ISH® HYBRID CONNECTOR (INERTIA LOCK)

Test Report

0	RS0942	June 14, 2023	Y. Nishimura	J. Mukunoki	J. Tateishi
Rev.	ECN	Date	Prepared by	Checked by	Approved by

1. Purpose

To evaluate performance of ISH CONNECTOR HYBRID.

2. Specimen

Items shown in Table 1 were evaluated.

Table 1. List of samples

Pole	KEY CODING	Lock type	Cable	PARTS No.			Test result
				MALE ASS'Y	FEMALE SUB ASS'Y	FEMALE TERMINAL	
20P	A	INERTIA	0.5mm：AESSX-HT 0.3sq 1.5mm：BEAMEX-ER500 0.5sq	V0123-020E-01	V0124-020B-01	0.5mm：VT009-01 x 18pin 1.5mm：VT011-01 x 2pin	Initial：Sheet 3 Durablity：Sheet 4～6
	B			V0123-020E-11	V0124-020B-11		

3. Test conditions

In compliance with Product Specification 【PSS-0035】.

4. Result

All test items were satisfied.

・For detail of the test results, see Table 2 ~ 5.

・For resistance monitoring during durability test, see Graphs 1 ~ 4.

Table 2. List of results: Initial properties (20P)

	Measurement			Specification	Set	n	Unit	Data					Judge.
								Avg.	Max.	Min.	s	Avg.±3s	
Initial characteristics	Terminal appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Terminal outer dimension			Satisfy drawing dimension	5	5	-	Satisfies drawing dimension					✓
	Housing appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Housing outer dimension			Satisfy drawing dimension	5	5	-	Satisfies drawing dimension					✓
	Feeling (insertion/removal)			No discomfort	5	5	-	No discomfort					✓
	Connector mating force			70N MAX.	5	5	N	51.18	52.8	50.0	1.08	54.42	✓
	Connector unmating force			55N MAX.	5	5	N	37.16	39.3	35.6	1.54	41.78	✓
	Connector retention force		Direction 1	100N MIN.	5	5	N	315.50	319.5	313.2	2.56	307.82	✓
			Direction 2	100N MIN.	5	5	N	451.79	465.9	432.7	11.97	415.88	✓
			Direction 3	100N MIN.	5	5	N	371.23	393.3	334.7	23.76	299.95	✓
			Direction 4	100N MIN.	5	5	N	458.06	483.6	442.6	15.60	411.26	✓
	Unlocking force			50N MAX.	5	5	N	10.22	10.3	10.1	0.08	10.46	✓
	Insulation resistance		Between terminals	100MΩ MIN.	5	5	-	1,000MΩ以上					✓
			Between terminal and housing	100MΩ MIN.	5	5	-	1,000MΩ以上					✓
	Withstanding voltage		Between terminals	No insulation breakdown or erosion	5	5	-	No insulation breakdown					✓
			Between terminal and housing	No insulation breakdown or erosion	5	5	-	No insulation breakdown					✓
	Temperature rise	Single pom	0.5mm	⊿T=50℃ MAX.	5	5	℃	25.85	26.1	25.4	0.33	26.84	✓
			1.5mm	⊿T=50℃ MAX.	5	5	℃	30.14	30.9	29.4	0.64	32.06	✓
		All pin	0.5mm	⊿T=50℃ MAX.	5	5	℃	41.48	42.5	40.7	0.72	43.64	✓
			1.5mm	⊿T=50℃ MAX.	5	5	℃	31.67	32.8	30.4	1.02	34.73	✓
	Leak current			1mA MAX.	5	5	-	1μA以下					✓
	Coplanarity			0.1mm MAX.	5	5	mm	0.06 Max.					✓
	Peg strength		Position 1	70N MIN.	5	5	N	191.81	198.0	175.7	9.27	164.00	✓
			Position 2	100N MIN.	5	5	N	331.40	352.8	316.3	14.48	287.96	✓
			Position 3	100N MIN.	5	5	N	927.90	948.7	903.8	16.06	879.72	✓
	Audible click			60dB MIN.	5	5	dB	69.65	71.8	66.4	2.85	61.10	✓
	Terminal crimp strength		0.5mm	70N MIN.	-	18	N	80.64	83.1	77.3	1.96	74.76	✓
			1.5mm	90N MIN.	-	10	N	121.83	124.7	117.6	2.50	114.33	✓
	Terminal insertion force		0.5mm	0.5N～3.0N	-	10	N	1.710	1.81	1.64	0.055	1.875	✓
			1.5mm	3.5N～4.5N	-	10	N	3.913	3.97	3.83	0.071	4.126	✓
	Terminal removal force		0.5mm	0.5N～3.0N	-	10	N	1.688	1.90	1.48	0.143	2.117	✓
			1.5mm	3.5N～4.5N	-	10	N	3.869	4.00	3.74	0.093	4.148	✓
	Terminal contact force		0.5mm	3N MIN.	-	10	N	3.208	3.40	3.02	0.138	2.794	✓
			1.5mm	4N MIN.	-	10	N	8.532	8.59	8.48	0.041	8.409	✓
	Terminal bend strength	a	0.5mm	Must not bend 1mm or over	-	10	-	Does not bend 1mm or over					✓
			1.5mm	Must not bend 1mm or over	-	20	-	Does not bend 1mm or over					✓
		b	0.5mm	Terminal bending 30° MAX.	-	10	N	2.404	5.23	0.26	1.570	7.114	✓
			1.5mm	Terminal bending 30° MAX.	-	20	N	1.012	2.87	0.00	0.846	3.550	✓
	Voltage drop		0.5mm	10mV/A MAX.	5	90	mV/A	2.451	2.66	2.20	0.171	2.964	✓
			1.5mm	10mV/A MAX.	5	10	mV/A	0.770	1.00	0.50	0.176	1.298	✓
	Dry circuit resistance		0.5mm	10mΩ MAX.	5	90	mΩ	2.569	2.92	2.20	0.248	3.313	✓
			1.5mm	10mΩ MAX.	5	10	mΩ	0.751	0.92	0.52	0.125	1.126	✓
	Microcut			1μsMIN.7ΩMAX.	-	-	-	Confirm by each durability test					-
	Terminal retention force	With secondary lock	0.5mm	49N MIN.	1	18	N	83.10	83.8	81.2	0.73	80.91	✓
			1.5mm	100N MIN.	3	6	N	131.67	133.8	128.4	2.01	125.64	✓
		Without secondary lock	0.5mm	20N MIN.	1	18	N	53.50	56.7	49.5	2.12	47.14	✓
			1.5mm	60N MIN.	3	6	N	70.03	71.1	69.4	0.67	68.02	✓
	Terminal to housing insertion force		0.5mm	10N MAX.	1	18	N	3.572	4.14	2.99	0.315	4.517	✓
			1.5mm	15N MAX.	5	10	N	5.600	7.20	4.50	0.831	8.093	✓
	Retainer insertion/removalforce		Insertion force	29.4N MAX.	5	5	N	19.95	20.5	19.5	0.33	20.94	✓
			Removal force	14.7N MIN.	5	5	N	41.61	44.3	39.0	2.25	34.86	✓
	Housing lock strength without terminals			49N MIN.	5	5	N	286.83	288.9	283.9	2.20	280.23	✓
	Sn whisker			125μm MAX.	5	5	-	No whisker					✓

