ELCON Mini cable-to-board power connector system, Four Position

1. INTRODUCTION

1.1 Purpose

Testing was performed on the ELCON Mini four position cable-to-board connector system, using connectors with the optional shield, and cable connectors with the optional shield to determine its conformance to requirements of Design Objectives 108-19429, Revision B.

1.2 Scope

This report covers the electrical, mechanical, and environmental performance of the cable connector plug (part number 2173168-1, 2173200-1) and board connector (part number 2173211-1, 2173132-1). Testing was performed at the Engineering Assurance Product Testing Laboratory.

1.3. Conclusion

The cable connector plug (part number 2173168-1, 2173200-1) and board connector (part number 2173211-1, 2173132-1) conformed to the electrical, mechanical, and environmental performance requirements of Design Objectives 108-19429, Revision B.

1.4. Environmental Conditions

Unless otherwise stated. The following environmental conditions prevailed during testing

Temperature: 15 to 35°C
Relative Humidity: 25 to 75%

2. PRODUCT QUALIFICATION AND REQUALIFICATION TEST SEQUENCE

2.1 Sample Description

The tests were executed on 25 pieces of the board-connector, P/N 2173211-1, 2173132-1 with 20 counter-part cable-connector plug P/N 2173168-1, 2173200-1. All test-groups consist of 5 connector pairs.

2.2 Test Procedures

IEC 60512-1-1: Test 1a	**Visual examination:** The test samples were visually inspected under a stereomicroscope, at a 10x magnification, with suitable illumination.
IEC 60512-2-1: Test 2a	**Termination resistance:** The termination resistance was measured with an open circuit voltage of 20mVolt and a maximum current of 100mA DC.
IEC 512-2-4a:	**Voltage proof: (Unmated)** This measurement was done with a high voltage tester. The test duration was one minute at 1120Vrms.

IEC 60512-3-1: Test 3a	**Insulation resistance: (Unmated)** This measurement was done with a programmable electrometer. The measuring voltage was 100 Volt during one minute.
IEC 60512-5-1: Test 5a	**Temperature rise:** Two diagonal oriented contacts were charged with a test current of successively 22, 25 and 30A . This current was maintained for a stabilization period of 1 hour minimum. The temperature measurements were, inside the connector, done by means of a thermocouple.
IEC 60512-9-2: Test 9b	**Electrical load and temperature:** With this current, the samples were subjected to a temperature of 85°C during 500 hrs.
IEC 60512-5-2: Test 5b	**Current-temperature derating curve:** The test samples were charged with a test current of successively 22, 25 and 30A . This current was maintained for a stabilization period of 1 hour. After stabilization, the temperature was measured. Then the current through all contacts was increased in steps of 1A, and every time after stabilization the temperature was measured until a Δt of 30K was reached.
	Shield contact spring force: At a deflection of 0.26 mm, the contact force of the shield contacts was measured.
IEC 60512-13-2: Test 13b	**Mating / unmating forces:** The test samples were mounted on a push-pull tester. During a mechanical operation, at a rate of 10 mm per minute, the mating and unmating forces were measured.
IEC 60512-13-5: Test 13e	**Polarization method:** In all wrong mating manners, a force of 250N was applied to the connector for 10 seconds. This should not lead to any damages.
	Latch activation force: The force to activate the latch was measured.
IEC 60512-9-1: Test 9a	**Mechanical operation (enduration):** The samples were mated and unmated for 50 times at a rate of 500 cycles per hour.
IEC 60512-15-1: Test 15a	**Contact retention in insert:** The contact retention force per contact was measured on a push-pull tester, with a force of max. 50N.
IEC 60512-17-3: Test 17c	**Side load,4 directions:** A force of 40N was applied to the samples. This force was maintained during 10 seconds.
IEC 60512-15-1: Test 15a	**Locking latch strengths:** A force of 100N was applied on the cable connector in unmating direction, with the locking feature latched.
	Board connector mounting force: The force to mount the board connector was measured.

