

## HD10 Series Connector System

### 1. SCOPE

#### 1.1. Content

This specification covers performance, tests and quality requirements for the TE Connectivity (TE) HD10 Series Connector System.

#### 1.2. Qualification

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

#### 1.3. Qualification

Successful qualification testing on the subject product line was completed in 1985. The Qualification Test Report number for testing is 501-151034. This documentation is on file at and available from Product Engineering, Industrial Commercial Transportation. (ICT)

### 2. APPLICABLE DOCUMENTS AND FORMS

The following documents and forms constitute a part of this specification to the extent specified herein. Unless otherwise indicated, the latest edition of the document applies.

#### 2.1. TE Connectivity (TE) Documents

- [109-1](#): General Requirements for Testing
- [114-151000](#): Application Specification DEUTSCH Size 16 S&F Pin & Socket (16-01)
- [114-151001](#): Application Specification DEUTSCH Size 16 S&F Pin & Socket (16-12 & 16-14)
- [114-151002](#): Application Specification DEUTSCH size 12 S&F Pin & Socket (12-01)
- [114-151004](#): Application Specification DEUTSCH Size 4-20 HD Solid Contacts
- [114-151006](#): Application Specification DEUTSCH size 12 S&F Pin & Socket (12-02)
- [408-151007](#): Instruction Guide DEUTSCH Extraction Tools for Rear-Release Connectors
- [501-151034](#): HD10 Qualification Test Report
- Part Numbers

X refers to N, E seal type. XXXX refers to special modification.

HD10-3-16PX-XXXX	3 pin Rcpt, Flange	HD14-3-16PX-XXXX	3 pin Rcpt, Inline	HD16-3-16SX-XXXX	3 pin Plug
HD10-3-96PX-XXXX	3 pin Rcpt, Flange	HD14-3-96PX-XXXX	3 pin Rcpt, Inline	HD16-3-96SX-XXXX	3 pin Plug
HD10-4-4PX-XXXX	4 pin Rcpt, Flange	HD14-5-16PX-XXXX	5 pin Rcpt, Inline	HD16-4-4SX-XXXX	4 pin Plug
HD10-5-16PX-XXXX	5 pin Rcpt, Flange	HD14-6-12PX-XXXX	6 pin Rcpt, Inline	HD16-5-16SX-XXXX	5 pin Plug
HD10-6-12PX-XXXX	6 pin Rcpt, Flange	HD14-6-14PX-XXXX	6 pin Rcpt, Inline	HD16-6-12SX-XXXX	6 pin Plug
HD10-6-14PX-XXXX	6 pin Rcpt, Flange	HD14-6-16PX-XXXX	6 pin Rcpt, Inline	HD16-6-16SX-XXXX	6 pin Plug
HD10-6-16PX-XXXX	6 pin Rcpt, Flange	HD14-6-96PX-XXXX	6 pin Rcpt, Inline	HD16-6-96SX-XXXX	6 pin Plug
HD10-6-96PX-XXXX	6 pin Rcpt, Flange	HD14-9-16PX-XXXX	9 pin Rcpt, Inline	HD16-9-16SX-XXXX	9 pin Plug
HD10-9-16PX-XXXX	9 pin Rcpt, Flange	HD14-9-1939PX-XXXX	9 pin Rcpt, Inline	HD16-9-1939SX-XXXX	9 pin Plug
HD10-9-1939PX-XXXX	9 pin Rcpt, Flange	HD14-9-96PX-XXXX	9 pin Rcpt, Inline	HD16-9-96SX-XXXX	9 pin Plug
HD10-9-96PX-XXXX	9 pin Rcpt, Flange				

## 2.2. Industry Documents

- DIN 40050-9: Road vehicles Degrees of Protection (I P Code)
- DIN 72551-6: Road Vehicles—Low-Tension Cables—Part 6: Single-Core, Unscreened with Thin Insulation Wall; Dimensions, Materials, Marking
- IEC 60529: Degrees of Protection Provided by Enclosures (IP Code)
- ISO 6722: Road Vehicles—60 V and 600 V Single-Core Cables—Dimensions, Test Methods, and Requirements
- MIL-STD-202: Test Method Standard Electronic and Electrical Components Part
- MIL-STD-1344: Test Methods for Electrical Connectors
- SAE J1128: Low Voltage Primary Cable
- SAE J2030: Heavy-Duty Electrical Connector Performance Standard

