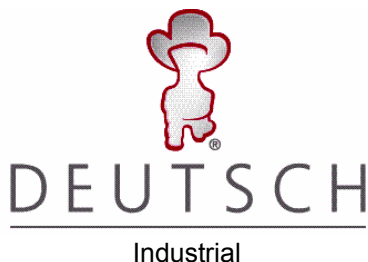


Qualification Test Report

DRCP 86 Pin Header and Plug

07/06/2012

Deutschesch Industrial



1.0 QUALIFICATION TEST FOR DRCP 86 PIN HEADER AND PLUG

2.0 SPECIFICATION REFERENCES

2.1 DCPM 2000 Deutsch Calibration Procedures Manual

3.0 TEST CONDITIONS AND EQUIPMENT

3.1 Test Conditions

Unless otherwise specified all test and measurements were conducted within the following conditions.

Temperature	+18C to +35C (+65F to +95F)
Relative Humidity	5% to 95%
Barometric Pressure	650 to 800 mm Hg

3.2 Test Equipment

Instrument calibration was performed in accordance with Deutsch Calibration Procedure Manual DCPM 2000 prior to using the instrument for testing. Calibration records are maintained and are directly traceable to the National Bureau of Standards with no more than three levels of separation.

The following data concerning the test equipment was recorded on the data format for each test:

- a. Descriptive name.
- b. Laboratory identification.
- c. Date of last calibration prior to use.

4.0 DOCUMENTATION

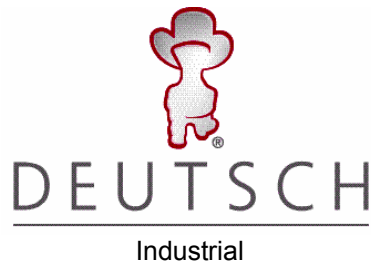
4.1 Recorded Data

All measurements were recorded to as many significant digits as are meaningful under the accuracy limits of the equipment used. All data was recorded on 8 1/2" x 11" data forms.

The ambient test conditions (temperature and relative humidity) and the date were recorded on the data form.

If a test was conducted on more than one day, the ambient test conditions and dates were recorded for each testing day.

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The data includes whenever applicable, any diagrams and sketches of the following:

- a. Electrical hookups that are peculiar to this test program or might prohibit duplication of the test method and results involved if not supplied.
- b. The orientation of samples to the direct force imparted during any physical shock or vibration testing.
- c. Any fixtures that would be used for mounting the test samples that were fabricated exclusively for this sequence.

5.0 TEST COMPONENTS

5.1 Test Samples

<u>Part Number</u>	<u>Description</u>
DRCP25-86PAA-G005	86 pin Header Key A Tin plated
DRCP25-86PBB-GC05	86 pin (De-pop) Header Key B Tin plated
DRCP25-86PCC-GC05	86 pin (De-pop) Header Key C Tin plated
DRCP28-86SA	Plug connector Key A
DRCP28-86SB	Plug connector Key B
DRCP28-86SC	Plug connector Key C
1062-20-0377	#20 sleeveless stamped socket – Tin
1062-12-0166	#12/14 stamped socket – Nickel/Tin
1062-12-0222	#10 /12 stamped socket - Nickel
0413-204-2005	#20 Sealing Plug
114017	#12/16 Sealing Plug

5.2 Wire Samples

Each test group was wired with the appropriate wire size for the individual tests. Sealing groups were wired with wire samples representing the full connector sealing range. All wire samples were chemically cross-linked polyethylene insulated per SAE J1128. All samples were crimped to each contact with Deutsch DCT12-02-00 DCT-20-02-00 crimp tooling.

Note: Test wire samples are within sealing range of connector – see Envelope DWG

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Connector Sealing Range

SEALING RANGE		
CAVITY SIZE	MINIMUM	MAXIMUM
#20	.063" [1.6mm]	.124" [3.15mm]
#12	.118" [3.0mm]	.210" [5.3mm]

Test Samples

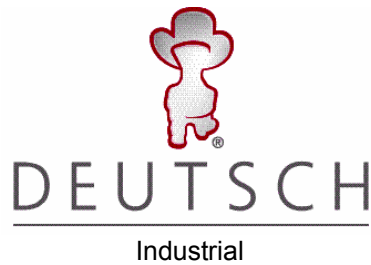
	Specification Insulation OD - Max		Sample Measurements	
	inch	mm	inch	mm
J1128				
20 TXL	0.076	1.93	0.068	1.73
18 TXL	0.084	2.13	0.074	1.88
18 SXL	0.12	3.05	0.102	2.59
16 SXL	0.135	3.43	0.120	3.05
14 SXL	0.155	3.94	0.134	3.40
12 SXL	0.18	4.57	0.159	4.04
10 SXL	0.21	5.33	0.200	5.08

6.0 TEST GROUPS

6.1 Group Description

Test groups were created to test the functionality of the DRCP 86 connector system. The test groups include group 1, 2, 3, 4, 5 and 6 qualification groups. The sample parts were divided into test groups as follows:

- Group 1 Intended to confirm thermal and sealing performance.
- Group 2 Intended to confirm mechanical performance.
- Group 3 Intended to confirm vibration and electrical performance.
- Group 4 Intended to confirm thermal and chemical resistance.
- Group 5 Intended to confirm thermal and electrical performance.
- Group 6 Intended to confirm sealing and environmental performance.



7.0 Test Sequence

Each sample group was subjected to the following test methods as outlined below. The tests were conducted in the order shown.

<u>Group 1</u>	<u>Sealing</u>	<u>Para.</u>
1.	Visual Inspection	9.1.1
2.	Insulation Resistance	9.1.2
3.	Thermal Shock Liquid Dunk	9.1.3
4.	Insulation Resistance	9.1.4
5.	Visual Inspection	9.1.5
6.	Thermal Cycle	9.1.6
7.	Thermal Shock Liquid Dunk	9.1.7
8.	Insulation Resistance	9.1.8
9.	Visual Inspection	9.1.9
10.	Pressure Washing	9.1.10
11.	Insulation Resistance	9.1.11
12.	Sealing, External Air Pressure	9.1.12
13.	Sealing Interior Air Pressure	9.1.13
14.	Visual Inspection	9.1.14
<u>Group 2</u>	<u>Mechanical</u>	<u>Para.</u>
1.	Visual Inspection	9.2.1
2.	Durability	9.2.2
3.	Temperature Life	9.2.3
4.	Terminal Retention Axial	9.2.4
5.	Terminal Retention Rotation	9.2.5
6.	Cross Key Mating	9.2.6
7.	Scoop Proof Mating	9.2.7
8.	Connector Coupling Strength	9.2.8
9.	Maintenance Aging	9.2.9
10.	Drop	9.2.10
11.	Crimp Tensile	9.2.11
12.	Over Torque	9.2.12
13.	Visual Inspection	9.2.13
<u>Group 3</u>	<u>Vibration</u>	<u>Para.</u>
Group 3a		
1.	Visual Inspection	9.3a.1
2.	Low Signal Contact Resistance	9.3a.2
3.	Voltage Drop	9.3a.3
4.	Thermal Cycle	9.3a.4
5.	Low Signal Contact Resistance	9.3a.5
6.	Temperature Life	9.3a.6
7.	Vibration	9.3a.7
8.	Low Signal Contact Resistance	9.3a.8
9.	Voltage Drop	9.3a.9
10.	Vibration	9.3a.10
11.	Low Signal Contact Resistance	9.3a.11
12.	Voltage Drop	9.3a.12
13.	Visual Inspection	9.3a.13



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Group 3b

1.	Visual Inspection	9.3b.1
2.	Low Signal Contact Resistance	9.3b.2
3.	Voltage Drop	9.3b.3
4.	Vibration	9.3b.4
5.	Thermal Cycle	9.3b.5
6.	Vibration	9.3b.6
7.	Low Signal Contact Resistance	9.3b.7
8.	Visual Inspection	9.3b.8

Group 4 Chemical Para.

