# Mono-Shape™

**GPL 394** MONO-SHAPE Tab and Bridge Connector P Code 0316
MONO-SHAPE Tab & Bridge Contact P Code 0317
MONO-SHAPE Tab Single Way Connector P Code 0322

## 1. SCOPE

### 1.1 Content

This specification covers performance, test and quality requirements for the Mono-Shape™ 5 mm Pitch I.D.C. Connectors for Tab contacts. These connectors are designed and developed for multiple lead connections for household appliances and other commercial equipment.
The proper mateable counterparts are plastic connectors assembled with tab contacts, TAB s must be shaped according to DIN 46244 - A6.3-0.8 and RAST5 standards, See also product Drawing 282002 and 282086 or Catalog N°296599 for detail.
Product is applicable on 0.5- 1.5 mm² single stranded wires as describe on par.3.2

## 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 inspection drawing, inspection drawing shall take precedence. In the event of conflict between requirements of this specification and referenced documents, this specification shall take precedence.

| | |
|---|---|
| - TE Product Drawings | Refer to TE Customer Drawing N° 282002, 282086 and 284288 as typical product design |
| - TE Application Specification | 114-20016 AND 114-20017 for I.D.C. Connector 5mm Pitch for TAB Contacts and Single Way |
| - RAST5 | Raster Anschluß Steck Technik 5mm Teilung (Grid connection plug-in technology 5mm pitch) |
| - DIN 41611Teil 6 | Testing For Insulation Displacement Connection |
| - DIN 46244 -A6,3 - 0,8 -Bz | For Tab Contact shape and dimensioning. |
| - DIN 0281 HD 21.3 S3 | Electrical cables, thermoplastic insulated dimensions. |
| - VDE 0627 (REV. JUNE 1986) | Connector and plug-and-socket devices for rated voltages up to 1000Va.c./d.c. and rated currents up to 500A for each pole. |
| - IEC 60998-1 (rev.1990-04) | Connecting devices for low voltage circuits for household and similar purposes. Part 1: General requirements |
| - IEC 60998-2-3 (rev.1991-10) (CEI23-20) | Connecting devices for low-voltage circuits for household and similar purposes - Part 2-3: Particular requirements for connecting devices as separate entities with insulation piercing clamping units. |
| - TE 109- series | TE Test specifications. |
| - TE Catalog N°296599 | Connector Systems for Household Appliances |
| - IEC 60695-2 | Fire hazard testing Glow-wire end-product test and guidance |
| - IEC 60112 | Current Tracking Index |
| - EN 60998 - 1 | Ball Pressure Test |

| | | | | |
|---|---|---|---|---|
| C3 | Revised parag. 5.3.1 | D. CHIARELLI | F. LUPO | 17.SEP.2021 |
| C2 | Clarify flammability rating on 3.3. | KD. CHEON | F. LUPO | 31.JUL.2019 |
| C1 | Current rating increase after tesing and approval | KD. CHEON | R. ROBONE | 15.APR.2016 |
| C | Revised Pag. 10-11 | C.C. | G.T. | DEC.2009 |
| B3 | Revised parag. 5.5.1 & 5.4.2 | C.CORDOLA | G.TURCO | FEB.2008 |



* Trademark

## 3. REQUIREMENTS

### 3.1. Design and Construction

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

### 3.2. Definition

**3.2.1 Insulation Displacement Connection (I.D.C.)** A terminating technique whereby an insulated wire is forced into a restrictive slot in a terminal, during which time the wire insulation is displaced, and the bare wire engages the sides of the slot.
**3.2.2 Housing-connector** An insulating encapsulation for contacts. When pins or sockets are inserted into a housing, the assembly is usually referred to as a connector. Housing is sometimes referred to as "block."
**3.2.3 TAB** (terminal) Used to describe the flat blade portion of certain terminals (eg a FASTON* tab, a taper tab, a solder tab).
**3.2.4 Bridge Connector** Used to describe and identify a special version, similar to the TAB connector, but assembled with short-circuit contacts properly designed to join adjacent ways together.