Table 3. List of results: Properties after endurance tests – I (20P)

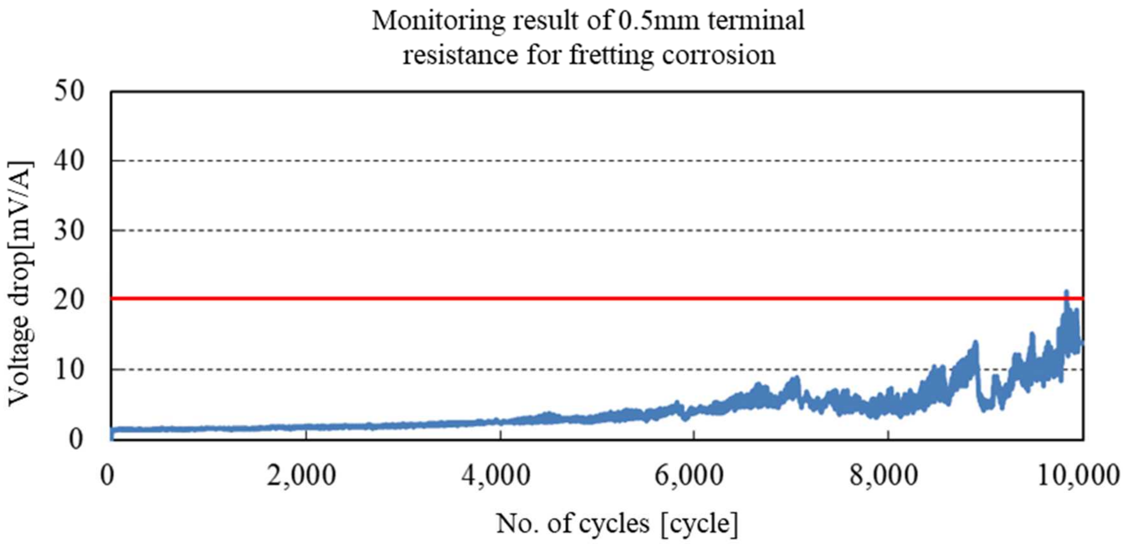
Item	Measurement			Requirements	Set	n	Unit	Data					Judge.
								Avg.	Max.	Min.	s	Avg.±3s	
Repeated insertion/removal	Connector mating force		After 5 repeat	70N MAX.	5	5	N	39.00	42.3	36.2	2.24	45.72	✓
			After test	70N MAX.	5	5	N	49.29	51.7	47.2	1.64	54.21	✓
	Connector unmating force		After 5 repeat	55N MAX.	5	5	N	30.13	39.3	24.8	5.57	46.84	✓
			After test	55N MAX.	5	5	N	47.74	49.7	46.5	1.72	52.90	✓
	Voltage drop	Initial	0.5mm	10mV/A MAX.	5	90	mV/A	2.469	3.31	2.07	0.319	3.426	✓
			1.5mm	10mV/A MAX.	5	10	mV/A	0.836	0.89	0.80	0.039	0.953	✓
		After test	0.5mm	20mV/A MAX.	5	90	mV/A	3.887	5.02	2.20	0.712	6.023	✓
			1.5mm	20mV/A MAX.	5	10	mV/A	1.311	2.02	0.88	0.308	2.235	✓
Resistance to forcedmating	Connector mating force			55N MAX.	5	5	N	38.77	45.9	32.9	5.32	54.73	✓
	Connector unmating force			45N MAX.	5	5	N	24.14	32.5	19.3	5.08	39.38	✓
	Voltage drop	Initial	0.5mm	10mV/A MAX.	5	90	mV/A	2.486	2.68	2.23	0.135	2.891	✓
			1.5mm	10mV/A MAX.	5	10	mV/A	0.647	0.85	0.52	0.112	0.983	✓
		After test	0.5mm	20mV/A MAX.	5	90	mV/A	3.684	5.37	2.64	0.980	6.624	✓
			1.5mm	20mV/A MAX.	5	10	mV/A	2.497	3.44	1.56	0.655	4.462	✓
Fretting corrosion	Dry circuit resistance		0.5mm	Grasp the ability value	-	5	-	See Graphs 1 and 2.					✓
Thermal a going	Housing appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Feeling (insertion/removal)			No discomfort	5	5	-	No discomfort					✓
	Connector retention force		Direction 1	100N MIN.	5	5	N	318.23	321.3	314.4	2.78	309.89	✓
	Terminal crimp strength		0.5mm	70N MIN.	-	10	N	78.84	80.3	76.8	1.19	75.27	✓
			1.5mm	90N MIN.	-	10	N	122.22	130.4	118.2	3.48	111.78	✓
	Dry circuit resistance	Initial	0.5mm	10mΩ MAX.	5	90	mΩ	2.448	3.13	2.08	0.276	3.276	✓
			1.5mm	10mΩ MAX.	5	10	mΩ	0.739	0.90	0.60	0.095	1.024	✓
		After test	0.5mm	20mΩ MAX.	5	90	mΩ	2.570	3.82	0.08	0.457	3.941	✓
			1.5mm	20mΩ MAX.	5	10	mΩ	1.262	1.79	0.97	0.269	2.069	✓
	Terminal retention force	With secondary lock	0.5mm	49N MIN.	2	18	N	77.89	81.4	74.7	1.80	72.49	✓
			1.5mm	100N MIN.	3	6	N	132.23	133.2	130.1	1.07	129.02	✓
		Without secondary lock	0.5mm	20N MIN.	2	18	N	43.14	48.1	38.3	2.95	34.29	✓
			1.5mm	60N MIN.	3	6	N	72.22	73.4	71.6	0.65	70.27	✓
	Housing lock strength without terminals			49N MIN.	5	5	N	292.87	298.3	285.4	4.94	278.05	✓
Low temprature a going	Housing appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Feeling (insertion/removal)			No discomfort	5	5	-	No discomfort					✓
	Dry circuit resistance	Initial	0.5mm	10mΩ MAX.	5	90	mΩ	2.398	2.91	2.07	0.190	2.968	✓
			1.5mm	10mΩ MAX.	5	10	mΩ	0.774	1.04	0.61	0.153	1.233	✓
		After test	0.5mm	20mΩ MAX.	5	90	mΩ	2.319	2.96	1.83	0.250	3.069	✓
			1.5mm	20mΩ MAX.	5	10	mΩ	0.850	1.30	0.60	0.190	1.420	✓
	Terminal retention force	With secondary lock	0.5mm	49N MIN.	2	18	N	82.53	84.0	75.1	2.92	73.77	✓
			1.5mm	100N MIN.	3	6	N	129.89	133.5	121.7	4.21	117.26	✓
		Without secondary lock	0.5mm	20N MIN.	2	18	N	54.56	63.5	46.3	5.19	38.99	✓
			1.5mm	60N MIN.	3	6	N	71.15	74.1	64.6	3.49	60.68	✓
	Housing lock strength without terminals			49N MIN.	5	5	N	278.93	282.7	275.7	2.80	270.53	✓
Thermal shock	Housing appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Feeling (insertion/removal)			No discomfort	5	5	-	No discomfort					✓
	Connector retention force		Direction 1	100N MIN.	5	5	N	327.46	333.70	319.30	5.57	310.75	✓
	Terminal crimp strength		0.5mm	70N MIN.	-	10	N	78.16	80.10	74.50	1.65	73.21	✓
			1.5mm	90N MIN.	-	10	N	121.40	125.70	113.60	3.36	111.32	✓
	Dry circuit resistance	Initial	0.5mm	10mΩ MAX.	5	90	mΩ	2.934	3.54	2.43	0.349	3.981	✓
			1.5mm	10mΩ MAX.	5	10	mΩ	4.953	5.15	4.53	0.172	5.469	✓
		After test	0.5mm	20mΩ MAX.	5	90	mΩ	4.081	5.47	2.86	0.796	6.469	✓
			1.5mm	20mΩ MAX.	5	10	mΩ	2.197	2.74	1.72	0.352	3.253	✓
	Terminal retention force	With secondary lock	0.5mm	49N MIN.	2	18	N	82.67	83.8	79.0	1.37	78.56	✓
			1.5mm	100N MIN.	3	6	N	132.39	133.7	130.3	1.40	128.19	✓
		Without secondary lock	0.5mm	20N MIN.	2	18	N	39.06	55.4	34.5	5.87	21.45	✓
			1.5mm	60N MIN.	3	6	N	74.12	75.6	72.2	1.66	69.14	✓