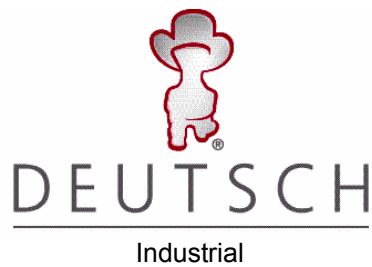
1.	Visual Inspection	9.4.1
2.	Salt Exposure	9.4.2
3.	Insulation Resistance	9.4.3
4.	Chemical Exposure	9.4.4
	<i>Diesel</i>	
	<i>Bio-Diesel</i>	
	<i>Kerosene</i>	
	<i>Motor Oil</i>	
	<i>Brake Fluid</i>	
	<i>Coolant</i>	
	<i>Transmission Oil</i>	
	<i>Urea</i>	
5.	Sealing Interior Air Pressure	9.4.5
6.	Visual Inspection	9.4.6

Group 5 Current Para.

1.	Visual Inspection	9.5.1
2.	Thermal Cycle	9.5.2
3.	Current Cycling	9.5.3
4.	Voltage Drop	9.5.4
5.	Visual Inspection	9.5.5

Group 6 Sealing / Environmental Para.

1.	Visual Inspection	9.6.1
2.	Temperature / Humidity	9.6.2
3.	Insulation Resistance	9.6.3
4.	Thermal Shock Liquid Dunk	9.6.4
5.	Insulation Resistance	9.6.5
6.	Visual Inspection	9.6.6
7.	Sealing, Interior Air Pressure	9.6.7
8.	Sealing, External Air Pressure	9.6.8
9.	Terminal Retention Axial	9.6.9
10.	Terminal Retention Rotation	9.6.10
11.	Visual Inspection	9.6.11



8.0 Sample Description

8.1 Group 1 - Sealing

All connectors wired with crimped 4ft test leads. Test leads to include service connectors for insulation resistance testing. Headers to have potted (sealed) open circuit pin contacts for immersion tests. Test group to investigate the lower diameter wire sizes (per table).

Group 1		
Sample Number	Wire Size	
1	20 TXL	12 SXL
2	20 TXL	12 SXL
3	20 TXL	12 SXL
4	18 TXL	12 SXL
5	18 TXL	12 SXL
6	18 SXL	14 TXL
7	18 SXL	14 TXL
8	18 SXL	14 TXL
9	16 SXL	12 SXL
10	16 SXL	12 SXL
11	16 SXL	12 SXL
1-1	18 TXL	12 SXL
1-2	18 TXL	12 SXL
1-3	18 TXL	12 SXL
1-4	18 SXL	12 SXL
1-5	18 SXL	12 SXL
1-6	18 SXL	12 SXL
1-7	Sealing Plugs	Sealing Plugs
1-8	Sealing Plugs	Sealing Plugs
1-9	Sealing Plugs	Sealing Plugs

8.2 Group 2 – Mechanical

All connectors wired with crimped 2ft test leads.

Group 2		
Sample Number	Wire Size	
1 (Key A)	18 SXL	12 SXL
2 (Key B)	18 SXL	12 SXL
3 (Key C)	18 SXL	12 SXL

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8.3 Group 3 – Vibration

All connectors wired with crimped 4 ft test leads. Wires to include service connectors and millivolt drop taps. Headers to be mounted to vibration fixtures. Wires to be tie-wrapped in the “down” direction for samples 1-3 in group 3a. Wires to be tie-wrapped in the “across” direction for samples 4-6 in group 3b. Header pins to be bussed and soldered in pairs. Subtract reference wire reading from total. All voltage drop and resistance readings are divided by two.

Group 3a		
Sample Number	Wire Size	
1	18 SXL	12 SXL
2	18 SXL	12 SXL
3	18 SXL	12 SXL

Group 3b		
Sample Number	Wire Size	
4	18 SXL	12 SXL
5	18 SXL	12 SXL
6	18 SXL	12 SXL

8.4 Group 4 – Chemical

All connectors wired with crimped 2 ft test leads. Test leads to include service connectors for insulation resistance testing. Headers to be potted. Pins are open circuit.

Group 4					
Sample	Fluids	Temperature	Time	Wire Size	
1,2,3	Diesel Fuel #2	60°C	24 hours	18 SXL	12 SXL
4,5,6	Bio-Diesel Fuel (including Toyu)	60°C	24 hours	18 SXL	12 SXL
7,8,9	Kerosene	60°C	24 hours	18 SXL	12 SXL
10,11,12	Motor Oil 30wt	120°C	7 Days	18 SXL	12 SXL
13,14,15	Brake Fluid (disc type 1)	25°C	24 hours	18 SXL	12 SXL
16,17,18	50/50 Antifreeze / Water mixture	100°C	24 hours	18 SXL	12 SXL
19,20,21	Transmission Oil 90wt	100°C	7 Days	18 SXL	12 SXL
22,23,24	Urea (32.5%) / Water (67.5%)	25°C	24 hours	18 SXL	12 SXL

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8.5 Group 5 – Current

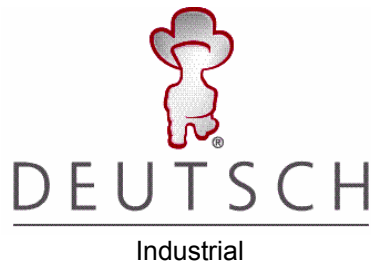
All connectors wired with crimped 6-inch looped test leads. Header pins to be bussed in pairs and soldered together. Subtract reference wire reading from total. Average voltage drop of each contact pair is obtained by dividing test reading by the total number of terminals. Samples to include thermal couple probes to measure internal contact temperature.

Group 5				
Sample Number	Wire Size	Amperage	Wire Size	Amperage
1	16 SXL	10	10 SXL	30
2	16 SXL	10	10 SXL	30
3	16 SXL	10	10 SXL	30

8.6 Group 6 – Sealing / Environmental

All connectors wired with crimped 4ft test leads. Test leads to include service connectors for insulation resistance testing. Headers to have potted (sealed) open circuit pin contacts for immersion tests.

Group 6		
Sample Number	Wire Size	
1	18 SXL	12 SXL
2	18 SXL	12 SXL
3	18 SXL	12 SXL



9.0 TEST METHOD AND RESULTS

The validation test and its results are summarized in the following pages. Refer to the Appendix for the detailed laboratory test forms.

9.1 GROUP 1 -- SEALING

9.1.1 Visual Inspection

Test Method:

1. The connectors were visually inspected for correct use of materials, proper construction, correct part number and insert markings and over-all quality of workmanship.
2. Poor molding fabrication, loose materials, damaged or improperly manufactured contacts, galling of metal parts, nicks and burrs of metal parts, torn seals or cracked plastic are considered adequate basis for rejection.

