



IPC/WHMA-A-620D



# Requirements and Acceptance for Cable and Wire Harness Assemblies

If a conflict occurs between the English and translated versions of this document, the English version will take precedence.

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-620C -  
January 2017  
IPC/WHMA-A-620B with  
Amendment 1 -  
August 2013  
IPC/WHMA-A-620B -  
October 2012  
IPC/WHMA-A-620A -  
July 2006  
IPC/WHMA-A-620 -  
January 2002

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

Contact:

IPC

Wiring Harness Manufacturers Assoc.  
(An affiliate of IPC)

# Table of Contents

<p><b>1 General</b> ..... 1-1</p> <p><b>1.1 Scope</b> ..... 1-1</p> <p><b>1.2 Purpose</b> ..... 1-1</p> <p><b>1.3 Classification</b> ..... 1-1</p> <p><b>1.4 Measurement Units and Applications</b> ..... 1-1</p> <p>1.4.1 Verification of Dimensions ..... 1-1</p> <p><b>1.5 Definition of Requirements</b> ..... 1-1</p> <p>1.5.1 Inspection Conditions ..... 1-2</p> <p>1.5.1.1 Acceptable ..... 1-2</p> <p>1.5.1.2 Defect ..... 1-2</p> <p>1.5.1.2.1 Disposition ..... 1-2</p> <p>1.5.1.3 Process Indicator ..... 1-2</p> <p>1.5.1.4 Combined Contitions ..... 1-3</p> <p>1.5.1.5 Conditions Not Specified ..... 1-3</p> <p>1.5.1.6 Uncommon or Specialized Designs ..... 1-3</p> <p>1.5.2 Material and Process Nonconformance ..... 1-3</p> <p><b>1.6 Process Control</b> ..... 1-3</p> <p>1.6.1 Statistical Process Control ..... 1-3</p> <p><b>1.7 Order of Precedence</b> ..... 1-4</p> <p>1.7.1 Clause References ..... 1-4</p> <p>1.7.2 Appendices ..... 1-4</p> <p><b>1.8 Terms and Definitions</b> ..... 1-4</p> <p>1.8.1 FOD (Foreign Object Debris) ..... 1-4</p> <p>1.8.2 Inspection ..... 1-4</p> <p>1.8.3 Manufacturer (Assembler) ..... 1-4</p> <p>1.8.4 Objective Evidence ..... 1-4</p> <p>1.8.5 Process Control ..... 1-4</p> <p>1.8.6 Supplier ..... 1-4</p> <p>1.8.7 User ..... 1-5</p> <p>1.8.8 Wire Diameter (D) ..... 1-5</p> <p>1.8.9 Engineering Documentation ..... 1-5</p> <p><b>1.9 Requirements Flowdown</b> ..... 