



ASSOCIATION CONNECTING
ELECTRONICS INDUSTRIES®



IPC/WHMA-A-620A

Requirements and Acceptance for Cable and Wire Harness Assemblies

Developed by the IPC Task Group (7-31f) of the Product Assurance Subcommittee (7-30) and the WHMA Industry Technical Guidelines Committee (ITGC)

Supersedes:
IPC/WHMA-A-620 -
January 2002

Users of this publication are encouraged to participate in the development of future revisions.

Contact:

IPC
3000 Lakeside Drive, Suite 309S
Bannockburn, Illinois
60015-1219
Tel 847 615.7100
Fax 847 615.7105

Wiring Harness Manufacturers Assoc.
7500 Flying Cloud Drive, Suite 900
Eden Prairie, Minnesota
55344
Tel 952 835.4180
Fax 952 835.4774

Table of Contents

1 Requirements and Acceptance for Cable and Wire Harness Assemblies	1-1	2 Applicable Documents	2-1
1.1 Scope	1-1	2.1 IPC	2-1
1.2 Purpose	1-1	2.2 Joint Industry Standards	2-1
1.3 Approach to This Document	1-1	2.3 Society of Automotive Engineers (SAE)	2-1
1.4 Shall or Should	1-1	2.4 American National Standards Institute (ANSI)	2-2
1.5 Uncommon or Specialized Designs	1-1	2.5 International Organization for Standardization (ISO)	2-2
1.6 Terms and Definitions	1-1	2.6 ESD Association (ESDA)	2-2
1.7 Classes of Products	1-2	3 Preparation	3-1
1.8 Document Hierarchy	1-2	3.1 Stripping	3-2
1.9 Tool and Equipment Control	1-2	3.2 Strand Damage and End Cuts	3-2
1.10 Observable Criteria	1-3	3.3 Conductor Deformation/Birdcaging	3-5
1.11 Defects and Process Indicators	1-3	3.4 Twisting of Wires	3-7
1.12 Inspection Conditions	1-3	3.5 Wire Insulation Damage	3-8
1.12.1 Target	1-3	4 Soldered Terminations	4-1
1.12.2 Acceptable	1-3	4.1 Material, Components and Equipment	4-2
1.12.3 Process Indicator	1-3	4.1.1 Materials	4-2
1.12.4 Defect	1-3	4.1.1.1 Solder	4-2
1.12.5 Disposition	1-3	4.1.1.2 Flux	4-2
1.12.6 Product Classification Implied Relationships	1-3	4.1.1.3 Adhesives	4-3
1.12.7 Conditions Not Specified	1-3	4.1.1.4 Solderability	4-3
1.13 Electrical Clearance	1-3	4.1.1.5 Tools and Equipment	4-3
1.14 Measurement Units and Applications	1-4	4.1.2 Gold Removal	4-3
1.15 Verification of Dimensions	1-4	4.2 Cleanliness	4-4
1.16 Visual Inspection	1-4	4.2.1 Presoldering	4-4
1.16.1 Lighting	1-4	4.2.2 Postsoldering	4-4
1.16.2 Magnification Aids and Lighting	1-4	4.2.2.1 Particulate Matter	4-4
1.17 Electrostatic Discharge (ESD) Protection	1-5	4.2.2.2 Flux Residue	4-5
1.18 Contamination	1-5	4.2.2.2.1 Cleanable Flux	4-5
1.19 Materials and Processes	1-5	4.2.2.2.2 No-Clean Process	4-5
		4.3 Solder Connection	4-6
		4.3.1 General Requirements	4-7
		4.3.2 Soldering Anomalies	4-8
		4.3.2.1 Exposed Basis Metal	4-8
		4.3.2.2 Exposed Surface Finishes	4-8
		4.3.2.3 Partially Visible or Hidden Solder Connections	4-8

Table of Contents (cont.)

