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IPX8 High Temperature Process Product Specifications

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1.0 SCOPE

This specification defines the performance of USB Type-C IPX8 high temperature process waterproofing products.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. In the event of conflict between the requirements of this specification and the product drawing, the product drawing shall take precedence. In the event of conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.

2.1 COMMERCIAL STANDARDS AND SPECIFICATION

EIA-364 ELECTRICAL CONNECTOR/SOCKET TEST PROCEDURES INCLUDING ENVIRONMENTAL CLASSIFICATIONS
IEC INTERNATIONAL ELECTRO-TECHNICAL COMMISSION
MIL AMERICAN MILITARY STANDARD

3.0 REQUIREMENTS

3.1 DESIGN AND CONSTRUCTION

Product shall be of the design, construction and physical dimensions specified on the applicable product drawing.
Solder components shall meet Lead-Free soldering requirements and the connectors shall be RoHS & Halogen Free Compliant.

3.2 MATERIALS

A. Housing: High Temperature Plastic ; Receptacle tongue : High Temperature Plastic
C. Contact (Terminal) : copper alloy
Finish: (a) contact area: gold plating
(b) solder area: gold plating or tin plating
(c) underplated: nickel plating
D. Emc & Latch : stainless steel, Finish: nickel plating overall.
E. Shell: stainless steel, Finish: nickel plating overall.

3.3 OPERATING CONDITIONS

3.3.1 The operating temperature is the ambient temperature range between which the component can be operated continuously at rated voltage and current.
Current Rating: 5A min, Voltage Rating: 5V/20V
Operating temperature range: -40℃ to 85℃

3.4 STORAGE CONDITIONS

3.4.1 Storage conditions are only applied to original packaging, invalid if the package is opened.
The storage temperature is the ambient temperature range between which the component can be stored without load. (Not laboratory reliability test of high temperature and high humidity test environment)
Storage and Shipping temperature: 5℃ to 30℃
Humidity: 25%~75%. non- condensing
Storage period: 6 months (calculate starts from the shipping date based on package label, not product date code)