1-5</p> <p><b>1.10 Personnel Proficiency</b> ..... 1-5</p> <p><b>1.11 Acceptance Requirements</b> ..... 1-5</p> <p><b>1.12 Inspection Methodology</b> ..... 1-5</p> <p>1.12.1 Process Verification Inspection ..... 1-5</p> <p>1.12.2 Visual Inspection ..... 1-5</p> <p>1.12.2.1 Lighting ..... 1-5</p> <p>1.12.2.2 Magnification Aids ..... 1-5</p>	<p><b>1.13 Facilities</b> ..... 1-6</p> <p>1.13.1 Field Assembly Operations ..... 1-6</p> <p>1.13.2 Health and Safety ..... 1-6</p> <p><b>1.14 Electrostatic Discharge (ESD) Protection</b> ..... 1-6</p> <p><b>1.15 Tools and Equipment</b> ..... 1-7</p> <p>1.15.1 Control ..... 1-7</p> <p>1.15.2 Calibration ..... 1-7</p> <p><b>1.16 Materials and Processes</b> ..... 1-7</p> <p><b>1.17 Electrical Clearance</b> ..... 1-8</p> <p><b>1.18 Contamination</b> ..... 1-8</p> <p><b>1.19 Rework/Repair</b> ..... 1-8</p> <p>1.19.1 Rework ..... 1-8</p> <p>1.19.2 Repair ..... 1-8</p> <p>1.19.3 Post Rework/Repair Cleaning ..... 1-8</p> <p><b>2 Applicable Documents</b> ..... 2-1</p> <p><b>2.1 IPC</b> ..... 2-1</p> <p><b>2.2 Joint Industry Standards</b> ..... 2-1</p> <p><b>2.3 Society of Automotive Engineers (SAE)</b> ..... 2-1</p> <p><b>2.4 American National Standards Institute (ANSI)</b> ..... 2-1</p> <p><b>2.5 International Organization for Standardization (ISO)</b> ..... 2-1</p> <p><b>2.6 ESD Association (ESDA)</b> ..... 2-2</p> <p><b>2.7 United States Department of Defense (DoD)</b> .... 2-2</p> <p><b>2.8 International Electrotechnical Commission (IEC)</b> ..... 2-2</p> <p><b>2.9 Aerospace Industries Association (AIA/NAS)</b> .... 2-2</p> <p><b>2.10 Electronics Industries Alliance</b> ..... 2-2</p> <p><b>2.11 ASTM International</b> ..... 2-2</p> <p><b>2.12 Institute of Electrical and Electronics Engineers</b> ..... 2-2</p> <p><b>3 Preparation</b> ..... 3-1</p> <p><b>3.1 Stripping</b> ..... 3-2</p> <p><b>3.2 Strand Damage and End Cuts</b> ..... 3-2</p> <p><b>3.3 Conductor Deformation/Birdcaging</b> ..... 3-5</p>
--	---

