ISH® INLINE CONNECTOR

Product Specification

Qualification Test Report No. STR-16033

Rev.	ECN	Date	Prepared by	Checked by	Approved by
3	RS0737	November 10, 2020	K.Hanaki	J.Tateishi	E.Kawabe
2	RS0612	July 19, 2019	S.Tanaka	J.Tateishi	E.Kawabe
1	RS0513	July 12, 2018	D.Matsushita	T.Osuga	E.Kawabe
0	RS0311	October 14, 2016	K.Hanaki	J.Mukunoki	T.Endo

1. Scope： This CONNECTOR is a 0.5mm terminal miniature inline connector.

2. Purpose：This specification covers the requirements for product performance and test methods of ISH INLINE CONNECTOR.

3. Application items

This specification is applicable to the items listed below

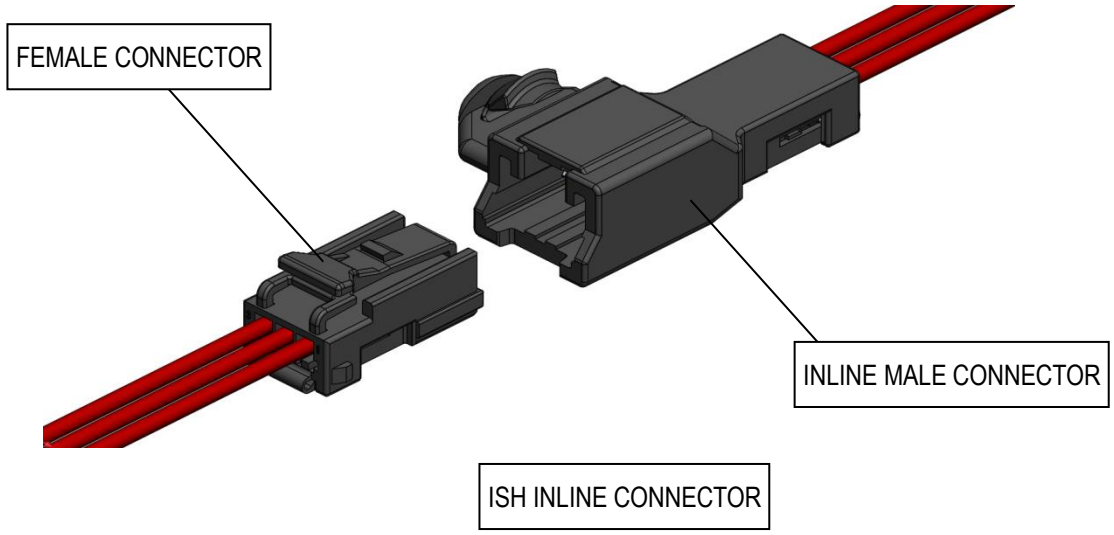

Table 1. Product Line

Pole	TYPE		PARTS No.			
	KEY CODING	Lock	MALE HOUSING	INLINE MALE TERMINAL	FEMALE HOUSING	FEMALE TERMINAL
3P	STANDARD	STANDARD	V0014-91003-221	VT002-012	V0013-91003-211	VT001-512

4. Operating Condition

Temperature ：-40～125℃（including temperature rise）

5. Construction, Materials and Finish

5.1 ISH INLINE CONNECTOR

(1)INLINE MALE HOUSING・・・・・Material：PBT, Flame retardance：UL94-HB, Color：BLACK

(2)INLINE MALE TERMINAL・・・・・Material：BRASS, Plating：Sn(Reflow)

(3)FEMALE HOUSING・・・・・Material：PBT, Flame retardance：UL94-HB, Color：BLACK

(4)FEMALE RETAINER・・・・・Material：PBT, Flame retardance：UL94-HB, Color：BLACK

(5)FEMALE TERMINAL・・・・・BOX Material：BRASS, Plating：Sn(Reflow)

Spring Material：Copper alloy, Plating：Sn(Reflow)

(6)Applicable Cable・・・・・Cross section：0.3mm^2、0.5mm^2、 Outer diameter：1.60mm MAX.

5.2 Terminal crimp specification

Terminal crimp specification compliant with Handling Manual【HDM-0006】

6. Test Methods and Performances

6.1 Initial characteristics

Test method is described in 7.1 Initial characteristics Test Method.