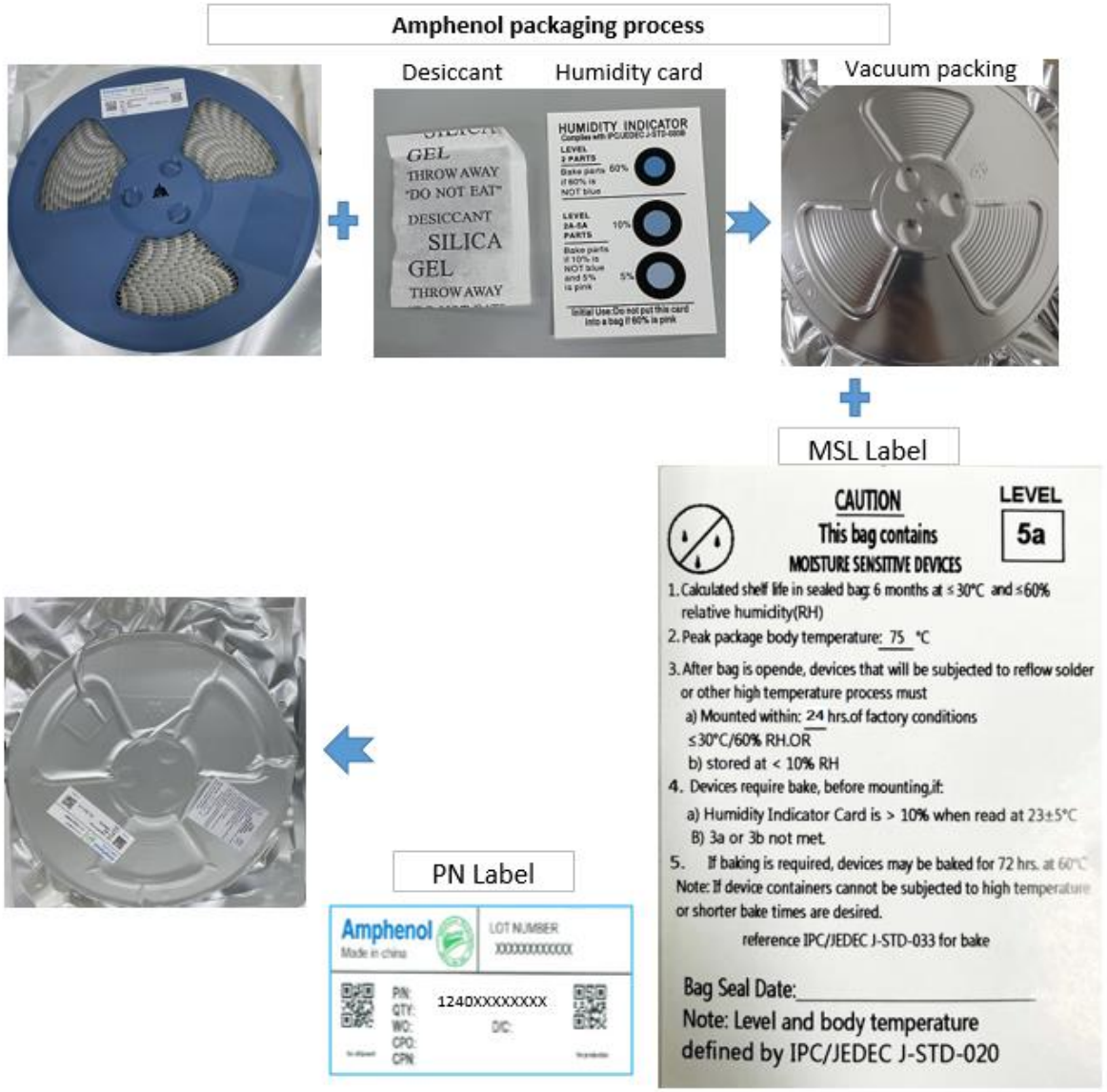
3.5 PACKAGING AND PRECAUTIONS FOR CUSTOMER USING IN WORKSHOP

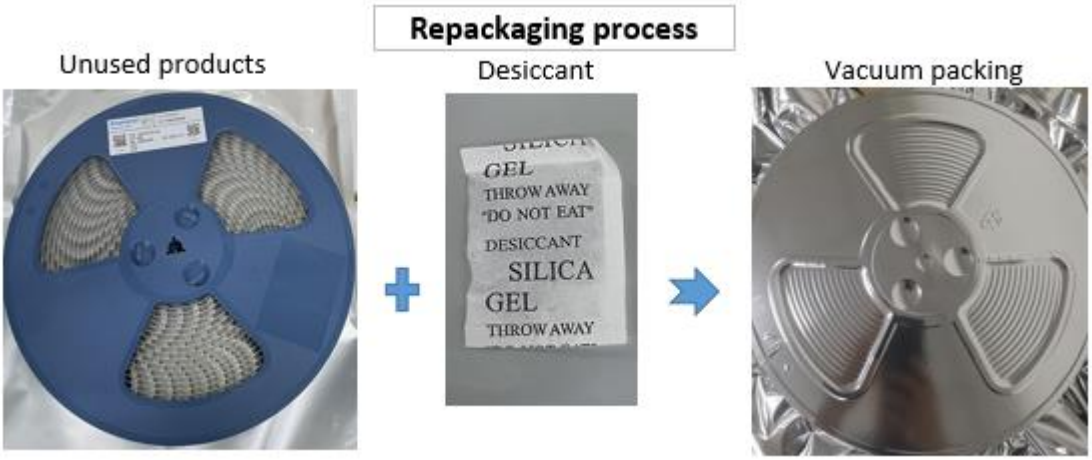
3.5.1 Amphenol packaging process

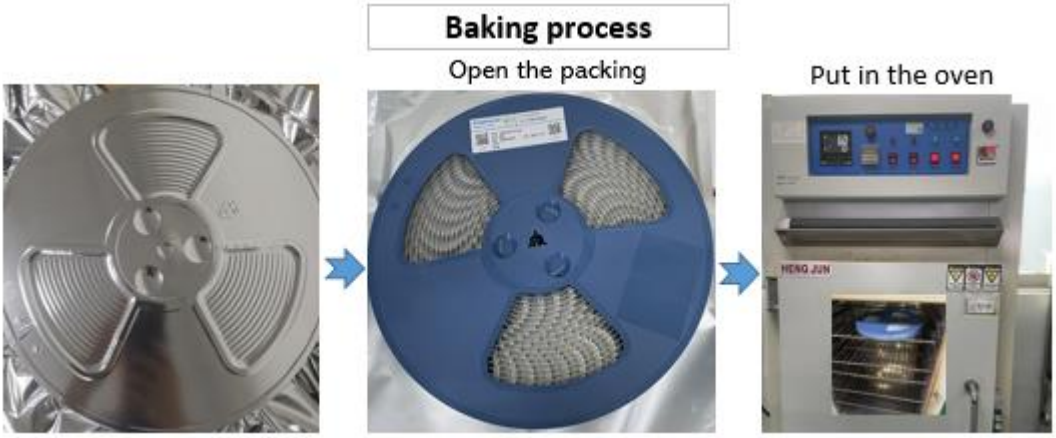
The product is packed in the carrier belt, put into aluminum foil bag for vacuum packaging together with desiccant & moisture sensitive label, and then paste MSL&PN label, details please refer to below pictures.

