2.8mm series

1. SCOPE

1.1. Content

This specification covers the requirements for product performance, test methods and quality assurance provisions of 2.8mm series

1.2. Qualification

When tests are performed on the subject product line, procedures specified in Figure 1 shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.

1.3. Qualification Test Results

Successful qualification testing on the subject product line has not been completed. The Qualification Test Report number will be issued upon successful qualification testing.

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 Documents

- 109-1: General Requirements for Test specifications.
- 936059: Customer Drawing (2.8mm SLD 2P plug ASSY)
- 936103: Customer Drawing (2.8MM SLD 2P PLUG RETAINER)
- 936111: Customer Drawing (2.8MM SEALED 2P COVER)
- 1743451: Customer Drawing (2.8MM SEALED 2P COVER)
- 1743544: Customer Drawing (2.8MM SEALED 2P COVER)
- 936462: Customer Drawing (2.8MM SEALED 2P CAP HSG)
- 1897017: Customer Drawing (2.8mm SLD 2P plug ASSY)
- 936060: Customer Drawing (2.8mm SLD 3P plug ASSY)
- 936106: Customer Drawing (2.8MM SLD 3P PLUG RETAINER)
- 936112: Customer Drawing (2.8MM SEALED 3P COVER)
- 936061: Customer Drawing (2.8mm SLD 3P plug ASSY)
- 2297696: Customer Drawing (COVER HSG FOR 2.8MM SLD 3P PLUG ASSY)
- 936062: Customer Drawing (2.8mm SLD 5P plug ASSY)
- 936110: Customer Drawing (2.8MM SLD 5P PLUG RETAINER)
- 936113: Customer Drawing (2.8MM SEALED 5P COVER)
- 936394: Customer Drawing (2.8MM SLD 5P PLUG RETAINER)
- 936397: Customer Drawing (DBL HSG FOR 2.8mm SLD 6P PLUG ASSY)
- 936398: Customer Drawing (COVER HSG FOR 2.8MM SLD 6P PLUG)
- 2219569: Customer Drawing (110_EVP_6P_HEADER_ASSY)

3. REQUIREMENTS

3.1. Design and Construction

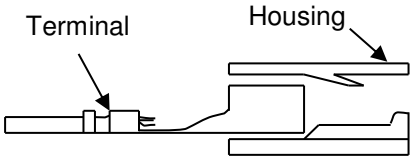
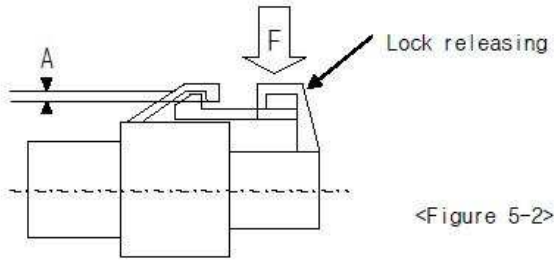
Product shall be of the design, construction, materials and physical dimensions specified on the applicable product drawing.

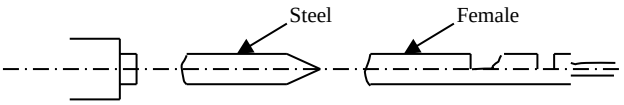
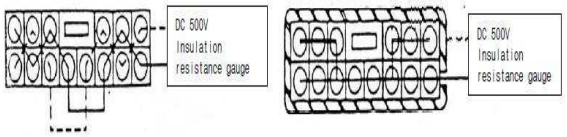
3.2. Ratings

Voltage	Temperature	Humidity
12V DC	25±5℃	60±20%

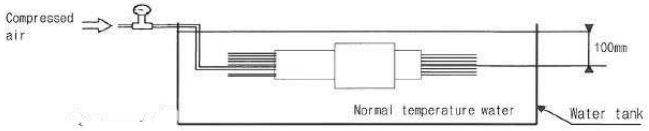
3.3. Test Requirements and Procedures Summary

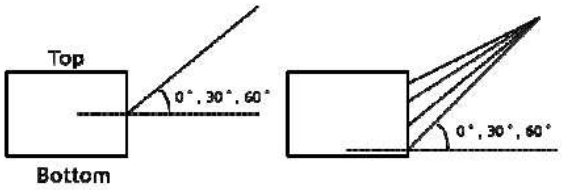
Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