Table 2. Initial characteristics

Item	Measurement		Requirements
1	Terminal appearance		No detrimental deformation
2	Terminal outer dimension		Satisfy drawing dimension
3	Housing appearance		No detrimental deformation
4	Housing outer dimension		Satisfy drawing dimension
5	Feeling (insertion/removal)		No discomfort
6	Connector mating force		24.5N Max.
7	Connector unmating force		15N Max.
8	Connector retention force		90N Min.
9	Unlocking force		50N Max.
10	Insulation resistance		100MΩ Min.
11	Withstanding voltage		No insulation breakdown or errosion
12	Temperature rise	single pole	⊿T=50℃Max.
		All poles	⊿T=50℃Max.
13	Leak current		1mA Max.
14	Audible click		60db(A) Min.
15	Terminal crimp strength		70N Min.
16	Terminal insertion force		0.5N Min.～3N Max.
17	Terminal removal force		0.5N Min.～3N Max.
18	Terminal contact force		3N Min.

Table 3. Initial characteristics

Item	Measurement	Requirements	
19	Voltage drop	Initial	10mV/A Max.
		After test	20mV/A Max.
20	Dry circuit resistance	Initial	10mΩ Max.
		After test	20mΩMax.
21	Microcut monitoring	Not exceed 7Ω for more than 1μs	
22	Male terminal retention force	With secondary lock	49N Min.
		Without secondary lock	20N Min.
23	Female terminal retention force	With secondary lock	49N Min.
		Without secondary lock	20N Min.
24	Terminal to housing insertion force	10N Max.	
25	Retainer insertion/removal force	Insertion force	29.4N Max.
		Removal force	14.7N Max.
26	Housing lock strength without terminals	49N Min.	
27	Sn whisker	125μm Max.	
28	Connector clip mating force	50N Max.	
29	Connector clip unmating force	F1	90N Min.
		F2	90N Min.
		F3	90N Min.
		F1'	90N Min.
		F2'	90N Min.
		F3'	90N Min.

6.2 Environmental Performances

Test method is described in 7.2 Environmental Performances Test Method.

Table 4. Environmental Performances

Item	Test name	Measurement		Requirements
1	Repeated insertion/removal	Connector mating force	After 5 repeat	24.5N Max.
			After test	24.5N Max.
		Connector unmating force	After 5 repeat	15N Max.
			After test	15N Max.
		Voltage drop	Initial	10mV/A Max.
			After test	20mV/A Max.
2	Resistance to forced mating (with 98N in 4 directions)	Connector mating force	After test	24.5N Max.
		Connector unmating force	After test	15N Max.
		Voltage drop	Initial	10mV/A Max.
			After test	20mV/A Max.
3	Thermal aging	Housing appearance		No detrimental deformation
		Feeling(insetrion/removal)		No discomfort
		Connector retention force	Direction 1	90N Min.
		Terminal crimp strength		70N Min.
		Dry circuit resistance	Initial	10mΩ Max.
			After test	20mΩ Max.
		Male terminal retention force	With secondary lock	49N Min.
			Without secondary lock	20N Min.
		Female terminal retention force	With secondary lock	49N Min.
			Without secondary lock	20N Min.
		Housing lock strength without terminals		49N Min.
		Connector clip retention force		90N Min.
4	Low temperature aging	Housing appearance		No detrimental deformation
		Feeling(insetrion/removal)		No discomfort
		Dry circuit resistance	Initial	10mΩ Max.
			After test	20mΩ Max.
		Male terminal retention force	With secondary lock	49N Min.
			Without secondary lock	20N Min.
		Female terminal retention force	With secondary lock	49N Min.
			Without secondary lock	20N Min.
		Housing lock strength without terminals		49N Min.
		Connector clip retention force		90N Min.
5	Thermal shock	Housing appearance		No detrimental deformation
		Feeling(insetrion/removal)		No discomfort
		Connector retention force	Direction 1	90N Min.
		Terminal crimp strength		70N Min.
		Dry circuit resistance	Initial	10mΩ Max.
			After test	20mΩ Max.
		Male terminal retention force	With secondary lock	49N Min.
			Without secondary lock	20N Min.
		Female terminal retention force	With secondary lock	49N Min.
			Without secondary lock	20N Min.
		Connector clip retention force		90N Min.
6	Temperature/humidity cycle	Housing appearance		No detrimental deformation
		Feeling(insetrion/removal)		No discomfort
		Insulation resistance		100MΩ Min.
		Withstand voltage		No insulation breakdown or errosion
		Leak current		1mA Max.
		Dry circuit resistance	Initial	10mΩ Max.
			After test	20mΩ Max.
		Male terminal retention force	With secondary lock	49N Min.
			Without secondary lock	20N Min.
		Female terminal retention force	With secondary lock	49N Min.
			Without secondary lock	20N Min.
		Connector clip retention force		90N Min.