Requirements:

The connectors shall be correctly constructed, marked and shall show good quality and workmanship. Connector after conditioning shall not show signs of damage or any detectable loss of function.

Results:

The connectors were thoroughly inspected and showed no evidence of cracking, distortion or any defects detrimental to part function.

9.1.2 Insulation Resistance

Test Method:

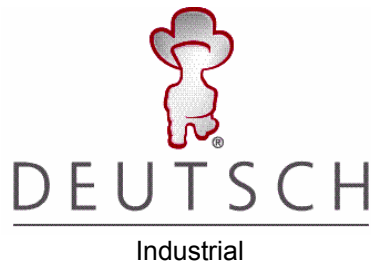
Checked insulation resistance between each contact to all other contacts and shell using a 1000 VDC Megohmmeter.

Requirements:

The resistance shall be 10 megohms minimum.

Results:

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The insulation resistance exceeded 10 megohms for all the tested samples.

9.1.3 Thermal Shock Liquid Dunk

Test Method:

The wired mated test samples were placed in an oven at $+125\pm 3^{\circ}\text{C}$ for two hours and then immediately be placed in water with 5% salt by weight content and 0.1g/L wetting solution to a depth of 1 meter for 30 minutes. The free ends of wires were sealed and remained out of the water.

Requirements:

Test samples must meet Insulation Resistance per section 9.1.4 and Visual Inspection per section 9.1.5.

Results:

Inspected samples per section 9.1.4 and 9.1.5.

9.1.4 Insulation Resistance

Test Method:

After thermal shock liquid dunk per section 9.1.3, checked insulation resistance between each contact to all other contacts and shell using a 1000 VDC Megohmmeter.

Requirements:

The resistance shall be 10 megohms minimum.

Results:

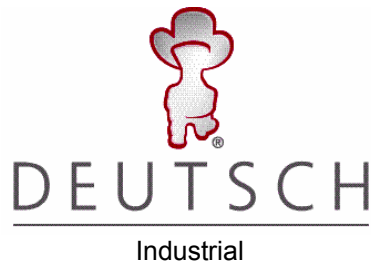
The insulation resistance exceeded 10 megohms for all the tested samples.

9.1.5 Visual Inspection

Test Method:

Each sample was visually inspected for anything that could affect the performance or serviceability of the product.

Results:



There was no evidence of leaking, cracking or detrimental damage to the test samples.

9.1.6 Thermal Cycle

Test Method:

Mated test samples were thermal cycled a total of 20 complete cycles between $-55\pm 3^{\circ}\text{C}$ and $+125\pm 3^{\circ}\text{C}$ at the rate of 3°C per minute. Test samples were remained at each temperature extreme for one hour.

Requirements:

There shall be no evidence of cracking, distortion or other damage detrimental to the normal operation of the connector.

Results:

No visual or mechanical degradation was observed following the test.

9.1.7 Thermal Shock Liquid Dunk

Test Method:

After thermal cycle per section 9.1.6, the wired mated test samples were placed in an oven at $+125\pm 3^{\circ}\text{C}$ for two hours and then immediately be placed in water with 5% salt by weight content and 0.1g/L wetting solution to a depth of 1 meter for 30 minutes. The free ends of wires were sealed and remained out of the water.

Requirements:

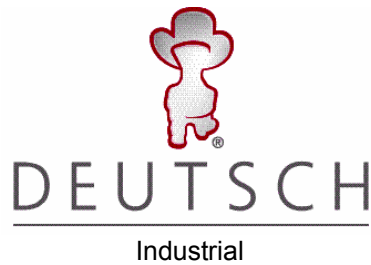
Test samples must meet Insulation Resistance per section 9.1.8 and Visual Inspection per section 9.1.9.

Results:

Examined samples per section 9.1.8 and 9.1.9.

9.1.8 Insulation Resistance

Test Method:



After thermal shock liquid dunk per section 9.1.7, checked insulation resistance between each contact to all other contacts and shell using a 1000 VDC Megohmmeter.

Requirements:

The resistance shall be 10 megohms minimum.

Results:

The insulation resistance exceeded 10 megohms for all the tested samples.

9.1.9 Visual Inspection

Test Method:

Each sample was visually inspected for anything that could affect the performance or serviceability of the product.

Results:

There was no evidence of cracking, distortion or detrimental damage to the test samples.

9.1.10 Pressure Washing

Test Method:

The mated test sample mounted firmly onto a push cart was exposed to the room temperature water spray for about 3 to 5 seconds period per connector for a total of 20 minutes. The fan nozzles, with a source pressure of approximately 1200 psi gage, were located 20 to 30 cm away providing 100% coverage of the test sample.

Requirements:

Test samples must meet Insulation Resistance per section 9.1.11.

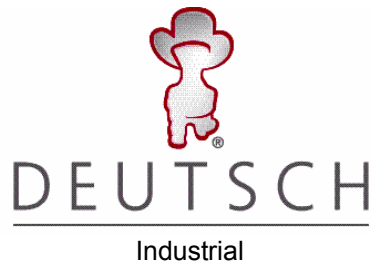
Results:

Examined samples per section 9.1.11.

9.1.11 Insulation Resistance

Test Method:

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After pressure washing per section 9.1.10, checked insulation resistance between each contact to all other contacts and shell using a 1000 VDC Megohmmeter.

Requirements:

The resistance shall be 10 megohms minimum.

Results:

The insulation resistance exceeded 10 megohms for all the test samples.

9.1.12 Sealing, External Air Pressure

Test Method:

The mated test sample was placed in the sealed pressure chamber with vent tube attached. A 35 ± 5 kPa dry compressed air source was applied to the chamber for 30 minutes minimum.

Requirements:

No air bubbles are allowed to exit the vent tube after the first fifteen minutes.

Results:

Very slow bubbles were observed coming out of the venting tube after the first fifteen minutes. Testing apparatus might have issues which could lead to the slow leakage.

9.1.13 Sealing, Interior Air Pressure

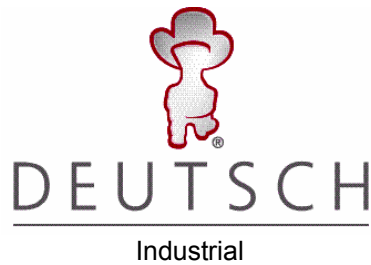
Test Method:

The mated test sample was completely submerged in the water with a pressure tubing introduced into the sealed portion of the test sample. Pressure was slowly applied from zero to 35 kPa at a rate about 2 kPa/sec and maintained at the peak for 30 minutes minimum.

Requirements:

After 15 minutes, no air bubbles are allowed to leak from the sample.

Results:



There was no air bubbles observed after the first 15 minutes.

9.1.14 Visual Inspection

Test Method:

This was the last step of this group. Each sample was unmated and visually inspected for evidence of leaking, cracking or anything that could affect the performance or serviceability of the product.

Results:

There was no evidence of leaking, cracking or detrimental damage to the test samples.

9.2 GROUP 2 -- MECHANICAL

9.2.1 Visual Inspection

Test Method:

1. The connectors were visually inspected for correct use of materials, proper construction, correct part number and insert markings and over-all quality of workmanship.
2. Poor molding fabrication, loose materials, damaged or improperly manufactured contacts, galling of metal parts, nicks and burrs of metal parts, torn seals or cracked plastic are considered adequate basis for rejection.