4.4 Wire/Lead Preparation, Tinning	4-9	5.4 Termination Ferrule Crimp	5-29
4.5 Wire Insulation	4-11	6 Insulation Displacement Connection (IDC)	6-1
4.5.1 Clearance	4-11	6.1 Mass Termination, Flat Cable	6-2
4.5.2 Postsolder Damage	4-13	6.1.1 End Cutting	6-2
4.6 Insulation Sleeving	4-14	6.1.2 Notching	6-3
4.7 Birdcaged Wire (Soldered)	4-16	6.1.3 Planar Ground Plane Removal	6-4
4.8 Connection Requirements	4-17	6.1.4 Connector Position	6-5
4.8.1 Turret Terminals	4-19	6.1.5 Connector Skew & Lateral Position	6-8
4.8.2 Bifurcated Terminals	4-21	6.1.6 Retention	6-9
4.8.2.1 Side Route Attachments	4-21	6.2 Discrete Wire Termination	6-10
4.8.2.2 Bottom and Top Route Attachments	4-23	6.2.1 General	6-10
4.8.2.3 Staked Wires	4-24	6.2.2 Position of Wire	6-11
4.8.3 Slotted Terminals	4-25	6.2.3 Overhang (Extension)	6-12
4.8.4 Pierced/Perforated/Punched Terminals	4-26	6.2.4 Wire Holder	6-13
4.8.5 Hook Terminals	4-27	6.2.5 Damage in Connection Area	6-15
4.8.6 Cup Terminals	4-29	6.2.6 End Connectors	6-16
4.8.7 Series Connected Terminals	4-30	6.2.7 Wiremount Connectors	6-18
4.8.8 Lead/Wire Placement - AWG 30 and Smaller Diameter Wires	4-31	6.2.8 Subminiature D-Connector (Series Bus Connector)	6-19
4.9 Solder Connection	4-32	6.2.9 Modular Connectors (RJ Type)	6-21
4.9.1 Turret Terminals	4-34	7 Ultrasonic Welding	7-1
4.9.2 Bifurcated Terminals	4-35	7.1 Insulation Clearance	7-2
4.9.3 Slotted Terminals	4-37	7.2 Weld Nugget	7-3
4.9.4 Pierced/Perforated Terminals	4-38	8 Splices	8-1
4.9.5 Hook Terminals	4-39	8.1 Soldered Splices	8-2
4.9.6 Cup Terminals	4-40	8.1.1 Mesh	8-2
5 Crimp Terminations (Contacts and Lugs)	5-1	8.1.2 Wrap	8-4
5.1 Stamped and Formed - Open Barrel	5-2	8.1.3 Hook	8-5
5.1.1 Insulation Support Crimp	5-3	8.1.4 Lap	8-6
5.1.2 Insulation Inspection Window	5-5	8.1.4.1 Two or More Conductors	8-7
5.1.3 Conductor Crimp	5-7	8.1.4.2 Insulation Opening (Window)	8-9
5.1.4 Crimp Bellmouth	5-9	8.1.5 Heat Shrinkable Solder Devices	8-11
5.1.5 Conductor Brush	5-11	8.2 Crimped Splices	8-13
5.1.6 Stamped and Formed Carrier Cutoff Tab	5-13	8.2.1 Barrel	8-13
5.2 Stamped and Formed - Closed Barrel	5-14	8.2.2 Double Sided	8-16
5.2.1 Insulation Support Crimp	5-15	8.3 Ultrasonic Weld Splices	8-20
5.2.2 Conductor Crimp and Bellmouth	5-17	9 Connectorization	9-1
5.3 Machined Contacts	5-19	9.1 Hardware Mounting	9-2
5.3.1 Insulation Clearance	5-19	9.1.1 Jackpost - Height	9-2
5.3.2 Insulation Support Style	5-22	9.1.2 Jackscrews - Protrusion	9-3
5.3.3 Conductor Location	5-23		
5.3.4 Crimping	5-25		
5.3.5 CMA Buildup	5-27		

Table of Contents (cont.)