## Table of Contents (cont.)

<b>3.4 Twisting of Wires</b> .....	3-7	4.8.3.2 Solder .....	4-34
<b>3.5 Insulation Damage – Stripping</b> .....	3-8	4.8.4 Pierced/Perforated/Punched .....	4-35
<b>4 Soldered Terminations</b> .....	4-1	4.8.4.1 Lead/Wire Placement .....	4-35
<b>4.1 Material, Components and Equipment</b> .....	4-2	4.8.4.2 Solder .....	4-37
4.1.1 Materials .....	4-2	4.8.5 Hook .....	4-38
4.1.1.1 Solder .....	4-2	4.8.5.1 Lead/Wire Placement .....	4-38
4.1.1.1.1 Solder Purity Maintenance .....	4-3	4.8.5.2 Solder .....	4-40
4.1.1.2 Flux .....	4-4	4.8.6 Cup .....	4-41
4.1.1.3 Adhesives .....	4-4	4.8.6.1 Lead/Wire Placement .....	4-41
4.1.1.4 Solderability .....	4-5	4.8.6.2 Solder .....	4-42
4.1.1.5 Tools and Equipment .....	4-5	4.8.7 Series Connected .....	4-44
4.1.2 Gold Removal .....	4-5	4.8.8 Lead/Wire Placement – AWG 30 and Smaller Diameter Wires .....	4-45
<b>4.2 Cleanliness</b> .....	4-6	<b>5 Crimp Terminations (Contacts and Lugs)</b> .....	5-1
4.2.1 Presoldering .....	4-6	<b>5.1 Stamped and Formed – Open Barrel</b> .....	5-3
4.2.2 Postsoldering .....	4-6	5.1.1 Insulation Support .....	5-4
4.2.2.1 Foreign Object Debris (FOD) .....	4-6	5.1.1.1 Inspection Window .....	5-4
4.2.2.2 Flux Residue .....	4-7	5.1.1.2 Crimp .....	5-6
4.2.2.2.1 Cleaning Required .....	4-7	5.1.2 Insulation Clearance if No Support Crimp .....	5-8
4.2.2.2.2 No-Clean Process .....	4-7	5.1.3 Conductor Crimp .....	5-9
<b>4.3 Solder Connection</b> .....	4-8	5.1.4 Crimp Bellmouth .....	5-11
4.3.1 General Requirements .....	4-10	5.1.5 Conductor Brush .....	5-13
4.3.2 Soldering Anomalies .....	4-11	5.1.6 Carrier Cutoff Tab .....	5-15
4.3.2.1 Exposed Basis Metal .....	4-11	5.1.7 Individual Wire Seal .....	5-16
4.3.2.2 Partially Visible or Hidden Solder Connections .....	4-11	<b>5.2 Stamped and Formed – Closed Barrel</b> .....	5-18
<b>4.4 Wire/Lead Preparation, Tinning</b> .....	4-12	5.2.1 Insulation Clearance .....	5-19
<b>4.5 Wire Insulation</b> .....	4-14	5.2.2 Insulation Support Crimp .....	5-20
4.5.1 Clearance .....	4-14	5.2.3 Conductor Crimp and Bellmouth .....	5-21
4.5.2 Postsolder Damage .....	4-16	5.2.4 Cutoff Tabs .....	5-23
<b>4.6 Insulation Sleeving</b> .....	4-17	<b>5.3 Machined Contacts</b> .....	5-24
<b>4.7 Soldered Strand Separation (Birdcaging)</b> .....	4-19	5.3.1 Insulation Clearance .....	5-24
<b>4.8 Terminals</b> .....	4-20	5.3.2 Insulation Support Style .....	5-26
4.8.1 Turrets and Straight Pins .....	4-23	5.3.3 Conductor .....	5-27
4.8.1.1 Lead/Wire Placement .....	4-23	5.3.4 Crimping .....	5-29
4.8.1.2 Solder .....	4-25	5.3.5 CMA Buildup .....	5-31
4.8.2 Bifurcated .....	4-26	<b>5.4 Termination Ferrule Crimp</b> .....	5-33
4.8.2.1 Lead/Wire Placement – Side Route .....	4-26	<b>5.5 Shrink Sleeving – Wire Support – Crimped Terminals</b> .....	5-35
4.8.2.2 Lead/Wire Placement – Bottom and Top Route .....	4-28	<b>6 Insulation Displacement Connection (IDC)</b> .....	6-1
4.8.2.3 Lead/Wire Placement – Staked/ Constrained Wires .....	4-30	<b>6.1 Mass Termination, Flat Cable</b> .....	6-2
4.8.2.4 Solder .....	4-31	6.1.1 End Cutting .....	6-2
4.8.3 Slotted .....	4-33	6.1.2 Notching .....	6-3
4.8.3.1 Lead/Wire Placement .....	4-33	6.1.3 Planar Ground Plane Removal .....	6-4
		6.1.4 Connector Position .....	6-5
		6.1.5 Connector Skew and Lateral Position .....	6-8
		6.1.6 Retention .....	6-9

