
The product described in this document has not been fully tested to ensure conformance to the requirements outlined below. Therefore, TE Connectivity (TE) makes no representation or warranty, express or implied, that the product will comply with these requirements. Further, TE may change these requirements based on the results of additional testing and evaluation. Contact TE Engineering for further details.

Title	JPT SEALED 2P, 3P PLUG ASSY
-------	-----------------------------

1 Scope**2 Quality****3 Requirements****4 Requirements Measuring Method**

- 4.1 Appearance
- 4.2 CONN engage and disengage force
- 4.3 Reverse insertion between housing
- 4.4 Reverse insertion between terminal and housing
- 4.5 Engage force between terminal and housing
- 4.6 HSG Lock strength
- 4.7 HSG Lock releasing force
- 4.8 Terminal retention force
- 4.9 Voltage drop
- 4.10 Insulation resistance
- 4.11 Leakage current
- 4.12 High voltage test
- 4.13 Temperature rise
- 4.14 Instant short circuit
- 4.15 Sealing test
- 4.16 CONNECTOR coupling sound

5 Test conditions

- 5.1 specimen

5.2 Laboratory condition

5.3 Basic current

5.4 Evaluation

5.5 Cable size

6 Test Method

6.1 Connector endurance test (Twisting test + CONN Engage / Disengage endurance test)

6.2 Cold temperature test

6.3 Cold and hot temperature shock test

6.4 High temperature test

6.5 Temperature and humidity cycle test

6.6 Dust test

6.7 Waterproof test

6.8 Oil and liquid test

6.9 Ozone test

6.10 Salt water test

6.11 Sulfur(SO₂) gas test

6.12 Complex environment endurance test B

1. SCOPE

This SPEC defines the test method for low voltage connectors (connector) and low voltage terminals (terminal).

* **Related specification: ES91500-00**

2. QUALITY

Quality of connector shall satisfy the characteristics of each item described in clause 3 after performing the test.

3. REQUIREMENTS

NO	items	characteristics	Measuring method		
1	Appearance	No harmful crack, rust, burr, damage, deformation, discoloration etc.	4.1		
2	CONN engage And disengage Force	7.6kgf or less	4.2		
3	Reverse insertion Between housing	It shall not be incorrectly inserted and flowed current between terminals by housing deformation on applying force of 20kgf.	4.3		
4	Reverse insertion between terminal and housing	5kgf or more	4.4		
5	Engage force between terminal and housing	1.5kgf or less	4.5		
6	Strength of HSG lock	10kgf or more (test condition: 60°C) All terminal: 5kgf or more	4.6		
7	Lock release force	Force on release force point of lock part shall be 0.5 or more and 6kgf or less	4.7		
8	Terminal retention force	6kgf or more	4.8		
9	Voltage drop	Division	Initial	After endurance	4.9
		110	3 mV/A or less	10 mV/A or less	
10	Insulation resistance	Division	Initial	After endurance	4.10
		Waterproof	100MΩ or more	100MΩ or more	
11	Leakage current	Division	Initial	After endurance	4.11
		Non-waterproof	10 μA or less	1 μA or less	
12	High voltage test	There shall be no insulation break.			4.12
13	Temperature rise	Division	After endurance		4.13
		General CONNECTOR	40°C or less		
14	Instant short circuit	There shall be no 10 μS or more instant short circuit.			4.14
15	Sealing test	initial	After endurance		4.15
		1.0kgf/cm ² or more	0.5kgf/cm ² or more		
16	Connector Coupling sounds	Connector coupling sounds : 65 dB(A) or more			4.16

< Table 3.1 >

4. REQUIREMENTS MEASURING METHOD

4.1. Apperance

By sense of sight and touch

4.2. CONNECTOR engage and disengage force

Measure force by engaging and disengaging the connector with terminal assembled at constant 50 mm/min speed. However, remove lock part when measuring disengage force.

4.3. Reverse insertion between housings

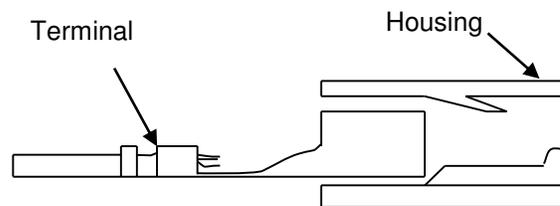
- A. Insert terminal to housing
- B. Fix housing of female connector to moving part of measuring instrument in reverse insertion direction. (Reverse insertion: 180 degree rotation on the locking part)
- C. Set a measuring instrument to stop at force of 20kgf and insert that. At this moment, monitor resistance of one terminal matched to identify current carrying between terminals.
- D. Check the insertion by housing modification of male connector after connector insertion.

4.4. Reverse insertion between terminal and housing

Crimp cable of maximum size on terminal and then, insert it into housing by the end of insulation.