### 3.3 Materials

(1) I.D.C. Terminals: Brass CuZn30 Post-Tinned
(2) TAB connector Housings: Polyammide 6/6 glass fiber filled, UL 94V-0 and/or UL 94V-2
(3) Wires Types suitable for this product refer to the table shown below

| cross section nominal mm² (AWG) | Stranded Wires diameter mm | numbers of single wire and max. diameter mm | single wire material | *insulation material type | Insulation Outside diam. MAX Ref. DIN0281 HD 21.3 S3 |
|---|---|---|---|---|---|
| 0.5 - (AWG20) | 1 | 16x0.21 | tinned or unplated copper | PVC | 2.3 |
| 0.75 - (AWG18) | 1.2 | 24x0.21 | tinned or unplated copper | PVC | 2.5 |
| 1.0 - (AWG17) | 1.4 | 32x0.21 | tinned or unplated copper | PVC | 2.7 |
| 1.5 - (AWG16) | 1.6 | 30x0.26 | tinned or unplated copper | PVC | 3.0 |

***Cable termination process on product, looking at insulation material type, must be analyzed and examined together with the Application Tooling Manufacturer of the Tooling used to terminate the product.**

### 3.4 Ratings

**3.4.1 Voltage/Current:** Voltages 380 Max, current Rating according to wire size

| Wire Sec.(mm²) | Current (max.) |
|---|---|
| 0.5 | 6A |
| 0.75 | 6A |
| 1.0 | 10A |
| 1.5 | 16A |

**3.4.2 Operating temperature:** (**increase due to current load Included)** -25°C to +105°C

## 4. SAMPLE COMPOSITION AND PREPARATION.

Connectors are designed to meet the electrical, mechanical and environmental performances requirements according to test conditions as specified on following paragraphs.
Tests are splitted in four sections
SECTION A: Tests on connection between Wire and I.D.C. contact slot
SECTION B: Tests on connection between Contacts and TAB
SECTION C: Tests on the total connection (wire-I.D.C. contact-TAB)
SECTION D: Tests on the connector (mechanical tests)
For each section of wire applicable the minimum suggested group submitted to the test sequence is listed on paragraph 4.4, at list the minimum wire section (0,5mm²) and the maximum (1.5mm²) must be used for testing.

See attached Fig.1 for detail on mentioned features.

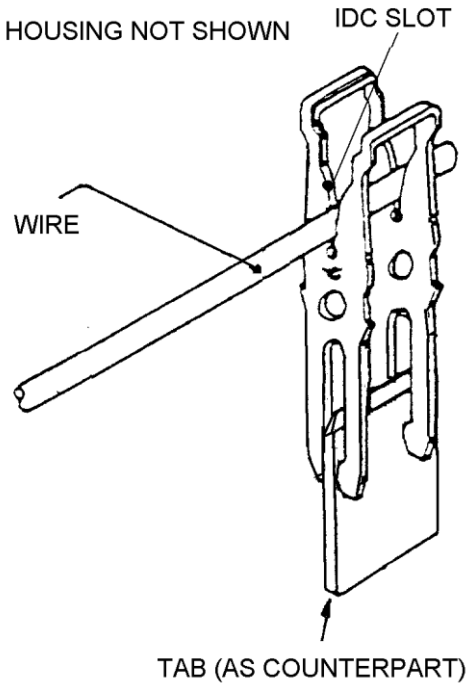



**FIG.1**

### 4.1 Samples selection.
Samples for testing must be selected at random for current production, must be in accordance to the relevant Product drawings and functional per applicable inspection plan.

### 4.2 Samples Preparation.
All the operation made in order to prepare Samples for testing must be done in accordance to the relevant Specification (Application spec for termination), wires and TAB must be inspected to verify the conformance to the correspondent specification. Where a temperature measurement probe on the product is requested, this must be applied at the hottest point of the connection. Operations which could be cause of damage or could influence the functionality of the product must be avoided.

**4.3 Environmental Test Condition (Laboratory).**
Unless otherwise specified, all tests shall be conducted at:
- Temperature 20°C ±5°
- Relative humidity 30 ÷ 95 %
- Atmospheric pressure 860 ÷ 1060 mBar

**4.4 Suggested Samples for Test Group Composition.**
Unless otherwise specified each group of connectors to be tested, shall be composed at least by:
N°6 Single way connectors
N°2 Tab Connector 2 ways
N°1 Tab Connector 4 ways
N°1 Tab Connector 7 ways
N°1 Tab Connector 8 ways

Unless otherwise specified above listed quantity is requested for each section of the wire used to terminate samples under test (see Par. 6 for test group and sequence).

