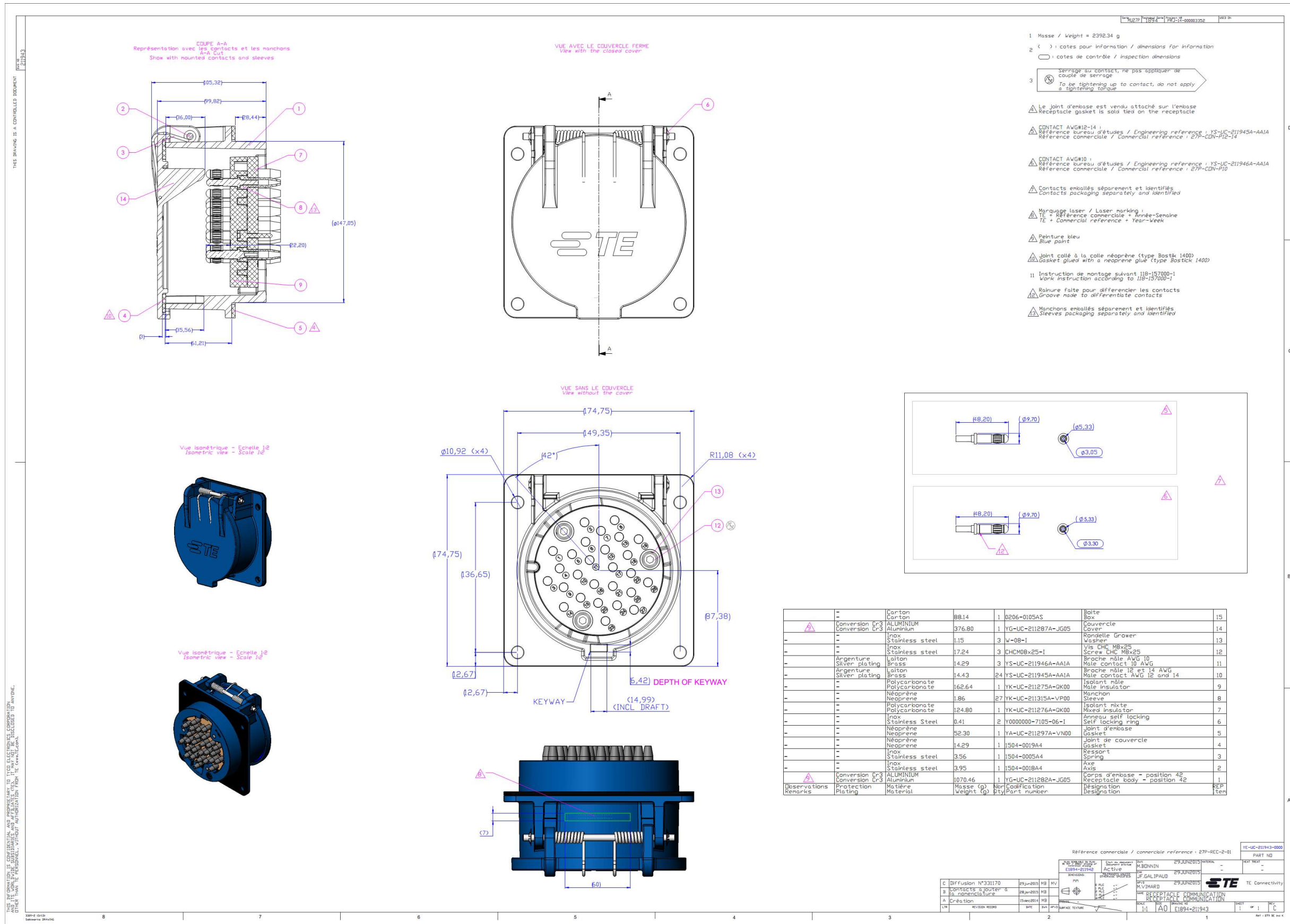
1 Masse / Weight = 2020,23 g  
2 ( ) : cotes pour information / dimensions for information  
3 ( ) : cotes de contrôle / inspection dimensions  
4 Serrage au contact, ne pas appliquer de couple de serrage  
To be tightening up to contact, do not apply a tightening torque  
5 CDCONTACT AVG#12-14  
Référence bureau d'études / Engineering reference : YS-UC-212072A-AA1A  
Référence commerciale / Commercial reference : 27P-CDI-312-14  
6 CDCONTACT AVG#10  
Référence bureau d'études / Engineering reference : YS-UC-212073A-AA1A  
Référence commerciale / Commercial reference : 27P-CDI-310  
7 Contacts emballés séparément et identifiés  
Contacts packaging separately and identified  
8 Marquage laser / Laser marking  
TE + Référence commerciale + Année-Semaine  
TE + Commercial reference + Year-Week  
9 Peinture bleue  
Blue paint  
10 Instruction de montage suivant 118-157000-2  
Work instruction according to 118-157000-2  
11 Rainure faite pour différencier les contacts  
Groove made to differentiate contacts  
12 Manchons emballés séparément et identifiés  
Sleeves packaging separately and identified

