



IPC/WHMA-A-620E



Requirements and Acceptance for Cable and Wire Harness Assemblies

If a conflict occurs
between the English
language 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 WHMA

Supersedes:

IPC/WHMA-A-620D – January 2020
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

Tel 847 615.7100
Fax 847 615.7105

Wiring Harness Manufacturers
Assoc.
(An affiliate of IPC)

Tel 847 615.7100
email: contact.us@whma.org

Table of Contents

1.0 General	1-1	1.13 Facilities	1-6
1.1 Scope	1-1	1.13.1 Field Assembly Operations	1-6
1.2 Purpose	1-1	1.13.2 Health and Safety	1-6
1.3 Classification	1-1	1.14 Electrostatic Discharge (ESD) Protection	1-6
1.4 Measurement Units and Applications	1-1	1.15 Tools and Equipment	1-6
1.4.1 Verification of Dimensions	1-1	1.15.1 Control	1-6
1.5 Definition of Requirements	1-1	1.15.2 Calibration	1-7
1.5.1 Inspection Conditions	1-2	1.16 Materials and Processes	1-7
1.5.1.1 Acceptable	1-2	1.17 Electrical Clearance	1-7
1.5.1.2 Defect	1-2	1.18 Contamination	1-7
1.5.1.2.1 Disposition	1-2	1.19 Rework/Repair	1-8
1.5.1.3 Process Indicator	1-2	1.19.1 Rework	1-8
1.5.1.4 Conditions Not Specified	1-2	1.19.2 Repair	1-8
1.5.1.5 Uncommon or Specialized Designs	1-2	1.19.3 Post Rework/Repair Cleaning	1-8
1.5.2 Material and Process Nonconformance	1-3	2.0 Applicable Documents	2-1
1.6 Process Control	1-3	2.1 IPC	2-1
1.6.1 Statistical Process Control	1-3	2.2 Joint Industry Standards	2-1
1.7 Order of Precedence	1-3	2.3 Society of Automotive Engineers (SAE)	2-1
1.7.1 Clause References	1-4	2.4 American National Standards Institute (ANSI)	2-1
1.7.2 Appendices	1-4	2.5 International Organization for Standardization (ISO)	2-2
1.8 Terms and Definitions	1-4	2.6 ESD Association (ESDA)	2-2
1.8.1 FOD (Foreign Object Debris)	1-4	2.7 United States Department of Defense (DoD)	2-2
1.8.2 Inspection	1-4	2.8 International Electrotechnical Commission (IEC)	2-2
1.8.3 Manufacturer (Assembler)	1-4	2.9 Aerospace Industries Association (AIA/NAS)	2-2
1.8.4 Objective Evidence	1-4	2.10 Electronics Industries Alliance	2-2
1.8.5 Process Control	1-4	2.11 ASTM International	2-2
1.8.6 Supplier	1-4	2.12 Institute of Electrical and Electronics Engineers	2-2
1.8.7 User	1-4	3.0 Wires	3-1
1.8.8 Diameter	1-4	3.1 Stripping	3-1
1.8.8.1 Conductor	1-4	3.2 Strand Damage and End Cuts	3-1
1.8.8.2 Wire	1-4	3.3 Conductor Deformation/Birdcaging	3-4
1.8.8.3 Strand	1-4	3.4 Twisting of Wires	3-6
1.8.9 Engineering Documentation	1-4	3.5 Insulation Damage – Stripping	3-7
1.9 Requirements Flowdown	1-4	4.0 Soldered Terminations	4-1
1.10 Personnel Proficiency	1-5	4.1 Materials and Components	4-1
1.11 Acceptance Requirements	1-5		
1.12 Inspection Methodology	1-5		
1.12.1 Process Verification Inspection	1-5		
1.12.2 Visual Inspection	1-5		
1.12.2.1 Lighting	1-5		
1.12.2.2 Magnification Aids	1-5		

Table of Contents (cont.)