**5. PERFORMANCE: TEST DESCRIPTION.**

**5.1 Section A - Tests on connection between Wire and I.D.C. contact slot**
This section is focused on testing the performance of the I.D.C. connection, in order to reduce the influence of the TAB portion of the connection, the contact could be soldered to the TAB in the mating area, for reference see sketch on paragraph 4

**5.1.1 Contact Resistance (dry circuit see also TYCO#109-6-6)**
Conformance of the product shall be measured as shown on following Fig.2. The potential drop shall be measured between points (1) and (2) the applicable test Voltage/Current is 20mV/20mA. After mechanical, electrical or environmental tests sequences, where a contact resistance check is requested, and if not otherwise specified, the difference between Initial and Final values must be $\leq 5m\Omega$.

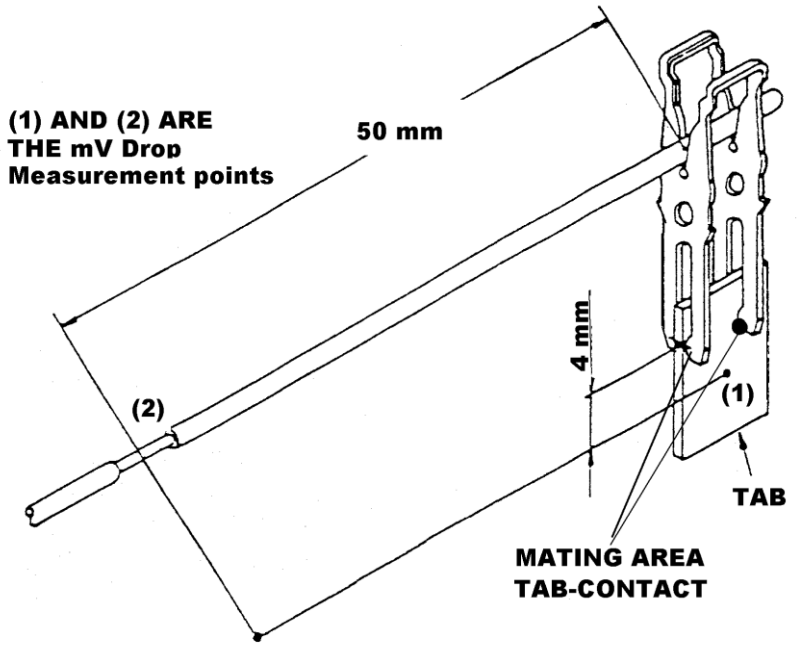



**FIG.2**

### 5.1.2 Current Overload

The connectors shall be subjected for a period of 45 minutes to an overload of 1.3 times the nominal current in relations with the wire section used, as specified on Par. 3.4. After the test, connectors shall show no evidence of damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

### 5.1.3 Vibration (see also IEC60068-2-6 & Mil STD 1344 A - was Tyco 109-21)

The connectors shall be mounted assembled with a proper counterpart simulating a typical application (see attached Fig.3 for reference) and fixed on a suitable adapter plate rigidly attached to the vibration table. The wire bundles shall be clamped to the plate in a point at least 200mm from the rear of the connectors.
Test Condition and procedure:
Displacement Amplitude 1.0mm acceleration amplitude 5g (peak values).
Frequency ranges, 10-200-10Hz, speed 1 octave/minute, duration 8 hours in each of 3 mutually perpendicular planes.
Contacts shall be wired in series and powered with 100 ±10 mA of current flow, to monitor electrical discontinuance (resistance limit 100 Ohm). During the test electrical discontinuities of 1 microsecond or longer duration shall be monitored and registered. Mated connector are subjected to sinusoidal vibration having an harmonic motion with amplitude of 1,0 mm pk to pk up to crossover frequency, than with an acceleration of 5g. The vibration frequency varies logarithmically between the limits of 10 and 200 Hz and return to 10 at a rate of 1 octave/minute. At the end of the test there shall be no loosening of parts nor indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

