COPALUM* Lite Sealed Terminals and Standard Butt Splices

1. SCOPE

1.1. Content

This specification covers the performance, tests and quality requirements for the TE Connectivity (TE) COPALUM* lite Sealed Terminals and Standard Butt Splices, sizes 2 AWG through 4/0, intended for termination to stranded aluminum wire used in the aerospace industry.

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.

2. APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the latest edition of the document applies. In the event of any conflict between the requirements of this specification and the product drawing, the product drawing shall take precedence. In the event of any conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.

2.1. TE Documents

- 501-134033: Qualification Test Report
- 114-32098: Application Specification
- 408-32087: Application Tooling Instruction Sheet
- 109-197: Test Specification (TE Test Specifications vs EIA and IEC Test Methods)

2.2. Industry Standards

- EIA-364: Electrical Connector/Socket Test Procedures Including Environmental Classifications

3. REQUIREMENTS

3.1. Design and Construction

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

3.3. Ratings

- Voltage: 600 V
- Current: See Figure 4
- Temperature: 175°C Max Continuous Aluminum Wire Conductor Temperature

3.5. Test Requirements and Procedures Summary
Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

Test Description	Requirement	Procedure
Initial Examination of Product	Meets requirements of product drawing and Application Spec 114-32098.	EIA-364-18. Visual at 5X magnification, dimensional and functional per quality inspection plans.
Final Examination of Product	Free of defects or damage that have negative impact on electrical or mechanical performance.	EIA-364-18. Visual at 5X magnification.
ELECTRICAL		
Crimp Millivolt Drop	See millivolt drop (MVD) limits in Figure 4.	EIA-364-6. Measure MVD per Figure 5.
Current Cycling, Rated Current	The temperature of the terminal lug shall be lower than that of the aluminum wire conductor.	EIA- 364-55 Subject to rated current per Figure 4 for 60 minutes, then remove current for 30 minutes, repeat for 400 cycles.
Current Cycling, 125% Rated Current	The temperature of the terminal lug shall be lower than that of the aluminum wire conductor.	EIA- 364-55 Subject to 125% rated current per Figure 4 for 60 minutes, then remove current for 30 minutes, see Figure 2 for number of cycles.
MECHANICAL		
Random Vibration	See Note.	EIA-364-28 Test Condition V with following exceptions: Subject to 19.24 Grms random vibration profile in X, Y, and Z axis for 5 hours: Freq. (Hz) Power Density (G^2/Hz) 10 0.15 36 0.15 60 0.40 350 0.40 2000 0.08 Test setup shown in Figure 6.
Crimp Tensile Strength, Pre and Post Test	See tensile limits in Figure 7.	EIA-364-8. Subject to axial pull at 1 inch (25.4 mm) per minute until failure. Record force and failure mode.

Figure 1 (continued)

Test Description	Requirement	Procedure
ENVIRONMENTAL		
Salt Spray (500 hours)	See Note.	EIA-364-26 Condition C. Subject to 5% salt concentration for 500 hours.
Humidity/Temperature Cycling	See Note.	EIA-364-31 Method III with following exceptions. Subject to -54 to 72°C, 95 to 100% RH, hold 15 minutes at each temperature, rate of temperature change to be 5°C/minute, repeat 400 cycles.
Hydrostatic Pressure Seal	No visible leakage at exposed wire end.	EIA-364-39 with following exceptions: Subject to 0 PSI for 5 minutes followed by 80 PSI for 5 minutes, repeat 25 cycles. Test setup shown in Figure 8.
Energized Thermal Shock	See Note.	EIA-364-32 Test Condition V. Subject reduced length test wire per Figure 9 to -65 to 175°C (terminal temperature) with specimen energized to rated current per Figure 3 in hot chamber for 60 minutes, then remove current for 60 minutes in cold chamber, repeat for 300 cycles.
Lightning Strike	See Note.	Subject to 6 strikes at peak current using Waveform 5A plus a follow-on charge transfer, followed by 6 strikes at peak current using Waveform Component D per ARP5412 Rev. A. See Figure 10 for Lightning Strike Configuration.