4.5. Engage force between terminal and housing

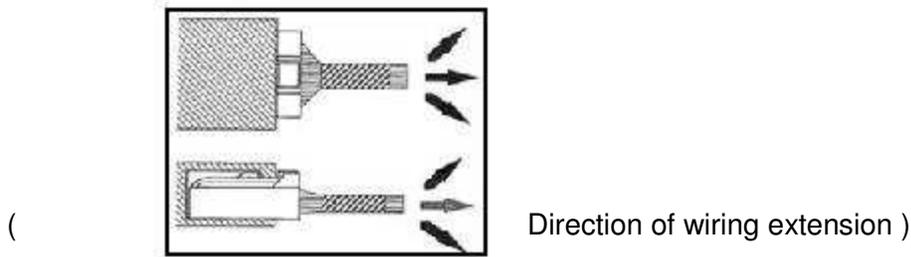
As shown in the following figure 4-1, measure the weight while inserting terminal into fixed housing at 50mm/min speed.



<Fig. 4-1>

4.6. HSG Lock strength

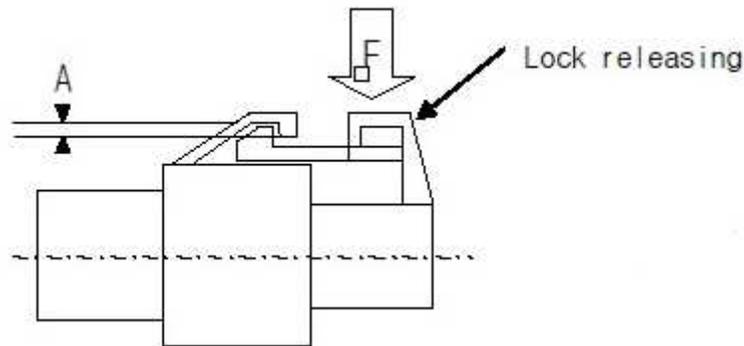
Combine housing only, fix the one side of housing in completely locked condition, and extend the other side in axial direction and 30 angle direction at a constant speed of 100mm/min. Then measure weight when lock structure is disengaged or destroyed.



<Fig. 4-2>

4.7. HSG lock releasing force

Apply force (F) to lock releasing part, and measure weight on the point of A=0. However, cut connector and then perform test at the section in order to secure visibility.



<Fig. 4-3>

4.8. Terminal retention force

Fix the housing after inserting crimped terminals. Extend one line of cable in axial direction at a speed of 50mm/min at a position 50~100mm away from crimped part, and measure weight when terminal is disengaged from the housing.

4.9. Voltage Drop

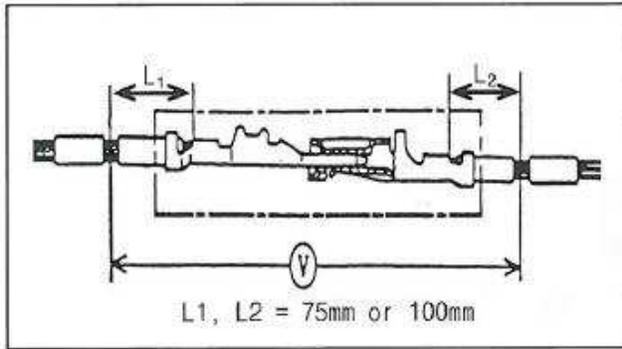
Measure the circuit voltage drop (V) by sending voltage and current described in the table 2 with terminal combined on the connector. Then calculate a voltage drop (V_D) in terminal by subtracting cable resistance (L) from the circuit voltage drop (V).

A. HARNESS vs. HARNESS : $V_D = V - (L_1 + L_2)$

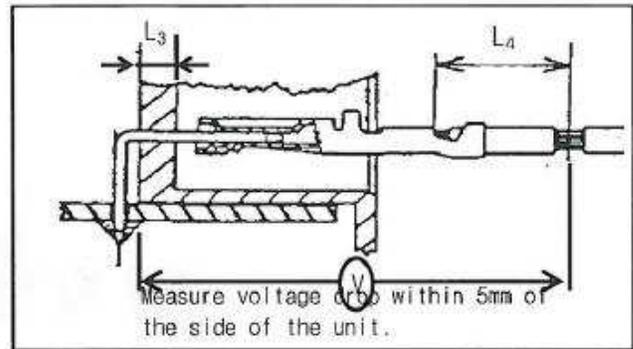
B. HARNESS vs. UNIT : $V_D = V - (L_3 + L_4)$

Application	Open voltage	Short circuit current	Division
Signal circuit	$20 \pm 5\text{mV}$	10 mA	ECU, Sensor
Power circuit	13 V	1 A	Other than the above

< Table 4.1 >



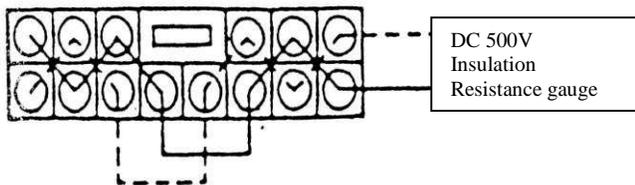
< Fig. 4-5 : HARNESS vs. HARNESS >



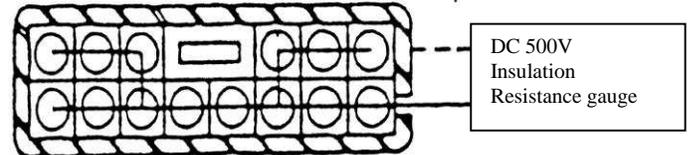
< Fig. 4-6 : HARNESS vs. UNIT >

4.10. Insulation resistance

Measure resistance between neighbor terminals (Figure 4-6), and between terminal and housing surface (Figure 4-7) with DC 500V insulation resistance gauge with connector combined.