## Table of Contents (cont.)

<b>6.2 Discrete Wire Termination</b> .....	6-10	<b>9.4 Connector Damage</b> .....	9-15
6.2.1 General .....	6-10	9.4.1 Criteria .....	9-15
6.2.2 Position of Wire .....	6-11	9.4.2 Limits – Hard Face – Mating Surface .....	9-16
6.2.3 Overhang (Extension) .....	6-12	9.4.3 Limits – Soft Face – Mating Surface or Rear Seal Area .....	9-17
6.2.4 Insulation Crimp .....	6-13	9.4.4 Contacts .....	9-18
6.2.5 Damage in Connection Area .....	6-15	<b>9.5 Installation of Contacts and Sealing Plugs into Connectors</b> .....	9-19
6.2.6 End Connectors .....	6-16	9.5.1 Installation of Contacts .....	9-19
6.2.7 Pass Through Connectors .....	6-17	9.5.2 Installation of Sealing Plugs .....	9-21
6.2.8 Wiremount Connectors .....	6-18	<b>10 Over-Molding/Potting</b> .....	10-1
6.2.9 Subminiature D-Connector (Series Bus Connector) .....	6-19	<b>10.1 Over-Molding</b> .....	10-4
6.2.10 Modular Connectors (RJ Type) .....	6-21	10.1.1 Mold Fill .....	10-4
<b>7 Ultrasonic Welding</b> .....	7-1	10.1.1.1 Inner .....	10-4
<b>7.1 Insulation Clearance</b> .....	7-2	10.1.1.2 Outer .....	10-7
<b>7.2 Weld Nugget</b> .....	7-3	10.1.1.2.1 Mismatch .....	10-10
<b>8 Splices</b> .....	8-1	10.1.1.2.2 Fit .....	10-11
<b>8.1 Soldered Splices</b> .....	8-2	10.1.1.2.3 Cracks, Flow Lines, Chill Marks (Knit Lines) or Weld Lines .....	10-14
8.1.1 Mesh .....	8-3	10.1.1.2.4 Color .....	10-16
8.1.2 Wrap .....	8-5	10.1.2 Blow Through .....	10-17
8.1.3 Hook .....	8-7	10.1.3 Position .....	10-18
8.1.4 Lap .....	8-8	10.1.4 Flashing .....	10-21
8.1.4.1 Two or More Conductors .....	8-9	10.1.5 Wire Insulation, Jacket or Sleeving Damage .....	10-23
8.1.4.2 Insulation Opening (Window) .....	8-12	10.1.6 Curing .....	10-24
8.1.5 Heat Shrinkable Solder Devices .....	8-13	<b>10.2 Potting (Thermoset Molding)</b> .....	10-25
<b>8.2 Crimped Splices</b> .....	8-15	10.2.1 Filling .....	10-25
8.2.1 Barrel .....	8-15	10.2.2 Fit to Wire or Cable .....	10-29
8.2.2 Double Sided .....	8-18	10.2.3 Curing .....	10-31
8.2.3 Contact .....	8-21	<b>10.3 Over-Molding of Flexible Flat Ribbon</b> .....	10-32
8.2.4 Wire In-Line Junction Devices (Jiffy Junctions) ..	8-23	10.3.1 Mounting and Alignment Feature Adhesion .....	10-35
<b>8.3 Ultrasonic Weld Splices</b> .....	8-24	10.3.2 Adhesion Between Ribbon and Connector Potting .....	10-36
<b>9 Connectorization</b> .....	9-1	10.3.3 Mounting Hardware .....	10-37
<b>9.1 Hardware Mounting</b> .....	9-2	<b>11 Measuring Cable Assemblies and Wires</b> .....	11-1
9.1.1 Jackpost – Height .....	9-2	<b>11.1 Measuring – Cable and Wire Length Tolerance</b> .....	11-2
9.1.2 Jackscrews – Protrusion .....	9-3	<b>11.2 Measuring – Cable</b> .....	11-2
9.1.3 Retaining Clips .....	9-4	11.2.1 Reference Surfaces – Straight/Axial Connectors .....	11-2
9.1.4 Connector Alignment .....	9-5	11.2.2 Reference Surfaces – Right-Angle Connectors .....	11-3
<b>9.2 Strain Relief</b> .....	9-6	11.2.3 Length .....	11-3
9.2.1 Clamp Fit .....	9-6	11.2.4 Breakout .....	11-4
9.2.2 Wire Dress .....	9-7		
9.2.2.1 Straight Approach .....	9-8		
9.2.2.2 Side Approach .....	9-9		
<b>9.3 Sleeving and Boots</b> .....	9-10		
9.3.1 Position .....	9-10		
9.3.2 Bonding .....	9-11		