4.1.1	Materials	4-1	4.8.5	Hook	4-37
4.1.1.1	Solder	4-1	4.8.5.1	Lead/Wire Placement	4-37
4.1.1.1.1	Solder Purity Maintenance	4-2	4.8.5.2	Solder	4-39
4.1.1.2	Flux	4-3	4.8.6	Cup	4-40
4.1.1.3	Adhesives	4-3	4.8.6.1	Lead/Wire Placement	4-40
4.1.1.4	Solderability	4-4	4.8.6.2	Solder	4-41
4.1.2	Gold Removal	4-4	4.8.7	Series Connected	4-43
4.2	Cleanliness	4-5	4.8.8	Connection Requirements – Lead/Wire Placement – AWG 30 and Smaller Diameter Wires	4-44
4.2.1	Presoldering	4-5	5.0	Crimp Terminations (Contacts and Lugs)	5-1
4.2.2	Postsoldering	4-5	5.1	Stamped and Formed – Open Barrel	5-3
4.2.2.1	Foreign Object Debris (FOD)	4-5	5.1.1	Insulation Support	5-4
4.2.2.2	Flux Residue	4-6	5.1.1.1	Inspection Window	5-4
4.2.2.2.1	Cleaning Required	4-6	5.1.1.2	Crimp	5-6
4.2.2.2.2	No-Clean Process	4-6	5.1.2	Insulation Clearance if No Support Crimp	5-8
4.3	Solder Connection	4-7	5.1.3	Conductor Crimp	5-9
4.3.1	General Requirements	4-9	5.1.4	Crimp Bellmouth	5-11
4.3.2	Soldering Anomalies	4-10	5.1.5	Conductor Brush	5-13
4.3.2.1	Exposed Basis Metal	4-10	5.1.6	Carrier Cutoff Tab	5-15
4.3.2.2	Partially Visible or Hidden Solder Connections	4-10	5.1.7	Individual Wire Seal	5-16
4.4	Wire/Lead Preparation, Tinning	4-11	5.2	Stamped and Formed – Closed Barrel	5-18
4.5	Wire Insulation	4-13	5.2.1	Insulation Clearance	5-19
4.5.1	Clearance	4-13	5.2.2	Insulation Support Crimp	5-20
4.5.2	Postsolder Damage	4-15	5.2.3	Conductor Crimp and Bellmouth	5-21
4.6	Insulation Sleeving	4-16	5.2.4	Cutoff Tabs	5-23
4.7	Soldered Strand Separation (Birdcaging)	4-18	5.3	Machined Contacts	5-24
4.8	Terminals	4-19	5.3.1	Insulation Clearance	5-24
4.8.1	Turrets and Straight Pins	4-22	5.3.2	Insulation Support Style	5-26
4.8.1.1	Lead/Wire Placement	4-22	5.3.3	Conductor	5-27
4.8.1.2	Solder	4-24	5.3.4	Crimping	5-29
4.8.2	Bifurcated	4-25	5.3.5	CMA Buildup	5-31
4.8.2.1	Lead/Wire Placement – Side Route	4-25	5.4	Termination Ferrule Crimp	5-33
4.8.2.2	Lead/Wire Placement – Bottom and Top Route	4-27	5.5	Shrink Sleeving – Wire Support – Crimped Terminals	5-35
4.8.2.3	Lead/Wire Placement – Staked/Constrained Wires	4-29	6.0	Insulation Displacement Connection (IDC)	6-1
4.8.2.4	Solder	4-30	6.1	Mass Termination, Flat Cable	6-2
4.8.3	Slotted	4-32	6.1.1	End Cutting	6-2
4.8.3.1	Lead/Wire Placement	4-32	6.1.2	Notching	6-3
4.8.3.2	Solder	4-33	6.1.3	Planar Ground Plane Removal	6-4
4.8.4	Pierced/Perforated/Punched	4-34	6.1.4	Connector Position	6-5
4.8.4.1	Lead/Wire Placement	4-34	6.1.5	Connector Skew and Lateral Position	6-8
4.8.4.2	Pierced/Perforated/Punched – Solder	4-36	6.1.6	Retention	6-9

Table of Contents (cont.)