Table 4. List of results: Properties after endurance tests – Ⅱ (20P)

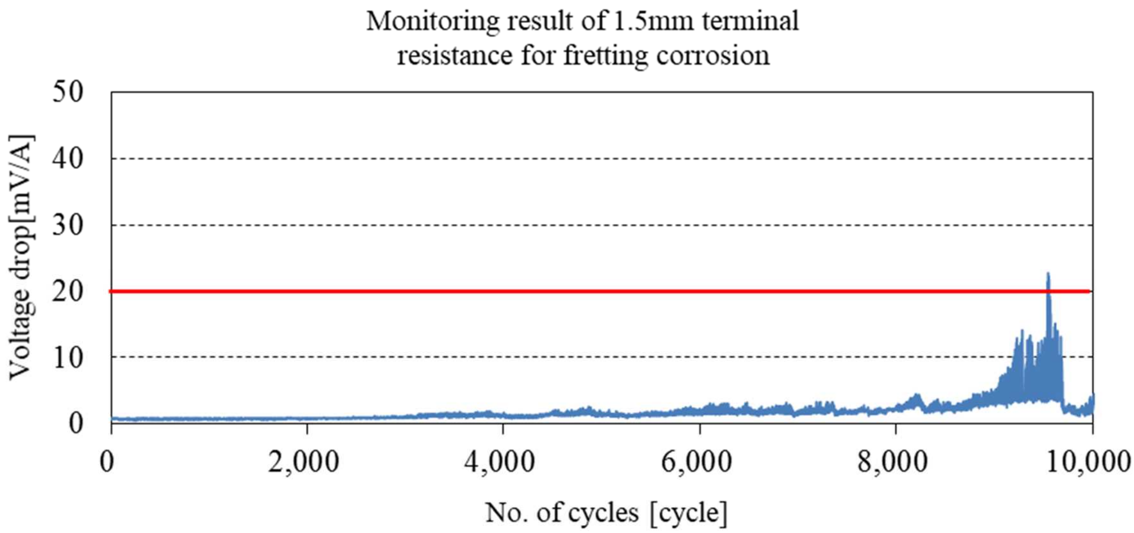
Item	Measurement			Requirements	Set	n	Unit	Data Avg.	Max.	Min.	s	Avg.±3s	Judge.
Temperature /humidity cycle	Housing appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Feeling (insertion/removal)			No discomfort	5	5	-	No discomfort					✓
	Insulation resistance		Between terminals	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
			Between terminal and housing	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
	Withstanding voltage		Between terminals	No insulation breakdown or erosion	5	5	-	No insulation breakdown					✓
			Between terminal and housing	No insulation breakdown or erosion	5	5	-	No insulation breakdown					✓
	Leak current			1mA MAX.	5	5	-	1.7μA MAX.					✓
	Dry circuit resistance	Initial	0.5mm	10mΩ MAX.	5	90	mΩ	3.024	3.65	2.67	0.255	3.789	✓
			1.5mm	10mΩ MAX.	5	10	mΩ	1.110	1.19	1.05	0.043	1.239	✓
		After test	0.5mm	20mΩ MAX.	5	90	mΩ	3.179	4.16	2.83	0.347	4.220	✓
			1.5mm	20mΩ MAX.	5	10	mΩ	1.350	1.63	1.19	0.146	1.788	✓
	Terminal retention force	With secondary lock	0.5mm	49N MIN.	2	18	N	82.82	85.6	73.1	3.55	72.17	✓
			1.5mm	100N MIN.	3	6	N	132.61	134.2	130.0	1.51	128.08	✓
		Without secondary lock	0.5mm	20N MIN.	2	18	N	48.50	55.2	43.0	4.24	35.78	✓
			1.5mm	60N MIN.	3	6	N	72.52	73.8	71.6	0.78	70.18	✓
Resistance to humidity	Housing appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Connector retention force		Direction 1	100N MIN.	5	5	N	313.78	317.6	310.3	3.23	304.08	✓
	Insulation resistance		Between terminals	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
			Between terminal and housing	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
	Withstanding voltage		Between terminals	No insulation breakdown or erosion	5	5	-	No insulation breakdown					✓
			Between terminal and housing	No insulation breakdown or erosion	5	5	-	No insulation breakdown					✓
	Leak current			1mA MAX.	5	5	-	1.4μA MAX.					✓
	Dry circuit resistance	Initial	0.5mm	10mΩ MAX.	5	90	mΩ	3.287	3.55	3.03	0.261	4.069	✓
			1.5mm	10mΩ MAX.	5	10	mΩ	1.092	1.17	1.01	0.085	1.345	✓
		After test	0.5mm	20mΩ MAX.	5	90	mΩ	3.222	4.08	2.73	0.745	5.457	✓
			1.5mm	20mΩ MAX.	5	10	mΩ	1.409	1.59	1.20	0.194	1.992	✓
	Terminal retention force	With secondary lock	0.5mm	49N MIN.	2	18	N	80.57	85.3	73.9	5.92	62.81	✓
			1.5mm	100N MIN.	3	6	N	132.12	133.7	130.3	1.72	126.97	✓
		Without secondary lock	0.5mm	20N MIN.	2	18	N	48.98	55.5	43.1	6.20	30.40	✓
			1.5mm	60N MIN.	3	6	N	74.05	75.2	73.5	0.96	71.18	✓
Resistance to abrasion	Terminal appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Housing appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Voltage drop	Initial	0.5mm	10mV/A MAX.	5	90	V/A	3.112	3.51	2.92	0.127	3.493	✓
			1.5mm	10mV/A MAX.	5	10	V/A	1.251	1.33	1.07	0.071	1.464	✓
		After test	0.5mm	20mV/A MAX.	5	90	V/A	2.852	3.31	2.60	0.150	3.302	✓
			1.5mm	20mV/A MAX.	5	10	V/A	1.069	1.20	0.88	0.085	1.324	✓
Corrosion gas	Terminal appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Housing appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Terminal crimp strength		0.5mm	70N MIN.	-	10	N	79.53	80.7	75.7	1.46	75.15	✓
			1.5mm	90N MIN.	-	10	N	121.49	125.1	118.1	2.50	113.99	✓
	Voltage drop	Initial	0.5mm	10mV/A MAX.	5	90	V/A	2.428	2.68	2.21	0.160	2.908	✓
			1.5mm	10mV/A MAX.	5	10	V/A	0.662	0.90	0.54	0.097	0.953	✓
		After test	0.5mm	20mV/A MAX.	5	90	V/A	3.045	4.00	2.27	0.390	4.215	✓
			1.5mm	20mV/A MAX.	5	10	V/A	2.639	7.92	1.39	1.920	8.399	✓
Resistance to stress corrosion	Terminal appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Terminal crimp strength		0.5mm	70N MIN.	-	10	N	77.63	80.4	75.2	1.39	73.46	✓
			1.5mm	90N MIN.	-	10	N	120.64	125.0	114.9	3.31	110.71	✓
Conden sation	Terminal appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Housing appearance			No detrimental deformation	5	5	-	No detrimental deformation					✓
	Insulation resistance		Between terminals	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
			Between terminal and housing	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
	Withstanding voltage		Between terminals	No insulation breakdown or erosion	5	5	-	No insulation breakdown					✓
			Between terminal and housing	No insulation breakdown or erosion	5	5	-	No insulation breakdown					✓
	Leak current			1mA MAX.	5	5	-	1μA MAX.					✓
	Dry circuit resistance	Initial	0.5mm	10mΩ MAX.	5	90	mΩ	2.612	2.98	2.16	0.296	3.500	✓
			1.5mm	10mΩ MAX.	5	10	mΩ	0.684	0.81	0.55	0.082	0.930	✓
		After test	0.5mm	20mΩ MAX.	5	90	mΩ	3.500	3.95	2.90	0.304	4.412	✓
			1.5mm	20mΩ MAX.	5	10	mΩ	0.998	1.49	0.62	0.313	1.937	✓

Table 5. List of results: Properties after endurance tests –Ⅲ (20P)