## Table of Contents (cont.)

11.2.4.1 Breakout Measurement Points .....	11-4	<b>13.9 Center Pin</b> .....	13-20
11.2.4.2 Breakout Length .....	11-5	13.9.1 Position .....	13-20
<b>11.3 Measuring – Wire</b> .....	11-6	13.9.2 Damage .....	13-21
11.3.1 Electrical Terminal Reference Location .....	11-6	<b>13.10 Semirigid Coax</b> .....	13-22
11.3.2 Length .....	11-7	13.10.1 Bending and Deformation .....	13-23
<b>12 Marking/Labeling</b> .....	12-1	13.10.2 Surface Condition .....	13-25
<b>12.1 Content</b> .....	12-2	13.10.2.1 Solid .....	13-25
<b>12.2 Legibility</b> .....	12-2	13.10.2.2 Conformable Cable .....	13-27
<b>12.3 Permanency</b> .....	12-4	13.10.3 Dielectric Cutoff .....	13-28
<b>12.4 Location and Orientation</b> .....	12-5	13.10.4 Dielectric Cleanliness .....	13-30
<b>12.5 Functionality</b> .....	12-6	13.10.5 Center Conductor Pin .....	13-31
<b>12.6 Marker Sleeve</b> .....	12-7	13.10.5.1 Point .....	13-32
12.6.1 Wrap Around .....	12-7	13.10.5.2 Damage .....	13-34
12.6.2 Tubular .....	12-9	13.10.6 Solder .....	13-34
<b>12.7 Flag Markers</b> .....	12-10	<b>13.11 Swage-Type Connector</b> .....	13-36
12.7.1 Adhesive .....	12-10	<b>13.12 Soldering and Stripping of Biaxial/ Multi-Axial Shielded Wire</b> .....	13-37
<b>12.8 Tie Wrap Markers</b> .....	12-10	13.12.1 Jacket and Tip Installation .....	13-37
<b>13 Coaxial and Biaxial Cable Assemblies</b> .....	13-1	13.12.2 Ring Installation .....	13-39
<b>13.1 Stripping</b> .....	13-2	<b>14 Securing</b> .....	14-1
<b>13.2 Center Conductor Termination</b> .....	13-4	<b>14.1 Tie Wrap/Lacing Application</b> .....	14-2
13.2.1 Crimp .....	13-4	14.1.1 Tightness .....	14-7
13.2.2 Solder .....	13-6	14.1.2 Damage .....	14-8
<b>13.3 Solder Ferrule Pins</b> .....	13-8	14.1.3 Spacing .....	14-8
13.3.1 General .....	13-8	<b>14.2 Breakouts</b> .....	14-9
13.3.2 Insulation .....	13-10	14.2.1 Individual Wires .....	14-9
<b>13.4 Coaxial Connector – Printed Wire Board Mount</b> .....	13-11	14.2.2 Spacing .....	14-10
<b>13.5 Coaxial Connector – Center Conductor Length – Right Angle Connector</b> .....	13-12	<b>14.3 Routing</b> .....	14-13
<b>13.6 Coaxial Connector – Center Conductor Solder</b> .....	13-13	14.3.1 Wire Crossover .....	14-13
<b>13.7 Coaxial Connector – Terminal Cover</b> .....	13-15	14.3.2 Bend Radius .....	14-14
13.7.1 Soldering .....	13-15	14.3.3 Coaxial Cable .....	14-15
13.7.2 Press Fit .....	13-16	14.3.4 Unused Wire Termination .....	14-16
<b>13.8 Shield Termination</b> .....	13-17	14.3.4.1 Shrink Sleeving .....	14-16
13.8.1 Clamped Ground Rings .....	13-17	14.3.4.2 Flexible Sleeving .....	14-17
13.8.2 Crimped Ferrule .....	13-18	14.3.5 Ties over Splices and Ferrules .....	14-17
		<b>14.4 Broom Stitching</b> .....	14-18
		<b>15 Harness/Cable Electrical Shielding</b> .....	15-1
		<b>15.1 Braided</b> .....	15-2
		15.1.1 Direct Applied .....	15-3
		15.1.2 Prewoven .....	15-5
		<b>15.2 Shield Termination</b> .....	15-6
		15.2.1 Shield Jumper Wire .....	15-6
		15.2.1.1 Attached Lead .....	15-6