6.2	Discrete Wire Termination	6-10	9.2.2	Wire Dress	9-6
6.2.1	General	6-10	9.2.2.1	Straight Approach	9-7
6.2.2	Position of Wire	6-11	9.2.2.2	Side Approach	9-8
6.2.3	Overhang (Extension)	6-12	9.3	Sleeving and Boots	9-9
6.2.4	Insulation Crimp	6-13	9.3.1	Position	9-9
6.2.5	Damage in Connection Area	6-15	9.3.2	Bonding	9-10
6.2.6	End Connectors	6-16	9.4	Connector Damage	9-13
6.2.7	Pass Through Connectors	6-17	9.4.1	Criteria	9-13
6.2.8	Wiremount Connectors	6-18	9.4.2	Limits – Hard Face – Mating Surface	9-14
6.2.9	Subminiature D-Connector (Series Bus Connector)	6-19	9.4.3	Limits – Soft Face – Mating Surface or Rear Seal Area	9-15
6.2.10	Modular Connectors (RJ Type)	6-21	9.4.4	Contacts	9-16
7.0	Ultrasonic Welding	7-1	9.5	Installation of Contacts and Sealing Plugs into Connectors	9-17
7.1	Insulation Clearance	7-1	9.5.1	Installation of Contacts	9-17
7.2	Weld Nugget	7-3	9.5.2	Installation of Sealing Plugs	9-19
8.0	Splices	8-1	10.0	Over-Molding/Potting	10-1
8.1	Soldered Splices	8-1	10.1	Over-Molding	10-2
8.1.1	Mesh	8-2	10.1.1	Mold Fill	10-2
8.1.2	Wrap	8-3	10.1.1.1	Inner	10-2
8.1.3	Hook	8-4	10.1.1.2	Outer	10-5
8.1.4	Lap	8-5	10.1.1.2.1	Mismatch	10-8
8.1.4.1	Two or More Conductors	8-5	10.1.1.2.2	Fit	10-9
8.1.4.2	Insulation Opening (Window)	8-7	10.1.1.2.3	Cracks, Flow Lines, Chill Marks (Knit Lines) or Weld Lines	10-12
8.1.5	Heat Shrinkable Solder Devices	8-8	10.1.1.2.4	Color	10-14
8.2	Crimped Splices	8-10	10.1.2	Blow Through	10-15
8.2.1	Barrel	8-10	10.1.3	Position	10-16
8.2.1.1	Insulation Opening (Window)	8-13	10.1.4	Flashing	10-19
8.2.2	Double Sided	8-14	10.1.5	Wire Insulation, Jacket or Sleeving Damage	10-21
8.2.3	Contact	8-17	10.1.6	Curing	10-22
8.2.4	Wire In-Line Junction Devices (Jiffy Junctions)	8-18	10.2	Potting (Thermoset Molding)	10-23
8.3	Ultrasonic Weld Splices	8-19	10.2.1	Filling	10-23
8.4	Sleeving Over Splices	8-20	10.2.2	Fit to Wire or Cable	10-26
9.0	Connectorization	9-1	10.2.3	Curing	10-28
9.1	Hardware Mounting	9-1	10.3	Over-Molding of Flexible Flat Ribbon	10-29
9.1.1	Jackpost – Height	9-1	10.3.1	Mounting and Alignment Feature Adhesion	10-31
9.1.2	Jackscrews – Protrusion	9-2	10.3.2	Adhesion Between Ribbon and Connector Potting	10-31
9.1.3	Retaining Clips	9-3	10.3.3	Mounting Hardware	10-32
9.1.4	Connector Alignment	9-4	11.0	Measuring Cable Assemblies and Wires	11-1
9.2	Strain Relief	9-5			
9.2.1	Clamp Fit	9-5			

Table of Contents (cont.)