<Fig. 4-7: Between neighboring terminals>



<Fig. 4-8: Between neighboring terminal and housing surface>

4.11. Leakage current

Measure it by applying DC 14V between neighboring terminals (Figure 4-7).

4.12. High voltage test

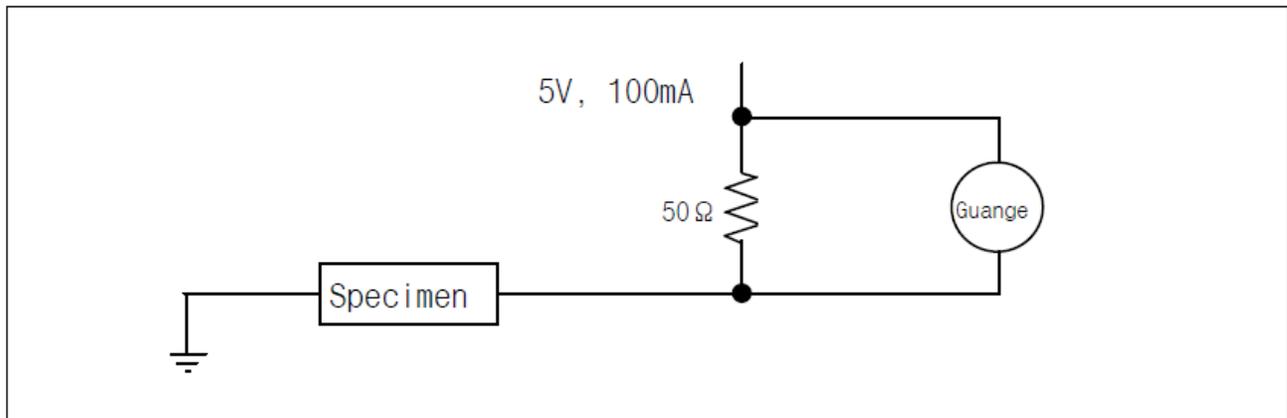
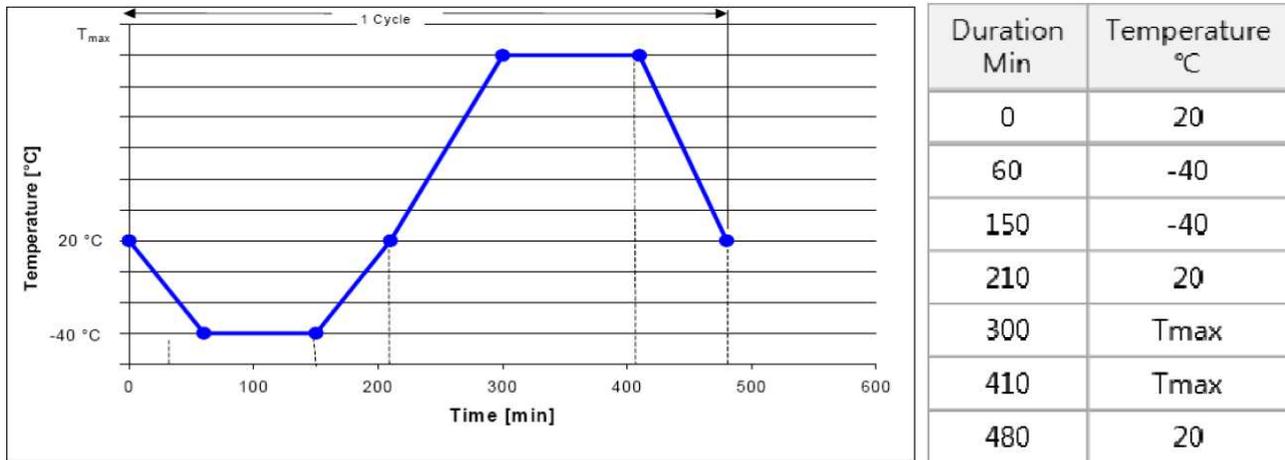
Apply AC 1000V voltage of normal frequency for 1 minute between neighboring terminals (Figure 4-6), and between housing surfaces of terminal (Figure 4-8), with connector combined.

4.13. Temperature rise

Apply basic current ($I=10 \cdot K$) of clause 5.3 to the connector with electrodes in series in the room free from wind (normal temperature). And measure a temperature of crimped part after reaching saturation temperature. Then calculate a temperature of crimped part by subtracting ambient temperature from the temperature.

4.14. Instant short circuit

It is instant short circuit, when 3.5V or less voltage continues for 10 μ s or more in gauge by applying 1 mA, 5V open voltage. Figure 5- 8 is an example of measured circuit.



<Fig. 4-9: Instant short circuit of measured circuit >

4.15. Sealing test

1. Sealing of terminal

Put the combined connectors with terminals in all circuits in the water tank as shown figure 13 and supply 10Kpa(0.1kg/cm²) to connector for 30 seconds. Then increase it by 10Kpa(0.1kg/cm²) until 200Kpa(2kg/cm²) is reached and maximum value shall be specified in the test report for reference.