Figure 1 (end)

NOTE
Shall meet visual requirements show no physical damage, and meet requirements of additional tests as specified in the Product Qualification and Requalification Test Sequence shown in Figure 2

3.6 Product Qualification and Re-qualification Test Sequence

Test or Examination	Test Group (a)				
	1	2	3	4	5
	Test Sequence (b)				
Initial Examination of Product	1	1	1	1	1
Crimp Millivolt Drop	2,4,6,9,11	2,4	2,5,7		
Salt Spray (500 hours)		3			
Humidity/Temperature Cycling	3				
Vibration	5				
Current Cycling, Rated Current (c)	7		3		
Current Cycling, 125% Rated Current (c)	8(d)		4(e)		
Energized Thermal Shock	10				
Hydrostatic Pressure Sealing				2	
Lightning Strike			6		
Crimp Tensile Strength	13	6	9		2
Final Examination of Product	12	5	8		

Figure 2 – Qualification Test Sequence

NOTE

(a) Test specimens shall be prepared in accordance with standard production methods, chosen at random, and shall be prepared in accordance with applicable Instruction Sheets. Test groups 1 through 3 shall consist of a minimum of 8 data points for each wire type and test groups 4 and 5 shall consist of a minimum of 3 data points for each wire type.

- The 2/0 size dual hole lug terminals on 2/0 size wire shall be submitted for all test groups, and be representative of product line for test groups 1, 2, and 3.
- The remaining size dual hole lug terminals and their respective wire, 2 AWG, 1/0, 3/0 and 4/0, shall be submitted for test groups 4 and 5.
- Test specimens shall be submitted crimped to general purpose stranded aluminum conductor wire for power feeder applications rated to >175°C, 2000 V ETFE Insulated and 600 V PTFE Tape Insulated, or their respective equivalents, for all test groups.
- Test specimens shall be submitted attached to dual studded terminal block for test groups 1, 2, and 3.
- Place jumper wire on terminal block, then terminal test wire, then NAS1149C0632R washer or equivalent on each stud, then NAS1068C3M self-locking nut or equivalent on each stud, torque nuts to 215 in-lbs (24.3 N-m), then clean any debris or metal shavings with lint free cloth and air pressure.

(b) Numbers indicate sequence in which test are performed.

(c) Record terminal temperature rise and aluminum wire conductor temperature every 50th cycle.

(d) Preform 100 cycles.

(a) Perform 50 cycles.

4. QUALITY ASSURANCE PROVISIONS

4.5. Qualification by Similarity

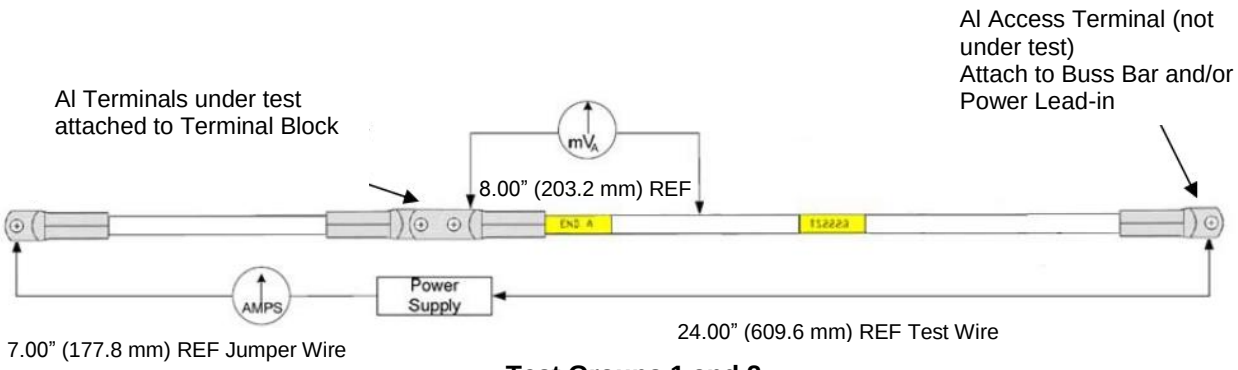
Single hole lug terminals and butt splices have the same crimp barrel geometry and are terminated using the same crimp tooling as dual hole lug terminals. The single hole lug terminals and butt splices shall be considered qualified by similarity to the dual hole lug terminals as indicated in Figure 3.