Requirements:

The connectors shall be correctly constructed, marked and shall show good quality and workmanship. Connector after conditioning shall not show signs of damage or any detectable loss of function.

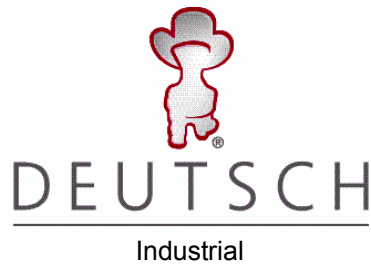
Results:

The connectors were thoroughly inspected and showed no evidence of cracking, distortion or any defects detrimental to part function.

9.2.2 Durability

Test Method:

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The connectors were mated and unmated for a total of 50 complete cycles at room temperature. The connectors were re-torqued to the recommended torque 44 - 62 in*lb [5 - 7 N*m] after each cycle.

Requirements:

After 50 cycles, There should be no evidence of damage to the contacts, contact plating, connector housing or seals following the test. No visual or mechanical degradation is permitted.

Results:

Debris was observed falling off the brass insert and the tin plated power pins after the first five cycles.

9.2.3 Temperature Life

Test Method:

The wired and mated connectors were subject to 1000 h at 125°C ±3°C.

Requirements:

No visual or mechanical performance degradation is allowed.

Results:

There was no evidence of cracking, distortion or detrimental damage to the test samples following the test.

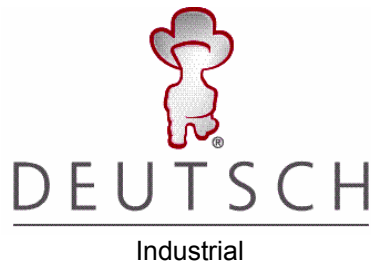
9.2.4 Terminal Retention Axial

Test Method:

The contact in the plug was axially loaded by the force of 89N (20 lbf) on the 20 size contact and 111 N (25 lbf) on the 12 size contact. The force was applied at a uniform rate of 0.189 in/min. Terminal position assurance device was utilized and in the locked position during the test. Eight cavities of the 20 size contact and one cavity of the 12 size contact were selected from each sample.

Requirements:

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1. The contact displacement shall not exceed 0.8mm for both 20 size and 12 size contact.
2. The maximum bearing load for the 20 size contact and 12 size contact before separation shall be greater than 89N (20 lbf) and 111N (25 lbf) respectively.

Results:

All the test samples passed the force requirement. For the displacement requirement, there were some terminals that exceeded 0.8mm on each sample. Please refer to the lab test form Para 9.2.4 in the appendix I for the details.

9.2.5 Terminal Retention Rotation

Test Method:

10% of cavities different from the ones been tested in Terminal Retention Axial per section 9.2.4 were selected for testing. The wired test sample was rigidly mounted on the table such that the wires could hang downward vertically. A 4.54 kg (10 lbs) weight was affixed to the end of a 610 mm (2 feet) long wire. Each socket in the cavity was rotated by five full turns by spinning the weighted wire.

Requirements:

There shall be no mechanical degradation or discontinuity following the test.

Results:

All the tested samples passed the requirements.

9.2.6 Cross Key Mating

Test Method:

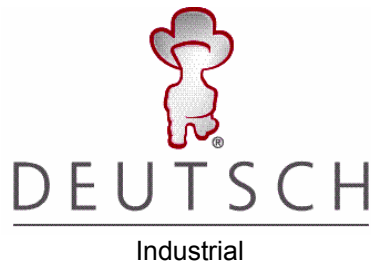
A mating force of 350 N was applied while attempting to cross-key mate by aligning connector halves into each geometric possible position. All key design possibilities were inspected and tested. Electrical contact was monitored during the test.

Requirements:

For all connector key design options, connector halves must only mate in one position. Any partial mating of connectors with electrical contact is considered to be a failure.

Results:

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There was no evidence of cracking, distortion or detrimental damage to the key configuration. No electrical contact observed during the test.

9.2.7 Scoop Proof Mating

Test Method:

The wired connector was mated through all kinds of intended improper orientation during assembly.

Requirements:

The connector shall incorporate features preventing its contacts, either male or female, from being touched by the front of the mating connector by improper assembly.

Results:

All the contacts of the connector were untouched due to the scoop proof features.

9.2.8 Connector Coupling Strength

Test Method:

A tensile load of 100 lb [445 N] was applied to the wire bundle of the mated connector for a period of one (1) minute.

Requirements:

The mated test sample shall withstand 100 lb [445 N] load for a minimum of 30 sec without any damage or disengagement. No visual or mechanical degradation is permitted.

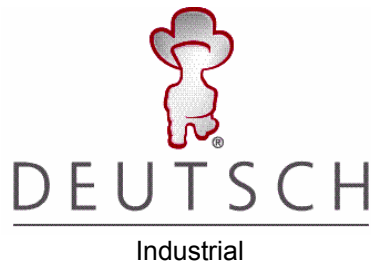
Results:

There was no evidence of cracking, distortion or detrimental damage to the connector and no uncoupling following the test.

9.2.9 Maintenance Aging

Test Method:

20% of the cavities different from the ones been tested in Terminal Retention Axial and Rotation per section 9.2.4 and 9.2.5 were subjected to ten cycles of inserting and



removing its respective contact. Disassembly of the terminal position assurance device required to remove the contacts was included in the ten cycles. The connectors was mated and unmated during each cycle. Insertion and removal was performed using manufacturer's recommended tools.

Requirements:

No mechanical degradation or failure is permitted.

Results:

Examined samples per section 9.2.10 and 9.2.11

9.2.10 Drop

Test Method:

The wired connector was attached to the free end of a 5 feet long cord. The other end of the cord was fixed to a wall at a height of 2.5 feet above a concrete floor. The test sample was held so that the cord was horizontal and then fell to the concrete floor eight times. The test sample was rotated approximately 45 degrees at its fixing each time.

Requirements:

There shall be no evidence of cracking, distortion or detrimental damage to the connector. Small chips and dents that do not affect connector's performance or serviceability are disregarded.

Results:

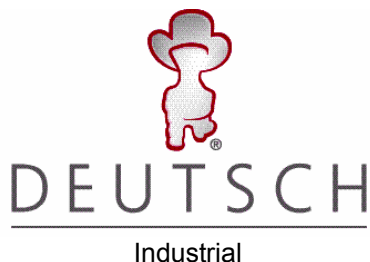
Only small chips and dents were observed on the backshell following the test.

9.2.11 Crimp Tensile

Test Method:

Each wired terminal was tested using a tensile tester without the influence of an insulation strain relief crimp. An axial force was applied to the wire and terminal at a speed of 25.4 ± 6 mm per minute separating the contact and conductor. 18 SXL and 12 SXL wires were tested.

Requirements:



The minimum crimp tensile force for the 18 SXL and 12 SXL wires are 111 N and 311 N respectively.

Results:

All tested terminals met the minimum force values.

9.2.12 Over Torque

Test Method:

The connector was torqued to 92 in*lb [10.5 N*m] which is 1.5 times of the maximum allowable torque.

Requirements:

There should be no evidence of cracking, distortion or detrimental damage to the test samples.