(Seal the wires at the end of wire that is not for the test to keep sealing)

- Initial test

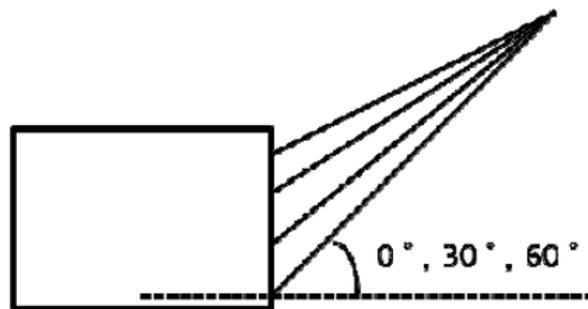
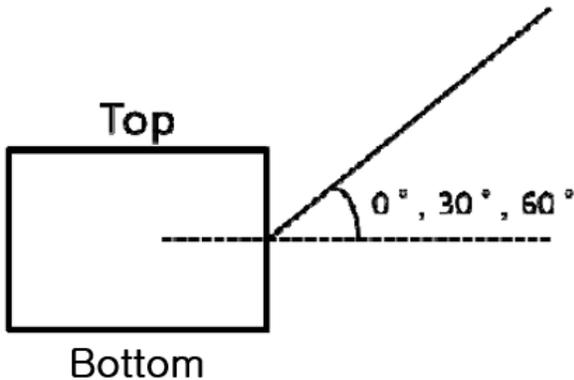
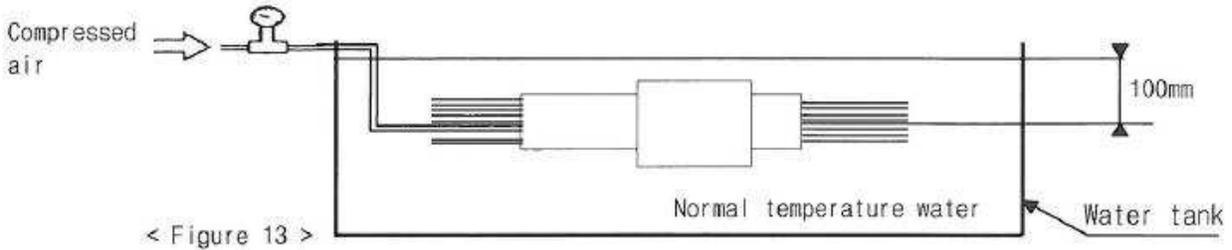
Change wire angles(0°, 30°, 60°) and evaluate whether the bubble is floated or not to verify sealing depending on wire tension and bending

- Endurance test

2. Sealing test after the endurance test

Sealing of Cavity plug and dummy seal

Test the same initial and endurance test on the connector with only cavity plug and dummy seal to evaluate sealing of cavity plug and dummy seal



※ the criteria of over 1 row multi circuit connector:
lowest wire with the surface of basement

4.16. Connector coupling sounds

Put sound measurement equipment on 350 ± 50 mm away from the connector. Measure the peak sound that occurs when you combine the connector. Sounds unit: dB(A)

5. TEST CONDITIONS

5.1. Specimen

Unless there is specific mention, initial sample should use for the test specimen, and test specimen shall be 5EA or more for each cavity. However, if performance is expected to be clearly satisfactory ever by applying load to the same specimen in turn, it is possible to apply multiple test items to the same specimen. In such case, performance shall be satisfied with each item.

5.2. Laboratory condition

Perform each test at designated temperature and humidity. And control humidity at designated absorption ratio for the connector which uses absorbent resin housing.

- Temperature: 25 ± 5 °C
- Humidity: 60 ± 20 %
- Standard absorption ratio (reference value)
- 6 NYLON: 2 ~ 4%
- 66 NYLON: 1.5 ~ 3%

5.3. Basic current

Basic current value “I” shall be based on the following. (I = I0 * K)

Cable size (SQ)	I ₀		Remarks
	General	L TYPE -375	
0.22	4 A		
0.3	6 A		4A for signal
0.5	8 A		5A for signal
0.85	10 A		
1.25	14 A		
2	18 A		
3	22 A	34 A	
5	25 A	46 A	
8		60 A	

< Table 5.1 >

Number of simultaneous electrode within the same connector	K
	Reduction factor
1	1
2 ~ 3	0.75
4 ~ 5	0.6
6 ~ 8	0.55
9 ~ 10	0.5
11 ~ 25	0.4
26 or more	0.3
-	-

< Table 5.2 >

5.4. Evaluation

Evaluation shall be represented by evaluation applicable connector. And Annual evaluation of connectors shall be represented by evaluation of connectors of the maximum number of poles in the same series.

5.5. Cable size

The size of connector lead wire used in each test shall be follow Table 5.3

Test Item	MIN WIRE	MAX WIRE	Test Item	MIN WIRE	MAX WIRE	
CONN engage And disengage Force	-	○	High temperature test	Voltage Drop	-	○
Reverse insertion between housing	-	○		Sealing	○	○
CPA engage and retention forces	-	-	Soldering test		-	-
Reverse insertion between terminal and housing	-	-	Temperature and humidity cycle test	Voltage Drop	-	○
Engage force between terminal and housing	○	-		Insulation resistance	○	○
CONN'R CLIP engage and disengage force	-	-		Leakage current	-	○
HSG lock strength	-	-		Sealing	○	○
HSG Lock release force	-	-	Dust test	Voltage Drop	-	○