Wire & Terminal Size	Terminal Under Test	Qualified By Similarity	
	Dual Hole Lug Terminal	Single Hole Lug Terminal	Butt Splice
2	2102579-1	2102571-1	2226081-1
1/0	2102580-1	2102572-1	2226082-1
2/0	2102581-1	2102573-1	2226083-1
3/0	2102582-1	2102574-1	2226084-1
4/0	2102583-1	2102575-1	2226085-1

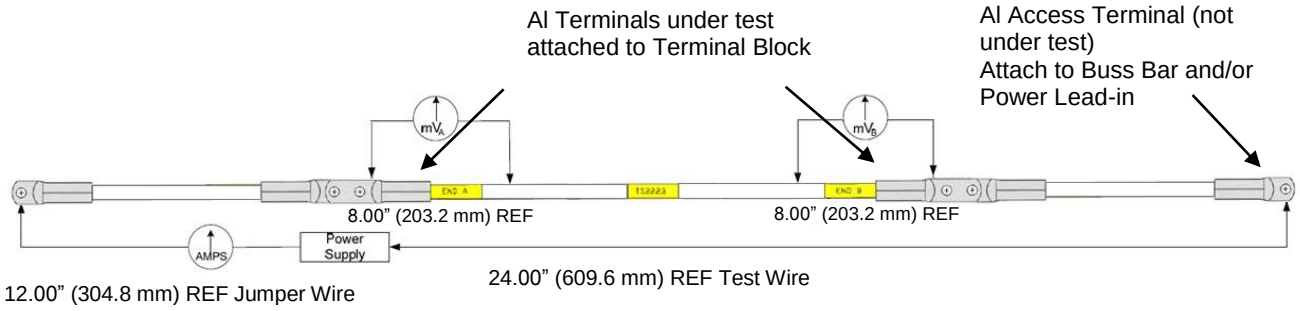
Figure 3 – Qualification by Similarity

Wire & Terminal Size	Rated Test Current (Amperes)	125% Rated Test Current (Amperes)	Maximum Initial MVD (Millivolts)	Maximum Post Test MVD (Millivolts)
2	152	190	3.9	4.3
1/0	202	252	5.2	5.7
2/0	235	294	6.0	6.6
3/0	275	344	7.0	7.7
4/0	303	379	7.6	8.4