TEST DESCRIPTION	REQUIREMENT	PROCEDURE
Appearance	No crack, damage, distortion are permitted	Using sense of sight and touch.
CONN engage and disengage force	Max 10 kgf and less	Measure force by inserting and disengaging the connector with terminal assembled at constant 100mm/min speed. However, remove lock part when measuring disengage force.
Reverse insertion between housings	It shall not be incorrectly inserted by applying force of 2P : 20kgf 3P/5P/6P: 30kgf	Insert the housing with terminal by pushing it in reverse direction with applying 20kgf.
Reverse insertion between terminal and housing	5kgf or more	Crimp cable of maximum size on terminal and then insert it into housing by end of insulation barrel in the reserve direction.
Engage force between terminal and housing	1.5kgf or less	As shown in the following figure 4-1, measure the weight while inserting terminal into fixed housing at 100mm/min speed.  <Figure 4-1>
Strength of HSG lock	050~375 series 10kgf or more	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 50mm/min. Then measure weight when lock structure is disengaged or destroyed.
HSG lock releasing force	Max 6kgf	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.  <Figure 5-2>
Terminal retention force	2P, 6P: 6kg or more 3P, 5P : 10 or more	Fix the housing after inserting crimped terminals. Extend one line of cable in axial direction at a speed of 100mm/min at a position 50~100mm away from crimped part, and measure weight when terminal is disengaged from the housing.

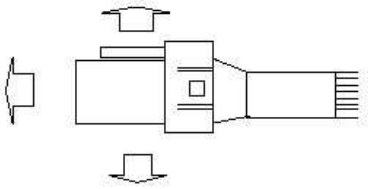
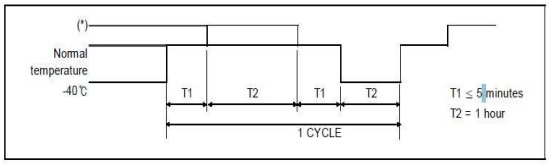
<table>
<tr><td rowspan="2">Terminal engage and disengage force (kgf)</td><td>Engage</td><td>2P, 6P : 0.3~1.5kgf
3P, 5P: 0.31-1.02kgf</td><td rowspan="2">As shown in figure 4-3, engage and disengage male terminal or steel gauge into or from female terminal at 100 mm/min speed.
 
</td></tr>
<tr><td>Disengage</td><td>2P, 6P : 0.15~1.5kg
3P, 5P: 0.31-1.02kgf</td></tr>
<tr><td>Crimp strength (kgf)</td><td colspan="2">0.85SQ: Min 13kgf or more
0.5SQ : Min 9kgf or more
1.25SQ : Min 17kgf or more</td><td>Fix the crimped terminal, and draw the cable at a position 50~100 mm away from crimped part in axial direction at 100 mm/min speed. Then measure the weight when cable is cut or disengaged from the crimped part</td></tr>
<tr><td>Voltage Drop</td><td colspan="2">090~375 series Max 3Mv/A</td><td>Measure the circuit voltage drop (V) by sending voltage and current described in the table 5-1 with terminal combined on the connector.
Then calculate a voltage drop (VD) in terminal by subtracting cable resistance (L) from the circuit voltage drop (V).
1)HARNESS versus UNIT:VD =V(L3+L4)
<table><tr><th>Application</th><th>Open voltage</th><th>Short circuit current</th><th>Division</th></tr><tr><td>Signal circuit</td><td>20 ± 5 mV</td><td>10 mA</td><td>ECU, Sensor</td></tr><tr><td>Power circuit</td><td>13 V</td><td>1 A</td><td>Other than the above</td></tr></table><Table5-1></td></tr>
<tr><td>Insulation resistance</td><td colspan="2">Min 250 MΩ</td><td>Measure resistance between neighbor terminals (figure 5-6), and between terminal and housing surface (figure 5-7) with DC 500V insulation resistance gauge with connector combined.
 

<Figure 5-6: Between neighboring terminals> <Figure 5-7: Between neighboring terminal and housing surface></td></tr>
<tr><td>Leakage Current</td><td colspan="2">1 μA or less</td><td>Measure it by applying DC 14V between neighboring terminals (figure 5-6).</td></tr>
<tr><td>High voltage test</td><td colspan="2">No allowed
Insulation breakdown</td><td>Measured by applying test potential of 1000 V AC between the adjacent contact between the contact and housing.</td></tr>
<tr><td>Temperature rise</td><td colspan="2">Max 30℃</td><td>Apply basic current (I = Io *K) of clause 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.</td></tr>
<tr><td>Instant short circuit</td><td colspan="2">There shall be no 10μs or more instant short circuit.</td><td>It is instant short circuit, when 3.5V or less voltage continues for 10 μs or more in gauge by applying 1 mA, 5V open voltage. Figure 5- 8 is an example of measured circuit</td></tr>
</table>