3.5.2 Precautions for customer using in workshop

1. IPX8 connectors in workshop should follow MSL grade 5a, in the conditions of temperature ≤ 30℃, humidity ≤ 60%. (it is ambient temperature/humidity not LAB condition)
2. It is recommended that customers use it up within 24 hours after unpacking. Details please refer to MSL label as below.
3. After unpacking, those connectors which have not been used up for more than 24 hours are suggested to be vacuum-packed with desiccant, and then recommended to be baked based on below baking process(item4) before being put into use (SMT) again.
4. Baking process: remove the connectors from the vacuum packaging of aluminum foil bag, put it into the oven with the carrier, and bake it at 60℃ for 72 hours.
5. If customer's storage & floor life didn't follow MSL 5a and above suggestions, it will impact the air leakage performance after SMT reflow.







3.6 TEST REQUIREMENTS AND PROCEDURES SUMMARY

3.6.1 TEST CONDITION

The product is designed to meet the electrical, mechanical and environmental Performance requirements specified in Para. 3.5.

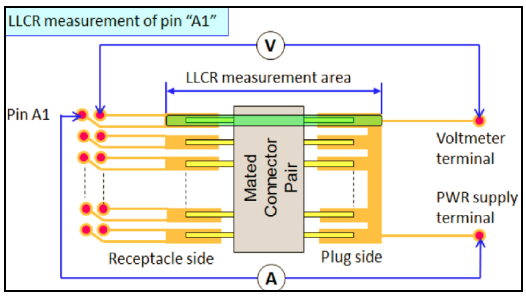
Temperature range: 25℃±10℃

Humidity range: 25%~85%

3.6.2 EXAMINATION

ITEM	DESCRIPTION	REQUIREMENT	PROCEDURED
1	Examination of Product	Meets requirements of product drawing	Visual inspection No physical damage

3.6.3 ELECTRICAL

ITEM	DESCRIPTION	Performance Requirement	Test Procedure
1	Low Level Contact Resistance （LLCR）	The following requirements apply to the power and signal contacts: 40 mΩ (max) initial for VBUS, GND and all other contacts. 50 mΩ maximum after initial measurement.	EIA-364-23 Measure at 20 mV (Max) open circuit at 100 mA. The low level contact resistance (LLCR) measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle. The test boards shall be provided with the connectors to be tested. 
2	Insulation Resistance	A minimum of 100 MΩ insulation resistance is required between adjacent contacts of unmated and mated connectors.	EIA-364-21 100 MΩ Min Initial, Add100 V DC Applicable to both receptacle and plug.
3	Dielectric Withstanding Voltage	100 Volts AC (RMS) is applied between adjacent contacts of unmated and mated connectors.	EIA-364-20 Measurement per Method B. Applicable to both receptacle and plug. No Breakdown
4	Contact Current Rating	When current is applied to the contacts, the temperature rise shall not exceed limit at the location defined in Appendix C.	EIA 364-70 - Method B See Appendix C

3.6.4 MECHANICAL

ITEM	DESCRIPTION	REQUIREMENT	PROCEDURED
1	Insertion Force	The initial connector insertion force shall be within the range from 5 N to 20 N This requirement does not apply to the plugs that are used for direct docking without a cable.	EIA-364-13 At a maximum rate of 12.5 mm (0.492") per minute.
2	Extraction Force	8 N to 20 N measured after a preconditioning of five insertion/extraction cycles 6 N to 20 N after the specified insertion/extraction or durability cycles.	EIA-364-13 at a maximum rate of 12.5 mm (0.492") per minute (This requirement does not apply when the connectors are used in a mechanical docking application.)
3	Durability	No evidence of physical damage	EIA 364-9 Cycle rate of 500 ± 50 cycles per hour (total of 10,000 plug/unplug cycles, flipping every 2,500 cycles).

4	Vibration	After test contact resistance 50 mΩ Max. Discontinuity less than 1µs and no physical damage.	EIA-364-28D
5	4-Axis Continuity Test	No discontinuities greater than 1 microsecond duration in any of the four orientations tested.	See Appendix D for detailed test fixtures and procedures. Plug and Receptacle: Subject the mating interface to the moments defined in Appendix D for at least 10 seconds.