11.1 Measuring – Cable and Wire Length Tolerance	11-1	13.7.1 Soldering	13-15
11.2 Measuring – Cable	11-1	13.7.2 Press Fit	13-16
11.2.1 Reference Surfaces – Straight/Axial Connectors	11-1	13.8 Shield Termination	13-17
11.2.2 Reference Surfaces – Right-Angle Connectors	11-2	13.8.1 Clamped Ground Rings	13-17
11.2.3 Length	11-2	13.8.2 Crimped Ferrule	13-18
11.2.4 Breakout	11-3	13.9 Center Pin	13-20
11.2.4.1 Breakout Measurement Points	11-3	13.9.1 Position	13-20
11.2.4.2 Breakout Length	11-4	13.9.2 Damage	13-21
11.3 Measuring – Wire	11-5	13.10 Semirigid Coax	13-22
11.3.1 Electrical Terminal Reference Location	11-5	13.10.1 Bending and Deformation	13-23
11.3.2 Length	11-6	13.10.2 Surface Condition	13-25
12.0 Marking/Labeling	12-1	13.10.2.1 Solid	13-25
12.1 Content	12-1	13.10.2.2 Conformable Cable	13-27
12.2 Legibility	12-2	13.10.3 Dielectric Cutoff	13-28
12.3 Permanency	12-3	13.10.4 Dielectric Cleanliness	13-30
12.4 Location and Orientation	12-4	13.10.5 Center Conductor Pin	13-31
12.5 Functionality	12-5	13.10.5.1 Point	13-32
12.6 Marker Sleeve	12-6	13.10.5.2 Damage	13-34
12.6.1 Wrap Around	12-6	13.10.6 Semirigid Coax – Solder	13-34
12.6.2 Tubular	12-8	13.11 Swage-Type Connector	13-36
12.7 Flag Markers	12-9	13.12 Soldering and Stripping of Biaxial/Multi-Axial Shielded Wire	13-37
12.7.1 Adhesive	12-9	13.12.1 Jacket and Tip Installation	13-37
12.8 Tie Wrap Markers	12-10	13.12.2 Ring Installation	13-39
13.0 Coaxial and Biaxial Cable Assemblies	13-1	14.0 Securing	14-1
13.1 Stripping	13-1	14.1 Tie Wrap/Lacing Application	14-1
13.2 Center Conductor Termination	13-4	14.1.1 Tightness	14-6
13.2.1 Crimp	13-4	14.1.2 Damage	14-7
13.2.2 Solder	13-6	14.1.3 Spacing	14-7
13.3 Solder Ferrule Pins	13-8	14.2 Breakouts	14-8
13.3.1 General	13-8	14.2.1 Individual Wires	14-8
13.3.2 Insulation	13-10	14.2.2 Spacing	14-9
13.4 Coaxial Connector – Printed Wire Board Mount	13-11	14.3 Routing	14-12
13.5 Coaxial Connector – Center Conductor Length – Right Angle Connector	13-12	14.3.1 Wire Crossover	14-12
13.6 Coaxial Connector – Center Conductor Solder	13-13	14.3.2 Bend Radius	14-13
13.7 Coaxial Connector – Terminal Cover	13-15	14.3.3 Coaxial Cable	14-14
		14.3.4 Unused Wire Termination	14-15
		14.3.4.1 Shrink Sleeving	14-15
		14.3.4.2 Flexible Sleeving	14-16
		14.3.5 Ties over Splices and Ferrules	14-16
		14.4 Broom Stitching	14-17
		15.0 Harness/Cable Electrical Shielding	15-1

Table of Contents (cont.)

15.1 Braided	15-1	17.2.1.1 Minimum Torque	17-5
15.1.1 Direct Applied	15-2	17.2.2 Wires	17-7
15.1.2 Prewoven	15-4	17.2.2.1 Solid Wires	17-8
15.2 Shield Termination	15-5	17.2.2.2 Stranded Wires	17-10
15.2.1 Shield Jumper Wire	15-5	17.2.3 Safety Wiring	17-11
15.2.1.1 Attached Lead	15-5	17.2.4 Safety Cable	17-13
15.2.1.1.1 Solder	15-6	17.3 Wire/Harness Installation	17-14
15.2.1.1.2 Crimp	15-10	17.3.1 Stress Relief	17-14
15.2.1.2 Shield Braid	15-11	17.3.2 Wire Dress	17-15
15.2.1.2.1 Woven	15-11	17.3.3 Service Loops	17-16
15.2.1.2 Combed and Twisted	15-11	17.3.4 Clamping	17-17
15.2.1.3 Daisy Chain	15-12	17.3.5 Tie Wrap/Lacing	17-17
15.2.1.4 Common Ground Point	15-12	17.3.6 Raceways	17-18
15.2.2 Unterminated Shield	15-13	17.3.7 Grommets	17-19
15.2.2.1 Shield Not Folded Back	15-13	17.3.7.1 Sealing Not Required	17-19
15.2.2.2 Shield Folded Back	15-14	17.3.7.2 Sealing Required	17-20
15.3 Shield Termination – Connector	15-15	18.0 Solderless Wrap	18-1
15.3.1 Shrink	15-15	19.0 Testing	19-1
15.3.2 Crimp	15-17	19.1 Nondestructive Tests	19-1
15.3.3 Shield Jumper Wire Attachment	15-19	19.2 Testing After Rework or Repair	19-1
15.3.4 Soldered	15-20	19.3 Intended Table Usage	19-1
15.4 Shield Termination – Splicing Prewoven	15-20	19.4 Electrical Test	19-2
15.4.1 Soldered	15-21	19.4.1 Selection	19-2
15.4.2 Tie/Tape On	15-23	19.5 Electrical Test Methods	19-3
15.5 Tapes – Barrier and Conductive, Adhesive or Non-Adhesive	15-24	19.5.1 Continuity	19-3
15.6 Conduit (Shielding)	15-25	19.5.2 Shorts	19-4
15.7 Shrink Tubing – Conductive Lined	15-26	19.5.3 Dielectric Withstanding Voltage (DWV) ..	19-5
16.0 Cable/Wire Harness Protective Coverings	16-1	19.5.4 Insulation Resistance (IR)	19-6
16.1 Braid	16-1	19.5.5 Voltage Standing Wave Ratio (VSWR) ...	19-7
16.1.1 Direct Applied	16-1	19.5.6 Insertion Loss	19-7
16.1.2 Prewoven	16-3	19.5.7 Reflection Coefficient	19-8
16.2 Sleeve/Shrink Tubing	16-5	19.5.8 User Defined	19-8
16.2.1 Sealant	16-6	19.6 Mechanical Test	19-9
16.3 Spiral Plastic Wrap (Spiral Wrap Sleeve)	16-7	19.6.1 Selection	19-9
16.4 Wire Loom Tubing – Split and Unsplit	16-8	19.7 Mechanical Test Methods	19-10
16.5 Tapes, Adhesive and Non-Adhesive	16-8	19.7.1 Crimp Height (Dimensional Analysis) ...	19-10
17.0 Finished Assembly Installation	17-1	19.7.1.1 Terminal Positioning	19-11
17.1 General	17-1	19.7.2 Pull Force (Tensile)	19-12
17.2 Hardware Installation	17-2	19.7.2.1 Without Documented Process Control ...	19-13
17.2.1 Threaded Fasteners	17-3	19.7.3 Crimp Force Monitoring	19-17
		19.7.4 Crimp Tool Qualification	19-17
		19.7.5 Contact Retention Verification	19-17