## Table of Contents (cont.)

15.2.1.1.1 Solder .....	15-7	<b>17.3 Wire/Harness Installation</b> .....	17-15
15.2.1.1.2 Crimp .....	15-11	17.3.1 Stress Relief .....	17-15
15.2.1.2 Shield Braid .....	15-12	17.3.2 Wire Dress .....	17-16
15.2.1.2.1 Woven .....	15-12	17.3.3 Service Loops .....	17-17
15.2.1.2.2 Combed and Twisted .....	15-12	17.3.4 Clamping .....	17-18
15.2.1.3 Daisy Chain .....	15-13	17.3.5 Tie Wrap Lacing .....	17-18
15.2.1.4 Common Ground Point .....	15-13	17.3.6 Raceways .....	17-19
15.2.2 No Shield Jumper Wire .....	15-14	17.3.7 Grommets .....	17-20
15.2.2.1 Shield Not Folded Back .....	15-14	17.3.7.1 Wire/Cable/Bundle Sealing Not Required ..	17-20
15.2.2.2 Shield Folded Back .....	15-15	17.3.7.1.1 Wire/Cable Sealing Required .....	17-21
<b>15.3 Shield Termination – Connector</b> .....	15-16	<b>18 Solderless Wrap</b> .....	18-1
15.3.1 Shrink .....	15-16	<b>19 Testing</b> .....	19-1
15.3.2 Crimp .....	15-18	<b>19.1 Nondestructive Tests</b> .....	19-2
15.3.3 Shield Jumper Wire Attachment .....	15-20	<b>19.2 Testing After Rework or Repair</b> .....	19-2
15.3.4 Soldered .....	15-21	<b>19.3 Intended Table Usage</b> .....	19-2
<b>15.4 Shield Termination – Splicing Prewoven</b> .....	15-21	<b>19.4 Electrical Test</b> .....	19-3
15.4.1 Soldered .....	15-22	19.4.1 Selection .....	19-3
15.4.2 Tie/Tape On .....	15-24	<b>19.5 Electrical Test Methods</b> .....	19-4
<b>15.5 Tapes – Barrier and Conductive, Adhesive or Nonadhesive</b> .....	15-25	19.5.1 Continuity .....	19-4
<b>15.6 Conduit (Shielding)</b> .....	15-26	19.5.2 Shorts .....	19-5
<b>15.7 Shrink Tubing – Conductive Lined</b> .....	15-27	19.5.3 Dielectric Withstanding Voltage (DWW) .....	19-6
<b>16 Cable/Wire Harness Protective Coverings</b> .....	16-1	19.5.4 Insulation Resistance (IR) .....	19-7
<b>16.1 Braid</b> .....	16-2	19.5.5 Voltage Standing Wave Ratio (VSWR) .....	19-8
16.1.1 Direct Applied .....	16-2	19.5.6 Insertion Loss .....	19-8
16.1.2 Prewoven .....	16-4	19.5.7 Reflection Coefficient .....	19-9
<b>16.2 Sleeving/Shrink Tubing</b> .....	16-6	19.5.8 User Defined .....	19-9
16.2.1 Sealant .....	16-7	<b>19.6 Mechanical Test</b> .....	19-10
<b>16.3 Spiral Plastic Wrap (Spiral Wrap Sleeving)</b> ....	16-8	19.6.1 Selection .....	19-10
<b>16.4 Wire Loom Tubing – Split and Unsplit</b> .....	16-9	<b>19.7 Mechanical Test Methods</b> .....	19-11
<b>16.5 Tapes, Adhesive and Nonadhesive</b> .....	16-9	19.7.1 Crimp Height (Dimensional Analysis) .....	19-11
<b>17 Finished Assembly Installation</b> .....	17-1	19.7.1.1 Terminal Positioning .....	19-12
<b>17.1 General</b> .....	17-2	19.7.2 Pull Force (Tensile) .....	19-13
<b>17.2 Hardware Installation</b> .....	17-3	19.7.2.1 Without Documented Process Control .....	19-14
17.2.1 Threaded Fasteners .....	17-4	19.7.3 Crimp Force Monitoring .....	19-18
17.2.1.1 Minimum Torque .....	17-6	19.7.4 Crimp Tool Qualification .....	19-18
17.2.2 Wires .....	17-8	19.7.5 Contact Retention Verification .....	19-18
17.2.2.1 Solid Wires .....	17-9	19.7.6 RF Connector Shield Pull Force (Tensile) ...	19-19
17.2.2.2 Stranded Wires .....	17-11	19.7.7 RF Connector Shield Ferrule Torsion .....	19-20
17.2.3 Safety Wiring .....	17-12	19.7.8 User Defined .....	19-20
17.2.4 Safety Cable .....	17-14	<b>20 High Voltage Applications</b> .....	20-1