3.6.5 ENVIRONMENTAL

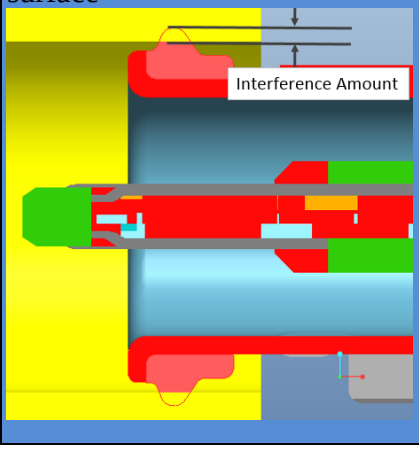
ITEM	DESCRIPTION	REQUIREMENT	PROCEDURED
1	Temperature Life	Appearance: No damage Low level contact resistance 50 mΩ (Max)	EIA 364-17, Method A. 105º C without applied voltage for 120 hours. 105º C without applied voltage for 72 hours when used as preconditioning.
2	Cyclic temperature and humidity	After test contact resistance 50 mΩ Max. no physical damage.	EIA-364-31 Cycle the connector between 25 °C ±3 °C at 80 % ±3% RH and 65 °C ±3 °C at 50 % ±3% RH. Ramp times should be 0.5 hour and dwell times should be 1.0 hour. Dwell times start when the temperature and humidity have stabilized within the specified levels. Perform 24 such cycles.
3	Mixed Flow Gas	After test contact resistance 50 mΩ Max. no physical damage.	EIA 364-65,Class II A Samples should be placed in an environmentally controlled 'test chamber' that is monitored by a gas analyzing system for controlled concentrations of the specified gas mixture. Test coupons shall also be used and the weight gain reported. Test duration is 7 days.
4	Thermal Shock	After test contact resistance 50 mΩ Max. no physical damage.	EIA-364-32, test condition I 10 cycles with the exception of exposure times. Place a thermocouple in the center of the largest mass component of the connector that is in the center of the test chamber to insure that the contacts reach the temperature extremes before ramping to the other temperature.
5	Thermal disturbance	After test contact resistance 50 mΩ Max. no physical damage.	Cycle the connector or socket between 15 °C ±3 °C and 85 °C ± 3 °C, as measured on the part. Ramps should be a minimum of 2 °C per minute, and dwell times should insure that the contacts reach the temperature extremes (a minimum of 5 minutes). Humidity is not controlled. Perform 10 such cycles.

6	Salt spray	After test contact resistance 50 mΩ Max. no corrosion.	EIA-364-26B Test condition B At temp.35°±2°cR/H95-98% Salt NaCl Mist5%,48 hours continuous spray for FG,No cleaning and brush, 35 degree baking Within no more than 16hours
7	Resistance to soldering heat	Meets requirements of product drawing. No physical damage.	Solder temperature: 245°+0°/-5° Period: 10 sec.