Results:

No cracking, distortion or detrimental damage to the test sample observed following the test.

9.2.13 Visual Inspection

Test Method:

This was the last step of this group. Each sample was visually inspected for evidence of cracking, distortion or anything that could affect the performance or serviceability of the product.

Results:

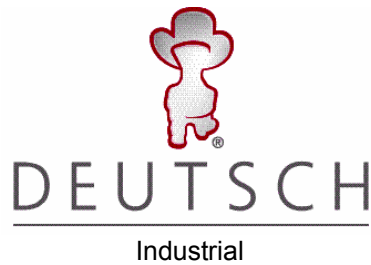
The connectors were thoroughly inspected and showed no evidence of cracking, distortion or any defects detrimental to the part function.

9.3 GROUP 3a -- VIBRATION

9.3a.1 Visual Inspection

Test Method:

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1. The connectors were visually inspected for correct use of materials, proper construction, correct part number and insert markings and over-all quality of workmanship.
2. Poor molding fabrication, loose materials, damaged or improperly manufactured contacts, galling of metal parts, nicks and burrs of metal parts, torn seals or cracked plastic are considered adequate basis for rejection.

Requirements:

The connectors shall be correctly constructed, marked and shall show good quality and workmanship. Connector after conditioning shall not show signs of damage or any detectable loss of function.

Results:

The connectors were thoroughly inspected and showed no evidence of cracking, distortion or any defects detrimental to part function.

9.3a.2 Low Signal Contact Resistance

Test Method:

The mated connector was tested with applied voltage not to exceed 20 millivolts open circuit and the current limited to 100 milliamps. The contact resistance was obtained by subtracting the reference wire resistance from the test reading and dividing by two.

Requirements:

The maximum contact resistance shall be 6 milliohms for 16 AWG wire and 9 milliohms for 18 AWG wire.

Results:

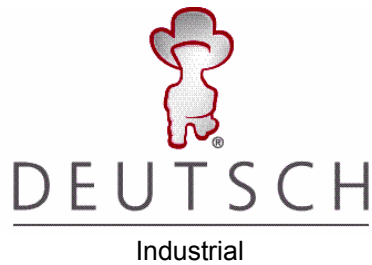
All the contacts of each connector were tested and passed the requirements.

9.3a.3 Voltage Drop

Test Method:

The mated connector was tested using 7.5 amps on 18 AWG wire and 20 amps on 12 AWG wire with the test voltage set to be 4.50 ± 0.25 VDC open circuit. The voltage drop was recorded by deducting the reference wire measurements and dividing by two.

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Requirements:

The voltage drop shall not exceed 100 millivolts.

Results:

All the samples tested passed the requirements.

9.3a.4 Thermal Cycle

Test Method:

Mated test samples were thermal cycled a total of 20 complete cycles between $-55\pm 3^{\circ}\text{C}$ and $+125\pm 3^{\circ}\text{C}$ at the rate of 3°C per minute. Test samples were remained at each temperature extreme for one hour.

Requirements:

There shall be no evidence of cracking, distortion or other damage detrimental to the normal operation of the connector.

Results:

No visual or mechanical degradation was observed following the test.

9.3a.5 Low Signal Contact Resistance

Test Method:

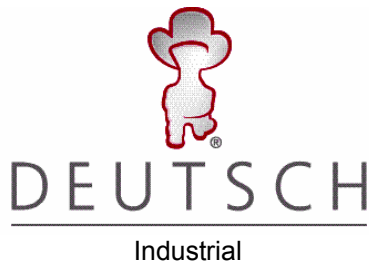
The mated connector was tested with applied voltage not to exceed 20 millivolts open circuit and the current limited to 100 milliamps. The contact resistance was obtained by subtracting the reference wire resistance from the test reading and dividing by two.

Requirements:

The maximum contact resistance shall be 6 milliohms for 16 AWG wire and 9 milliohms for 18 AWG wire.

Results:

All the contacts of each connector were tested and passed the requirements.



9.3a.6 Temperature Life

Test Method:

The wired and mated connectors were subject to 1000 h at 125°C ±3°C.

Requirements:

No visual or mechanical performance degradation is allowed.

Results:

There was no evidence of cracking, distortion or detrimental damage to the test samples following the test.

9.3a.7 Vibration

Test Method:

Three wired and mated connectors as a test group were rigidly mounted to three mutually perpendicular axis and randomly vibrated for 20 hours in each axis. Vibration profile was attached in the appendix I Para. 9.3b.6. The wire harness was bent 90 degree and firmly tied to the router with tie-wraps. The free end was hooked up to the discontinuity monitor from which 100 milliamps load was applied.

Requirements:

There shall be no discontinuity greater than 10 ohms in excess of 1 microsecond. Any physical damage or loosening of components are not allowed.

Results:

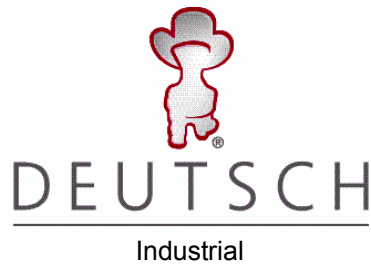
All the samples passed the vibration test.

9.3a.8 Low Signal Contact Resistance

Test Method:

The mated connector was tested with applied voltage not to exceed 20 millivolts open circuit and the current limited to 100 milliamps. The contact resistance was obtained by subtracting the reference wire resistance from the test reading and dividing by two.

Requirements:



The maximum contact resistance shall be 6 milliohms for 16 AWG wire and 9 milliohms for 18 AWG wire.

Results:

All the contacts of each connector were tested and passed the requirements.

9.3a.9 Voltage Drop

Test Method:

The mated connector was tested using 7.5 amps on 18 AWG wire and 20 amps on 12 AWG wire with the test voltage set to be 4.50 ± 0.25 VDC open circuit. The voltage drop was recorded by deducting the reference wire measurements and dividing by two.

Requirements:

The voltage drop shall not exceed 100 millivolts.

Results:

All the samples tested passed the requirements.

9.3a.10 Vibration

Test Method:

Three wired and mated connectors as a test group were rigidly mounted to three mutually perpendicular axis and randomly vibrated for 20 hours in each axis. Vibration profile was attached in the appendix I Para. 9.3a.10. The wire harness was bent 90 degree and firmly tied to the router with tie-wraps. The free end was hooked up to the discontinuity monitor from which 100 milliamps load was applied.

Requirements:

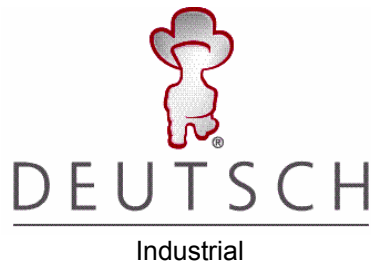
There shall be no discontinuity greater than 10 ohms in excess of 1 microsecond. Any physical damage or loosening of components are not allowed.

Results:

All the samples passed the vibration test.

9.3a.11 Low Signal Contact Resistance

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Test Method:

The mated connector was tested with applied voltage not to exceed 20 millivolts open circuit and the current limited to 100 milliamps. The contact resistance was obtained by subtracting the reference wire resistance from the test reading and dividing by two.

Requirements:

The maximum contact resistance shall be 6 milliohms for 16 AWG wire and 9 milliohms for 18 AWG wire.