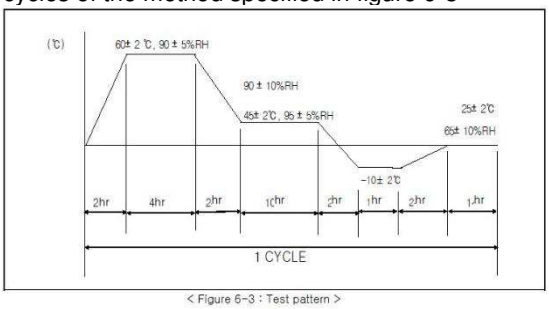
<table>
<tr><td rowspan="2">Sealing test</td><td>After endurance</td><td rowspan="2">Put the combined connector in water as shown in the figure 5-9 and supply 10Kpa(0.1kg/㎠) to connector for 30 seconds. Then increase it by 10Kpa(0.1kg/㎠) until 200Kpa(2kg/㎠) is reached and maximum value shall be specified in the test report for reference. (Use a wire of which the pressure does not leak at the end)
 



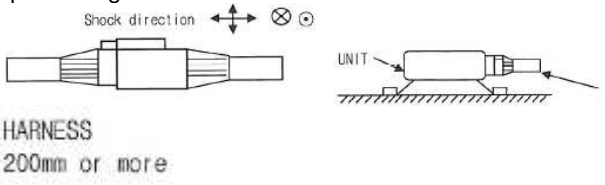

</td></tr>
<tr><td>1kgf/ cm^2</td></tr>
<tr><td>Twisting Test
- Connector Engage and Disengage Endurance Test</td><td>Appearance</td><td>No crack, damage, distortion are permitted</td><td>Apply 8kgf force on the end part of combined connector 10 times each in the (front, rear, left, right) directions perpendicular to axial direction.
Make combine connectors engage and disengage at 100mm/min. Perform it 50 times.
(Do not use locking device)</td></tr>
<tr><td></td><td colspan="2">Max 10Mv/A</td><td></td></tr>
<tr><td rowspan="5">Overcurrent cycle test</td><td>Appearance</td><td colspan="2">No crack, damage distortion are permitted</td><td rowspan="5">Engage and disengage connector with terminal assembled 10 times with hands, and apply the following current 1000 cycles for the connector with electrodes in series at 60℃ of ambient temperature.
<table><tr><td rowspan="2">Current application condition A</td><td>Applied current</td><td>2 times of basic current</td></tr><tr><td>Current application time</td><td>1 minute - ON, 9 minutes - OFF</td></tr><tr><td rowspan="2">Current application condition B</td><td>Applied current</td><td>5 times of basic current</td></tr><tr><td>Current application time</td><td>10 seconds - ON, 590 seconds - OFF</td></tr></table></td></tr>
<tr><td rowspan="2">Voltage Drop</td><td>Condition A</td><td rowspan="2">Max 10Mv/A</td></tr>
<tr><td>Condition B</td></tr>
<tr><td rowspan="2">Temp rise</td><td>Condition A</td><td rowspan="2">Max 40℃</td></tr>
<tr><td>Condition B</td></tr>
<tr><td rowspan="4">Cold temperature test</td><td>Appearance</td><td colspan="2">No crack, damage, distortion are permitted</td><td rowspan="4">Engage and disengage connector with terminal assembled 10 times with hands, and leave it
in temperature chamber of -40℃ for 120 hours. Make connector engaged and disengaged 5 times immediately, and drop it onto the concrete surface from 1m height 3 times in the direction of figure 6-1. (Voltage drop & Temperature rise test perform at normal temperature) :</td></tr>
<tr><td rowspan="2">Insulation Resistance</td><td rowspan="2">Sealed CONN'R :
Min 100 MΩ</td><td>Between terminals</td></tr>
<tr><td>housing surface</td></tr>
<tr><td>Current Leakage</td><td colspan="2">Max 100 ㎂</td></tr>
</table>

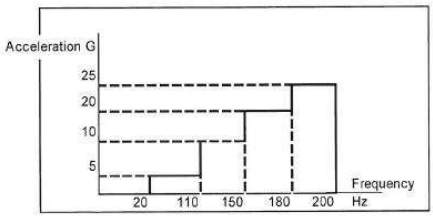
	Sealing	Min 0.5kgf/ cm^2	 <Figure 6-1>
Cold and hot temperature shock test	Appearance	No crack, damage, distortion are permitted	Engage and disengage Connector with terminal assembled 10 times with hands, this repeats 200 CYCLE by below test condition. (Sealed : 120℃, Non-Sealed : 80℃) 
	Voltage Drop	Max 10Mv/A	
	Sealing	Max 0.5kgf/ cm^2	
High temperature test	Appearance	No crack, damage, distortion are permitted	Engage and disengage connector with terminal assembled 10 times with hands, and leave it in combined state at the temperature chamber of the table 6-1 for 300 hours. Then pick it out and leave it until it returns to normal temperature.
	Voltage Drop	Max 10Mv/A	
	Sealing	Min 0.5kgf/cm^2	