-	-	Carton	60,00	1	Y00000-0206-0217AS	Boîte en carton	11
-	-	Inox	23,20	3	CHCM08x40-1	Vis CHC	10
-	-	Inox	2,56	3	MU-08-1	Rondelle plate	9
-	-	Inox	1,72	3	1504-0030U4	Entretoise	8
-	-	Inox	1,72	3	1504-0030U4	Entretoise	8
-	-	Aluminium	14,62	1	1504-0002U4	Cône de serrage	7
-	-	Argenture	17,53	3	YC-UC-212073A-AA1A	Contact femelle AVG 10	6
-	-	Argenture	17,53	3	YC-UC-212073A-AA1A	Contact femelle AVG 12 et 14	5
-	-	Argenture	17,53	3	YC-UC-212073A-AA1A	Contact femelle AVG 12 et 14	5
-	-	Néoprène	258,94	1	YK-UC-211288A-YU00	Isolant femelle	4
-	-	Néoprène	1,36	27	1504-0008A4	Manchon	3
-	-	Polycarbonate	24,80	1	YK-UC-211276A-0K00	Isolant mixte	2
-	-	Conversion Cr-3	1026,58	1	YF-UC-211324A-JG05	Corps de fiche - position 42	1
-	-	Cr-3 conversion	1026,58	1	YF-UC-211324A-JG05	Plug body - position 42	1
Observations	Protection	Matière	Masse (g)	Nbr	Codification	Désignation	REP
Remarks	Plating	Material	Weight (g)	Qty	Part number	Designation	Rev

TE Connectivity

108-157001





- 1 Masse / Weight = 2392,34 g
- 2 ( ) : cotes pour information / dimensions for information
- 3 ( ) : cotes de contrôle / inspection dimensions
- 3 Serrage au contact, ne pas appliquer de couple de serrage  
To be tightening up to contact, do not apply a tightening torque
- Le joint d'embase est vendu attaché sur l'embase  
Receptacle gasket is sold tied on the receptacle
- CONTACT AVG812-14 :  
Référence bureau d'études / Engineering reference : YS-UC-211945A-AA1A  
Référence commerciale / Commercial reference : 27P-CON-P12-14
- CONTACT AVG810 :  
Référence bureau d'études / Engineering reference : YS-UC-211946A-AA1A  
Référence commerciale / Commercial reference : 27P-CON-P10
- Contacts emballés séparément et identifiés  
Contacts packaging separately and identified
- Marquage laser / Laser marking :  
TE + Référence commerciale + Année-Semaine  
TE + Commercial reference + Year-Week
- Peinture bleu  
Blue paint
- Joint collé à la colle néoprène (type Bostik 1400)  
Gasket glued with a neoprene glue (type Bostik 1400)
- 11 Instruction de montage suivant 118-157000-1  
Work instruction according to 118-157000-1
- Rainure faite pour différencier les contacts  
Groove made to differentiate contacts
- Manchons emballés séparément et identifiés  
Sleeves packaging separately and identified