9.2 Strain Relief	9-4	11.2 Wire Measuring	11-5
9.2.1 Clamp Fit	9-4	11.2.1 Electrical Terminal Reference Location	11-5
9.2.2 Wire Dress	9-5	11.2.2 Length	11-6
9.2.2.1 Straight Approach	9-6	12 Marking/Labeling	12-1
9.2.2.2 Side Approach	9-7	12.1 Content	12-2
9.3 Sleeving and Boots	9-8	12.2 Legibility	12-2
9.3.1 Position	9-8	12.3 Permanency	12-4
9.3.2 Bonding	9-9	12.4 Location and Orientation	12-4
9.4 Connector Damage	9-12	12.5 Functionality	12-6
9.4.1 Criteria	9-12	12.6 Marker Sleeve	12-7
9.4.2 Limits - Hard Face - Mating Surface	9-13	12.6.1 Wrap Around	12-7
9.4.3 Limits - Soft Face - Mating Surface or Rear Seal Area	9-14	12.6.2 Tubular	12-9
9.4.4 Contacts	9-15	12.7 Flag Markers	12-10
9.5 Installation of Contacts and Sealing Plugs into Connectors	9-16	12.7.1 Adhesive	12-10
9.5.1 Installation of Contacts	9-16	12.7.2 Tie Wrap	12-10
9.5.2 Installation of Sealing Plugs	9-18	13 Coaxial and Twinaxial Cable Assemblies	13-1
10 Molding/Potting	10-1	13.1 Stripping	13-2
10.1 Molding	10-2	13.2 Center Conductor Termination	13-4
10.1.1 Mold Fill - Initial	10-2	13.2.1 Crimp	13-4
10.1.2 Mold Fill - Final	10-4	13.2.2 Solder	13-6
10.1.3 Mismatch	10-8	13.3 Solder Ferrule Pins	13-8
10.1.4 Blow Through	10-9	13.3.1 General	13-8
10.1.5 Terminal/Contact Position	10-10	13.3.2 Insulation	13-10
10.1.6 Fit	10-12	13.4 Coaxial Connector - Printed Wire Board Mount	13-11
10.1.7 Flashing	10-14	13.5 Coaxial Connector - Center Conductor Length - Right Angle Connector	13-12
10.1.8 Cracks, Flow Lines, Chill Marks (Knit Lines) or Weld Lines	10-16	13.6 Coaxial Connector - Center Conductor Solder	13-14
10.1.9 Color	10-18	13.7 Coaxial Connector - Terminal Cover	13-16
10.1.10 Wire Insulation, Jacket or Sleeving Damage .	10-18	13.7.1 Soldering	13-16
10.1.11 Curing	10-20	13.7.2 Press Fit	13-17
10.1.12 Rework	10-21	13.8 Shield Termination	13-18
10.2 Potting	10-22	13.8.1 Clamped Ground Rings	13-18
10.2.1 Filling	10-22	13.8.2 Crimped Ferrule	13-19
10.2.2 Fit to Wire or Cable	10-23		
10.2.3 Curing	10-24		
11 Cable Assemblies and Wires	11-1		
11.1 Cable Measuring	11-2		
11.1.1 Reference Surfaces	11-2		
11.1.1.1 Straight/Axial Connectors	11-2		
11.1.1.2 Right-Angle Connectors	11-2		
11.1.2 Length	11-3		
11.1.3 Breakout	11-4		

Table of Contents (cont.)