Table 5. Environmental Performances

Item	Test name	Measurement		Requirements
7	Resistance to humidity	Housing appearance		No detrimental deformation
		Connector retention force	Direction 1	90N Min.
		Insulation resistance		100MΩ Min.
		Withstand voltage		No insulation breakdown or errosion
		Leak current		1mA Max.
		Dry circuit resistance	Initial	10mΩ Max.
			After test	20mΩ Max.
		Male terminal retention force	With secondary lock	49N Min.
			Without secondary lock	20N Min.
		Female terminal retention force	With secondary lock	49N Min.
			Without secondary lock	20N Min.
		Connector clip retention force		90N Min.
8	Resistance to abrasion	Terminal appearance		No detrimental deformation
		Housing appearance		No detrimental deformation
		Voltage drop	Initial	10mV/A Max.
			After test	20mV/A Max.
9	Corrosion gas	Terminal appearance		No detrimental deformation
		Housing appearance		No detrimental deformation
		Terminal crimp strength		70N Min.
		Voltage drop	Initial	10mV/A Max.
			After test	20mV/A Max.
10	Condensation	Terminal appearance		No detrimental deformation
		Housing appearance		No detrimental deformation
		Insulation resistance		100MΩ Min.
		Withstand voltage		No insulation breakdown or errosion
		Leak current		1mA Max.
		Dry circuit resistance	Initial	10mΩ Max.
			After test	20mΩ Max.
11	Dump heat cycle	Housing appearance		No detrimental deformation
		Leak current		1mA Max.
		Insulation resistance	250h	100MΩ Min.
			500h	100MΩ Min.
			750h	100MΩ Min.
			1000h	100MΩ Min.
		Migration		No migration
12	Current cycle	temperature rise		⊿T=50℃ Max.
		Voltage drop	Initial	10mV/A Max.
			After test	20mV/A Max.
13	Shock	Voltage drop	Initial	10mV/A Max.
			After test	20mV/A Max.
		Microcut		Not exceed 7Ω for more than 1μs
14	Vibration	temperature rise		⊿T=50℃ Max.
		Voltage drop	Initial	10mV/A Max.
			After test	20mV/A Max.
		Dry circuit resistance	Initial	10mΩ Max.
			After test	20mΩ Max.
		Microcut		Not exceed 7Ω for more than 1μs
15	Vibration with temperature change	Terminal appearance		No detrimental deformation
		Housing appearance		No detrimental deformation
		Terminal contact force		3N Min.
		Dry circuit resistance	Initial	10mΩ Max.
			After test	20mΩ Max.
		Voltage drop	Initial	10mV/A Max.
			After test	20mV/A Max.
		Microcut		Not exceed 7Ω for more than 1μs

7. Test method

7.1 Initial characteristics Test Method

(1) Terminal appearance

Test method・・・・Visual(e.g. magnifier) and tactile verification.

(2) Terminal outer dimension

Test method・・・・Measure dimensions using caliper, micrometer, projector.

(3) Housing appearance

Test method・・・・Visual(e.g. magnifier) and tactile verification.

(4) Housing outer dimension

Test method・・・・Measure dimensions using caliper, micrometer, projector.

(5) Feelinng (insertion/extraction)

Test method・・・・Verify the feeling by insertion/extraction of a pair of connectors and terminals.

(6) Connector mating force

Test method・・・・Measure the force required to mate female and male connectors at a rate of 100 mm/min. (terminals must be fully populated)

(7) Connector unmating Force

Test method・・・・Measure the force to pull the connectors apart at a rate of 100 mm/min. without the locking feature.