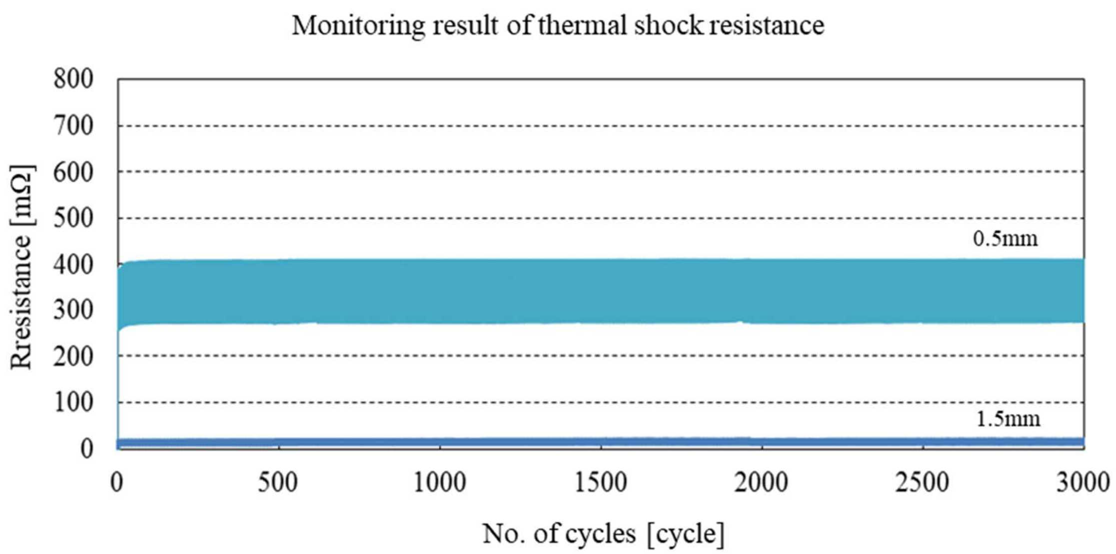
Item	Measurement				Requirements	Set	n	Unit	Data					Judge.
									Avg.	Max.	Min.	s	Avg.±3s	
Dump heat cycle	Housing appearance				No detrimental deformation	5	5	-	No detrimental deformation					✓
	Leak current				1mA MAX.	5	5	-	1μA MAX.					✓
	Insulation resistance	250h		0.5mm	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
				1.5mm	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
		500h		0.5mm	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
				1.5mm	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
		750h		0.5mm	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
				1.5mm	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
		1000h		0.5mm	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
				1.5mm	100MΩ MIN.	5	5	-	10,000MΩ MIN.					✓
	Migration				No migration	5	5	-	No migration					✓
Current cycle	Temperature rise	Initial	Single pole	0.5mm	⊿T=50℃ MAX.	5	5	℃	27.75	28.5	27.3	0.55	29.40	✓
				1.5mm	⊿T=50℃ MAX.	5	5	℃	30.79	32.5	29.2	1.27	34.60	✓
			All poles	0.5mm	⊿T=50℃ MAX.	5	5	℃	45.04	46.1	43.7	0.88	47.68	✓
				1.5mm	⊿T=50℃ MAX.	5	5	℃	28.95	29.6	28.4	0.45	30.30	✓
		After test	Single pole	0.5mm	⊿T=50℃ MAX.	5	5	℃	29.75	31.9	28.0	1.84	35.27	✓
				1.5mm	⊿T=50℃ MAX.	5	5	℃	34.57	35.7	33.7	0.97	37.48	✓
			All poles	0.5mm	⊿T=50℃ MAX.	5	5	℃	44.69	45.5	43.2	0.90	47.39	✓
				1.5mm	⊿T=50℃ MAX.	5	5	℃	29.18	29.9	28.6	0.52	30.74	✓
	Voltage drop	Initial		0.5mm	10mV/A MAX.	5	90	V/A	2.054	2.47	1.69	0.173	2.573	✓
				1.5mm	10mV/A MAX.	5	10	V/A	0.483	0.55	0.40	0.048	0.627	✓
		After test		0.5mm	20mV/A MAX.	5	90	V/A	3.036	3.96	2.58	0.300	3.936	✓
				1.5mm	20mV/A MAX.	5	10	V/A	1.143	1.50	0.97	0.154	1.605	✓
Shock	Voltage drop	Initial		0.5mm	10mV/A MAX.	5	90	V/A	2.504	2.99	2.21	0.231	3.197	✓
				1.5mm	10mV/A MAX.	5	10	V/A	0.681	0.81	0.53	0.092	0.957	✓
		After test		0.5mm	20mV/A MAX.	5	90	V/A	2.602	2.89	2.30	0.200	3.202	✓
				1.5mm	20mV/A MAX.	5	10	V/A	0.922	1.17	0.60	0.226	1.600	✓
	Microcut				1μsMIN.7ΩMAX.	5	5	-	No microcut					✓