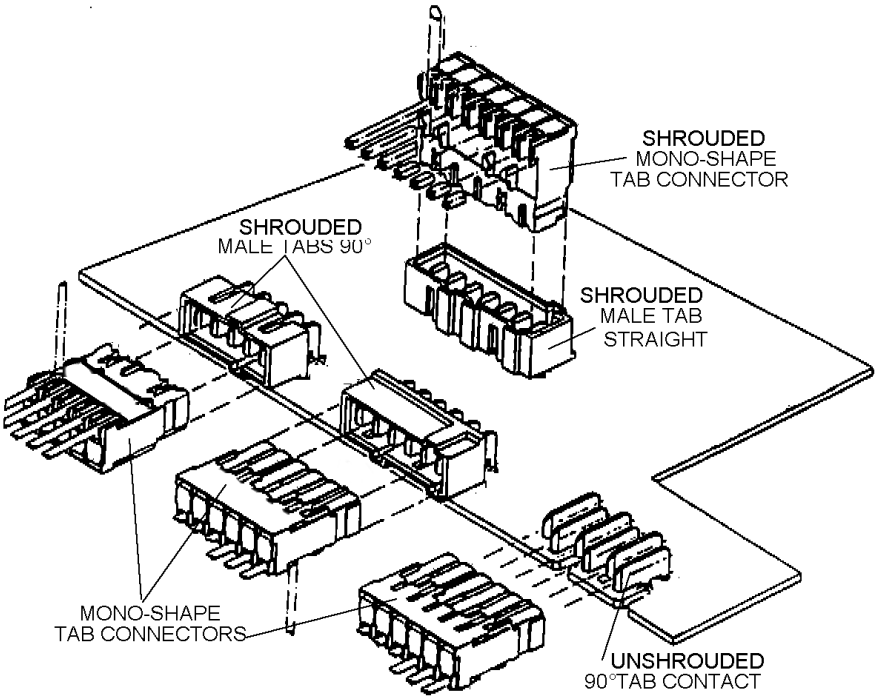



**FIG.3**

**5.1.4 Wires Movement**
Connector under test shall be subjected to 2 cycles of wire movement, according to Par. 7.2 of DIN 41611 Teil 6.
Fig. 3 on mentioned DIN must be followed for testing. At the end of the test there shall be no evidence of wires damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

**5.1.5 Current Cycling at High temperature (105°C). (see also TYCO#109-51)**
Connectors under test shall be subjected to 500 cycles. Contacts shall be wired in series and powered at a current rate according to wire section as reported on Par. 3.4.1.
Each cycle consists of:
45 minutes power on and 15 minutes power off. Test must be performed in a climatic chamber, chamber initial temperature shall be arranged if needed in order to have a room temperature of 105°C max when the power is on. This temperature must be reached within 20 minutes from the beginning of each cycle and maintained for the remaining portion of 45 minutes, then the current must be switched off for 15 minutes; this is a complete cycle. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

**5.1.6 Temperature Life (see also TYCO#109-43 test level 10)**
Connectors under test shall be withstand for 16 hours at a temperature of 105°C. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

**5.1.7 Damp Heat (steady state see also TYCO#109-23-2 Condition B)**
Connectors under test shall be withstand for 10 days at a temperature of 40°C and a relative humidity of 93%±2°. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

**5.1.8 Thermal Shock (see also TYCO#109-22)**
Connectors under test shall be withstand for 10 cycles. First step is 30 minutes at a room temperature of 105°C, second step is 30 minutes at -25°C. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

**5.1.9 Corrosion - Saturated atmosphere in the presence of sulfur dioxyde-Kesternich (see DIN 50018-0.2S)**
Connectors under test shall be withstand for 1 cycle to SO2 exposure. Test condition as follows:
Room temperature +40°C, S02 =0.2 $dm^3$ H2O =2 $dm^3$.
Samples exposure 8 hours plus 16 hours on air. Measure the contact resistance after test, the difference between Initial and Final values must be $\leq$ 5mΩ.
N.B. As alternative to Kesternich , Industrial Atmosphere shall be performed as follows
- SO2 (see also TYCO#109-5107-1)
Connectors under test shall be withstand for 10 days to SO2 exposure.
Gas concentration 10±3 PPM, humidity 90%-95% RH. At the end of the test there shall be no indication of damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