(8) Connector Retention Force

Test method・・・・Measure the maximum force to pull out female connector from mated state (Fig.1). Pull in four directions at a speed of 50mm/min. (Terminals must be fully populated)

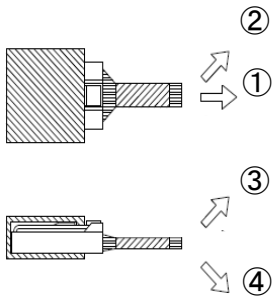

Fig 1.Measurement of connector retention force

(9) Unlocking force

Test method・・・・Measure the force required to disengage the lock.

(10) Insulation resistance

Test method・・・・Supply DC500V insulation resistance between (a) terminals (b) terminal and earth on mated connectors.

(11) Insulation resistance

Test method・・・・Supply AC1000V between (a) terminals (b) terminal and ground on mated connectors for 1minute.

Same connection as for insulation resistance test

(12) Temperature rise

Test method・・・・Supply current to mated connectors, measure the temperature rise at crimp area, when temperature is saturated. Female connector wire length: 300mm

Single pole：7A to 1 terminal

All poles：Connect all poles and apply the current that is calculated by 7A multiplied by the coefficient in Table 6.

Table 6. Coefficient

Poles	Coefficient
1	1
2～3	0.75
4～5	0.6
6～8	0.55
9～12	0.5
13～20	0.4

(13) Leak current

Test method・・・・Supply 16±0.1V to mated connector terminals. Measure maximum leak current.

(14) Audible click

Test method・・・・Horizontally insert fully populated female connector to male connector which is soldered onto PCB.

Measure by the sound with sound level meter, and analyze the frequency analyzer (FFT).

Measurement range:10kHz～20kHz

Background noise: 5 kHz MIN, Peak: 50dB MAX

Measurement must be done in a room.

Keep the position of the connector lock 600mm away from sound level meter.

Fix PCB and measure the lock sound without any touches.

(15) Terminal crimp strength

Test method・・・・Crimp wire of 100mm approx. to terminal and pull the wire at the speed of 50-100mm/min. Measure the force when the wire breaks or the wire comes out from the terminal. Do not use insulation barrel.

(16) Terminal insertion force

Test method・・・・Measure the force to insert fully male terminal into fixed female terminal at a speed of 100 mm/min.

(17) Terminal removal force

Test method・・・・Measure the force to pull out male terminal from fixed female terminal at a speed of 100 mm/min.

(18) Terminal contact force

Test method・・・・Calculate a contact force of female terminal and male terminal.
Measure female terminal spring displacement-force characteristics, and calculate a contact force from displacement upon male terminal insertion.
(Accuracy 0.01mm MAX)

(19) Voltage drop

Test method・・・・Open: 12V, Short circuit: 1A
Measure the voltage drop between male connector lead and temp. measurement point after where is 75mm for from the crimp area of female terminal.
temperature reached saturation at 75mm from female terminal crimp.
Then, subtract voltage drop of wires and male connector lead
Wire resistance: 3.77mΩ/75mm (20℃) or actual measurement.

(20) Dry circuit resistance

Test method・・・・Open: 20±5mV, Short circuit: 10±0.5mA

Measure resistance of point where is 75mm for from the crimp area of female terminal and male connector lead.

Then, subtract resistance of wire and male connector lead.