Vibration	Temperature rise	Initial	Single pole	0.5mm	⊿T=50℃ MAX.	5	5	℃	27.93	28.4	27.2	0.64	29.85	✓
				1.5mm	⊿T=50℃ MAX.	5	5	℃	31.27	32.3	29.7	1.02	34.33	✓
			All poles	0.5mm	⊿T=50℃ MAX.	5	5	℃	26.79	29.0	25.0	1.25	30.54	✓
				1.5mm	⊿T=50℃ MAX.	5	5	℃	19.66	21.3	17.7	1.32	23.62	✓
		After test	Single pole	0.5mm	⊿T=50℃ MAX.	5	5	℃	28.73	32.3	22.4	3.81	40.16	✓
				1.5mm	⊿T=50℃ MAX.	5	5	℃	32.91	35.1	31.7	1.45	37.26	✓
			All poles	0.5mm	⊿T=50℃ MAX.	5	5	℃	26.09	27.8	25.4	1.02	29.15	✓
				1.5mm	⊿T=50℃ MAX.	5	5	℃	19.86	21.4	18.5	1.08	23.10	✓
	Voltage drop	Initial		0.5mm	10mV/A MAX.	5	90	V/A	3.093	3.46	2.60	0.186	3.651	✓
				1.5mm	10mV/A MAX.	5	10	V/A	1.257	1.73	1.01	0.190	1.827	✓
		After test		0.5mm	20mV/A MAX.	5	90	V/A	2.702	3.91	1.93	0.442	4.028	✓
				1.5mm	20mV/A MAX.	5	10	V/A	0.973	2.00	0.55	0.398	2.167	✓
	Dry circuit resistance	Initial		0.5mm	10mΩ MAX.	5	90	mΩ	2.030	2.67	1.37	0.265	2.825	✓
				1.5mm	10mΩ MAX.	5	10	mΩ	0.713	1.21	0.51	0.157	1.184	✓
		After test		0.5mm	20mΩ MAX.	5	90	mΩ	2.770	3.71	2.02	0.387	3.931	✓
				1.5mm	20mΩ MAX.	5	10	mΩ	1.009	1.77	0.58	0.265	1.804	✓
	Microcut				1μsMIN.7ΩMAX.	5	5	-	No microcut					✓
Vibration with temperature change	Terminal appearance				No detrimental deformation	5	5	-	No detrimental deformation					✓
	Housing appearance				No detrimental deformation	5	5	-	No detrimental deformation					✓
	Terminal contact force			0.5mm	3N MIN.	-	10	N	3.569	3.80	3.31	0.165	3.074	✓
				1.5mm	4N MIN.	-	10	N	7.743	8.25	7.32	0.296	6.855	✓
	Voltage drop	Initial		0.5mm	10mV/A MAX.	5	90	V/A	2.299	2.60	2.00	0.184	2.851	✓
				1.5mm	10mV/A MAX.	5	10	V/A	0.741	0.80	0.70	0.031	0.834	✓
		After test		0.5mm	20mV/A MAX.	5	90	V/A	2.635	5.85	2.21	1.115	5.980	✓
				1.5mm	20mV/A MAX.	5	10	V/A	0.876	1.10	0.64	0.132	1.272	✓
	Dry circuit resistance	Initial		0.5mm	10mΩ MAX.	5	90	mΩ	2.259	2.69	1.73	0.196	2.847	✓
				1.5mm	10mΩ MAX.	5	10	mΩ	0.664	0.93	0.45	0.119	1.021	✓
		After test		0.5mm	20mΩ MAX.	5	90	mΩ	3.124	6.62	2.08	1.234	6.826	✓
				1.5mm	20mΩ MAX.	5	10	mΩ	1.195	2.91	0.75	0.567	2.896	✓
	Microcut				1μsMIN.7ΩMAX.	5	5	-	No microcut					✓