	-	-	Carton	88.14	1	0206-0105AS	Boîte	15
	-	-	Carton				Box	
	-	Conversion Cr3	ALUMINIUM	376.80	1	YG-UC-211287A-JG05	Couvercle	14
	-	-	Aluminum				Cover	
	-	-	Inox		3	W-08-1	Rondelle Grover	13
	-	-	Stainless steel	1.15			Washer	
	-	-	Inox		3	CHCM08x25-1	Vis CHC M8x25	12
	-	-	Stainless steel	17.24			Screw CHC M8x25	
	-	Argenture	Laiton	14.29	3	YS-UC-211946A-AA1A	Broche mâle AVG 10	11
	-	Silver plating	Brass				Male contact 10 AVG	
	-	Argenture	Laiton	14.43	24	YS-UC-211945A-AA1A	Broche mâle 12 et 14 AVG	10
	-	Silver plating	Brass				Male contact AVG 12 and 14	
	-	-	Polycarbonate	162.64	1	YK-UC-211275A-OK00	Isolant mâle	9
	-	-	Polycarbonate				Male insulator	
	-	-	Neoprène	1.86	27	YK-UC-211315A-VP00	Manchon	8
	-	-	Neoprene				Sleeve	
	-	-	Polycarbonate	124.80	1	YK-UC-211276A-OK00	Isolant mixte	7
	-	-	Polycarbonate				Mixed insulator	
	-	-	Inox	0.41	2	Y0000000-7105-06-1	Arrceau self locking	6
	-	-	Stainless Steel				Self locking ring	
	-	-	Neoprène	52.30	1	YA-UC-211297A-VN00	Joint d'embase	5
	-	-	Neoprene				Gasket	
	-	-	Neoprène	14.29	1	1504-0019A4	Joint de couvercle	4
	-	-	Neoprene				Gasket	
	-	-	Inox	3.56	1	1504-0005A4	Resort	3
	-	-	Stainless steel				Spring	
	-	-	Inox	3.95	1	1504-0018A4	Axe	2
	-	-	Stainless steel				Axis	
	Conversion Cr3	ALUMINIUM	1070.46	1	YG-UC-211282A-JG05	Corps d'embase - position 4P	1	
	Protection	Material	Masse (g)	Qty	Part number	Désignation	REP	
Observations	Remarks						Item	

Référence commerciale / commerciale reference : 27P-REC-2-01		PART NO	
1	1504-0194	Active	29JUN2015
2	1504-0194	Active	29JUN2015
3	1504-0194	Active	29JUN2015
4	1504-0194	Active	29JUN2015
5	1504-0194	Active	29JUN2015
6	1504-0194	Active	29JUN2015
7	1504-0194	Active	29JUN2015
8	1504-0194	Active	29JUN2015
9	1504-0194	Active	29JUN2015
10	1504-0194	Active	29JUN2015
11	1504-0194	Active	29JUN2015
12	1504-0194	Active	29JUN2015
13	1504-0194	Active	29JUN2015
14	1504-0194	Active	29JUN2015

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COUPE A-A  
Représentation avec les contacts et les manchons  
A-A Cut  
Show with mounted contacts and sleeves

1 (05,32)  
2 (06)  
3 (09,82)  
4 (08,44)  
5 (0147,05)  
6 (02,20)  
7 (03,56)  
8 (01,21)

VUE AVEC LE COUVERCLE FERME  
View with the closed cover

1 Masse / Weight = 2392,22 g  
2 ( ) : cotes pour information / dimensions for information  
3 ( ) : cotes de contrôle / inspection dimensions

⚠ Serrage au contact, ne pas appliquer de couple de serrage  
To be tightening up to contact, do not apply a tightening torque

⚠ Le joint d'embase est vendu attaché sur l'embase  
Receptacle gasket is sold tied on the receptacle

⚠ CONTACT AVG12-14 :  
Référence bureau d'études / Engineering reference : YS-UC-211945A-AA1A  
Référence commerciale / Commercial reference : 27P-CDN-PI1

⚠ CONTACT AVG10 :  
Référence bureau d'études / Engineering reference : YS-UC-211946A-AA1A  
Référence commerciale / Commercial reference : 27P-CDN-PI1

⚠ Contacts emballés séparément et identifiés  
Contacts packaging separately and identified

⚠ Marquage laser / Laser marking :  
TE = Référence commerciale + Année-Semaine  
TE = Commercial reference + Year-Week

⚠ Peinture blanche  
White paint

⚠ Joint collé à la colle néoprène (type Bostik 1400)  
Gasket glued with a neoprene glue (type Bostik 1400)

11 [Instruction de montage suivant 118-157000-1  
Work instruction according to 118-157000-1]