Results:

All the contacts of each connector were tested and passed the requirements.

9.3a.12 Voltage Drop

Test Method:

The mated connector was tested using 7.5 amps on 18 AWG wire and 20 amps on 12 AWG wire with the test voltage set to be 4.50 ± 0.25 VDC open circuit. The voltage drop was recorded by deducting the reference wire measurements and dividing by two.

Requirements:

The voltage drop shall not exceed 100 millivolts.

Results:

All the samples tested passed the requirements.

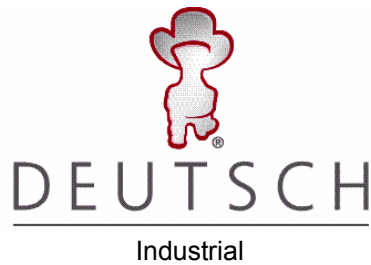
9.3a.13 Visual Inspection

Test Method:

This was the last step of this group. Each sample was visually inspected for evidence of cracking, distortion, terminal fretting or anything that could affect the performance or serviceability of the product.

Results:

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The connectors were thoroughly inspected and showed no evidence of distortion or any defects detrimental to the part function. Small crack detected in non-functional area of the bolt tower.

9.3 GROUP 3b -- VIBRATION

9.3b.1 Visual Inspection

Test Method:

3. The connectors were visually inspected for correct use of materials, proper construction, correct part number and insert markings and over-all quality of workmanship.
4. Poor molding fabrication, loose materials, damaged or improperly manufactured contacts, galling of metal parts, nicks and burrs of metal parts, torn seals or cracked plastic are considered adequate basis for rejection.

Requirements:

The connectors shall be correctly constructed, marked and shall show good quality and workmanship. Connector after conditioning shall not show signs of damage or any detectable loss of function.

Results:

The connectors were thoroughly inspected and showed no evidence of cracking, distortion or any defects detrimental to part function.

9.3b.2 Low Signal Contact Resistance

Test Method:

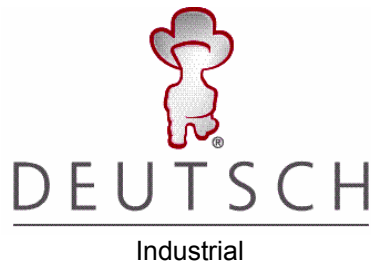
The mated connector was tested with applied voltage not to exceed 20 millivolts open circuit and the current limited to 100 milliamps. The contact resistance was obtained by subtracting the reference wire resistance from the test reading and dividing by two.

Requirements:

The maximum contact resistance shall be 6 milliohms for 16 AWG wire and 9 milliohms for 18 AWG wire.

Results:

De u t s c h Industrial



All the contacts of each connector were tested and passed the requirements.

9.3b.3 Voltage Drop

Test Method:

The mated connector was tested using 7.5 amps on 18 AWG wire and 20 amps on 12 AWG wire with the test voltage set to be 4.50 ± 0.25 VDC open circuit. The voltage drop was recorded by deducting the reference wire measurements and dividing by two.

Requirements:

The voltage drop shall not exceed 100 millivolts.

Results:

All the samples tested passed the requirements.

9.3b.4 Vibration

Test Method:

Three wired and mated connectors as a test group were rigidly mounted to three mutually perpendicular axis and randomly vibrated for 20 hours in each axis. Vibration profile was attached in the appendix I Para. 9.3.4. The wire harness was bent 90 degree and firmly tied to the router with tie-wraps. The free end was hooked up to the discontinuity monitor from which 100 milliamps load was applied.

Requirements:

There shall be no discontinuity greater than 10 ohms in excess of 1 microsecond. Any physical damage or loosening of components are not allowed.

Results:

All the samples passed the vibration test.

9.3b.5 Thermal Cycle

Test Method:

De u t s c h Industrial



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Industrial

Mated test samples were thermal cycled a total of 20 complete cycles between $-55\pm 3^{\circ}\text{C}$ and $+125\pm 3^{\circ}\text{C}$ at the rate of 3°C per minute. Test samples were remained at each temperature extreme for one hour.

Requirements:

There shall be no evidence of cracking, distortion or other damage detrimental to the normal operation of the connector.

Results:

No visual or mechanical degradation was observed following the test.

9.3b.6 Vibration

Test Method:

After thermal cycle per section 9.3b.5, the wired and mated connectors were rigidly mounted to three mutually perpendicular axis and randomly vibrated for 20 hours in each axis. Vibration profile was attached in the appendix I Para. 9.3.4. The wire harness was bent 90 degree and firmly tied to the router with tie-wraps. The free end was hooked up to the discontinuity monitor from which 100 milliamps load was applied.

Requirements:

There shall be no discontinuity greater than 10 ohms in excess of 1 microsecond. Any physical damage or loosening of components are not allowed.

Results:

All the samples passed the vibration test.

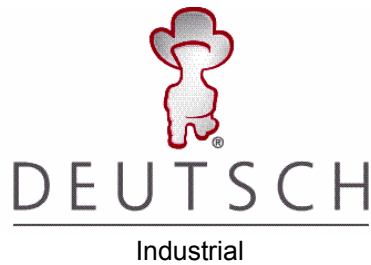
9.3b.7 Low Signal Contact Resistance

Test Method:

The mated connector was tested with applied voltage not to exceed 20 millivolts open circuit and the current limited to 100 milliamps. The contact resistance was obtained by subtracting the reference wire resistance from the test reading and dividing by two.

Requirements:

The maximum contact resistance shall be 6 milliohms for 16 AWG wire and 9 milliohms for 18 AWG wire.



Results:

All the contacts of each connector were tested and passed the requirements.

9.3b.8 Visual Inspection

Test Method:

This was the last step of this group. Each sample was visually inspected for evidence of cracking, distortion, terminal fretting or anything that could affect the performance or serviceability of the product.

Results:

The connectors were thoroughly inspected and showed no evidence of distortion or any defects detrimental to the part function. Small crack detected in non-functional area of the bolt tower.

9.4 GROUP 4 -- CHEMICAL

9.4.1 Visual Inspection

Test Method:

1. The connectors were visually inspected for correct use of materials, proper construction, correct part number and insert markings and over-all quality of workmanship.
2. Poor molding fabrication, loose materials, damaged or improperly manufactured contacts, galling of metal parts, nicks and burrs of metal parts, torn seals or cracked plastic are considered adequate basis for rejection.

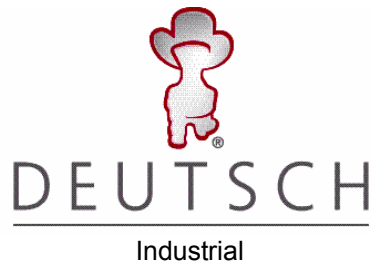
Requirements:

The connectors shall be correctly constructed, marked and shall show good quality and workmanship. Connector after conditioning shall not show signs of damage or any detectable loss of function.

Results:

The connectors were thoroughly inspected and showed no evidence of cracking, distortion or any defects detrimental to part function.

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9.4.2 Salt Exposure

Test Method:

The fully mated connectors were submerged in a fine mist of 5% by weight of salt solution for 240 hours. The salt spray chamber was maintained at $35 \pm 2^\circ\text{C}$. The free ends of wires were sealed in the service connectors with sealing plugs.

