New Modular Plugs that can Accommodate Solid and Stranded Wires

1.0 Scope

This Report provides a design overview and summarizes the electrical, mechanical, environmental and transmission performance of CommScope's modular plugs utilizing the new universal contact (product change Notification: P-15-011368). Testing was performed at the Greensboro Electrical Components Test Laboratory, Tewkesbury Electrical Components Test Laboratory, and Nederland Environmental Test Laboratory.

2.0 Design

The objective was to have one universal contact design that accommodates both stranded and solid conductors. This new design (Fig. 1) was developed utilizing CommScope's proven stranded contact and optimizing it to accommodate solid conductor wires.

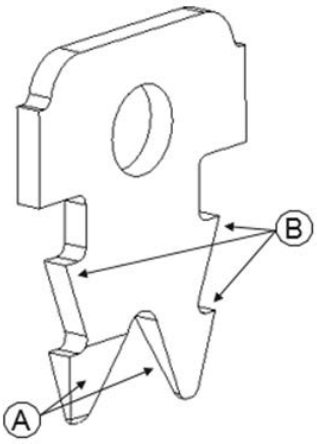

Figure 1

The two prong design consists of opposing chamfered faces (Fig. 1, A) that straddle the wire during termination, while piercing the outer insulation, and biting into the conductor/conductors (Fig. 2-4). This action progressively compresses the wire between the prongs, thereby providing a high normal force contact interface, ensuring a consistent and reliable termination. The prongs are designed to have deep penetration relative to the wire position in order to produce lateral normal forces and reduce vertical reaction forces.

The established retention barb features, located on each side of the contact (Fig. 1, B), ensure that the contact normal force is maintained by preventing the contact from backing out once terminated.

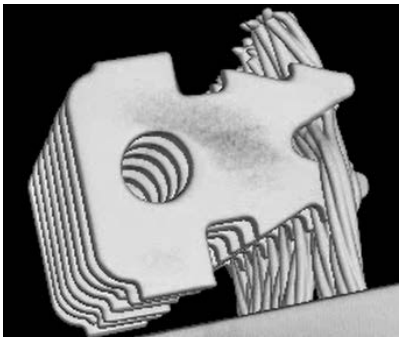

Figure 2
X-ray analysis of a terminated plug to stranded wires

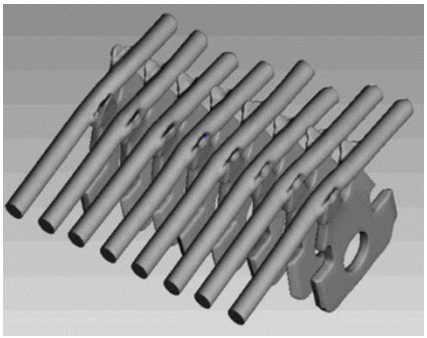

Figure 3
X-ray analysis of a terminated plug to solid wires

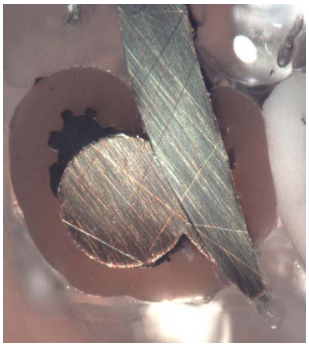

Figure 4
Micro-section showing typical contact interface achieved

3.0 Benefits

- *Single contact design across the whole range of modular plugs minimizes the number of top level plug assemblies.*
- *Reduces customer order management and stock holding requirements.*
- *Simplifies product range enabling easier product selection.*
- *Resolves inadvertent use of incorrect plug type.*
- *Provides improved contact termination reliability particularly with solid conductors.*
- *Complies with IEC 60352-6 and IEC 60603-7 series plug standards.*