## Table of Contents (cont.)

<b>Appendix A</b>	<b>Terms and Definitions</b> .....	A-1	<b>Table 13-2</b>	<b>Semirigid Coax Deformation</b> .....	13-24
<b>Appendix B</b>	<b>Reproducible Test Tables</b> .....	B-1	<b>Table 13-3</b>	<b>Dielectric Cutoff</b> .....	13-28
<b>Appendix C</b>	<b>Guidelines for Soldering Tools and Equipment</b> .....	C-1	<b>Table 14-1</b>	<b>Minimum Bend Radius Requirements</b> .....	14-14
<b>Table A-1</b>	<b>Electrical Clearance</b> .....	A-5	<b>Table 17-1</b>	<b>Minimum Swaged Ferrule Pull-Off Load</b> .....	17-14
<b>Table 1-1</b>	<b>Magnification Aid Applications – Wire and Wire Connections</b> .....	1-6	<b>Table 19-1</b>	<b>Electrical Test Requirements</b> .....	19-3
<b>Table 1-2</b>	<b>Magnification Aid Applications – Other</b> .....	1-6	<b>Table 19-2</b>	<b>Continuity Test Minimum Requirements</b> .....	19-4
<b>Table 3-1</b>	<b>Allowable Strand Damage</b> .....	3-4	<b>Table 19-3</b>	<b>Shorts Test (low voltage isolation) Minimum Requirements</b> .....	19-5
<b>Table 4-1</b>	<b>Maximum Limits of Solder Bath Contaminant</b> .....	4-3	<b>Table 19-4</b>	<b>Dielectric Withstanding Voltage Test (DWV) Minimum Requirements</b> ...	19-6
<b>Table 4-2</b>	<b>Solder Connection Anomalies</b> .....	4-11	<b>Table 19-5</b>	<b>Insulation Resistance (IR) Test Minimum Requirements</b> .....	19-7
<b>Table 4-3</b>	<b>Turret and Straight Pin Terminal Lead/Wire Placement</b> .....	4-23	<b>Table 19-6</b>	<b>Voltage Standing Wave Ratio (VSWR) Test Parameters</b> .....	19-8
<b>Table 4-4</b>	<b>Bifurcated Terminal Lead/Wire Placement – Side Route</b> .....	4-26	<b>Table 19-7</b>	<b>Insertion Loss Test Parameters</b> .....	19-8
<b>Table 4-5</b>	<b>Bifurcated Terminal Lead/Wire Placement – Bottom Route</b> .....	4-28	<b>Table 19-8</b>	<b>Reflection Coefficient Test Parameters</b> .....	19-9
<b>Table 4-6</b>	<b>Staking Requirements of Side Route Straight Through Connections – Bifurcated Terminals</b> .....	4-30	<b>Table 19-9</b>	<b>Mechanical Test Requirements</b> .....	19-10
<b>Table 4-7</b>	<b>Pierced/Perforated/Punched Terminal Lead/Wire Placement</b> .....	4-35	<b>Table 19-10</b>	<b>Crimp Height Testing</b> .....	19-11
<b>Table 4-8</b>	<b>Hook Terminal Lead/Wire Placement</b> ...	4-38	<b>Table 19-11</b>	<b>Pull Force Testing Minimum Requirements</b> .....	19-14
<b>Table 4-9</b>	<b>AWG 30 and Smaller Wire Wrap Requirements</b> .....	4-45	<b>Table 19-12</b>	<b>Pull Test Force Values</b> .....	19-15
<b>Table 10-1</b>	<b>Definitions of Molding/Potting Visual Anomalies</b> .....	10-2	<b>Table 19-13</b>	<b>Pull Test Force Values (Classes 1 &amp; 2) For UL, SAE, GM and Volvo</b> ...	19-16
<b>Table 11-1</b>	<b>Cable/Wire Length Measurement Tolerance</b> .....	11-2	<b>Table 19-14</b>	<b>Pull Test Force Values (Classes 1 &amp; 2) For IEC</b> .....	19-17
<b>Table 13-1</b>	<b>Coaxial and Biaxial Shield and Center Conductor Damage</b> .....	13-2	<b>Table 19-15</b>	<b>RF Connector Shield Pull Force Testing</b> .....	19-19