IEC 60512-17-3	**Straight cable pull:** The straight cable pull force was measured on a tensile tester. An axial load of 80N was applied on the cable of the cable connector during 10 seconds.
IEC 60512-6-4: Test 6d	**Vibration:** The samples were mounted on a vibration table. The frequency from 10-500-10 Hz was traversed with one octave per minute. Below the cross-over frequency the samples were vibrated with an amplitude of 0.75 mm, above that frequency with an acceleration of 10g. The duration was 60 minutes in each of the three mutually perpendicular directions. The samples were provided with a circuit to detect interruptions of continuity longer than 1 micro-second.
IEC 60512-6-3: Test 6c	**Shock test:** Acceleration 50g, half sine wave pulses of 11msec. 6 shocks in each of three mutually perpendicular directions were executed. The samples were provided with a circuit to detect interruptions of continuity longer than 1 micro-second.
IEC 60512-11-4: Test 11e	**Rapid change of temperature:** The samples were subjected to a rapid change of temperature test with the following parameters: One cycle consists of: Upper temperature : 90°C for 30 minutes. Lower temperature : -40°C for 30 minutes. Condition : mated. Number of cycles : 5
IEC 60512-11-1:	**Climatic sequence:** The samples were subjected to the following tests: Dry heat : 90➡C, 16 hours. Damp heat cyclic: 25➡C/ 55➡C, RH 93%, 24 hours, 1 cycle. Cold : -40➡C, 2 hours. Damp heat cyclic: 25➡C/ 55➡C, RH 93%, 24 hours, 5 cycles. Condition : mated.
IEC 60512-11-3: Test 11c	**Damp heat, steady state:** The samples were subjected to a damp heat steady state test under the following conditions: Temperature : 40°C. Rel. humidity : 95%. Condition : mated. Duration : 21 days.
TEC-109-201: Method C	**Resistance to soldering heat:** Samples were subjected to an IR reflow soldering curve, under the following conditions: - Average ramp rate: 3°C per second maximum - Preheat temperature (minimum): 150°C - Preheat temperature (maximum): 200°C - Preheat time: 60 to 180 seconds - Ramp to peak: 3°C per second maximum - Time over liquidus (217°C): 60 to 150 seconds - Peak temperature: 260 +0°-5°C - Time within 5°C of peak: 20 to 40 seconds - Ramp - cool down: 6°C per second maximum - Time 25°C to peak: 8 minutes maximum

2.2 Test Sequence

Test-group 1:
- Visual examination
- Termination resistance
- Temperature rise
- Termination resistance
- Electrical load and temperature
- Termination resistance
- Temperature rise
- Termination resistance
- Side-load in 4 directions
- Visual examination
- Locking latch strength
- Visual examination
- Cable pull force out crimp ferrule
- Visual examination
- Insertion force during wrong polarization
- Visual examination
- Contact-retention (cable-connector)
- Visual examination
- Termination resistance
- Visual examination

Test-group 2:
- Visual examination
- Shield contact spring force
- Insertion/withdrawal force (no latch)
- Termination resistance
- Mechanical operation
- Termination resistance
- Shield contact spring force
- Insertion/withdrawal force (no latch)
- Termination resistance
- Insertion/withdrawal force (no latch)
- Shield contact spring force
- Termination resistance
- Visual examination

Test-group 3:
- Visual examination
- Termination resistance
- Rapid change of temperature
- Termination resistance
- Vibration sinusoidal
- Physical shock
- Termination resistance
- Visual examination

Test-group 4:
- Visual examination
- Termination resistance
- Insulation resistance
- Voltage proof
- Climate sequence
- Termination resistance
- Insulation resistance
- Voltage proof
- Damp/heat steady-state
- Termination resistance
- Insulation resistance
- Voltage proof
- Visual examination

Test-group 5:
- Visual examination
- Mounting-force board-connector
- Resistance to soldering heat (Board-connector)
- Visual examination

2.3 Equipment Used

Equipment	Producer	Type	Series Nb	Cal. Due
Micro-ohmmeter	Hioki	3560	110202069	Mar-14.
Electrometer	Keithley	6517A	1068400	Mar-14.
High voltage tester	Sefelec	DXS506	1109582	Dec-13.
MultiMeter/DAS 2	Keithley	2700	1315592	Mar-14.
Switching Module 2	Keithley	7708	1306206	Mar-14.
Oven	Binder	FED 53 – E2	12-05379	Mar-14.
Tensile tester	MTS	400M	165811-20	Oct-14.
Load cell	MTS	500N	2239	Oct-14.
Vibration control	DataPhysics	3788		
Vibrator	Ling+B&K	PA2000	S1165-002	
Accelero meter	MMF	ks 94-01	723	Apr-14.
Climatic chamber	Weiss	80-200DU-ST	224/17413	Jan-14.
Climatic chamber	CTS	C-65/100	087130	Jan-14.
Climatic chamber	CTS	C-40/100	087131	Jan-14
Hot air reflow oven	AllSMT EasyFlow	6/30		

2.4 Results:

Test-group 1:

Low level contact resistance power contacts: the measured values after any of the executed tests do not exceed the requirement of 3 mΩ max. The highest measured value was 1.38 mΩ.