Terminal retention force		-	O		Sealing	O	O
Terminal engage and disengage force		-	O	Waterproof test	Insulation resistance	-	O
Crimp strength		O	O		Leakage current	-	O
Voltage drop		-	O		Sealing	O	O
Insulation resistance		-	O	Oil and liquid test	Voltage Drop	-	O
Leakage current		-	O		Sealing	O	O
High voltage test		-	O	Ozone test	Voltage Drop	-	O
CONN endurance test	Appearance	-	O		Sealing	O	O
	Voltage Drop	-	O	Salt water test	Voltage Drop	-	O
Overcurrent cycle Test	Appearance	-	O		Insulation resistance	-	O
	Voltage Drop	-	O		Leakage current	-	O
Cold temperature Test	Appearance	-	O	Sulfur test	Voltage Drop	-	O
	Voltage Drop	-	O		Sealing	O	O
	resistance		O	Mechanical shock test	Instant	-	O
	Leakage current	-	O		short circuit		
	Temperature rise	-	O	Complex environment Endurance test	Crimp strength	O	O
Sealing	O	O	Voltage Drop		-	O	
Cold and hot Temperature test	Voltage Drop	-	O		Temperature rise	-	O
	Sealing	O	O		Instant short circuit	-	O
Connector coupling sounds		-	-			Sealing	O

< Table 5.3 >

6. TEST METHOD

Test Items	Appearance	CONN engage and disengage Force	Reverse insertion Between housing	Reverse insertion between terminal and housing	Engage force between terminal and housing	HSG lock strength.	Lock release force	Terminal retention force	Terminal engage and disengage force (kgf)	Crimp strength (kgf)	Voltage drop	Insulation resistance	Leakage current	High voltage test	Temperature rise	Instant short circuit	CONNECTOR coupling sound
Initial test	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0
Connector twisting test	0										0						
Engage / Disengage endurance test	0										0						
Overcurrent cycle test	0										0				0		
Cold temperature test	0										0	0	0		0		
Cold and hot temperature shock test	0										0						
High temperature test	0										0						
Temperature and humidity cycle test	0										0	0	0				
Dust test											0						
Oil and liquid test	0										0						
Ozone test	0										0						
Sulfur test	0										0						
Mechanical shock test																	0
Complex environment endurance test A										0	0				0	0	

< Table 6.1 : Test items >

6.1. CONN endurance test (Twisting test+ CONN engage/Disengage endurance test)

Apply 8kgf on the end part of combined connector 10 times each in the (front, rear, left, right) directions perpendicular to axial direction.

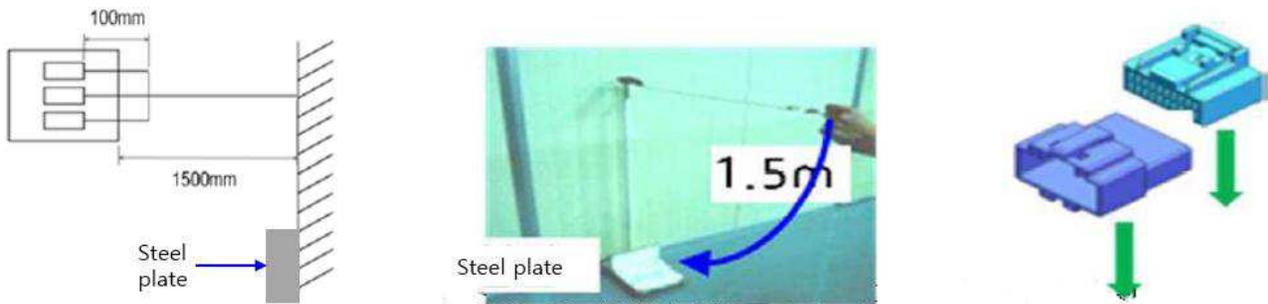
And make combine connectors engage and disengage. Perform it 50 times.

(Do not use locking device)

6.2. Cold temperature test

Leave connector with terminal assembled in temperature chamber of -40°C for 120 hours and estimate below items for each sample dividing two groups.

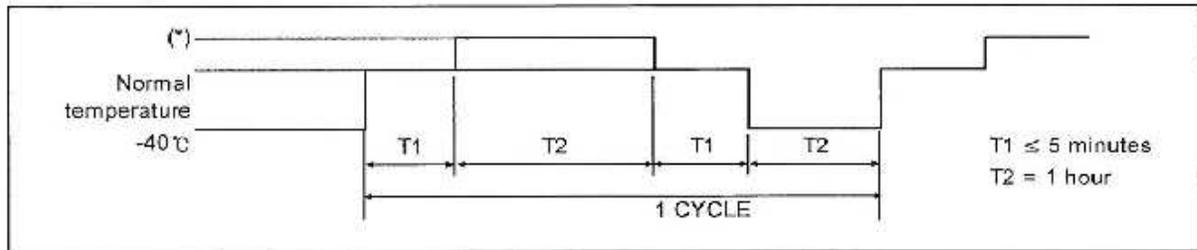
- A. Estimate voltage drop and leakage current assembled connector.
- B. Leave connector for 2 hours and separate connector with male and female, and then drop it onto the concrete surface more than 10T from 1.5m height 3 items. The method of connector drop follows figure 6-1.