**5.2 Section B - Tests on connection between I.D.C. contact and TAB**

This section is focused on testing the performance of the TAB side of the connection, in order to reduce the influence of the IDC portion of the connection, the contact could be soldered to the I.D.C. slot mating area, for reference see sketch on paragraph 4

**5.2.1 Contact Resistance at Specified Current (see also TYCO#109-25)**

Conformance of the product shall be measured as shown on following Fig.4 The potential drop shall be measured between points (1) and (2) the applicable test current is according to wire section as reported on Par. 3.4.1. After mechanical, electrical or environmental tests sequences (if a contact resistance check is requested), the difference between Initial and Final values must be ≤ 5mΩ.

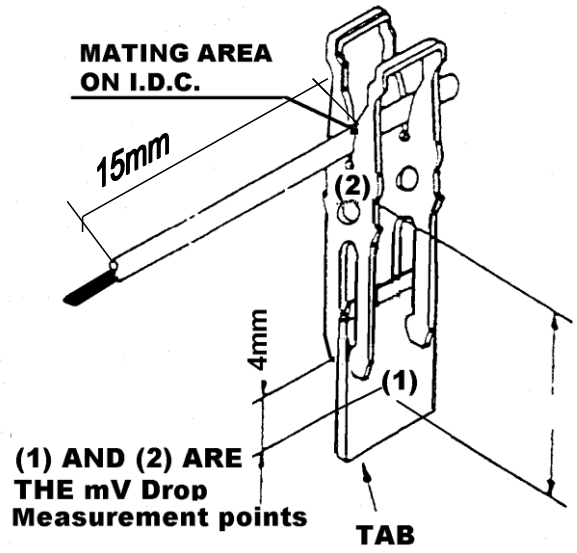



Fig. 4

**5.2.2 Durability Cycles (see also TYCO#109-27)**

Connector under test shall be withstand for 1 day of a pre-conditioning cycle, at 50% of relative humidity exposure. Then subjected to 6 cycles of Mating / Unmating using the TAB contact according to DIN 46244 - A6.3-0.8. Cycle rate shall be V= 25,4mm/minute. Time interval between cycles 30 seconds. At the end of the test there shall be no indication of damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

**5.2.3 Temperature Rise Versus Current (see also TYCO#109-45-1)**

Connector under test shall be withstand for 1 day of a pre-conditioning cycle, at 50% of relative humidity exposure. Then shall be withstand for 5 hours at the maximum current rate permitted, according to wire section as reported on Par. 3.4.1. Initial temperature T= 23°C. Test shall be considered passed if, within the 8 hours time line, thermal stability will be achieved and if temperature rise value will be according to following table:

| Wire Section (mm²) | Max. T Rise |
|---|---|
| 0.5 | ≤20°C |
| 0.75 | ≤20°C |
| 1.0 | ≤30°C |
| 1.5 | ≤40°C |

At the end of the test there shall be no indication of damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

**5.2.4 Thermal Shock (see also TYCO#109-22)**
Connectors under test shall be withstand for 1 cycle. First step is 2 hours at a room temperature of -25°C, second step is 168 hours at 105°C. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

**5.2.5 Withstanding Voltage (see also TYCO#109-29-1)**
Connector under test shall be withstand for 1 minute at a Voltage rate of 1750V. Test shall be considered passed if, within 1 minute time line, there will be no discharge. At the end of the test there shall be no indication of damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

**5.3 Section C - Tests on the total connection (Wire + I.D.C. contact + TAB).**
This section is focused on testing the performance of the total connection.

**5.3.1 Contact Resistance at Specified Current (see also TYCO#109-25)**
Conformance of the product shall be measured as shown on following Fig.5. The potential drop shall be measured between points (1) - (2) (total connection evaluation) and (2) - (3) (wire - I.D.C. slot) the applicable test Current is according to wire section as reported on Par. 3.4.1. After mechanical, electrical-environmental tests sequences (if a contact resistance check is requested), the difference between Initial and Final values must be ≤ 5,5mΩ.