## 3. REQUIREMENTS

### 3.1. Design and Construction

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

### 3.2. Ratings

- Voltage: 250 VAC/DC
- Current (Amp): See Figure 1

Contact Size	Wire Size AWG [mm <sup>2</sup> ]	All Circuits Energized (A) Max
4	4 [21.0-25.0]	100
	6 [13.0-16.0]	
12	12 [2.5-3.0]	25
	14 [2.0]	18
16	14 [2.0]	13
	16 [1.0-1.5]	
	18 [0.75]	10
	20 [0.5]	7.5

Figure 1

- Temperature: -55°C to +125°C
- Ingress Protection (IP) Level: IP68 and IP6K9K (with rear protection, such as backshell)
- Flammability (Inline, E28476): V-1. Parts have been successfully tested to the 20 mm Flame Test per Standard UL-94
- Flammability (Header): Not Tested

## 3.3. Test Requirements and Procedures Summary.

Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

Test Description	Requirement	Procedure
Examination of Product	The connectors shall be correctly constructed, marked and shall show good quality and workmanship	MIL-STD-1344 Visually inspected for use of materials, proper construction, correct part number and insert markings and over-all quality of workmanship. 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 were considered adequate basis for rejection.
<b>ELECTRICAL</b>		
Low Level Contact Resistance	6 mΩ max. (16 AWG) 7.5 mΩ max. (18 AWG) 11 mΩ max. (20 AWG)	MIL-STD-1344, Method 3002.1 Test current shall be 100 mA max with an open circuit test voltage of 20 mV maximum. The resistance of an equal length of wire shall be subtracted from all readings to determine the added resistance of the terminal.
Contact Resistance	60 mV max (solid contact) 100 mV max (S&F contact)	MIL-STD-1344, Method 3004.1 Test current per below with applied voltage of 12 VDC max open circuit. The resistance of an equal length of wire shall be subtracted from all readings to determine the added resistance of the terminal. Size 4 (4-6 AWG): 100A Size 12 (10-12 AWG): 25A Size 12 (14 AWG): 18A Size 16 (12-16 AWG): 13A Size 16 (18 AWG): 10A Size 16 (20 AWG): 7.5A
Insulation Resistance 1	1000 MΩ min.	MIL-STD-1344, Method 3003.1 Check each contact to all other contacts and the shell, if the shell is conductive. Use a 500 VDC megohmmeter.
Insulation Resistance 2	20 MΩ min.	J2030 Check each contact to all other contacts and the shell, if shell is conductive. Test to be performed using a 1000 VDC megohmmeter.
Dielectric Withstanding Voltage	No evidence of breakdown or flashover or current leakage in excess of 2.0 milliamps.	MIL-STD-1344, Method 3001.1 Check each contact to all other contacts and the shell electrically connected together for breakdown / flashover when subjected to a 1500 VAC test potential for a period of 1 minute.

Figure 2 Cont.

MECHANICAL		
Test Description	Requirement	Procedure
Maintenance Aging	There shall be not visible change or damage to the contact cavities	MIL-STD-1344, Method 2002.1 Subject 10% of the cavities to 10 cycles of inserting and removing its respective contact. Insert by hand, remove using removal tool.
Contact Retention	The contact shall remain in place	MIL-STD-1344, Method 2007.1 Subject each wired contact to an applied per below for a period of 15 seconds in a direction tending to push the contact or of the rear of the connector. Size 4: 35 lbf Size 12: 30 lbf Size 16: 25 lbf
Durability	No evidence of damage to the contacts, contacting plating, connector housing or seals detrimental to reliable connector performance. Coupling torque must not increase as a result of cycling past the point where it can reasonably be done by hand.	MIL-STD-1344, Method 2016 The connector shall be mated and unmated for a total of 100 complete cycles at room temperature.
Tool Abuse	There shall be no visible damage to the connector seals or contact cavities.	Use the applicable removal tool shall be inserted into the connector. With an axial load of 5 lbf applied, the tool shall be rotated 180° and then removed, also removing the terminal. Repeat 3 times.
Vibration	No discontinuity in excess of 1.0 $\mu$ s at 100 mA during the last hour of each axis. Shall meet visual requirements, show no physical damage and meet requirements of additional tests as needed.	MIL-STD-1344, Method 2005.1 Sine Sweep: 10 to 2000 Hz Sweep Cycle: 20 minutes Initial Displacement: .07 inch DA max Max Acceleration: 20G's Test Duration: 12 hours Time Per Axis X, Y, Z: 4 hours Test Current first 3 hours each axis: Size 4 (4-6 AWG): 46A Size 12 (10-12 AWG): 17A Size 12 (14 AWG): 14A Size 16 (12-16 AWG): 10A Size 16 (18 AWG): 8A Size 16 (20 AWG): 5A
Shock	No discontinuity in excess of 1.0 $\mu$ s at 100 mA during the last hour of each axis. Shall meet visual requirements, show no physical damage and meet requirements of additional tests as needed.	MIL-STD-1344, Method 2004.1 10 cycles of ½ sine pluses, 50g $\pm$ 15%, 11 $\pm$ 1 ms duration X and Z axis are to be tested.
External Bending Moment	No discontinuity in excess of 1.0 $\mu$ s at 100 mA during the test.	Mount the receptacle panel mounted in normal service to a rigid plane. Apply a 250 in-lbf bending moment at a rate of 1.0 lbf per second for 60 seconds.