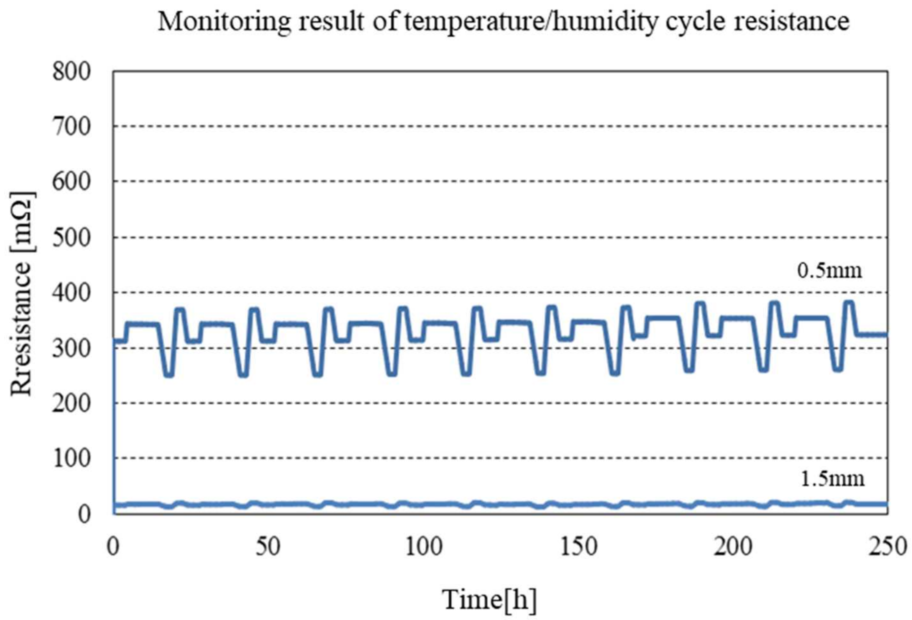
Graph 1. Monitoring result of 0.5mm terminal resistance for fretting corrosion



Graph 2. Monitoring result of 1.5mm terminal resistance for fretting corrosion



Graph 3. Monitoring result of thermal shock resistance



Graph 4. Monitoring result of temperature/humidity cycle resistance

Table 6. Initial performances test method - Ⅰ

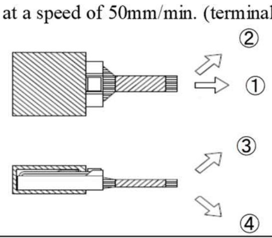
<table>
<tr><th>Test item</th><th>Procedure</th></tr>
<tr><td>Terminal external appearance</td><td>Visual(e.g. magnifier) and tactile verification.</td></tr>
<tr><td>Terminal outer dimension</td><td>Measure dimensions using caliper, micrometer, projector.</td></tr>
<tr><td>Housing appearance</td><td>Visual(e.g. magnifier) and tactile verification.</td></tr>
<tr><td>Housing outer dimension</td><td>Measure dimensions using caliper, micrometer, projector.</td></tr>
<tr><td>Feelinng (insertion/removal)</td><td>Verification of feeling by insertion/removal of connector and single terminal.</td></tr>
<tr><td>Connector mating force</td><td>Measure the force required to mate female and male connectors together at a uniform rate of 100 mm/min. (terminals must be fully populated)</td></tr>
<tr><td>Connector unmating force</td><td>Measure the force required to pull the connectors apart at a rate of 100 mm/min. with the locking feature disengaged.</td></tr>
<tr><td>Connector retention force</td><td>Measure the maximum force to pull out female connector from mated state(Figure below).
Pull in four directions at a speed of 50mm/min. (terminals must be fully populated)