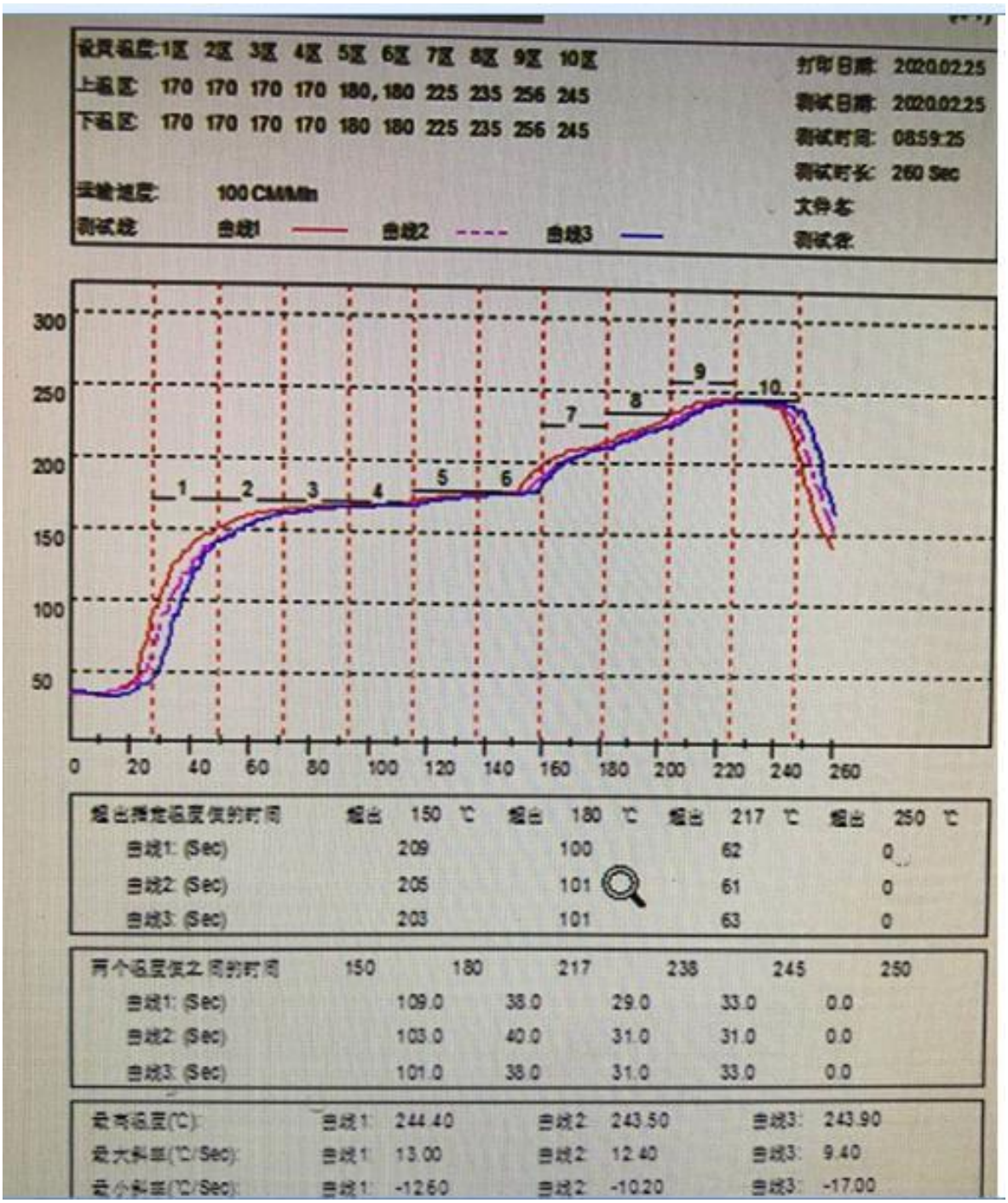
3.6.6 IPX8 water proof

1	IPX8 waterproof	No water leakage	refer to IEC/EN 60529 IPX8 requirement, 1.5m/30 minutes, reflow twice before test and tested after Group B, C.

Amphenol Test Method of Air Leakage	
Item	Reflow Temperature
High temperature soldering process	(245°+0°/-5° for 10 second)

Test Method	Test machine	Design of fixture and product interference
1. Test machine Air Leakage tester + Tooling (8 cavities). 2. Test parameter: Air pressure (Input)： 15Kpa Input time : 3s Stable time : 3s Test time : 5s 3. Standard of air leakage : After IR: 35Pa Max	 	The amount of interference is designed according to the drawing surface 

3.6.7 RECOMMENDED IR REFLOW PROFILE(PEAK TEMP : 245℃+0℃/-5℃)



3.7 PRODUCT QUALIFICATION AND REQUALIFICATION TEST SEQUENCE

All samples have to be soldered on PCB and reflow two times total before measuring and testing.

Test or Examination		Test Group										
		A	B	C	D	E	F	G	H	I		
		Test Sequence(a)										
Examination of Product		1,8	1,10	1,8	1,12	1,14	1,3	1,3	1,6	1,3		
Contact Resistance		2,5,7	2,5,7,9	2,5,7	2,5,7,9,11	3,11			2,5	4		
Insulation Resistance						13						
Dielectric Withstanding Voltage						2,12						
Contact Current Rating								2				
Insertion Force						5						
Extraction force						6,8,10						
Durability	Reseating (3 cycles)	6	8		10							
	×4 Cycles					4						
	×25 Cycles					7						
	×50Cycles	3	3	3	3				3			
	×10000Cycles					9						
Vibration				6								
4-Axis Continuity Test							2					
Temperature Life		4										
Temperature Life(preconditioning)				4	4							
Humidity and Temperature Cycles			6									
Mixed Flow Gas					6							
Thermal Shock			4									
Thermal disturbance					8							
Salt spray									4			
Resistance to soldering heat										2		
Waterproof			11	9								
Sample size		5	5	5	10	5	8	3	5	5		

NOTE:

(a) Numbers indicate sequence in which tests are performed.