Wire resistance: 3.77mΩ/75mm (20℃) or actual measurement

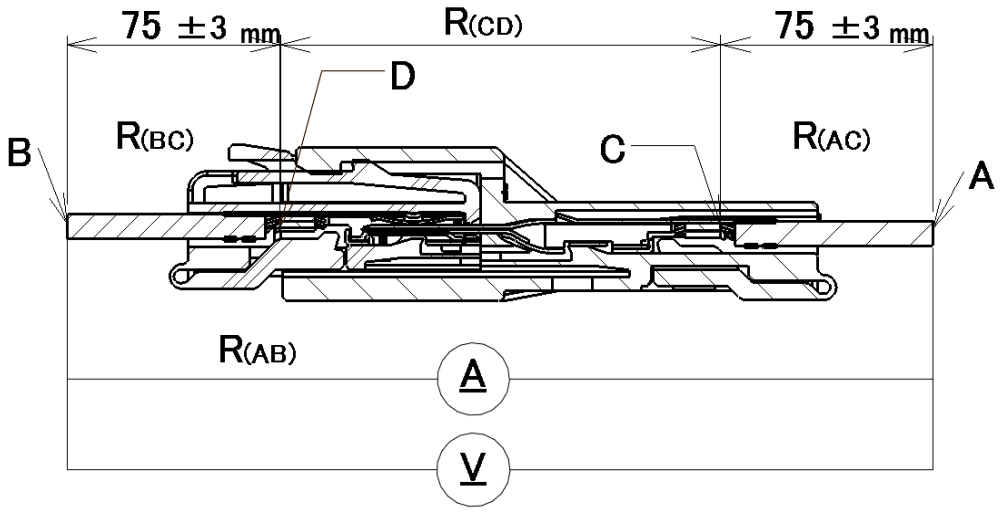

Fig 2. In-line Circuit Test Lead Location

(21) Microcut monitoring

Test method・・・・Measure dry circuit resistance.

(22) Male terminal retention force

Test method・・・・Measure the force to pull out wired male terminals from male connector housing at a speed of 100mm/min. Test with and without retainer or hinge.

(23) Female terminal retention force

Test method・・・・Measure the force to pull out wired female terminal from female connector housing at a speed of 100mm/min. Test with and without retainer or hinge.

(24) Terminal to housing insertion force

Test method・・・・Measure the force to fully insert terminal into connector housing at a speed of 100mm/min.

(25) Retainer/hinge insertion/removal force

Test method・・・・Fully populate male connector housing. Measure the force required to insert and extract the retainer/hinge at a speed of 100mm/min.

(26) Housing lock strength without terminals

Test method・・・・Measure the maximum force to pull out unpopulated female connector housing from mated status at a speed of 100mm/min.

(27) Sn whisker

Test method・・・・Check the surface of connector's metal portions(terminals, lead) with microscope, etc. to find Sn whisker. Use microscope with magnification of X100 MIN.
Check closely not to lose sight of whisker with different magnifications.

(28) Connector clip mating force

Test method・・・・Mate connectors. Measure the maximum force to insert the clip into the hole of fixing board at a speed of 100mm/min

(29) Connector clip retention force

Test method・・・・Mate connectors. Then the clip is inserted fully into the fixing board.
Measure the force required to remove or to break the connector clip when wires are pulled at a speed of 20mm/min in the following 3 axes and 6 directions: mating direction (F1, F1'), 2 directions that are 90°to mating directions (F2,F2', F3,F3').

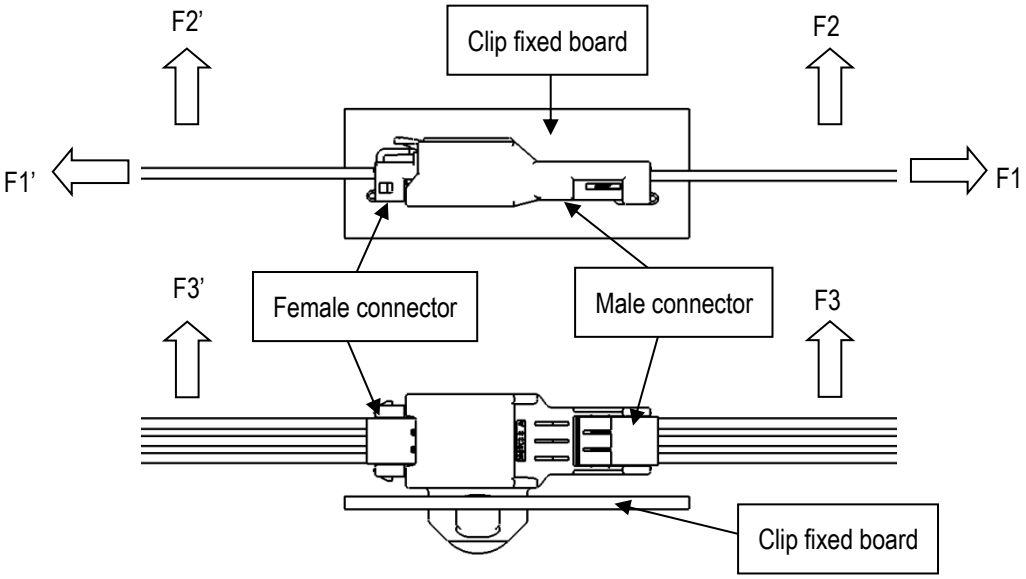

Fig 3.Directions of measuring connector clip retention force

7.2 Environmental Performances Test Method

(1) Repeated insertion/extraction

Test method・・・・Measure the force required to insert/extract populated female connector into/from fixed male connector at speed of 100mm/min. Repeat 10 times. Lock must be disengaged.