4.0 Product Validation Test Requirements and Procedures

Test Description	Requirement	Procedure
Examination		
Initial examination of product	ISO/IEC 11801, Annex C There shall be no defects that would impair normal operation. Dimensions shall comply with those specified on product drawing. Verify contact termination heights Verify plating thicknesses	IEC 60512-1-1 and -2 Visual and dimensional per quality inspection plan with Certificate of Conformance (C of C) IEC 60603-7 unshielded or 60603-7-1 for shielded connectors Dimensional per quality inspection plan with Certificate of Conformance (C of C) or laboratory verification
Visual examination of product	ISO/IEC 11801, Annex C There shall be no defect that would impair normal operation.	IEC 60512-1-1 Visual inspection.
Length, uncoiled patch cord	Length to be within print tolerance	Measure physical length of patch cord as shown on customer drawing
Electrical		
Contact resistance, IPC/wire interface	IEC 60352-6, Section 5, Table 2 Change from initial after conditioning: IPC/plated wire: 10 mΩ max. IPC/un-plated wire: 15 mΩ max.	IEC 60512-2-1 Derived by measuring the total voltage drop between the plugs IPC contact and terminated wire, then subtracting the average bulk resistance of these components. Test voltage shall not exceed 20 mV d.c. or peak voltage a.c. and test current shall not exceed 100 mA, a.c. or d.c.

Test Description	Requirement	Procedure
Mechanical		
Cable Bending	IEC 60352-6, Section 5.2.2.2 No discontinuities greater than 10 µs. Termination shall not be damaged and conductors shall not be broken.	IEC 60352-6, Section 5.2.2.2. Apply a 22 N axial load to the free end of cable terminated to a plug Bend cable α = 30 degrees in both directions from vertical position for 5 cycles each direction (10 cycles total). Monitor contact disturbance per IEC 60512-2-5.
Vibration, IPC/wire interface	IEC 60352-6-7, Section 5.2.2.3 Shall show no evidence of physical damage.	IEC 60512-6-4. Subject terminated plug to: Frequency: 10 to 55 Hz. Displacement Amplitude: 0.35 mm 10 sweep cycles per axis of 3 mutually perpendicular planes. Full Duration: 2.25 hours. Test specimen shall be firmly held on a vibration table.
Tensile, patch cord	IEC 61935-2, Section 6.2 1mm maximum outer cable sheath movement relative to plug boot.	Tensile force: 22 N applied along the common axis of the cable & plug. Duration: 1 minute
Flexural, patch cord	IEC 61935-2, Section 6.3 Shall show no evidence of physical damage.	Axial force applied cable: 2 N Total cycles (0°/+90°/-0°/-90°/0°): Solid conductor: 50 cycles Stranded conductor: 250 cycles Cycles divided between two perpendicular axes. Rate of flex: 20 complete cycles per minute.
Torsional, patch cord	Shall show no evidence of physical damage.	Twist length: 330 mm Axial force applied to cable: 10 N Total cycles: 100 (0°/+180°/0°/-180°/0°) Rate of torsion: 20 cycles per minute.
Environmental		
Rapid change of temperature, IPC/wire interface	IEC 60352-6, Section 5.2.4.1	IEC 60068-2-14, Test Na or Nb Subject terminated plugs to 5 cycles between -40°C & 70°C with 30 minute dwell at temp extremes. 2 hr recovery.
Climatic sequence	60352-6 Section 5.2.4.2	IEC 60068-2-61, Method 1 Subject terminated plugs to dry heat +70°C & cold -40°C for 1 cycle.
Flowing mixed gas corrosion, IPC/wire interface	IEC 60352-6, Section 5.2.4.3	IEC 60512-11-7, Method 1. H_2S: 100 ± 20 (10^{-9} vol/vol), SO_2: 500 ± 100 (10^{-9} vol/vol), Temp.: 25 ± 1°C, RH: 75 ± 3%, Test time: 10 days

Test Description	Requirement	Procedure
Transmission Patch Cord Component		
Wire Map	Wiring pattern as specified in test request.	IEC 61935-2 Section 5.2, as specified If not otherwise noted, test coiled state.
Return Loss, Coiled	TIA-568-C.2, Section 6.2.6	IEC 61935-1, Section 5.6 TIA-568-C.2, Annex C.5.2.3, Test in coiled state
Pair to Pair Near End Crosstalk (NEXT) loss, Coiled	ISO 11801, Section 6.4.4.1, TIA-568-C.2, Section 6.2.8,	IEC 61935-1, Section 5.7 TIA-568-C.2, Annex C.5.2.1, Test in coiled state
Return Loss, Uncoiled	TIA-568-C.2, Section 6.2.6	IEC 61935-1, Section 5.6 TIA-568-C.2, Annex C.5.2.3, Test in uncoiled state.
Pair to Pair Near End Crosstalk (NEXT) loss, Uncoiled	ISO 11801, Section 6.4.4.1, TIA-568-C.2, Section 6.2.8,	IEC 61935-1, Section 5.7 TIA-568-C.2, Annex C.5.2.1, Test in uncoiled state.