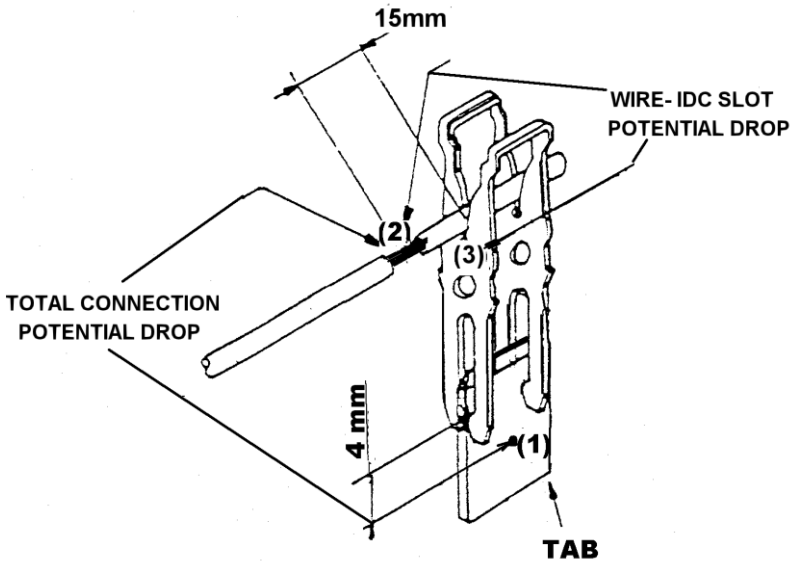



**FIG.5**

**5.3.2 Current Cycling at High temperature (105°C). (see also TYCO#109-51)**
Connectors under test shall be subjected to 500 cycles. Contacts shall be wired in series at a current rate according to wire section as reported on Par. 3.4.1. Each cycle consists of:
45 minutes power on and 15 minutes power off. Test must be performed in a climatic chamber, chamber initial temperature shall be arranged if needed in order to have a room temperature of 105°C max when the power is on. This temperature must be reached within 20 minutes from the beginning of each cycle and maintained for the remaining portion of 45 minute, then the current must be switched off for 15 minutes; this is a complete cycle. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

### 5.3.3 Salt Spray Corrosion (see also TYCO#109-24)

Connectors under test shall be subjected for 96 hours to a controlled salt atmosphere, salt solution concentration 5%(NaCl), Operating condition: Temperature 35°C±2. At the end of the test there shall be no indication of cracking, breaking or other damage which would interfere with mechanical or electrical performance requirements of the subsequent tests.

### 5.3.4 Insulation Resistance

The test is carried out measuring with a megaohmeter the resistance after the application during one minute of 500 V DC between live parts, connected together, and earth (earth being the outer metal parts, including a metal foil sheet placed in contact with the outer parts).
The insulation of the components must be 10 MΩ min.

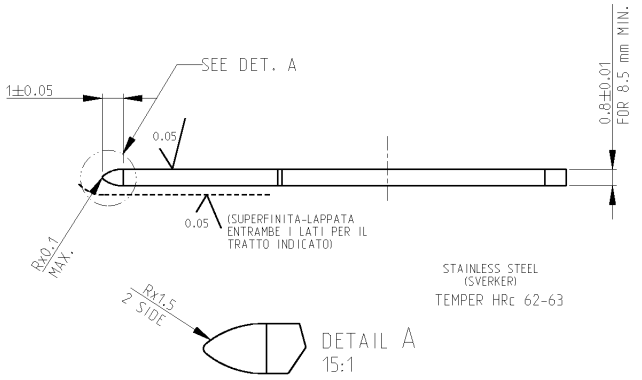
### 5.4 Section D - Mechanical Tests on the connector.