</td></tr>
<tr><td>Unlocking force</td><td>Measure the force required to disengage the lock.</td></tr>
<tr><td>Insulation resistance</td><td>Supply DC500V insulation resistance between (a) terminals (b) terminal and earth on mated connectors.</td></tr>
<tr><td>Withstanding voltage</td><td>Supply AC1000V between (a) terminals (b) terminal and ground on mated connectors for 1minute.
Same connection as for insulation resistance test</td></tr>
<tr><td>Temperature rise</td><td>Supply current to mated connectors, measure the temperature rise at crimp area, when temperature is saturated. Female connector wire length: 300mm
・Single pin : Apply current to 1 terminal.(1.5mm terminal : 11A, 0.5mm terminal : 7A)
・All poles : Connect 1.5 mm terminals and 0.5 mm terminals in series, and apply the current value that is calculated by the above current value (7A) multiplied by the coefficient in Table 4.
<table>
<tr><th>Pole</th><th>Coefficient</th></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>2～3</td><td>0.75</td></tr>
<tr><td>4～5</td><td>0.6</td></tr>
<tr><td>6～8</td><td>0.55</td></tr>
<tr><td>9～12</td><td>0.5</td></tr>
<tr><td>13～20</td><td>0.4</td></tr>
</table></td></tr>
<tr><td>Leak current</td><td>Supply 16±0.1V to mated connector terminals. Measure maximum leak current.</td></tr>
</table>

Table 7. Initial performances test method - Ⅱ

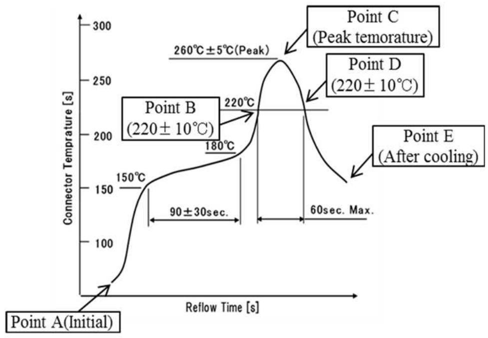
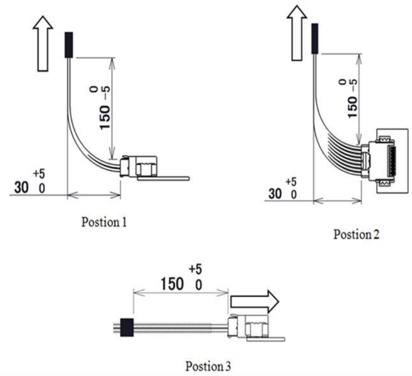
Test item	Procedure
Coplanarity	Measure coplanarity of male connector lead and peg at initial and 5 points specified in Figure below during the reflow. 
Peg strength	Mate a wired female connector to the soldered male connector, and pull the wire at a rate of 100mm/min. Measure the force when the peg comes out from the PCB. If mating portion has some breakage, it is needed to reinforce them. Fix the connector in the following 3 positions, and pull towards the arrowed direction. 

Table 8. Initial performances test method -Ⅲ

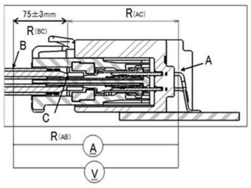
<table>
<tr><th>Test item</th><th>Procedure</th></tr>
<tr><td>Audible click of connector mating</td><td>Horizontally insert fully populated female connector to male connector which
is soldered onto PCB.
Measure by the sound with sound level meter, and analyze the frequency analyzer (FFT).
Measurement range:10kHz～20kHz
Background noise: 5kHz 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.</td></tr>
<tr><td>Terminal crimp strength</td><td>Crimp wire of 100mm approx. to female terminal and pull at the speed of
50-100mm/min. Measure the force required to break the wire or pull out of
the crimp portion. Do not used insulation barrel</td></tr>
<tr><td>Terminal insertion force</td><td>Measure the force to insert female terminal into fixed male connector at
a speed of 100 mm/min.</td></tr>
<tr><td>Terminal removal force</td><td>Measure the force to pull out female terminal from male connector at
a speed of 100 mm/min.</td></tr>
<tr><td>Terminal contact force</td><td>Calculate female and male terminal contact force.
Measure female terminal spring displacement-force characteristics, and calculate
contact force from displacement upon male terminal insertion.
(accuracy 0.01mm MAX)</td></tr>
<tr><td>Terminal bend strength</td><td>(a) Push male terminals in mating direction from housing entrance at speed of
50mm/min with the load (maximum of connector insertion force).
(b)Remove housing walls around male terminals. Push a terminals at a speed of
50mm/min to the perpendicular direction to mating axis (4 directions: up, down,
left, right)with the force.
1.5mm terminal : 12N (only up , down) , 0.5mm terminal : 3N (4 directions)
applies a load.</td></tr>
<tr><td>Voltage drop</td><td>Open: 12V, Short circuit: 1A
Measure the difference between male connector lead and temp. measurement point when
temperature reached saturation at 75mm from female terminal crimp.
Then, subtract voltage drop of wires and male connector lead.
Wire resistance: Table below or actual measurement.
<table><tr><th>Wire size(mm^2)</th><th>Resistance(mΩ)</th></tr><tr><td>0.3</td><td>3.77</td></tr><tr><td>0.5(JIS)</td><td>2.45</td></tr><tr><td>0.5(ISO)</td><td>2.8</td></tr><tr><td>0.75</td><td>1.77</td></tr><tr><td>1.0</td><td>1.4</td></tr><tr><td>1.25</td><td>1.07</td></tr></table></td></tr>
<tr><td>Dry circuit resistance</td><td>Open: 20±5mV, Short circuit: 10±0.5mA
Subtract resistance of point 75mm from female terminal crimp and male connector lead.
Then, subtract resistance of wires and male connector lead.
Wire resistance: Table above or actual measurement.</td></tr>
<tr><td>Microcut monitoring</td><td>Measure dry circuit resistance.</td></tr>
</table>

Table 9. Initial performances test method -Ⅳ

Test item	Procedure
Terminal retention force	Measure the force to pull out female terminal from female connector housing at a speed of 100mm/min. Test with and without retainer.
Terminal insertion force to housing	Measure the force to fully insert female terminal into female connector housing at a speed of 100mm/min.
Retainer insertion/removal force	Fully populate female connector housing with the female terminals. Measure the force to insert and remove the retainer at a speed of 100mm/min. Measure the forces for each of the two locking positions.
Housing lock strength without terminals	Measure the maximum force to pull out unpopulated female connector housing from mated status at a speed of 100mm/min.
Sn whisker	Check the surface of connector's metal portions(terminals, lead) with microscope, etc. to find Sn whisker. Use microscope with magnification of ×100 MIN. Check closely not to lose sight of whisker with different magnifications.