< Fig. 6-1 >

6.3. Cold and hot temperature shock test

Engage and disengage connector with terminal assembled 10 times with hands, and leave it in combined state at -40°C for 2hours, and perform 200 cycles according of the method specified in figure 6-1 and table 6. Then leave it at room temperature for 2 hours or more ((*) follows table 6.2).



< Fig 6-2: Test pattern >

Division	High temperature (*)	Connector using part
A	120°C	ENG room
B	80°C	except ENG room

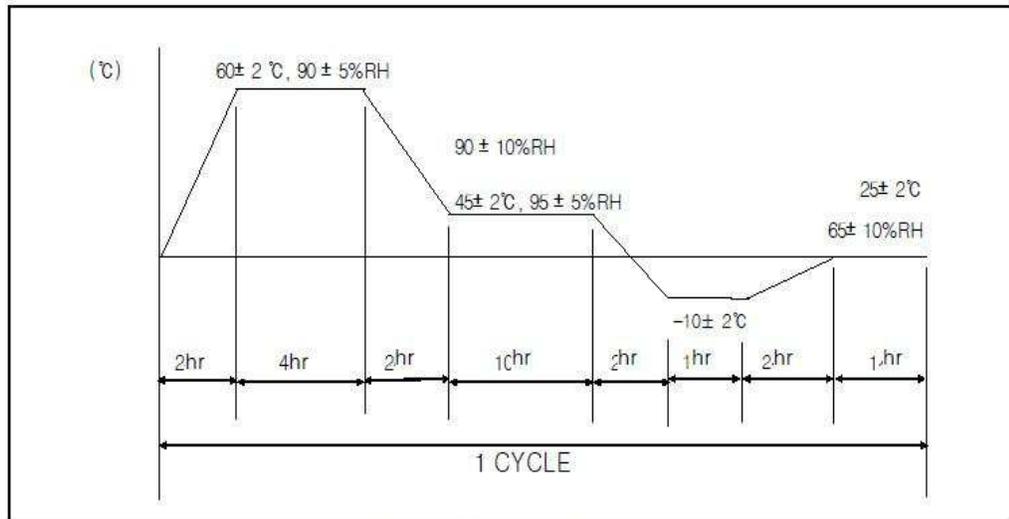
< Table 6.2 >

6.4. High temperature test

Engage and disengage connector with terminal assembled 10 times with hands, and leave it in combined state at the temperature chamber of the table 9 for 300 hours. Then pick it out and leave it until it returns to normal temperature.

6.5. Temperature and humidity cycle test

Engage and disengage connector with terminal assembled 10 times with hands, and leave it at 25°C ambient temperature and 65% relative humidity for 25 hours. And perform 5 cycles of the method specified in figure 6-3. Then pick connector out of chamber and dry it for 2 hours or more.



< Fig. 6-3 >

6.6. Dust test

Engage and disengage connector with terminal assembled 10 times with hands, and diffuse 1.5kg Portland cement(JIS R5210) with fan (or others) for 10 seconds per 15 minutes while maintaining 150mm distance from wall in the closed container of 900~1200mm length, width and height, with connector combined. After 1 hour, measure it.

6.7. Waterproof test (for waterproof connector)

Make combined connectors engaged and disengaged 10 times by hands, and leave it in combined state at 120°C(waterproof), 80°C(non-waterproof) ambient temperature for 40minutes and then spray water of normal temperature for 20 minutes according to S2 of JIS D0203. Repeat 48 cycles of this.

*. JIS D0203 S2 condition: Attach specimen at 400mm distance from the waterproof pipe with water spray hole or water discharge hole, and rotate waterproof pipe 23 times per minute around the axis (XX).

6.8. Oil and liquid test

Engage and disengage connector with terminal assembled 10 times with hands, and perform test each sample with connector combined.

- A. Immerse connector in combined state for 2 hours in mixed oil of $50 \pm 2^\circ\text{C}$ ENG oil (SAE10W) or equivalent oil and
- B. Immerse connector in combined state for 1 hour in car gasoline (JIS K2202) at normal temperature, and then pick it out.
- C. Immerse connector in combined state for 1 hour in brake liquid (pure product) at normal temperature, and then pick it out.
- D. Immerse connector in combined state for 1 hour in 100% washer liquid (pure product) at normal temperature, and then pick it out.

- E. Immerse connector in combined state for 1 hour in 50% LLC (Long life coolant) at normal temperature, and then pick it out.

6.9. Ozone test

Engage and disengage Connector with terminal assembled 10 times with hands, and samples keep at 40°C and 50±5pphm Ozone for 100hour. Then pick connector out of chamber and dry it for 2hours or more.

6.10. Salt water test (for waterproof connector)

Engage and disengage connector with terminal assembled 10 times with hand, and put it in 35 °C temperature regulation chamber, spray 5% salty water for 24 hours according to JIS Z2371, and maintain room temperature without spray for 1 hour. Then repeat this 4 times. Then pick connector out of chamber and dry it at room temperature for 2 hours or more.