(2) Resistance to forced mating (with 98N in 4 directions)

Test method・・・・Insert populated female connector into male connector. Apply force of 98N from 4 directions perpendicular to insertion axes.
Apply force twice per direction. Repeat 10 times.
Female connector insertion depths: 1)depth at which terminals start to touch and 2) depth of maximum insertion

(3) Thermal Aging

Test method・・・・Place mated connectors in thermal chamber at 125±3℃ for 120h.
Remove the connectors from the chamber and leave it to ambient temperature to recover.

(4) Low temperature aging

Test method・・・・Place mated connectors in thermal chamber at －40±3℃ for 120h.
Repeat insert/extract for 5 times immediately after removing from the chamber, then leave to recover to ambient temperature.

(5) Thermal shock

Test method・・・・Place mated connectors in thermal chamber and subject them to heat /cold cycle (85±3℃/-40±3℃). No of cycles: 3000
Duration (0.5h) may be shortened if sample's temperature reaches test temperature requirement early.

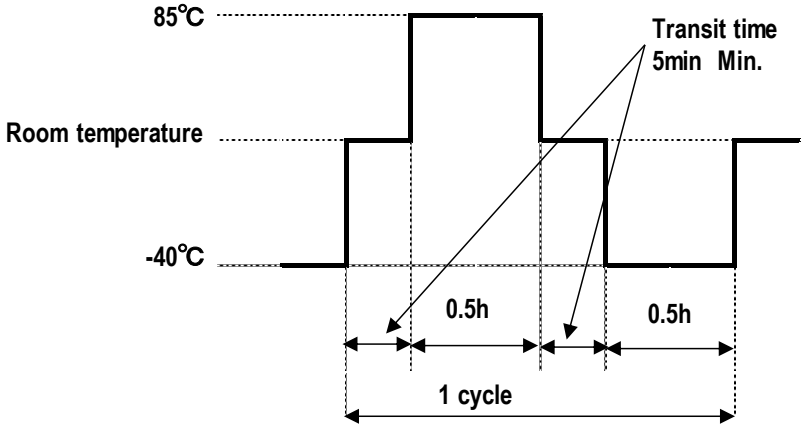

Fig 4. Thermal shock

(6) Temperature/humidity cycle

Test method・・・・Place mated connectors in climatic chamber and subject them to the cycle pattern specified in Fig. 5. Duration 24h, No. of cycles: 10, Temperature: 85±3℃