(b) Sampling Quantity: See sample size

Test Group A (required for all connectors)

Test Order	Test	Test procedure	Condition of test specimens	Test criteria
1	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	40 milliohms max for all contacts. Baseline measurement.
2	Durability (Preconditioning)	EIA-364-09 Perform 50 unplug/plug cycles		No evidence of physical damage
3	Temperature life	EIA-364-17, method A 105º C without applied voltage for 120 hours.	Mated	None
4	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	50 milliohms max.
5	Reseating	Manually unplug/plug the connector or socket. Perform 3 such cycles		No evidence of physical damage
6	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	50 milliohms max.

Test Group B (required for all connectors)

Test Order	Test	Test procedure	Condition of test specimens	Test criteria
1	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	40 milliohms max for all contacts. Baseline measurement.
2	Durability (Preconditioning)	EIA-364-09 Perform 50 unplug/plug cycles		No evidence of physical damage
3	Thermal shock	EIA-364-32, test condition I 10 cycles with the exception of exposure times. Place a thermocouple in the center of the largest mass component of the connector that is in the center of the test chamber to insure that the contacts reach the temperature extremes before ramping to the other temperature.	Mated	None.

4	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	50 milliohms max.
5	Cyclic temperature and humidity	EIA-364-31 Cycle the connector between 25 °C ±3 °C at 80 % ±3% RH and 65 °C ±3 °C at 50 % ±3% RH. Ramp times should be 0.5 hour and dwell times should be 1.0 hour. Dwell times start when the temperature and humidity have stabilized within the specified levels. Perform 24 such cycles.	Mated	None.
6	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	50 milliohms max.
7	Reseating	Manually unplug/plug the connector or socket. Perform 3 such cycles		No evidence of physical damage
8	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	50 milliohms max.
9	IPX8 water proof	refer to IEC/EN 60529 IPX8 requirement, 1.5m/30 minutes, reflow twice before test and tested after Group B,C.		No water leakage

Test Group C (required for all connectors)

Test Order	Test	Test procedure	Condition of test specimens	Test criteria
1	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	40 milliohms max for all contacts. Baseline measurement.
2	Durability (Preconditioning)	EIA-364-09 Perform 50 unplug/plug cycles		No evidence of physical damage
3	Temperature life (preconditioning)	EIA-364-17, method A 105º C without applied voltage for 72 hours when used as preconditioning.	Mated	None.
4	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	50 milliohms max.

5	Vibration	EIA-364-28, test condition VII, test condition letter D 15 minutes in each of 3 mutually perpendicular directions. Both mating halves should be rigidly fixed so as not to contribute to the relative motion of one contact against another. The method of fixturing should be detailed in the test report.	Mated	No evidence of physical damage. No discontinuities of 1 µS or longer duration when mated connector during test.
6	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	50 milliohms max
7	IPX8 water proof	refer to IEC/EN 60529 IPX8 requirement, 1.5m/30 minutes, reflow twice before test and tested after Group B,C.		No water leakage

Test Group D

Test Order	Test	Test procedure	Condition of test specimens	Test criteria
1	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	40 milliohms max for all contacts. Baseline measurement.
2	Durability (Preconditioning)	EIA-364-09 Perform 50 unplug/plug cycles		No evidence of physical damage
3	Temperature life (preconditioning)	EIA-364-17, method A 105º C without applied voltage for 72 hours when used as preconditioning.	Mated	None.
4	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	50 milliohms max.
5	Mixed flowing gas	EIA 364-65,Class II A Samples should be placed in an environmentally controlled 'test chamber' that is monitored by a gas analyzing system for controlled concentrations of the specified gas mixture. Test coupons shall also be used and the weight gain reported. Test duration is 7 days.	Mated	Low level contact resistance meets spec before and after the mixed flowing gas test.

6	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	50 milliohms max.
7	Thermal disturbance	Cycle the connector or socket between 15 °C ±3 °C and 85 °C ± 3 °C, as measured on the part. Ramps should be a minimum of 2 °C per minute, and dwell times should insure that the contacts reach the temperature extremes (a minimum of 5 minutes). Humidity is not controlled. Perform 10 such cycles.	Mated	None.
8	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	50 milliohms max.
9	Reseating	Manually unplug/plug the connector or socket. Perform 3 such cycles.		No evidence of physical damage
10	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	50 milliohms max.

NOTES
1. Plugs: 1) expose 1/2 of the specimens unmated for 2/3 of the test duration; 2) mate each specimen to the same receptacle that it was mated to during temperature life (preconditioning); and, 3) expose for the remainder of the test duration.