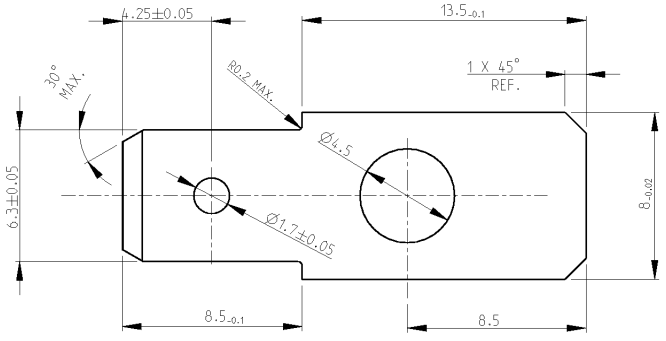
This section is focused on testing the mechanical performance of the connector. No electrical check are requested in this section.

### 5.4.1 Contact Insertion / Withdrawal force. IEC 60512-7 PAR. TEST 13b

The Insertion/ withdrawal force shall be verified using a polished flat steel gage, properly shaped as per sketch on Pag. 10 of 12. Rate value for insertion V= 25.4 mm / minute. Value to be verified must be according to attached table: (Value reported are in Newton)

| Detail of cavity types | MAX. insertion force (1st in) | MIN. withdrawal force (1st out) | MIN. withdrawal force (6st out) |
|---|---|---|---|
| **A –** value for Single Way connector and way n°1 for 2,3,4 position TAB connectors having a retention feature inside the relevant cavity | 50N | 25N | 3N |
| **B –** Value for all the other ways not included in the previous point. | 15N | 1,5N | 1,5N |



**5.4.2 Wire Termination Tensile Strength - Axial Load (see also TYCO#109-16)**
Wires terminated on the connectors under test shall be subjected to an axial tensile load as shown on attached Fig.6. Load rate V= 25.4mm/minute, the tensile force applied to the wire at a constant rate will cause the separation between wire and I.D.C. contact Slot. Record the tensile value and exanimate the type of failure.
Test is passed for values according to following table

| Wire Section (mm²) | Load |
|---|---|
| 0.5 | ≥50N |
| 0.75 | ≥60N |
| 1.0 | ≥70N |
| 1.5 | ≥130N |

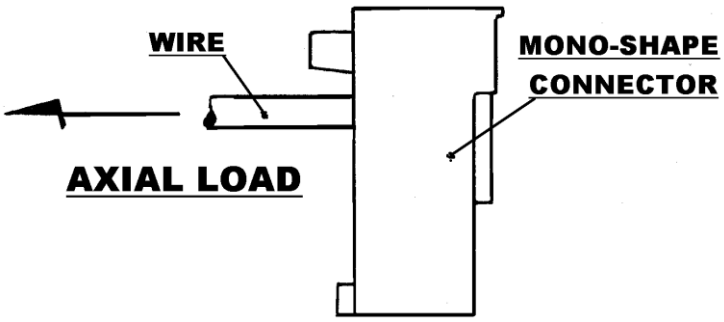



**Fig.6**

**5.4.3 Wire Termination tensile Strength - Perpendicular Load (see also TYCO#109-16)**
Wires terminated on the connectors under test shall be subjected to an axial tensile load as shown on attached Fig.7. Load rate V= 25.4mm/minute, the tensile force applied to the wire at a constant rate will cause the separation between wire and I.D.C. contact Slot. Record the tensile value and exanimate the type of failure.
Test is passed for values according to following table, one wire only for connector hast to be tested.

**Ways from 2 to 10**

| Wire Section (mm²) | Force |
|---|---|
| 0.5 | ≥50N |
| 0.75 | ≥60N |
| 1.0 | ≥70N |
| 1.5 | ≥80N |

**Single Way**

| Wire Section (mm²) | Force |
|---|---|
| 0.5 | ≥40N |
| 0.75 | ≥55N |
| 1.0 | ≥65N |
| 1.5 | ≥65N |