Requirements:

No evidence of corrosion on the connector or terminals after the connector is removed from the test. Test samples must meet Insulation Resistance per section 9.4.3.

Results:

No detrimental evidence of corrosion observed on the connector or terminals. Test samples were examined per section 9.4.3.

9.4.3 Insulation Resistance

Test Method:

After Salt Exposure per section 9.4.2, checked insulation resistance between each contact to all other contacts and shell using a 1000 VDC Megohmmeter.

Requirements:

The resistance shall be 10 megohms minimum.

Results:

The insulation resistance exceeded 10 megohms for all the tested samples.

9.4.4 Chemical Exposure

Test Method:

Each sample group consists of three connectors in the wired and mated condition was submerged in one fluid only as in the following table. All the fluids used in the test were not previously used.



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Fluids	Temperature	Time
Diesel Fuel #2	60°C	24 hours
Bio-Diesel Fuel (including Toyu)	60°C	24 hours
Kerosene	60°C	24 hours
Motor Oil 30wt	120°C	7 Days
Brake Fluid (disc type 1)	25°C	24 hours
50/50 Antifreeze / Water mixture	100°C	24 hours
Transmission Oil 90wt	100°C	7 Days
Urea (32.5%) / Water (67.5%)	25°C	24 hours

Requirements:

There shall be no evidence of cracking, distortion or detrimental damage to the connector following the test.

Results:

The connector shown compatibility with all the fluids as specified. No degradation to the connector appearance or performance was observed.

9.4.5 Sealing, Interior Air Pressure**Test Method:**

The mated test sample was completely submerged in the water with a pressure tubing introduced into the sealed portion of the test sample. Pressure was slowly applied from 0 to 35 kPa at a rate about 2 kPa/sec and maintained at the peak for 30 minutes minimum.

Requirements:

After 15 minutes, no air bubbles are allowed to leak from the sample.

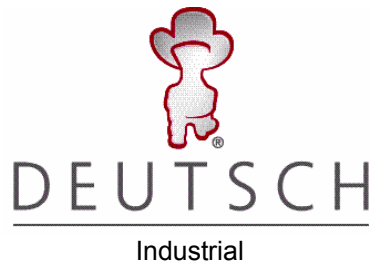
Results:

There was no air bubbles observed after the first 15 minutes.

9.4.6 Visual Inspection**Test Method:**

This was the last step of this group. Each sample was unmated and visually inspected for evidence of corrosion or anything that could affect the performance or serviceability of the product.

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Results:

There was no evidence of corrosion, leaking or detrimental damage to the test samples.

9.5 GROUP 5 -- CURRENT

9.5.1 Visual Inspection

Test Method:

1. The connectors were visually inspected for correct use of materials, proper construction, correct part number and insert markings and over-all quality of workmanship.
2. Poor molding fabrication, loose materials, damaged or improperly manufactured contacts, galling of metal parts, nicks and burrs of metal parts, torn seals or cracked plastic are considered adequate basis for rejection.

Requirements:

The connectors shall be correctly constructed, marked and shall show good quality and workmanship. Connector after conditioning shall not show signs of damage or any detectable loss of function.

Results:

The connectors were thoroughly inspected and showed no evidence of cracking, distortion or any defects detrimental to part function.

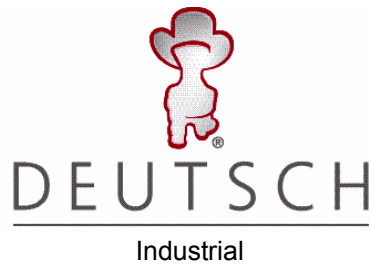
9.5.2 Thermal Cycle

Test Method:

Mated test samples were thermal cycled a total of 20 complete cycles between $-55\pm 3^{\circ}\text{C}$ and $+125\pm 3^{\circ}\text{C}$ at the rate of 3°C per minute. Test samples were remained at each temperature extreme for one hour.

Requirements:

There shall be no evidence of cracking, distortion or other damage detrimental to the normal operation of the connector.



Results:

No visual or mechanical degradation was observed following the test.

9.5.3 Current Cycling

Test Method:

The mated test sample was connected in a series circuit and applied by a current of 10 amps on 16 AWG wire and 30 amps on 10 AWG wire. Test samples were subjected to a total of 500 cycles divided by two stages:

- a) Test samples were placed in a thermal chamber at ambient of $+125\pm 3^{\circ}\text{C}$ for 200 cycles, each cycle consisted of 45 minutes with current on and 15 minutes with current off.
- b) Test samples were placed in a thermal chamber for 50 cycles, each cycle consisted of 20 minutes with current on at $+125\pm 3^{\circ}\text{C}$ and 60 minutes with current off at $+21\pm 3^{\circ}\text{C}$. Current was off during the temperature transition.

Requirements:

Test samples must pass Voltage Drop per section 9.5.4.

Results:

Examined samples per section 9.5.4.

9.5.4 Voltage Drop

Test Method:

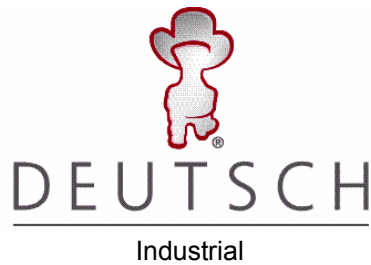
The mated connector was tested using 10 amps on 16 AWG wire and 30 amps on 10 AWG wire with the test voltage set to be 4.50 ± 0.25 VDC open circuit. Average voltage drop of each contact pair was obtained by deducting the reference wire measurements and dividing by the total number of terminals.

Requirements:

The voltage drop shall not exceed 100 millivolts.

Results:

All the samples tested passed the requirements.



9.5.5 Visual Inspection

Test Method:

This was the last step of this group. Each sample was visually inspected for evidence of burning, distortion, crimp relaxation or anything that could affect the performance or serviceability of the product.

Results:

The connectors were thoroughly inspected and showed no evidence of burning, distortion or any defects detrimental to the part function.

9.6 GROUP 6 -- SEALING / ENVIRONMENTAL

9.6.1 Visual Inspection

Test Method:

1. The connectors were visually inspected for correct use of materials, proper construction, correct part number and insert markings and over-all quality of workmanship.
2. Poor molding fabrication, loose materials, damaged or improperly manufactured contacts, galling of metal parts, nicks and burrs of metal parts, torn seals or cracked plastic are considered adequate basis for rejection.

Requirements:

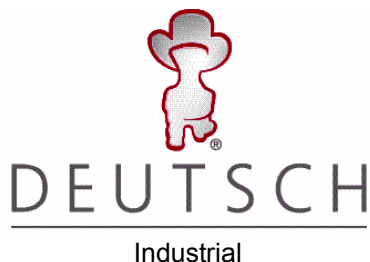
The connectors shall be correctly constructed, marked and shall show good quality and workmanship. Connector after conditioning shall not show signs of damage or any detectable loss of function.

Results:

The connectors were thoroughly inspected and showed no evidence of cracking, distortion or any defects detrimental to part function.

9.6.2 Temperature / Humidity

Test Method:



Mated test connectors were placed in a temperature / humidity chamber and were subjected to 42 cycles described as follows:

- a) Chamber temperature was raised to 55 °C at 3 °C/min and held for 16 hours at a relative humidity of 95%.
- b) Chamber temperature was lowered to -20 °C at 3 °C/min and held for 2 hours at a relative humidity of 0%.
- c) Chamber temperature was raised to 125 °C at 3 °C/min and held for 2 hours at a relative humidity of 0%.
- d) Chamber temperature was lowered to 25 °C at 3 °C/min and held for remainder of 24 hours cycle at a relative humidity of 95%.