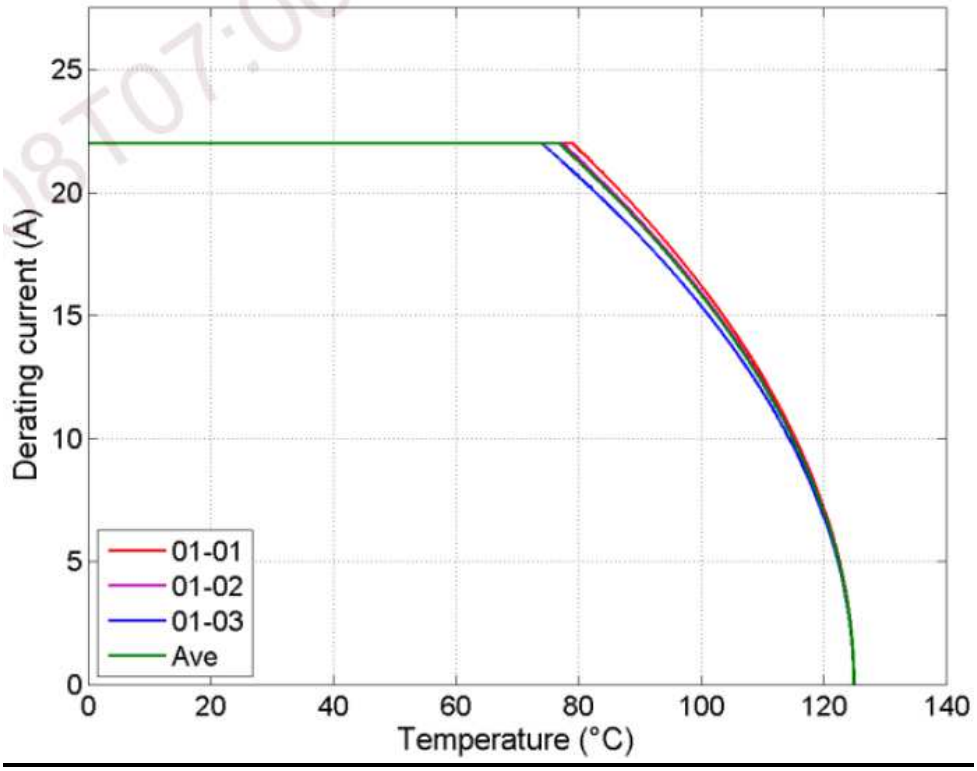
Low level contact resistance shield contacts: the measured values after any of the executed tests do not exceed the requirement of 10 mΩ max initially and 20 mΩ max finally. The highest measured value was 2.64 mΩ.

Latch activation force: see the table below.

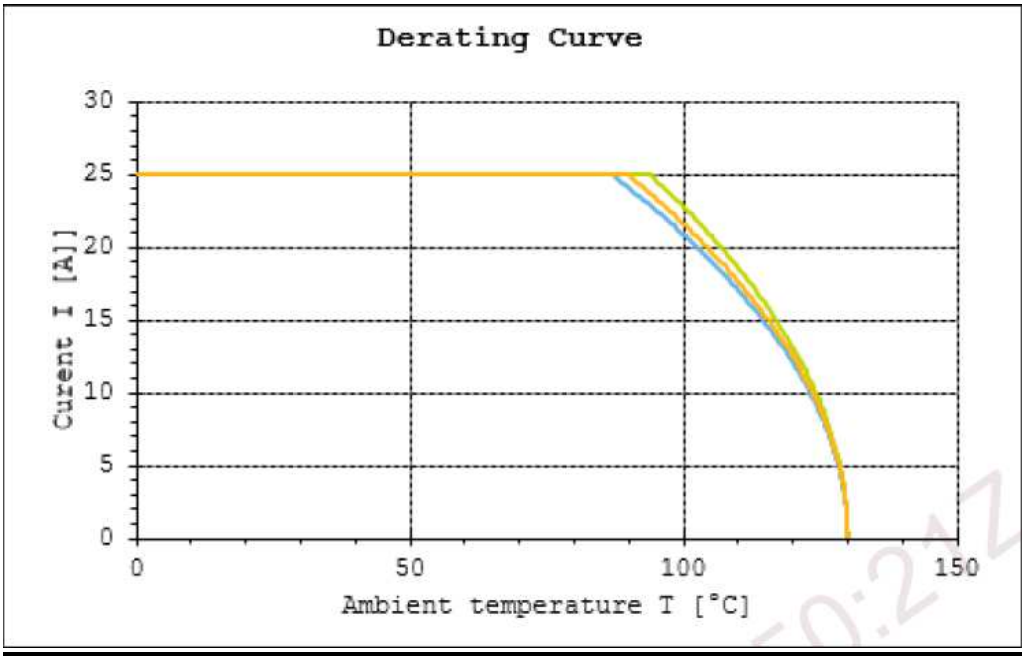
All values represented in Newton.			
Product name:	4 pos shielded power		
Column	**Group**	**Lot**	**Displacement (mm)**
-1-:	1	1-5	0.5
Sample	***-1-***		
1	15.60		
2	21.10		
3	17.56		
4	17.41		
5	13.69		
Max.	**21.10**		
Min.	**13.69**		
Mean.	**17.07**		