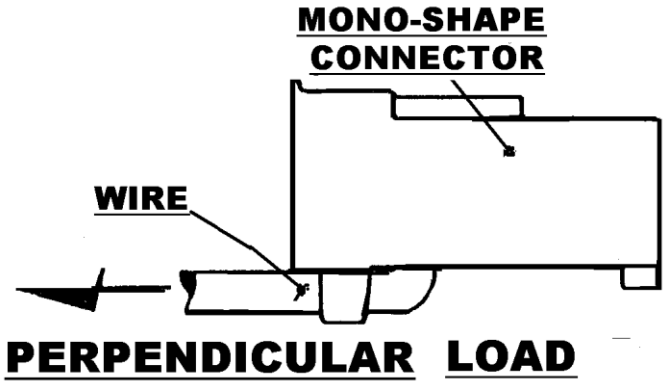



Fig.7

**5.5.1 Glow Wire Resistence ( IEC 60335-1 vedi anche IEC 60695-2-1/1)**

- Glow-wire flammability test method for end-products

Connectors are produced using plastic compound according to IEC 60335-1 edition 4 requirements, test on product/connectors are performed according the indication of this norm. The Annex O of the norm is describing the flow chart of the test performed.
Test parameter are defined based on material type and Current rating.

**5.5.2 Current Tracking Index (see IEC 60112 test A)**

- Method for the determination of the proof and the comparative tracking indices of solid insulating materials

Plastic Material used to mould Connectors must be tested to be in according to IEC rules, using relevant test procedure.
Test passed if Samples shall withstand at a CTI value of 250V min.

**5.5.3 Ball Pressure Test (EN 60998 - 1 test n° 16.3)**

- Fire hazard testing - Abnormal heat - Ball pressure test

Wires terminated Connectors must be tested to be in according to IEC rules, using relevant test procedure.
Test at 125°C temperature for 1 hour, passed if ball imprint diameter < 2 mm.

## 6. QUALIFICATION AND/OR PERIODIC TESTS, TABLE FOR GROUPS AND SEQUENCE.

| TEST DESCRIPTION | TEST PAR. | TEST GROUP AND SEQUENCE | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | XIII |
| **Contact Resistance** | **5.1.1** | **1,3,5,7,9,11** | **1,3,5** | **1,3** | **1,3** | | | | | | | | | |
| **Current Overload** | **5.1.2** | **2** | | | | | | | | | | | | |
| **Vibration** | **5.1.3** | **4** | | | | | | | | | | | | |
| **Wires Movement** | **5.1.4** | **6,10** | | | | | | | | | | | | |
| **Current Cycling** | **5.1.5** | **8** | | | | | | | | | | | | |
| **Temperature Life** | **5.1.6** | | **2** | | | | | | | | | | | |
| **Damp Heat** | **5.1.7** | | **4** | | | | | | | | | | | |
| **Thermal Shock** | **5.1.8** | | | **2** | | | | | | | | | | |
| **Corrosion Kesternich Test** | **5.1.9** | | | | **2** | | | | | | | | | |
| **Contact Resistance** | **5.2.1** | | | | | **1,3** | **1,3** | **1,3** | | | | | | |
| **Durability Cycles** | **5.2.2** | | | | | **2** | | | **2** | | | | | |
| **Temp. Rise Vs Current** | **5.2.3** | | | | | | **2** | | | | | | | |
| **Thermal Shock** | **5.2.4** | | | | | | | **2** | | | | | | |
| **Withstanding Voltage** | **5.2.5** | | | | | | | **4** | | | | | | |
| **Contact Resistance** | **5.3.1** | | | | | | | | **1,3,5,7** | | | | | |
| **Current Cycling** | **5.3.2** | | | | | | | | **4** | | | | | |
| **Salt Spray Corrosion** | **5.3.3** | | | | | | | | **6** | | | | | |
| **Insulation Resistance** | **5.3.4** | | | | | | | | **8** | | | | | |
| **Mating/ Unmating Force** | **5.4.1** | | | | | | | | | **1** | | | | |
| **Tensile Strength (Axial)** | **5.4.2** | | | | | | | | | | **1** | | | |
| **Tensile Strength (Perp.)** | **5.4.3** | | | | | | | | | | | **1** | | |
| **Glow Wire** | **5.5.1** | | | | | | | | | | | **1** | | |
| **Tracking Index** | **5.5.2** | | | | | | | | | | | | **1** | |
| **Ball Pressure** | **5.5.3** | | | | | | | | | | | | | **1** |

Notes: Groups from I to IV are relevant to samples to be tested according Section A of this specification
Groups from V to VII are relevant to samples to be tested according Section B of this specification
Groups VIII is relevant to samples to be tested according Section C of this specification
Groups from IX to XI are relevant to samples to be tested according Section D of this specification.