⚠ Rainure faite pour différencier les contacts  
Groove made to differentiate contacts

⚠ Manchons emballés séparément et identifiés  
Sleeves packaging separately and identified

Vue isométrique - Echelle 1:2  
Isometric view - Scale 1:2

Vue isométrique - Echelle 1:2  
Isometric view - Scale 1:2

VUE SANS LE COUVERCLE  
View without the cover

1 (074,75)  
2 (049,35)  
3 (077,50\*)  
4 (0110,92 (x4))  
5 (012,67)  
6 (012,67)  
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98 (014,99)  
99 (014,99)  
100 (014,99)

1 (08,20) (09,70)  
2 (05,33) (03,05)  
3 (08,20) (09,70)  
4 (05,33) (03,30)

Observations/Remarks	Conversion Cr3	Material	Qty	Weight (g)	Nbr Dty	Designation	Part No	REP Item
⚠	Conversion Cr3	ALUMINIUM	88.14	1	0206-0105AS	Boîte	15	
	Conversion Cr3	ALUMINIUM	376.80	1	YG-UC-211287A-JG07	Couvercle	14	
		Inox	1.15	3	W-08-1	Rosette Grover	13	
		Inox	17.24	3	CHCMBx25-1	Vis CHE M8x25	12	
		Argenture	14.29	3	YS-UC-211946A-AA1A	Broche mâle AWG 10	11	
		Argenture	14.43	24	YS-UC-211945A-AA1A	Broche mâle 12 et 14 AWG	10	
		Polycarbonate	162.64	1	YK-UC-211275A-DK00	Isolant mâle	9	
		Néoprène	1.86	27	YK-UC-211315A-VP00	Manchon	8	
		Polycarbonate	124.80	1	YK-UC-211276A-DK00	Isolant mixte	7	
		Inox	0.41	2	Y0000000-7105-06-1	Anneau self locking	6	
		Néoprène	52.30	1	YA-UC-211297A-VN00	Joint d'embase	5	
		Néoprène	14.29	1	1504-0019A4	Joint de couvercle	4	
		Inox	3.56	1	1504-0005A4	Ressort	3	
		Inox	3.95	1	1504-0018A4	Axe	2	
⚠	Conversion Cr3	ALUMINIUM	1070.35	1	YG-UC-211283A-JG07	Corps d'embase - position 77,5	1	
	Protection	Aluminium				Receptacle body - position 77,5		
	Plating	Material				Designation		

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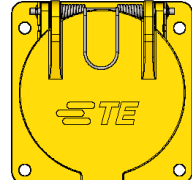




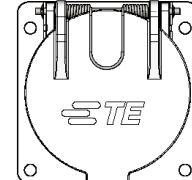


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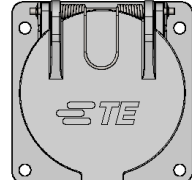
Reference commerciale / Commercial reference  
Z7P-DUM-Y (color yellow)

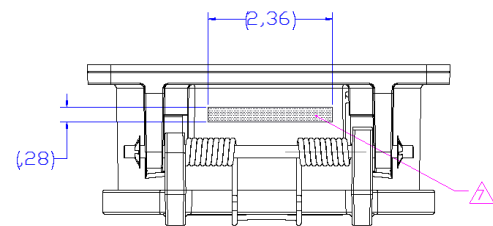


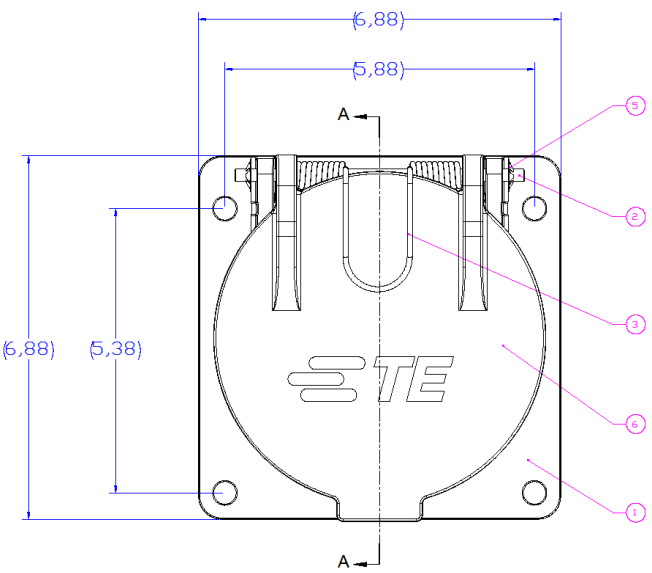
Reference commerciale / Commercial reference  
Z7P-DUM-W (color white)