Temperature rise: at the max current load (22,25 and 30A) the temp rise is within the requirement of Δt max ≤30℃.

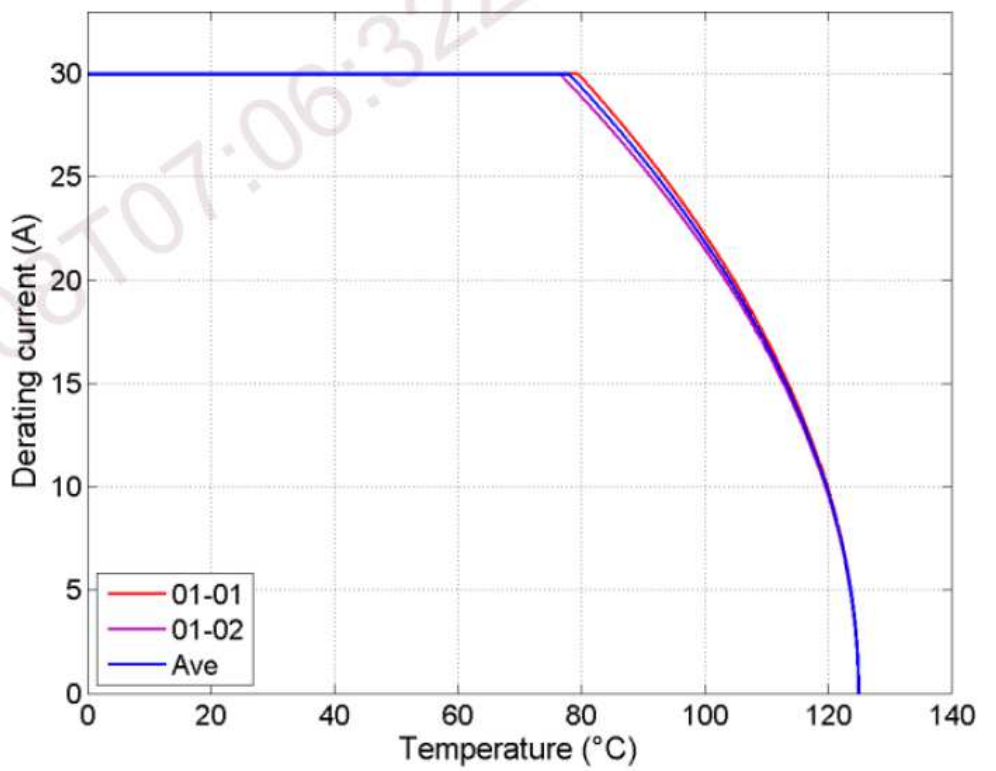
-Derating curve:



Connector with 14AWG cable (with shield)



Connector with 12AWG cable (without shield)



Connector with 10AWG cable (without shield)

- Side load in 4 directions,
- Locking latch strength,
- Cable pull force out crimp ferrule,
- Insertion force during wrong polarization,
- Contact-retention (cable-connector):

after subjection to these impacts, no aspects that can be detrimental for normal functionality of the products have been determined.

Test-group 2:

Low level contact resistance power contacts: the measured values after any of the executed tests do not exceed the requirement of 3 mΩ max. The highest measured value was 0.98 mΩ.

Low level contact resistance shield contacts: the measured values after any of the executed tests do not exceed the requirement of 10 mΩ max initially and 20 mΩ max finally. The highest measured value was 2.53 mΩ.

Shield contact spring force measurements:
Note: 'after M.O': after mechanical operation.