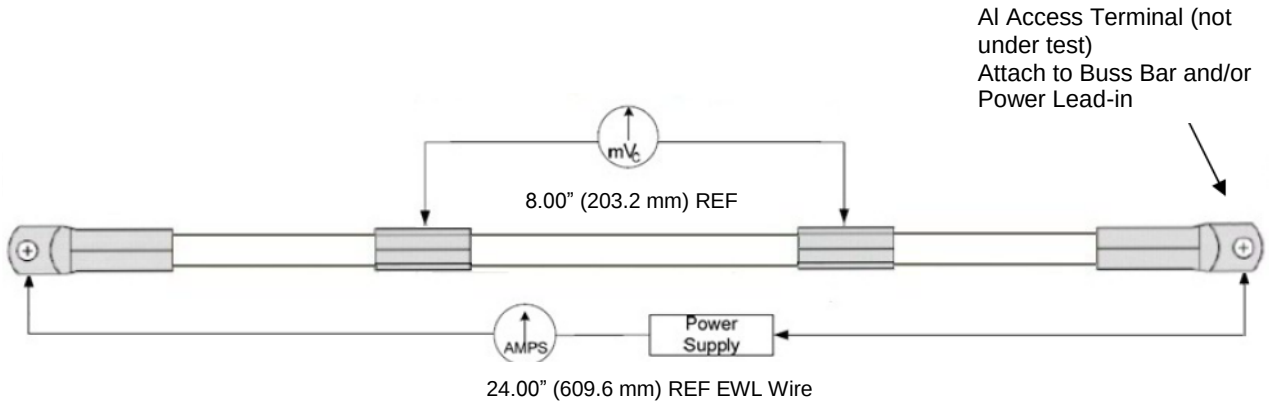
Figure 4 - Crimp Millivolt Drop Limits



Test Groups 1 and 2



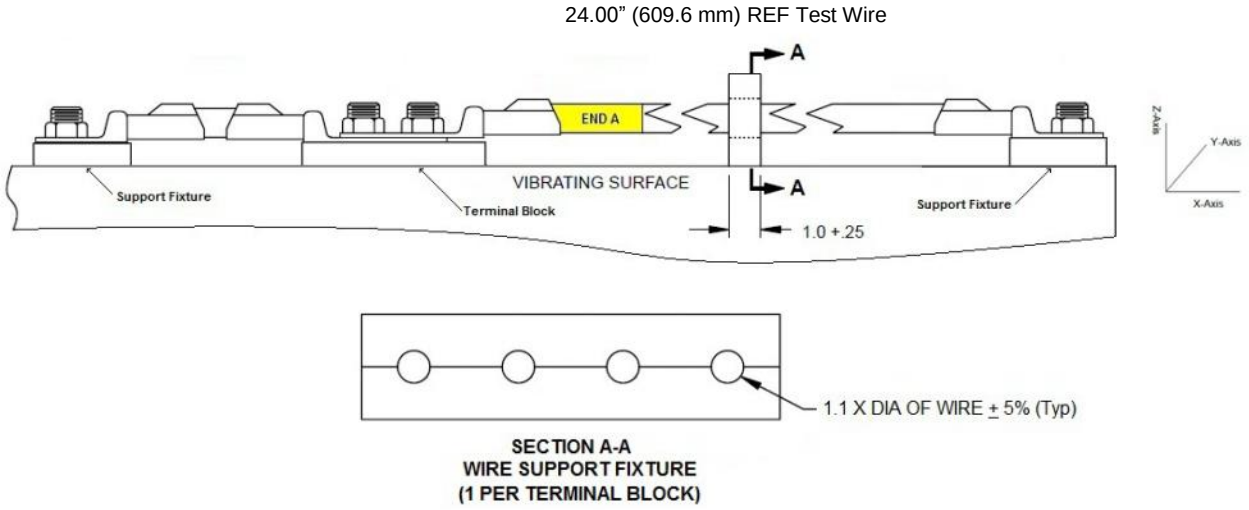
Test Group 3



Equal Wire Length (EWL)

- Distance between probe points is 8.00” (203.2 mm) REF.
- Measured Crimp Millivolt Drop for each test wire = mV_A and/or mV_B.
- EWL millivolt drop, mV_C, is an average of 4 EWL millivolt drop measurements.
- Calculated Crimp Millivolt Drop = $mV_A – mV_C$ and/or $mV_B – mV_C$.