High Temperature	Connector Using Part
120℃	Waterproof Connector

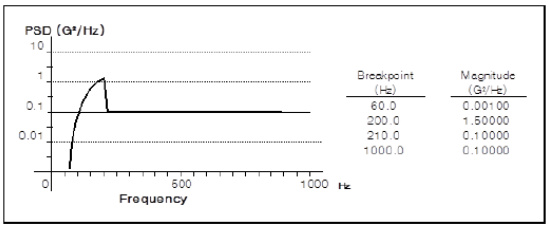
Temperature Humidity Test	Appearance	No crack, damage, distortion are permitted	Engage and disengage connector with terminal assembled 10 times with hands, and leave it at 25℃ ambient temperature and 65% relative humidity for 25 hours. And perform 5 cycles of the method specified in figure 6-3  < Figure 6-3 : Test pattern >
	Voltage Drop	Max 10Mv/A	
	Insulation Resistance	Min 100MΩ — Between terminals / housing surface	
	Current Leakage	Max 100 μA	
Dust Test	Appearance	No crack, damage, distortion are permitted	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.
	Voltage Drop	Max 10Mv/A	
	Sealing	Min 0.5kgf/cm^2	
Waterproof Test	Appearance	No crack, damage, distortion are permitted	Make combined connectors engaged and disengaged 10 times b hands, and leave it in combined state at 120 ℃ ambient tempera for 40 minutes and then spray water of normal temperature for 2

	Insulation Resistance	Min 100 MΩ	Between terminals	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.
			housing surface	
	Current Leakage	Max 100 μA		
	Sealing	Min 0.5kgf/cm^2		
Oil and liquid test	Appearance	No crack, damage, distortion are permitted		Engage and disengage connector with terminal assembled 10 times with hands, and perform test each sample with connector combined. A. Immerge connector in combined state for 2 hours in mixed oil of 50± 2℃ ENG oil (SAE10W) or equivalent oil and B. Immerge connector in combined state for1 hour in car gasoline (JIS K2202) at normal temperature, and then pick it out. C. Immerge connector in combined state for 1 hour in brake liquid (pure product) at normal temperature, and then pick it out. D. Immerge connector in combined state for 1 hour in 100% washer liquid (pure product) at normal temperature, and then pick it out. E. Immerge connector in combined state for 1 hour in 50% LLC (Long life coolant) at normal temperature, and then pick it out.
	Voltage Drop	Max 10Mv/A		
	Sealing	Min 0.5kgf/ cm^2		
Ozone Test	Appearance	No crack, damage, distortion are permitted		Engage and disengage Connector with terminal assembled 10 times with hands, and samples keep at 40℃ and 50±5pphm Ozone for 100hour. Then pick connector out of chamber and dry it for 2hours or more
	Voltage Drop	Max 10Mv/A		
	Sealing	Min 0.5kgf/cm^2		
Salt Water Test	Appearance	No crack, damage, distortion are permitted		Engage and disengage connector with terminal assembled 10 times with hands, and put it in 35℃ 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 four times. Then pick connector out of chamber and dry it at room temperature for 2 hours or more.
	Voltage Drop	Max 10Mv/A		
	Insulation Resistance	Min 100 MΩ	Between terminals	
			housing surface	
	Current Leakage	Max 100 μA		
Sulfur (SO2) gas test	Appearance	No crack, damage, distortion are permitted		Engage and disengage connector with terminal assembled 10 times with hands, and expose it in combined state to sulfur gas of 40±3℃, density 10ppm, humidity 90~95%, for 24 hours. Then pick connector out of chamber and dry it for 2 hours or more.
	Voltage Drop	Max 10Mv/A		

<table>
<tr>
<td>Mechanical shock test</td>
<td colspan="2">Instant short circuit:
Max 10 μs</td>
<td>Engage and disengage Connector with terminal assembled 10 ti with hands, and apply 1960, 3920, 5880, 9822 ㎨ shock in each direction of figure 20 and 21 using assembled male and female samples. Perform test in current application condition of DC13V open voltage and 10Ma short circuit current.
 