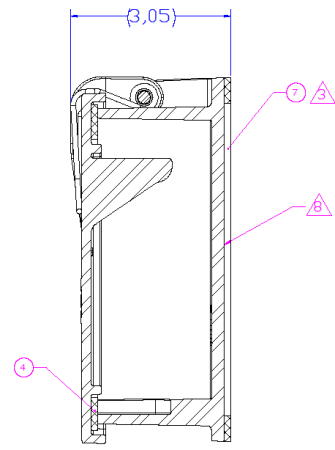
Reference commerciale / Commercial reference  
Z7P-DUM-0-01 (without color)







A-A VIEW



Reference BE Engineering reference		Commercial reference		Remarks	Data sheet	Plating	Material	Weight (g)	Pty	Part number	Designation	Item
X	X	X	-				Paper	5,00	1	YSPEC-408-157000-3	Mounting instruction	11
X	X	X	-					2,50	1	D206-0329AS	Dehydrating bag	10
X	X	X	-				Plastic	0,50	2	D158-0001-X	Collar	9
X	X	X	-				Carton	60,00	1	D206-0155AS	Box	8
X	X	X	△				Neoprene	22,30	1	YA-UC-211297A-VN00	Gasket	7
X	X	X	△				FMEL 31015					
X	X	X	△				FMME 4010 Cr3 conversion	376,80	1	YG-UC-211287A-JG08	Cover	6
X	X	X	△				FMME 4010 Cr3 conversion	376,80	1	YG-UC-211287A-JG07	Cover	6
X	X	X	-				FMME 4010 Cr3 conversion	376,80	1	YG-UC-211287A-JG8E	Cover	6
X	X	X	-				Stainless steel	0,17	2	Y0000000-7105-06-I	Self locking ring	5
X	X	X	-				FMEL 31016					
X	X	X	-				Neoprene	4,29	1	1504-0019A4	Gasket	4
X	X	X	-				Stainless steel	3,56	1	1504-0005A4	Spring	3
X	X	X	-				FMME 3017					
X	X	X	-				Stainless steel	3,95	1	1504-0018A4	Axis	2
X	X	X	△				FMME 4010 Cr3 conversion	965,15	1	YG-UC-211317A-JG08	Dummy receptacle	1
X	X	X	△				FMME 4010 Cr3 conversion	965,15	1	YG-UC-211317A-JG07	Dummy receptacle	1
X	X	X	-				FMME 4010 Cr3 conversion	965,15	1	YG-UC-211317A-JG8E	Dummy receptacle	1

Reference commerciale / Commercial reference : see table

THIS DRAWING IS A CONTROLLED DOCUMENT		REVISIONS		PART NO	
REVISED	DATE	BY	REASON	REV	DATE
C			Diffusion N°331170	1	
D			Add note 11 to table 11	2	
E			Add note 11 to table 11, product reference 1	3	

1 ( ) : cotes pour information / dimensions for information  
: cotes de controle / inspection dimensions

2 ( ) : INSTRUCTIONS de mise en oeuvre à appliquer par le client  
Customer instructions to be applied by the customer

△ Receptacle gasket is sold tied on the receptacle

△ Yellow paint

△ White paint

6 Work instruction according to 118-157000-3

△ Laser marking :  
TE + Commercial reference + Year-Week

△ Dummy receptacle completely enclosed

△ A label with the commercial reference and the complete BOM is glued on the cardboard

⑩ Standards :  
AAR 5-SIZ, APTA RP-E-03-99

11 Packaging Specification 107-157003

TE Connectivity		Boite de repos	
DUMY RECEPTACLE		Dummy receptacle	
408-157000-3		E1894-211944	
3122 lb		A0	
CUSTOMER DRAWING		REV. 01	



APPENDIX 3: INSULATION COORDINATION