5.0 Product Validation Test Sequence

Test or Examination	Test Sequence			
	IPC / Wire Interface			Patch Cord
	PV1	PV2	PV3	PV4
Initial examination of product	1	1	1	1
Visual examination of product	5	7	5	13
Length, uncoiled patch cord				5
Contact resistance, IPC/wire interface	2,4	2,6	2,4	
Cable bending	3			
Vibration, IPC/wire		3		
Tensile, patch cord				8
Flexural, patch cord				9
Torsional, patch cord				10
Rapid change of temp, IPC/wire		4		
Climatic Sequence		5		
Flowing mixed gas corrosion, IPC/wire			3	
Wire Map, patch cord coiled				2
Return Loss, patch cord coiled				3
Next loss, patch cord coiled				4
Return Loss, patch cord uncoiled				6, 11
Next loss, patch cord uncoiled				7, 12

6.0 Test Specimens:

Part Number	Description	Test Sequence				Total
		PV1	PV2	PV3	PV4	
6-2111983-3	8P Cat. 6 Shielded Plug	5	5	5	10	25
6-2111986-3	8P Cat 5e EMT Shielded Plug	5	5	5	10	25
6-569278-3	8P Cat. 5e UTP Plug	8	8	8	20	44
6-557315-3	8P Cat. 5 UTP Plug	8	8	8	20	44
6-641334-3	4P UTP Plug	5	5	5	10	25

Note: Total number of specimens represent 1,204 new universal contacts tested.

7.0 Summary of Testing

7.1 Initial Examination of Product – All Test Sequences
All specimens submitted for testing were representative of normal production lots. A Certificate of Conformance was issued and stored in the lab test files storage location.

7.2 Visual Examination of Product – All Test Sequences
All specimens were visually examined after testing and no evidence of physical damage detrimental to product performance was observed.

7.3 Contact Resistance, Final Delta – Test Sequences PV1, PV2, & PV3
All resistance measurements taken at 100 mA maximum and 20 mV maximum open circuit voltage were within specified limits.

7.4 Cable Bending – Test Sequence PV1
No physical damage or discontinuity occurred to the specimens as a result of cable bending for the total number of cycles.

7.5 Vibration, IPC/Wire Interface – Test Sequence PV2
All specimens passed vibration testing with no evidence of physical damage.

7.6 Tensile, Patch Cord – Test Sequence PV4
No physical damage occurred to the specimens for the applied tensile load.

7.7 Flexural, Patch Cord – Test Sequence PV4
No physical damage occurred to the specimens for the total number of flexural cycles.

7.8 Torsional, Patch Cord – Test Sequence PV4
No physical damage occurred to the specimens for the total number of torsional cycles.

7.9 Rapid Change of Temp, IPC/Wire Interface – Test Sequence PV2
No evidence of physical damage was visible as a result of exposure to rapid change in temperature.

7.10 Climatic Sequence – Test Sequence PV2
No evidence of physical damage was visible as a result of exposure to climatic sequence.

7.11 Flowing Mixed Gas Corrosion, IPC/Wire Interface – Test Sequence PV3
No evidence of physical damage was visible as a result of exposure to flowing mixed gas corrosion.

7.12 Wire Map, Patch Cord – Test Sequence PV4
All specimens passed the wire maps.

7.13 Return Loss, Patch Cord – Test Sequence PV4
All specimens passed RL requirements before and after mechanical testing.

7.14 NEXT, Patch Cord – Test Sequence PV4
All specimens passed NEXT requirements before and after mechanical testing.