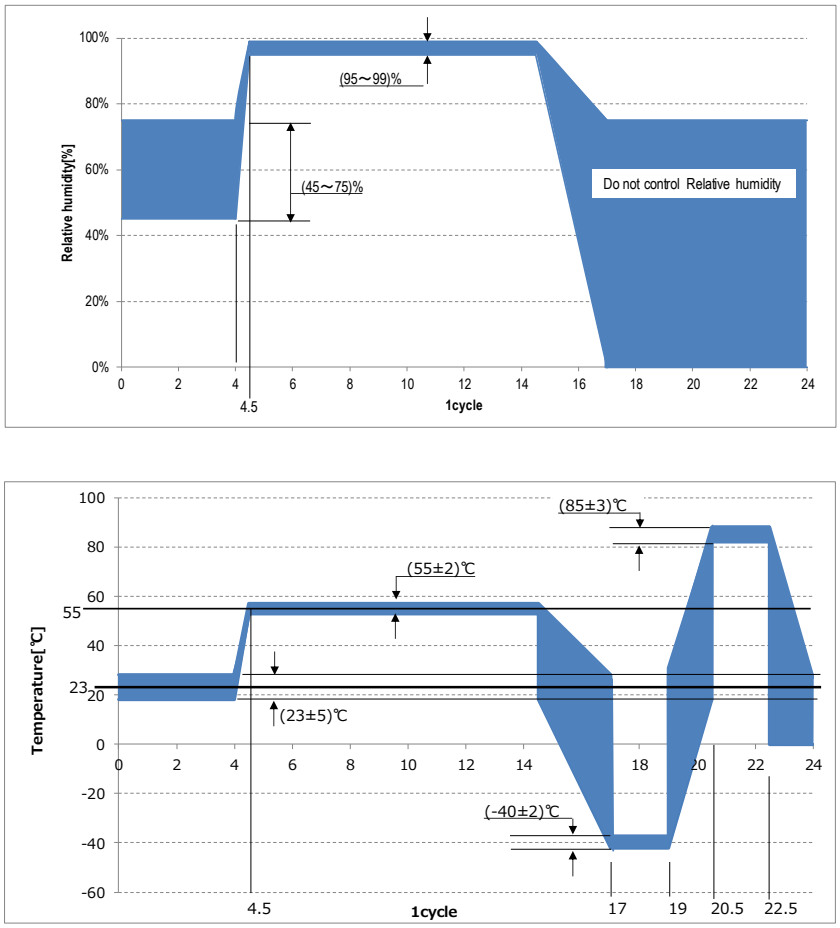

Fig 5. Temperature/humidity cycle

(7) Resistance to humidity

Test method・・・・Place mated connectors in climatic chamber and subject them to 60℃±5℃, 90～95%RH for 96h.

Hang connectors to prevent any dews developing on the connectors.

(8) Resistance to abrasion

Test method・・・・Suspend mated connectors in the chamber and spray dust for 10s every 15 min.

Insert/extract connectors every other cycle.

No. of cycles: 8

Chamber length must be 900-1200mm. Use approx. 1.5kg of dust particles of Kanto Loam layer or Portland cement (JIS R5210).

(9) Corrosion gas

Test method・・・・Place male and female connectors (not mated) in 25±5ppm, 40±2℃, 90-98%RH, SO2 gas for 96h.

(10) Condensation

Test method・・・・Place mated connectors in climatic chamber and subject them to the following cycle.

1 cycle: 1h at -30±3℃, then 1h at 25±3℃ and 90±5%RH

No. of cycles: 48

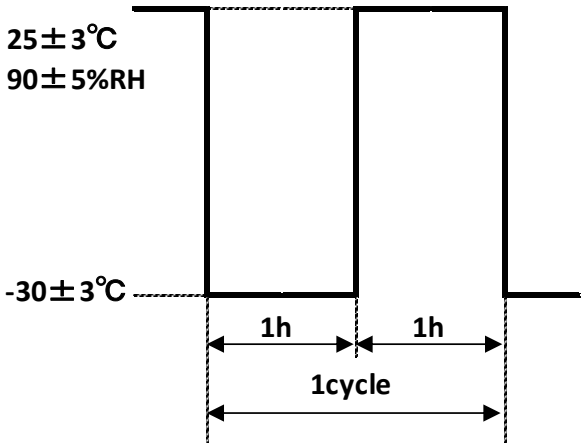

Fig 6. Condensation

(11) Dump heat cycle

Test method・・・・Place mated connectors in the chamber and apply current for 1000h at 85±3℃、85±5%RH. Measure the leak current during the test.

.

(12) Current cycle

Test method・・・・Place the mated connectors in thermal chamber at 70℃±3℃. Energize all terminals in series with 3A for 45min, then break for 15min. No, of cycles: 300.

(13) Shock

Test method・・・・Fi x mated connectors and subject to impact.

Use impact according to Fig.7 sinusoidal half-wave.

Duration D=6ms, Peak acceleration A=981m/s^2

Directions: 6 directions (top, down, left, right, front back), 3 shocks each direction

Connect all terminals in direct circuit.

Monitor resistance during test, open circuit 20±5mV, short circuit 10±0.5mA.