13.9 Center Pin Position	13-21	15.3 Shield Termination - Connector	15-15
13.10 Semirigid Coax	13-22	15.3.1 Shrink and Crimp	15-15
13.10.1 Bending and Deformation	13-22	15.3.2 Shield Jumper Wire Attachment	15-19
13.10.2 Surface Condition	13-25	15.4 Shield Termination - Splicing	15-20
13.10.3 Dielectric Cutoff	13-27	15.4.1 Solder	15-20
13.10.4 Dielectric Cleanliness	13-29	15.4.2 Tie/Tape On	15-22
13.10.5 Solder	13-30	15.5 Tapes - Barrier and Conductive, Adhesive or Nonadhesive	15-23
13.11 Swage-Type Connector	13-32	15.6 Conduit (Shielding)	15-24
13.12 Soldering and Stripping of Biaxial Wire	13-33	15.7 Shrink Tubing - Conductive Lined	15-25
13.12.1 Jacket and Tip Installation	13-33	16 Cable/Wire Harness Protective Coverings	16-1
13.12.2 Ring Installation	13-35	16.1 Braid	16-2
14 Securing	14-1	16.1.1 Direct Applied	16-2
14.1 Tie Wrap/Lacing Application	14-2	16.1.2 Prewoven	16-4
14.1.1 Tightness	14-6	16.2 Sleeving/Shrink Tubing	16-6
14.1.2 Damage	14-7	16.3 Spiral Plastic Wrap (Spiral Wrap Sleeving)	16-7
14.1.3 Spacing	14-8	16.4 Conduit (Containment Loom)	16-8
14.2 Breakouts	14-9	16.5 Tapes, Adhesive and Nonadhesive	16-9
14.2.1 Individual Wires	14-9	17 Finished Assembly Installation	17-1
14.2.2 Spacing	14-10	17.1 General	17-2
14.3 Routing	14-13	17.2 Hardware Installation	17-3
14.3.1 Wire Crossover	14-13	17.2.1 Threaded Fasteners	17-3
14.3.2 Bend Radius	14-14	17.2.2 Minimum Torque for Electrical Connections	17-6
14.3.3 Coaxial Cable	14-15	17.2.3 Wires	17-7
14.3.4 Unused Wire Termination	14-16	17.2.4 High Voltage Applications	17-10
14.3.5 Ties over Splices and Ferrules	14-17	17.3 Wire/Harness Installation	17-11
15 Harness/Cable Electrical Shielding	15-1	17.3.1 Stress Relief	17-11
15.1 Braided	15-2	17.3.2 Wire Dress	17-12
15.1.1 Direct Applied	15-3	17.3.3 Service Loops	17-13
15.1.2 Prewoven	15-5	18 Solderless Wrap	18-1
15.2 Shield Termination	15-6	18.1 Number of Turns	18-2
15.2.1 Shield Jumper Wire	15-6	18.2 Turn Spacing	18-3
15.2.1.1 Attached Lead	15-6	18.3 End Tails, Insulation Wrap	18-4
15.2.1.1.1 Solder/Heat Shrinkable Solder Device	15-7		
15.2.1.1.2 Crimp	15-11		
15.2.1.2 Shield Braid	15-11		
15.2.1.2.1 Woven	15-11		
15.2.1.2.2 Combed and Twisted	15-12		
15.2.1.3 Daisy Chain	15-12		
15.2.2 No Shield Wire	15-13		

Table of Contents (cont.)

18.4 Raised Turns Overlap	18-6	19.6 Mechanical Tests	19-10
18.5 Connection Position	18-7	19.6.1 Selection	19-10
18.6 Wire Dress	18-9	19.7 Mechanical Test Methods	19-11
18.7 Wire Slack	18-10	19.7.1 Crimp Height (Dimensional Analysis)	19-11
18.8 Plating	18-11	19.7.1.1 Terminal Positioning	19-12
18.9 Damage	18-12	19.7.2 Pull Force (Tensile)	19-13
18.9.1 Insulation	18-12	19.7.2.1 Without Documented Process Control	19-14
18.9.2 Wires and Terminals	18-13	19.7.3 Crimp Force Monitoring	19-16
19 Testing	19-1	19.7.4 Crimp Tool Qualification	19-16
19.1 Nondestructive Tests	19-2	19.7.5 Contact Retention Verification	19-16
19.2 Testing After Rework or Repair	19-2	19.7.6 Coaxial Shield Pull Force (Tensile)	19-17
19.3 Intended Table Usage	19-2	19.7.7 RF Connector Shield Ferrule Torsion	19-18
19.4 Electrical Test	19-3	19.7.8 User Defined	19-18
19.4.1 Selection	19-3	Appendix A Terms and Definitions	A-1
19.5 Electrical Test Methods	19-4	Appendix B Metric Conversion Table	B-1
19.5.1 Continuity	19-4	Appendix C Reproducible Test Tables	C-1
19.5.2 Shorts	19-5	Standard Improvement Form	
19.5.3 Dielectric Withstanding Voltage (DWV)	19-6		
19.5.4 Insulation Resistance (IR)	19-7		
19.5.5 Voltage Standing Wave Ratio (VSWR)	19-8		
19.5.6 Insertion Loss	19-8		
19.5.7 Reflection Coefficient	19-9		
19.5.8 User Defined	19-9		