< Fig. 6-4 > < Fig. 6-5 ></td>
</tr>
<tr>
<td rowspan="5">Complex environment endurance test</td>
<td>Appearance</td>
<td>No crack, damage, distortion are permitted</td>
<td rowspan="5">Engage and disengage connector with terminal assembled 10 times with hands, and leave it in combined state in the temperature chamber of 120℃ or 80℃ (follows table 7) for 48 hours.
And then perform the following vibration test. Then measure instant short circuit according to the method of clause 4.16 for 4 hours for X, Y, Z each.
0) Sine wave test
<table>
<tr><th>Division</th><th>Condition</th></tr>
<tr><td>Ambient temperature/humidity</td><td>120℃</td></tr>
<tr><td>Applied current</td><td>Basic current (Connector electrodes in series.)</td></tr>
<tr><td>Current application cycle</td><td>120 CYCLE (45 minutes-ON, 15 minutes-OFF)</td></tr>
<tr><td>Vibration acceleration</td><td>4.4g</td></tr>
<tr><td>Frequency</td><td>20Hz ~ 200Hz (sweep time: 3 minutes or less)</td></tr>
<tr><td>Vibration time</td><td>40 hours for X, Y, Z each</td></tr>
<tr><td>Connector attaching method</td><td>Test mode A, B, C</td></tr>
</table>


1) Random wave test
<table>
<tr><th>Division</th><th>Condition</th></tr>
<tr><td>Ambient temperature/humidity</td><td>Refer to figure 4-8, 90~95%</td></tr>
<tr><td>Applied current</td><td>Basic current (Connector electrodes in series.)</td></tr>
<tr><td>Current application cycle</td><td>24 CYCLE (45 minutes-ON, 15 minutes-OFF)</td></tr>
<tr><td>Vibration acceleration</td><td>Follow figure 6-8</td></tr>
<tr><td>Frequency</td><td>20Hz ~ 200Hz (sweep time: 3 minutes or less)</td></tr>
<tr><td>Vibration time</td><td>8 hours for X, Y, Z each</td></tr>
<tr><td>Connector attaching method</td><td>Test mode D, E, F</td></tr>
</table></td>
</tr>
<tr>
<td>Crimp Tensile Strength</td>
<td>2.0SQ Min 20kgf
0.85SQ Min 13kgf
1.25SQ Min 17kgf</td>
</tr>
<tr>
<td>Voltage Drop</td>
<td>Max 10Mv/A</td>
</tr>
<tr>
<td>Temperature Rise</td>
<td>Max 40℃</td>
</tr>
<tr>
<td>Instant short circuit</td>
<td>Max 10μs</td>
</tr>
</table>



3.4. Applied Part No List

TE Part no	Description
0-936059-1/2/3	2.8mm SLD 2P PLUG ASSEMBLY
1-936059-1/3	2.8mm SLD 2P PLUG ASSEMBLY
2-936059-1	2.8mm SLD 2P PLUG ASSEMBLY
1897017-3	2.8mm SLD 2P PLUG ASSEMBLY
0-936103-1/2/3	DBL HSG FOR 2.8mm SLD 2P PLUG ASSY
1-936103-3	DBL HSG FOR 2.8mm SLD 2P PLUG ASSY
936111-1	COVER HSG FOR 2.8mm SEALED 2P PLUG CONN'R
0-1743451-2	COVER HSG FOR 2.8mm SEALED 2P PLUG CONN'R
0-1743544-2	COVER HSG FOR 2.8mm SEALED 2P PLUG CONN'R
936462-1/2	2.8MM SEALED 2P CAP HSG
1-936462-2	2.8MM SEALED 2P CAP HSG
936060-1/2/3	2.8mm SLD 3P PLUG ASSEMBLY
1-936060-3	2.8mm SLD 3P PLUG ASSEMBLY
2-936060-1/3	2.8mm SLD 3P PLUG ASSEMBLY
0-936106-1/2/3	DBL HSG FOR 2.8mm SLD 3P PLUG ASSY
936112-1	COVER HSG FOR 2.8mm SEALED 3P PLUG CONN'R
2297696-2	COVER HSG FOR 2.8MM SLD 3P PLUG ASSY
936061-1/2	2.8mm SLD 3P PLUG ASSEMBLY
936062-1/3	2.8mm SLD 5P plug ASSY
936110-1/2/3	DBL HSG FOR 2.8mm SLD 5P PLUG ASSY
936113-1	COVER HSG FOR 2.8mm SEALED 5P PLUG CONN'R
936394-2	2.8MM SLD 6P PLUG ASSY
936397-2/3/5	DBL HSG FOR 2.8mm SLD 6P PLUG ASSY
936398-2	COVER HSG FOR 2.8MM SLD 6P PLUG
2219569-1	110 EVP 6P HEADER ASSY