2. Receptacles: 1) expose 1/2 of the specimens unmated for 2/3 of the test duration; 2) mate each specimen to the same plug that it was mated to during temperature life (preconditioning); and, 3) expose for the remainder of the test duration.

Test Group E

Test Order	Test	Test Procedure	Condition of Test Specimens	Test Criteria
1	Dielectric withstanding voltage	EIA-364-20, 100 VAC (RMS)	Mated	No disruptive discharge.
2	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	40 milliohms max for all contacts. Baseline measurement.
	Durability Preconditioning	EIA-364-09 Perform 4 unplug/plug cycles. followed by an unplug.		No evidence of physical damage.

3	Insertion force	EIA 364-13 Perform the measurement at a maximum speed of 12.5 mm (0.492”) per minute.		Within the range of 5 N to 20 N.
4	Extraction force	EIA 364-13 Perform the measurement at a maximum speed of 12.5mm (0.492") per minute.		Within the range of 8 N to 20 N. Initial reading
5	Durability	EIA 364-9 Perform 25 plug/unplug cycles. Cycle rate of 500 ± 50 cycles per hour followed by a plug.		No evidence of physical damage
6	Extraction force	EIA 364-13 Perform the measurement at a maximum speed of 12.5mm (0.492") per minute		Within: a) 33% of the initial reading, and b) 8 N to 20 N.
7	Durability	EIA 364-9 Perform 2,468 plug/unplug cycles. Rotate the receptacle or plug 180^0 and perform 2,500 plug/unplug cycles. Rotate the receptacle or plug 180^0 and perform 2,500 plug/unplug cycles. Rotate the receptacle or plug 180^0 and perform 2,500 plug/unplug cycles. Cycle rate of 500 ± 50 cycles per hour (total of 10,000 plug/unplug cycles, flipping every 2,500 cycles).		No evidence of physical damage
8	Extraction force	EIA 364-13 Perform the measurement at a maximum rate of 12.5mm (0.492") per minute.		Within 6 N to 20 N.
9	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	50 milliohms max.
10	Dielectric withstanding voltage	EIA-364-20, 100 VAC (RMS)	Mated	No disruptive discharge
11	Insulation Resistance	EIA 364-21. Applicable to both receptacle and plug.	Both unmated and mated	A minimum of 100 MΩ insulation resistance is required between adjacent contacts of unmated and mated connectors

NOTES
1. Separate sets of test specimens may be used to assess dielectric withstanding voltage and the change in low level contact resistance.
2. Dielectric withstanding voltage testing should involve different contacts than low level contact resistance testing.
3. The durability test requires that the plug be fully dis-engaged or separated from the receptacle during the cycling.

Test Group F

1	4-axes Continuity	See appendix D for detailed fixture and procedures. Plug and receptacle: Subject the mating interface to the moments defined in Appendix D for at least 10 seconds.	Mated	No discontinuities greater than 1 microsecond duration in any of the four orientations tested.

Appendix D:4-axes Continuity test

1. Test standards

Plugs shall be supplied with a representative overmold or mounted on a 2-layer printed circuit board (PCB) between 0.8 mm and 1.0 mm thickness as applicable. A USB Type-C receptacle shall be mounted on a 2-layer PCB between 0.8 mm and 1.0 mm thickness. The PCB shall be clamped on three sides of the receptacle no further than 5 mm away from the receptacle outline. The receptacle PCB shall initially be placed in a horizontal plane, and a perpendicular moment shall be applied to the plug with a 5 mm ball tipped probe for a period of at least 10 seconds at a distance of 15 mm from the mating edge of the receptacle shell in a downward direction, perpendicular to the axis of insertion. See Table D-1 for the force and moment to be applied.

The continuity across each contact shall be measured throughout the application of the tensile force. Each non-ground contact shall also be tested to confirm that it does not short to the shell during the stresses. The PCB shall then be rotated 90 degrees such that the cable is still inserted horizontally and the tensile force in Table D-1 shall be applied again in the downward direction and continuity measured as before. This test is repeated for 180 degree and 270 degree rotations. Passing parts shall not exhibit any discontinuities or shorting to the shell greater than 1 μs duration in any of the four orientations.

One method for measuring the continuity through the contacts is to short all the wires at the end of the cable pigtail and apply a voltage through a pull-up to each of VBUS, USB D+, USB D−, SBU, CC, and USB SuperSpeed pins, with the GND pins connected to ground. Alternate methods are allowed to verify continuity through all pins.