All values represented in Newton.			
Product name:	4pos shielded power		
Column	**Group**	**Lot**	**Test**
-1-:	2	1-5	initial
-3-:	2	1-5	after M.O.
-1-:	2	1-5	final
Sample	***-1-***	***-2-***	***-3-***
s1	1.81	1.54	1.70
s1	1.71	1.73	1.64
s2	1.75	1.62	1.68
s2	1.69	1.81	1.52
s3	1.73	1.70	1.60
s3	1.67	1.75	1.57
s4	1.78	1.57	1.58
s4	1.70	1.76	1.58
s5	1.78	1.58	1.61
s5	1.74	1.72	1.63
Max.	**1.81**	**1.81**	**1.70**
Min.	**1.67**	**1.54**	**1.52**
Mean.	**1.74**	**1.68**	**1.61**

Insertion/withdrawal forces (no latch):

All values represented in Newton.						
Product name:	4pos shielded power					
Column	**Group**	**Lot**	**Operation**	**Test**		
-1-:	2	1-5	Mating	initial		
-2-:	2	1-5	Unmating	initial		
-3-:	2	1-5	Mating	after MO		
-4-:	2	1-5	Unmating	after MO		
-5-:	2	1-5	Mating	final		
-6-:	2	1-5	Unmating	final		
Sample	***-1-***	***-2-***	***-3-***	***-4-***	***-5-***	***-6-***
1	56.96	50.45	34.63	33.22	31.92	28.91
2	69.84	57.14	41.83	31.48	42.66	32.62
3	66.36	57.39	36.44	28.78	37.19	34.21
4	50.86	47.09	40.65	33.89	40.07	31.95
5	67.18	58.78	41.91	35.24	44.90	38.11

Test-group 3:

Low level contact resistance power contacts: the measured values after any of the executed tests do not exceed the requirement of 3 mΩ max. The highest measured value was 0.98 mΩ.

Low level contact resistance shield contacts: the measured values after any of the executed tests do not exceed the requirement of 10 mΩ max initially and 20 mΩ max finally. The highest measured value was 3.67 mΩ.

Vibration and mechanical shock: no interruptions of continuity with a duration of > 1µsec have been detected.

Test-group 4:

Low level contact resistance power contacts: the measured values after any of the executed tests do not exceed the requirement of 3 mΩ max. The highest measured value was 1.77 mΩ.

Low level contact resistance shield contacts: the measured values after any of the executed tests do not exceed the requirement of 10 mΩ max initially and 20 mΩ max finally. The highest measured value was 2.18 mΩ.

Insulation resistance:
Power contacts:

All values represented in Ohms.			
Product name:	4pos shielded power		
Column.	**Group**	**Lot**	**Test**
-1-:	4	1-5	Initial
-1-:	4	1-5	damp heat
-1-:	4	1-5	final
	-1-	***-2-***	***-3-***
1	1.03E+12	3.77E+11	5.73E+11
2	4.53E+11	3.97E+10	7.31E+10
3	3.04E+11	4.34E+10	8.29E+10
4	1.64E+12	1.92E+11	2.47E+11
5	3.75E+10	8.19E+10	2.76E+08
Max.	**1.64E+12**	**3.77E+11**	**5.73E+11**
Min.	**3.75E+10**	**3.97E+10**	**2.76E+08**
Mean.	**6.95E+11**	**1.47E+11**	**1.95E+11**

Shield:

All values represented in Ohms.			
Product name:	4pos shielded power		
Column.	**Group**	**Lot**	**Test**
-1-:	4	1-5	Initial
-1-:	4	1-5	damp heat
-1-:	4	1-5	final
	-1-	***-2-***	***-3-***
1	2.35E+10	3.76E+11	2.28E+11
2	2.05E+11	2.09E+11	3.60E+10
3	2.39E+10	2.97E+10	3.82E+10
4	2.19E+11	2.29E+11	3.30E+11
5	1.23E+11	1.33E+10	1.17E+11
Max.	**2.19E+11**	**3.76E+11**	**3.30E+11**
Min.	**2.35E+10**	**1.33E+10**	**3.60E+10**
Mean.	**1.19E+11**	**1.71E+11**	**1.50E+11**

Voltage proof: in none of the cases flash-over or break-through occurred at a voltage of 1120Vrms.

Test-group 5:

Mounting-force board-connector:

All values represented in Newton.		
Product name:	4pos shielded power	
Column	**Group**	
-1-:	5	Mounting force
Sample	***-1-***	
1	6.77	
2	8.51	
3	7.70	
4	8.38	
5	8.31	
Max.	**8.51**	
Min.	**6.77**	
Mean.	**7.93**	