Figure 5 – Crimp Millivolt Drop Test Wire & EWL Configuration

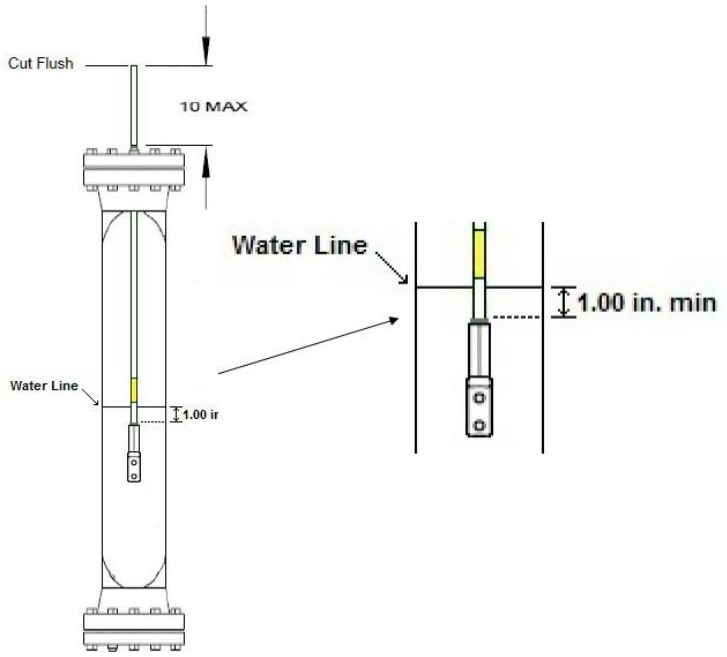


- Wire support to be placed in center of test wire 12.00” (304.8 mm) REF

Figure 6 – Vibration Test Configuration

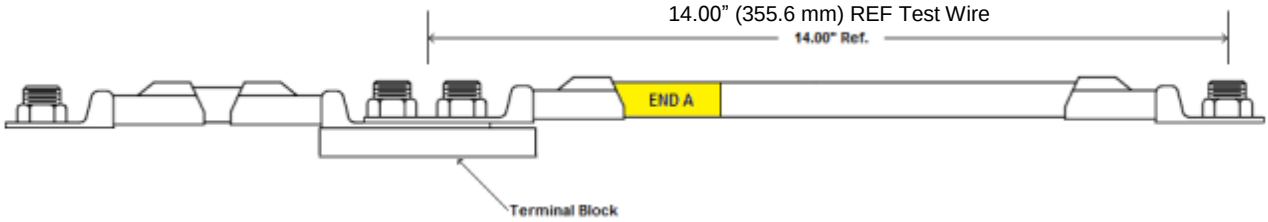
Terminal Size (AWG)	Tensile Strength	
	Control Cable	Post Test Cable
2	500 lbs. (2224 N)	375 lbs. (1668 N)
1/0	900 lbs. (4003 N)	675 lbs. (3003 N)
2/0	1100 lbs. (4893 N)	825 lbs. (3670 N)
3/0	1300 lbs. (5783 N)	975 lbs. (4337 N)
4/0	1450 lbs. (6450 N)	1125 lbs. (5004 N)

Figure 7 – Crimp Tensile Strength Minimum Requirements



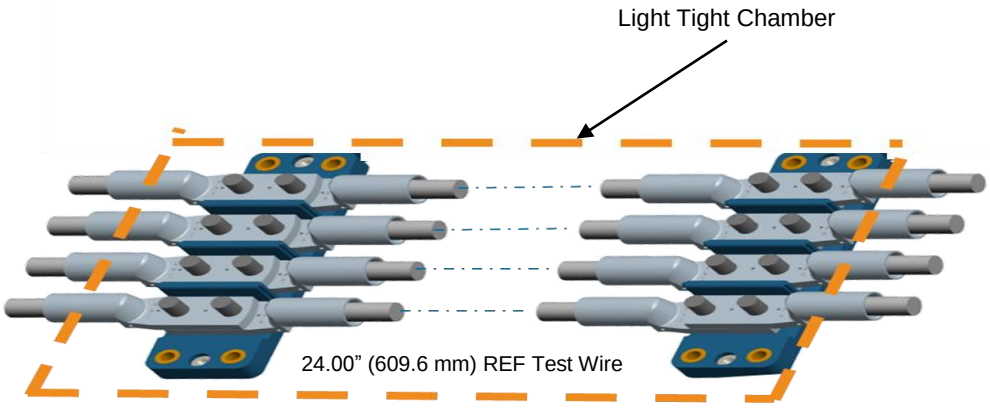
- Water line shall be 1.00” (25.4 mm) minimum above the inner wire seal.
- Length of wire extending from the pressure vessel shall be 10.00” (254.0 mm) maximum.

Figure 8 – Hydrostatic Pressure Seal Configuration



- Do not remove terminals from terminal block.
- Cut 24.00” (609.6 mm) REF test wire down and reterminate with new Al access terminal to 14.00” (355.6 mm) REF.

Figure 9 – Thermal Shock Reduced Length Test Wire



- Energize one test wire at a time.

Figure 10 – Lightning Strike Configuration