2. Load test force requirements：

Receptacle configuration with respect to mounting surface	Force at 15 mm from receptacle shell mating edge (N)	Moment with respect to receptacle shell mating edge (Nm)
Right angle	20	0.30
Vertical	8	0.12

Test Group G

1	Contact current rating	See appendix C	Mated	When current is applied to the contacts, the temperature rise shall not exceed limit at the location defined in Appendix C.

Appendix C:Contact Current Rating

1. Test PCB design

Item	Trace width (mm)	Trace length (mm) on each PCB	Thickness
Signal trace	0.25 max.	13 max.	35 μm (1 oz. copper)
Ground trace	1.57 max.	38 max.	35 μm (1 oz. copper)
VBUS and VCONN	1.25 max.	30 max.	35 μm (1 oz. copper)
PCB	N/A	N/A	0.80 – 1.20 mm

2. Test standards

A current of 5 A shall be applied collectively to VBUS pins (i.e., pins A4, A9, B4, and B9) and 1.25 A shall be applied to the VCONN pin (i.e., B5) as applicable, terminated through the corresponding GND pins (i.e., pins A1, A12, B1, and B12). A minimum current of 0.25 A shall also be applied individually to all the other contacts, as applicable. When current is applied to the contacts, the temperature of the connector pair shall be allowed to stabilize. The temperature rise of the outside shell surface of the mated pair above the VBUS and GND contacts shall not exceed 30° C above the ambient temperature. Figure C- provides an illustration of the measurement locations.

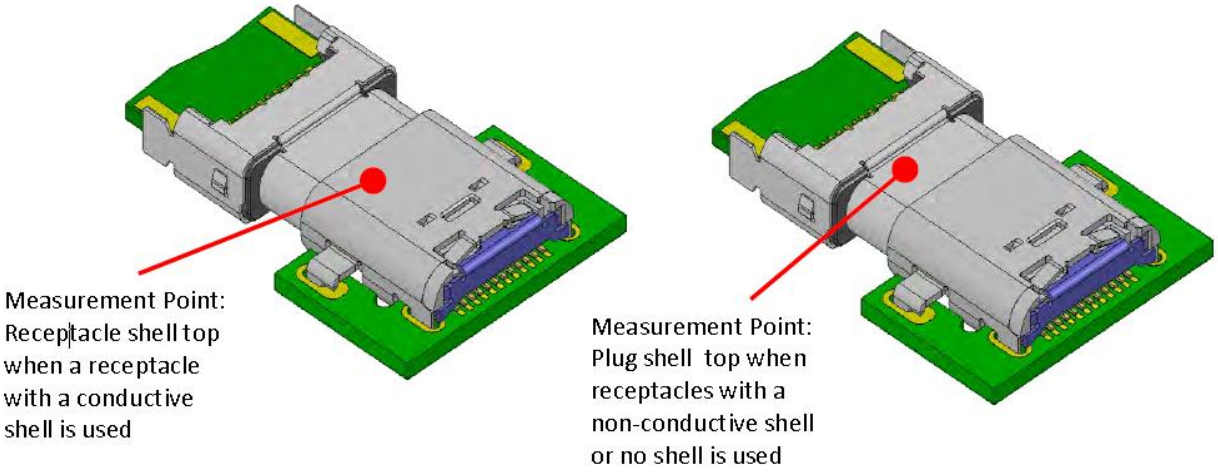


Figure C-1 Temperature Measurement Points

Test Group H

Test Order	Test	Test Procedure	Condition of Test Specimens	Test Criteria
1	Visual inspection	Meets requirements of product drawing. No physical damage.		No evidence of physical damage
2	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	40 milliohms max for all contacts. Baseline measurement.
3	Salt spray	EIA-364-26B Test condition B At temp.35°±2°cR/H95-98% Salt NaCl Mist5%,48 hours continuous spray for FG, No cleaning and brush, 35 degree baking Within no more than 16hours		No evidence of physical damage
4	Low level contact resistance	EIA-364-23 The measurement is made across the plug and receptacle mated contacts and does not include any internal paddle cards or substrates of the plug or receptacle.	Mated	50 milliohms max.
5	Visual inspection	Meets requirements of product drawing. No physical damage.		No evidence of physical damage

Test Group I

Test Order	Test	Test Procedure	Condition of Test Specimens	Test Criteria
1	Visual inspection	Meets requirements of product drawing. No physical damage.		No evidence of physical damage
2	Resistance to Soldering Heat	Solder temperature: 245°+0°/-5° Period: 10 sec.		The connector will withstand a lead free solder process. Standard test conditions associated with this requirement are as follows: Must withstand a solder process of 245C for 10 seconds.
3	Visual inspection	Meets requirements of product drawing. No physical damage.		No evidence of physical damage