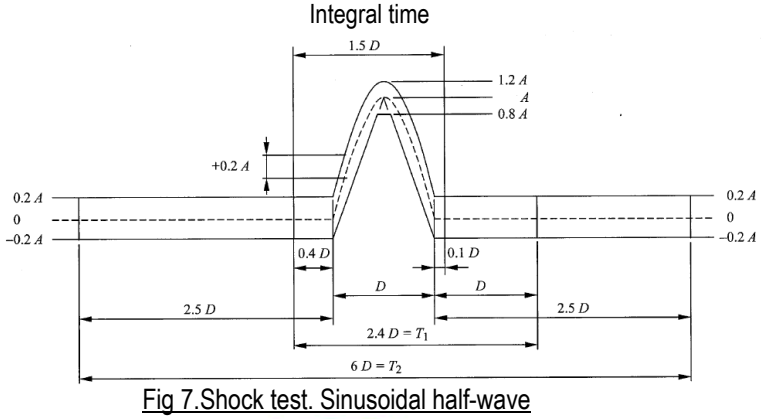

Fig 7.Shock test. Sinusoidal half-wave

(14) Vibration

Test method・・・・Fix mated connectors as shown in Fig. 8 and subject them to vibration.

◎Vibration condition

・Direction: 3 (front-back, left-right, top-bottom)

・Acceleration: 66.6m/s^2,

・Duration: 5h(front-back, left-right), 4h(top-bottom)

・Frequency: 10-50Hz

・Sweep time: 8min (per sweep)

Energize all terminals in series with, open 13+1/0V, short circuit 10±0.5mA, continuously during test.

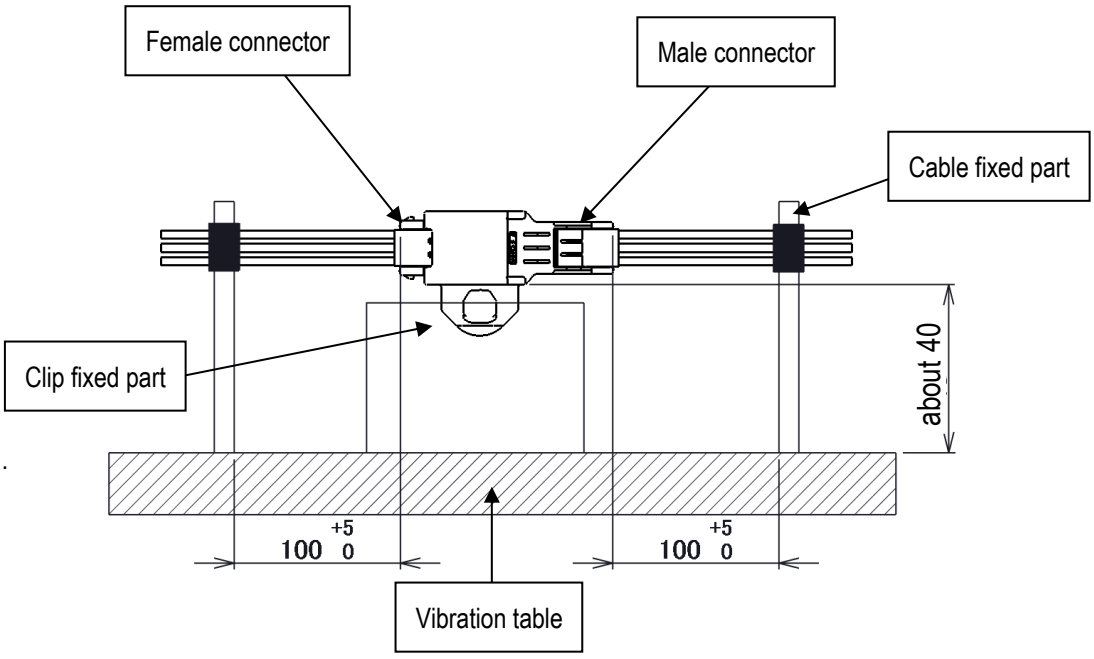

Fig 8. Fixing connectors for vibration test

(15) Vibration with temperature change

Test method・・・・Fix mated connectors in same way as the vibration test on fixture and subject them to vibration at 100±3℃.

◎Vibration condition

・Acceleration: 59.8m/s^2

・Frequency: 20-200Hz

・Sweep time: 3min (per sweep)

Energize all terminals at 2.2A for 45min, break for 15min. No. of cycles: 300

Repeat with other directions.

Monitor resistance during 2.2A current supply.

After test, carry out vibration test with 3 axes, each for 1h. Check for any microcuts.