Table 10. Environmental performances test method - Ⅰ

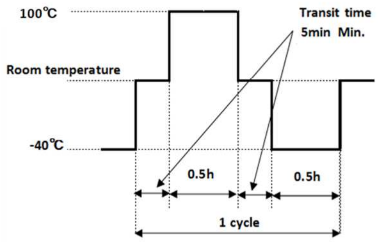
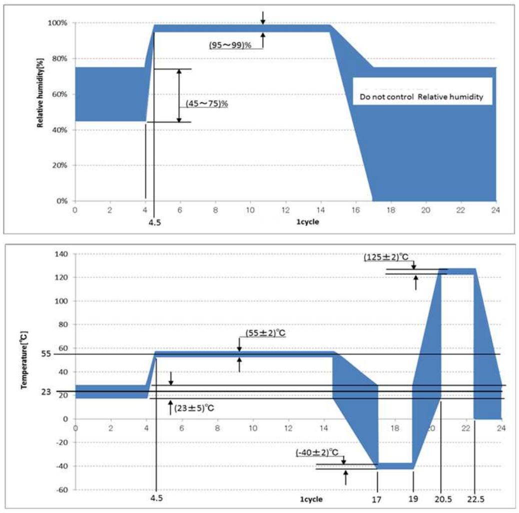
<table>
<tr><th>Test item</th><th>Procedure</th></tr>
<tr><td>Repeated insertion/removal</td><td>Measure the force required to insert/remove populated female connector into/from fixed male connector at speed of 100mm/min. Repeat 10 times. Lock must be disengaged.</td></tr>
<tr><td>Resistance to forced mating
(with 98N in 4 directions)</td><td>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.</td></tr>
<tr><td>Fretting corrosion</td><td>Insert female terminals into male connector and subject them to micro motion.
Frictional distance: 0.23mm, Cycle time: 1-2 Hz, No. of cycles: 5,000
Monitor dry circuit resistance during test.</td></tr>
<tr><td>Thermal aging</td><td>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.</td></tr>
<tr><td>Low temperature aging</td><td>Place mated connector in thermal chamber at −40±3℃ for 120h.
Repeat insert/remove for 5 times immediately after removing from the chamber, then leave to recover to ambient temperature.</td></tr>
<tr><td>Thermal shock</td><td>Place mated connectors in thermal chamber and subject them to heat /cold cycle (100±3℃/-40±3℃). No of cycles: 3000
Duration (0.5h) may be shortened if sample's temperature reaches test temperature requirement early.
Monitor resistance during test, open circuit 20±5mV, short circuit 10±0.5mA

</td></tr>
<tr><td>Temperature/humidity cycle</td><td>Place mated connectors in climatic chamber and subject them to the cycle pattern specified in Figure below. Duration 24h, No. of cycles: 10, Temperature: 85±3℃.

</td></tr>
</table>

Table 11. Environmental performances test method - Ⅱ

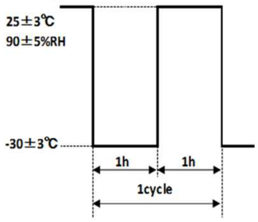
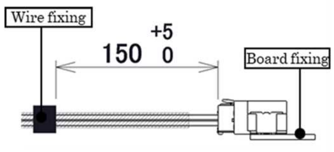
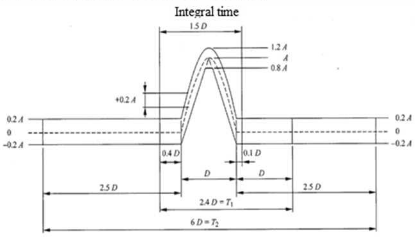
Test item	Procedure
Resistance to humidity	Place mated connectors in climatic chamber and subject them to 60℃±5℃, 90～95%RH for 96h. Hang connectors to prevent any dews developing on the connectors.
Resistance to abrasion	Suspend mated connectors in the chamber and spray dust for 10s every 15 min. Insert/remove 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).
Corrosion gas	Place male and female connectors (not mated) in 25±5ppm, 40±2℃, 90-95%RH, SO2 gas for 96h.
Resistance to stress corrosion	Degrease female terminals, cleanse with 10%H2SO4, rinse under water and dry. Submerge in solution of free ammonia 6N, copper 10.2g/L for 3h, then remove. Making test solution: Mix, ammonia (28%～30%): Purified water = 1:1.6, to make 6N ammonia water. Mix copper powder (10.2g) with 6N ammonia solution (1L).
Condensation	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 
Dump heat cycle	Place mated connectors in the chamber and apply current for 1000h at 85±3℃、 85±5%RH. Measure the leak current during the test.
Current cycle	Place the mated connectors in thermal chamber at 70℃±3℃. Energize 1.5mm terminals and 0.5mm terminals in series, and apply the current value (1.5mm terminal : 7A , 0.5mm terminal : 3A) for 45min, then break for 15min. No. of cycles: 300.
Shock	Fix mated connectors and subject to impact. Use impact according to Figure below sinusoidal half-wave. Duration D=6ms, Peak acceleration A=981m/s2 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.  Fixing method  Sinusoidal half-wave

Table 12. Environmental performances test method -Ⅲ

Test item	Procedure
Vibration	Fix mated connectors in same way as the shock test on fixture and subject them to vibration. ◎Vibration condition ・Direction: 3 (front-back, left-right, top-bottom) ・Acceleration: 66.6m/s2, ・Duration: 2h(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.
Vibration with temperature change	Fix mated connectors in same way as the shock test on fixture and subject them to vibration at 100±3℃. ◎Vibration condition ・Acceleration: 59.8m/s2 ・Frequency: 20-200Hz ・Sweep time: 3min (per sweep) Apply the current value(1.5mm terminal : 4.5A , 0.5mm terminal : 2A) for 45min, break for 15min. No. of cycles: 300 Repeat in other directions. Monitor resistance during current supply. After test, carry out vibration test on 3 axes, each for 1h. Check for any microcuts.