6.11. Sulfur (SO₂) gas test

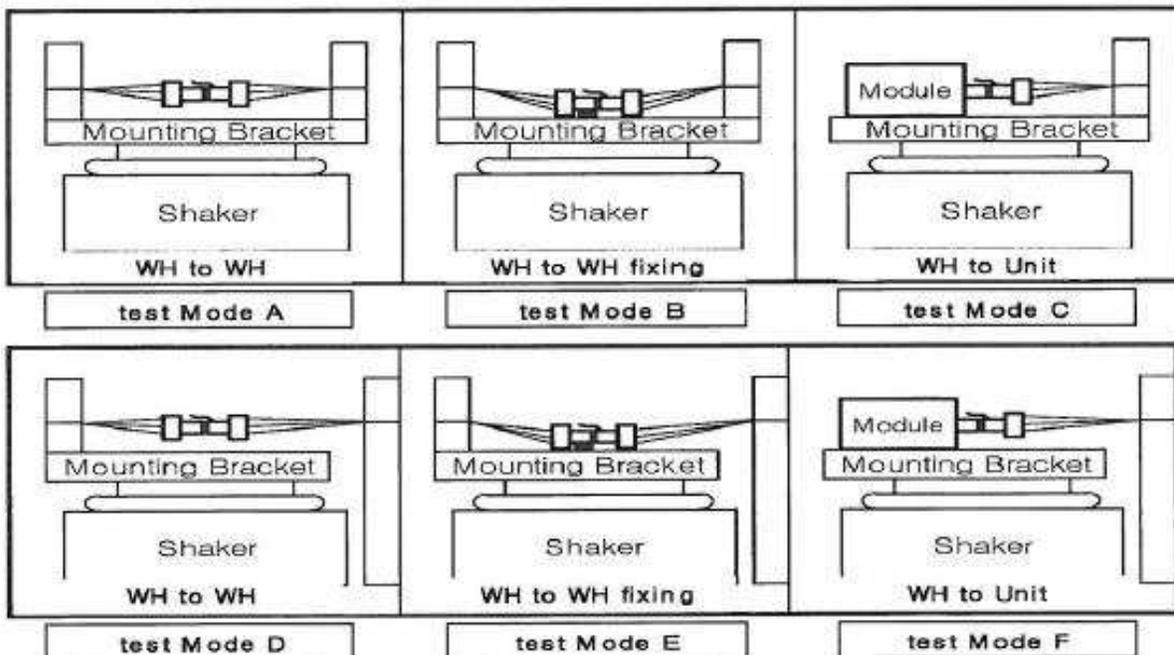
Engage and disengage connector with terminal assembled 10 times with hands, and expose it in combined state to sulfur gas of 40±3°C, density 10ppm, humidity 90~95%, for 24 hours. Then pick connector out of chamber and dry it for 2 hours or more.

6.12. Complex environment endurance test A (Refer to the attached test process #1)

Engage and disengage connector with terminal assembled 10 times with hands, and leave it in combined state in the temperature chamber of 120°C or 80°C (follows table 7) for 48 hours.

And then perform the following vibration test. Then measure instant short circuit according to the method of clause 4.14 for 4 hours for X, Y, Z each.

Follow figure 6-8 for connector attaching method.



< Fig 6-4 Connector attaching method >

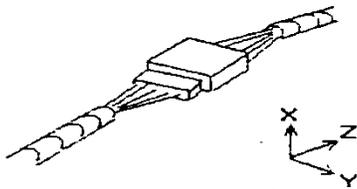
◆ Vibration test B (for waterproof connector)

Perform both of sine wave and random wave tests.

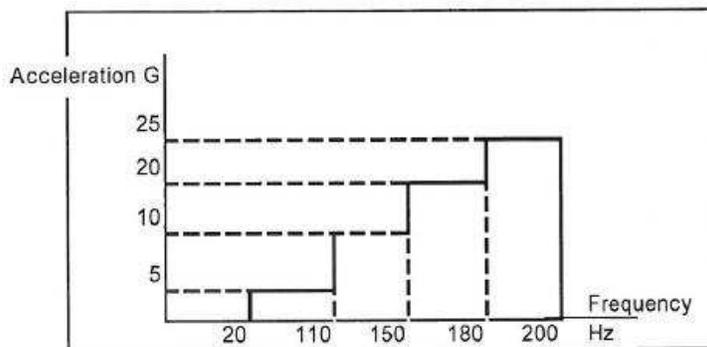
1. Sine wave test

Division	Condition
Ambient temperature/humidity	Refer to figure 12, 90~95%
Applied current	Basic current (Connector electrodes in series.)
Current application cycle	120 CYCLE (45 minutes-ON, 15 minutes-OFF)
Vibration acceleration	Follow figure 6-6
Frequency	20Hz ~ 200Hz (sweep time: 3 minutes or less)
Vibration time	40 hours for X, Y, Z each
Connector attaching method	Test mode A, B, C