Figure 2 Cont.

Test Description	Requirement	Procedure											
Insert Retention	The inserts shall retain their proper location inside the housing. There shall be no evidence of cracking, breaking, separation from housing or loose parts.	MIL-STD-1344, 2010.1 Apply a pulling force of 100 lbf at a rate of 10 lbf per second to the wire bundle that exist the rear of the connector for a period of 30 seconds.											
Coupling/ Uncoupling Torque	Coupling torque for mating and unmating connectors to be <table border="1" data-bbox="532 472 945 693"> <thead> <tr> <th>Shell Size</th> <th>Min Uncoupling Torque (in-lbf)</th> <th>Max Coupling Torque (in-lbf)</th> </tr> </thead> <tbody> <tr> <td>3</td> <td rowspan="5">1.00</td> <td rowspan="4">8.00</td> </tr> <tr> <td>4</td> </tr> <tr> <td>5</td> </tr> <tr> <td>6</td> </tr> <tr> <td>9</td> <td>10.00</td> </tr> </tbody> </table>	Shell Size	Min Uncoupling Torque (in-lbf)	Max Coupling Torque (in-lbf)	3	1.00	8.00	4	5	6	9	10.00	MIL-STD-1344, Method 2013.1 The receptacle connector of each sample mated pair shall be mounted on a torque testing fixture and stay stationary.
Shell Size	Min Uncoupling Torque (in-lbf)	Max Coupling Torque (in-lbf)											
3	1.00	8.00											
4													
5													
6													
9		10.00											
<b>ENVIRONMENTAL</b>													
Test Description	Requirement	Procedure											
Temperature Life	No evidence of physical damage which may be detrimental to reliable connector performance. Must meet functional tests.	MIL-STD-1344, Method 1005.1 Subject the wired mated connectors to 1000 hours at +125°C without current flowing.											
Thermal Shock 1	There shall be no evidence of cracking, distortion or detrimental damage to the connector following the test. Meet insulation resistance 500 MΩ minimum with 500 VDC applied.	MIL-STD-1344, Method 1003.1 Cycle mated connectors for 30 minutes at -67°F followed by 30 minutes at +257°F with 2 minute max transfer time. Repeat for 5 cycles. Insulation resistance measured during last heat cycle.											
Thermal Shock 2	There shall be no evidence of cracking, distortion or detrimental damage to the connector following the test.	SAE J2030 Subjected test sample to 10 cycles. One cycle is -55°C soak then transition within 2 min to +125°C soak then transition back to -55°C within 2 min. Soak times shall be the time needed to bring the internal connector temperature to within 5°C of each of the ambient temperatures.											
Salt Spray	There should be no evidence of corrosion on the connector or terminals after the connector is removed from the test and cleaned with tap water.	MIL-STD-1344, Method 1001.1 Connector shall be fully mated, then submerged in a fine mist of 5% by weight of salt solution for 96 hours. After test, rinse samples with warm (~38°C) tap water while using soft-hair brush. Dry for 16 hours max at 38°C. Inspect											

Figure 2 Cont.