## 1 General

# 1 General

**1.1 Scope** This standard prescribes practices and requirements for the manufacture of cable, wire and harness assemblies. This standard does not provide criteria for cross-section or X-ray evaluation.

**If a conflict occurs between the English and translated versions of this document, the English version will take precedence.**

The illustrations in this document portray specific points noted in the title of each section. A brief description follows each illustration. The development committee recognizes that different parts of the industry have different definitions for some terms used herein. For the purposes of this document, the terms cable and wire harness are used interchangeably.

IPC/WHMA-A-620 can be used as a stand-alone document for purchasing products, however it does not specify frequency of in-process inspection or frequency of end product inspection. No limit is placed on the number of process indicators or the number of allowable repair/rework of defects. Such information should be developed with a statistical process control plan (see IPC-9191).

**1.2 Purpose** This standard describes materials, methods, tests and acceptability criteria for producing crimped, mechanically secured, or soldered interconnections and the related assembly activities associated with cable and harness assemblies.

The intent of this document is to rely on process control methodology to ensure consistent quality levels during the manufacture of products.

Any method that produces an assembly conforming to the acceptability requirements described in this standard may be used.

Standards may be updated at any time, including with the use of amendments. The use of an amendment or newer revision is not automatically required. The revision in effect **shall [D1D2D3]** be as specified by the User.

**1.3 Classification** Use of this standard requires agreement on the Class to which the product belongs. The User has the ultimate responsibility for identifying the Class to which the assembly is evaluated. If the User does not establish and document the acceptance Class, the Manufacturer may do so. Criteria defined in this standard reflect three Product Classes, which are as follows:

### **Class 1 General Electronic Products**

Includes products suitable for applications where the major requirement is the function of the completed assembly.

### **Class 2 Dedicated Service Electronic Products**

Includes products where continued performance and extended life is required, and for which uninterrupted service is desired but not critical. Typically, the end-use environment would not cause failures.

### **Class 3 High Performance/Harsh Environment Electronic Products**

Includes products where continued performance or performance-on-demand is critical, equipment downtime cannot be tolerated, end-use environment may be uncommonly harsh, and the equipment must function when required, such as life support systems and other critical systems.

**1.4 Measurement Units and Applications** This document uses the International System of Units (SI) in accordance with ASTM SI10-10, IEEE/ASTM SI 10, American National Standard for Metric Practice (Section 3). Imperial English equivalent units follow in brackets. The derived SI units used in this document are millimeters (mm) [in] for dimensions and dimensional tolerances, Celsius (°C) [°F] for temperature and temperature tolerances, grams (g) [oz] for weight, and lux (lx) [footcandles] for illuminance.

**1.4.1 Verification of Dimensions** Where not specifically invoked by this standard, actual measurements, e.g., of specific solder fillet dimensions, determination of damage and wrap percentages, are not required except for referee purposes.

**1.5 Definition of Requirements** The word “**shall**” is used in the text of this document wherever there is a requirement for materials, process or acceptance of cable, wire and harness assemblies.

Where the word **shall** indicates a requirement for at least one Class, the requirements for each Class are in brackets next to the **shall** requirement.