< Table 6.3 >



<Fig. 6-5 : X, Y, Z vibration direction>



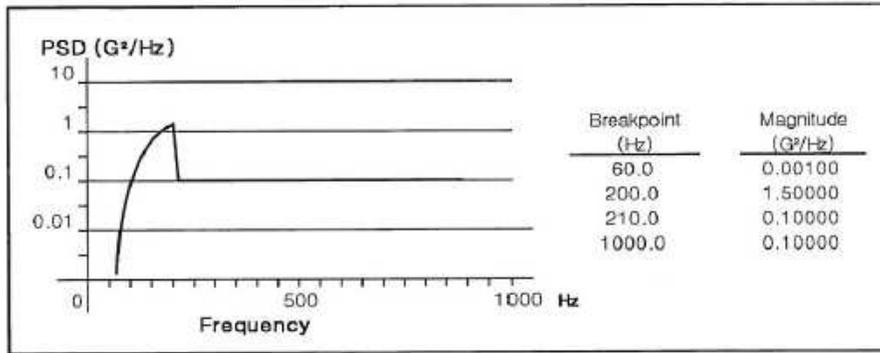
<Fig. 6-6>

2. Random wave test

Perform this test for the component of which sine wave test has been finished

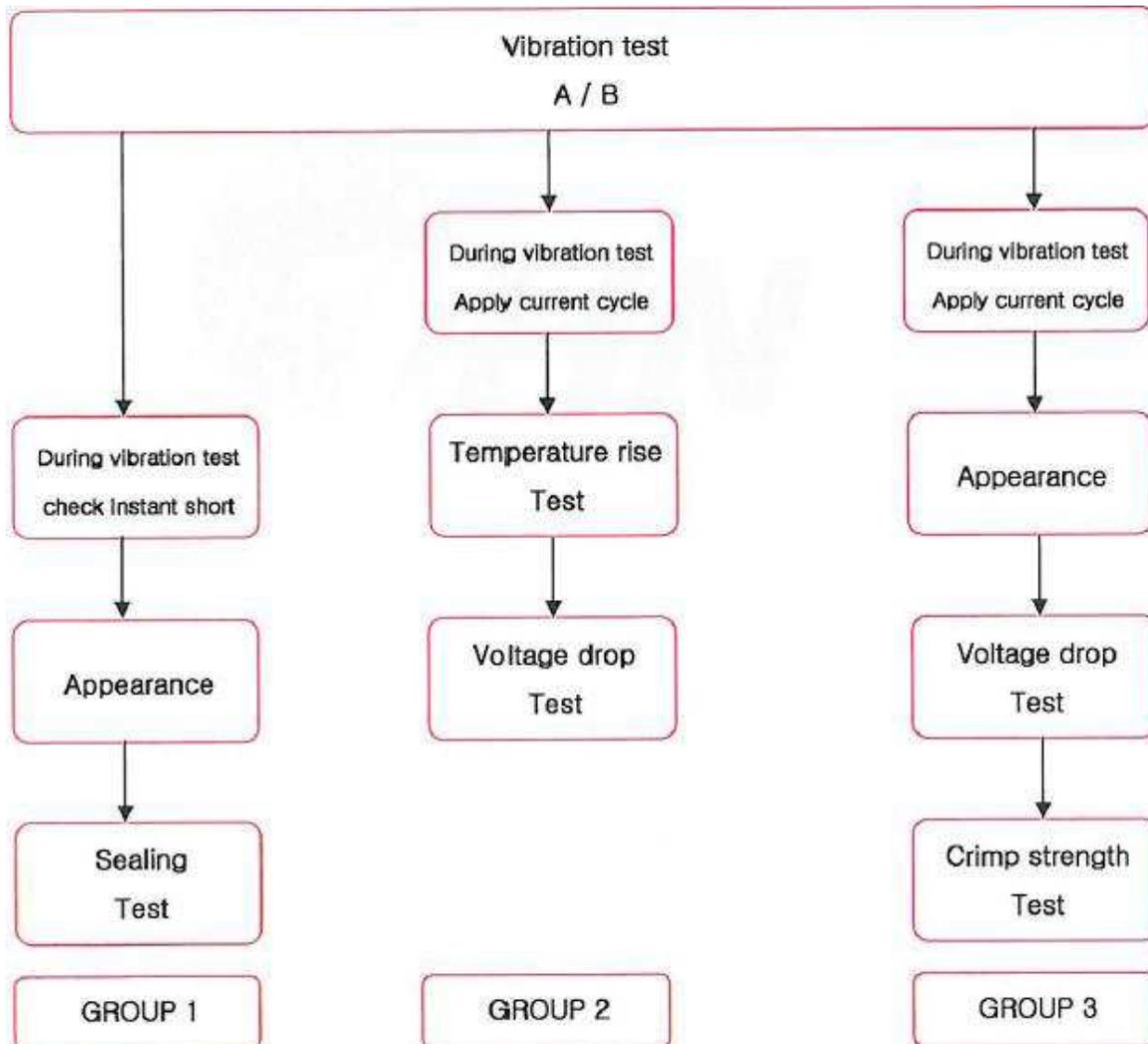
Division	Condition
Ambient temperature/humidity	Refer to figure 4-9, 90~95%
Applied current	Basic current (Connector electrodes in series.)
Current application cycle	24 CYCLE (45 minutes-ON, 15 minutes-OFF)
Vibration acceleration	Follow figure 6-7
Vibration time	8 hours for X, Y, Z each
Connector attaching method	Test Mode D, E, F

< Table 6.4 >



<Fig. 6-7>

Test process #1



<Fig. 6-8>

※ In the multipolar connector, Evaluation test at the same time for group 2/3

<i>Rev</i>	<i>Change</i>	<i>Description</i>	<i>Date</i>
A		Initial Released	23FEB2016

Prepared by,	Checked By,	Approved by
JM JEON	YJ YOUN	BW GANG
Product Engineer	Senior Product Engineer	Product Engineering Manager