Test Description	Requirement	Procedure
Altitude Immersion	Dielectric withstanding voltage. No evidence of breakdown or flashover or current leakage in excess of 2.0 mA.	MIL-STD-1344, Method 1004.1 Completely submerge sample in a container with tap water and placed in an altitude chamber with reduced pressure to 32.68 torr and maintained for 30 minutes, then returned to atmospheric pressure within 1 minute and maintained for another 30 minutes. Repeat 3 time. After the 3 <sup>rd</sup> cycle while samples are submerged in water test DWV.
Fluid Immersion	There shall be no evidence of cracking, distortion or detrimental damage to the connector following the test.	MIL-STD-1344, Method 1016 Subject each connector to one fluid only. The wired mated connectors shall be submerged in the fluids below at ambient temperature. Each connector shall be submerged for 5 minutes, then removed from the fluid to air dry for 24 hours. This cycle is to be completed a total of 5 cycles. -Motor Oil 30 weight -Brake Fluid (disc type 1) -Gasoline -Diesel Fuel #2 -Antifreeze Solution (max protection) -Gear Oil 90 weight
Protection Against Dust (IP6KX)	No dust visible inside mated connectors.	DIN 40050-9 Subject specimens to 20 cycles of 6seconds movement of air/dust mixture, pause of 15 minutes.
Protection Against Water (IPX8)	Insulation Resistance: 20 MΩ minimum.	IEC 60529 Subject specimens to immersion in water: 1m for 4 hours.
Protection Against High Pressure/Steam Jet Cleaning (IPX9K)	Insulation Resistance: 20 MΩ minimum.	DIN 40050-9 Subject specimens to water fan with rotational speed 5±1°/min, water flow 14- 16 l/min, water pressure 800-1000 kP, water temperature 80±5 °C for 30 seconds per position. Spray positions: 0°, 30°, 60°, 90°

Figure 2 End

## 3.4. Product Qualification and Requalification Test Sequence

Test or Examination	Test Group No. (a)								
	1	2	3	4	5	6	7	8	9
	Test Sequence (b)								
Examination of Product	1,13	1,13	1,14	1,12	1,11	1,11	1,6	1,6	1,6
Insulation Resistance 1	2	2	2	2	2	2			
Insulation Resistance 2							2,5	2,5	2,5
Dielectric Withstanding Voltage	3	3	3	3	3	3			
Maintenance Aging	4		4						
Temperature Life		4		4		4			
Contact Retention	5		5						
Durability		5	6		4				
Tool Abuse				5	5				
Salt Spray		6	7			5			
Altitude Immersion				6	6	6			
Fluid Immersion	6	7	8	7	7	7			
Thermal Shock 1	7	8				8			
Thermal Shock 2							3	3	3
Vibration	8		9	8					
Shock	9		10	9					
External Bending Moment		9	11			9			
Insert Retention	10			10	8				
Low Level Contact Resistance		10	12						
Coupling/Uncoupling Torque	11	11			9				
Contact Resistance	12	12	13	11	10	10			
Protection Against Dust (IP6KX)							4		
Protection Against Water (IPX8)								4	
Protection Against High Pressure/Steam Jet Cleaning (IPX9K)									4

**i** **NOTE**

- a) Specimens were prepared in accordance production drawings and were selected at random from current production.
- b) Numbers indicate sequence that tests were performed.
- c) Specimens shall consist of 9-16 pin arrangement connectors with DEUTSCH solid terminal size 16 nickel plated pin and socket contacts 16 AWG GXL wire.
- d) Crimp characteristics (i.e. height, width, etc.) shall be checked prior to testing.
- e) All unsealed cavities shall be secured with sealing plugs. To prevent capillary action on the sealed connector, all free wire ends and test points (i.e. millivolt test connection) shall be sealed with alcohol-based RTV silicone or equivalent and covered with heat shrink tubing.

#### 4. REVISION HISTORY

Rev	Brief Description of Change	Date	Dwn	Apvd
A	Initial Release	17-May-19	David Meyer	David Meyer
A1	Corrected Coupling/Uncoupling Torque table title typo. No changes to values. Min Uncoupling Torque (in-lbf) Max Coupling Torque (in-lbf)	3-Jun-19	David Meyer	David Meyer
B	Page 2, Sec 3.2. Clarified Flammability (Inline) Page 2, Sec 3.2. Added Flammability (Header): Not Tested	11-Oct-22	David Meyer	Irina Grantcharova
C	Page 2, Sec 3.2. Flammability (Inline) Added V-1 & UL file number	17-Feb-23	David Meyer	Irina Grantcharova