Requirements:

Test samples must pass Insulation Resistance per section 9.6.3.

Results:

Examined samples per section 9.6.3.

9.6.3 Insulation Resistance

Test Method:

After Temperature / Humidity per section 9.6.2, checked insulation resistance between each contact to all other contacts and shell using a 1000 VDC Megohmmeter.

Requirements:

The resistance shall be 10 megohms minimum.

Results:

The insulation resistance exceeded 10 megohms for all the tested samples.

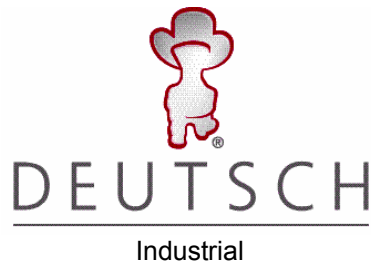
9.6.4 Thermal Shock Liquid Dunk

Test Method:

The wired mated test samples were placed in an oven at +125±3°C for two hours and then immediately be placed in water with 5% salt by weight content and 0.1g/L wetting solution to a depth of 1 meter for 30 minutes. The free ends of wires were sealed and remained out of the water.

Requirements:

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Test samples must meet Insulation Resistance per section 9.6.5.

Results:

Inspected samples per section 9.6.5.

9.6.5 Insulation Resistance

Test Method:

After Thermal Shock Liquid Dunk per section 9.6.4, checked insulation resistance between each contact to all other contacts and shell using a 1000 VDC Megohmmeter.

Requirements:

The resistance shall be 10 megohms minimum.

Results:

The insulation resistance exceeded 10 megohms for all the tested samples.

9.6.6 Visual Inspection

Test Method:

Each sample was visually inspected for anything that could affect the performance or serviceability of the product.

Results:

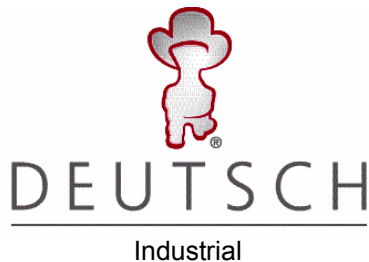
There was no evidence of leaking, cracking or detrimental damage to the test samples.

9.6.7 Sealing, Interior Air Pressure

Test Method:

The mated test sample was completely submerged in the water with a pressure tubing introduced into the sealed portion of the test sample. Pressure was slowly applied from zero to 35 kPa at a rate about 2 kPa/sec and maintained at the peak for 30 minutes minimum.

Requirements:



After 15 minutes, no air bubbles are allowed to leak from the sample.

Results:

There was no air bubbles observed after the first 15 minutes.

9.6.8 Sealing, External Air Pressure

Test Method:

The mated test sample was placed in the sealed pressure chamber with vent tube attached. A 35 ± 5 kPa dry compressed air source was applied to the chamber for 30 minutes minimum.

Requirements:

No air bubbles are allowed to exit the vent tube after the first fifteen minutes.

Results:

Slow bubbles were observed coming out of the venting tube after the first fifteen minutes. Testing apparatus might have issues which could lead to the slow leakage.

9.6.9 Terminal Retention Axial

Test Method:

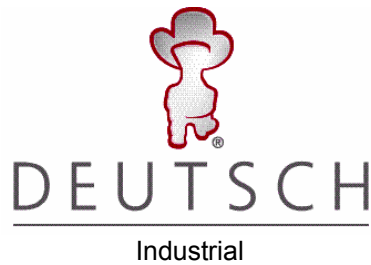
The socket in the plug was axially loaded by the force of 89N (20 lbf) on the 20 size contact and 111 N (25 lbf) on the 12 size contact. The force was applied at a uniform rate of 0.189 in/min. Terminal position assurance device was utilized and in the locked position during the test. Eight sockets of the 20 size contact and one socket of the 12 size contact were tested.

Requirements:

1. The contact displacement shall not exceed 0.8mm for both 20 size and 12 size contact.
2. The maximum bearing load for the 20 size contact and 12 size contact before separation shall be greater than 89N (20 lbf) and 111N (25 lbf) respectively.

Results:

Please refer to the lab test form Para 9.6.9 in the appendix I for the results.



9.6.10 Terminal Retention Rotation

Test Method:

The wired test sample was rigidly mounted on the table such that the wires could hang downward vertically. A 4.54 kg (10 lbs) weight was affixed to the end of a 610 mm (2 feet) long wire. Each socket in the cavity was rotated by five full turns by spinning the weighted wire. Eight sockets of the 20 size contact and one socket of the 12 size contact were tested.

Requirements:

There shall be no mechanical degradation or discontinuity following the test.

Results:

Please refer to the lab test form Para 9.6.10 in the appendix I for the results.

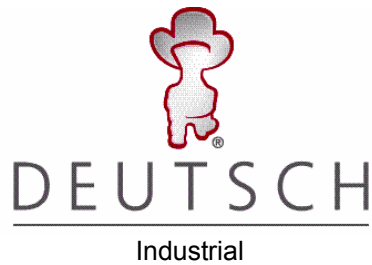
9.6.11 Visual Inspection

Test Method:

This was the last step of this group. Each sample was unmated and visually inspected for evidence of leaking, cracking or anything that could affect the performance or serviceability of the product.

Results:

There was no evidence of leaking, cracking or detrimental damage to the test samples.



10.0 CONCLUSION

10.1 Group 1 -- Sealing

Group 1 contained twenty samples that were tested to confirm thermal and sealing performance.

All the samples in group 1 passed all aspects of the tests.

10.2 Group 2 -- Mechanical

Group 2 contained three samples that were tested to confirm mechanical performance.

All the samples in group 2 passed all aspects of the tests.

10.3 Group 3 -- Vibration

Group 3 contained six samples that were tested to determine the effects of vibration within the predominant or random vibration frequency ranges and magnitudes that may be encountered during the life of the connector.

All the samples in group 3 passed all aspects of the tests.

10.4 Group 4 -- Chemical

Group 4 contained twenty-four samples that were tested to determine the ability of an electrical connector to resist degradation when exposed to specific fluids and salt laden atmosphere with which the connector may come into contact during its service life.

All the samples in group 4 passed all aspects of the tests.

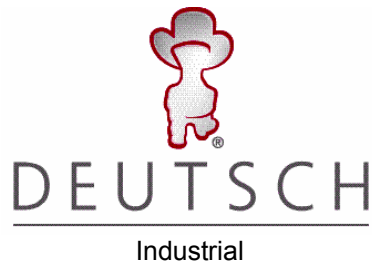
10.5 Group 5 -- Current

Group 5 contained three samples that were tested to evaluate contact resistance characteristics of electrical contacts and effects of crimp relaxation under current and thermal cycling.

All the samples in group 3 passed all aspects of the tests.

10.6 Group 6 -- Sealing / Environmental

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Group 6 contained three samples that were tested to evaluate the properties of materials used in connectors as they are influenced or deteriorated by the effects of high humidity at various temperatures and heat condition.

All the samples in group 6 passed all aspects of the tests.

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