Table of Contents (cont.)

19.7.6	RF Connector Shield Pull Force (Tensile)	19-18
19.7.7	RF Connector Shield Ferrule Torsion . . .	19-19
19.7.8	User Defined	19-19
20.0	High Voltage Applications	20-1
Appendix A	Terms and Definitions	A-1
Appendix B	Reproducible Test Tables	B-1
Appendix C	Guidelines for Soldering Tools and Equipment	C-1
Appendix D	X-Ray Guidelines	D-1

Tables

Table 1-1	Magnification Aid Applications – Wire and Wire Connections	1-5
Table 1-2	Magnification Aid Applications – Other. . .	1-6
Table 3-1	Allowable Strand Damage	3-3
Table 4-1	Maximum Limits of Solder Bath Contaminant	4-2
Table 4-2	Solder Connection Anomalies	4-10
Table 4-3	Turret or Straight Pin Terminal Lead/Wire Placement	4-22
Table 4-4	Bifurcated Terminal Lead/Wire Placement – Side Route.	4-25
Table 4-5	Bifurcated Terminal Lead/Wire Placement – Bottom Route	4-27
Table 4-6	Staking Requirements of Side Route Straight Through Connections – Bifurcated Terminals	4-29
Table 4-7	Pierced/Perforated/Punched Terminal Lead/Wire Placement	4-34
Table 4-8	Hook Terminal Lead/Wire Placement. . .	4-37
Table 4-9	AWG 30 and Smaller Wire Wrap Requirements	4-44
Table 11-1	Cable/Wire Length Measurement Tolerance.	11-1
Table 13-1	Coaxial and Biaxial Shield and Center Conductor Damage.	13-1
Table 13-2	Semirigid Coax Deformation	13-24
Table 13-3	Dielectric Cutoff.	13-28
Table 14-1	Minimum Bend Radius Requirements . .	14-13
Table 17-1	Minimum Swaged Ferrule Pull-Off Load	17-13
Table 19-1	Electrical Test Requirements	19-3

Table 19-2	Continuity Test Minimum Requirements	19-4
Table 19-3	Shorts Test (low voltage isolation) Minimum Requirements.	19-5
Table 19-4	Dielectric Withstanding Voltage Test (DWV) Minimum Requirements	19-6
Table 19-5	Insulation Resistance (IR) Test Minimum Requirements	19-7
Table 19-6	Voltage Standing Wave Ratio (VSWR) Test Parameters.	19-8
Table 19-7	Insertion Loss Test Parameters.	19-8
Table 19-8	Reflection Coefficient Test Parameters . .	19-9
Table 19-9	Mechanical Test Requirements.	19-10
Table 19-10	Crimp Height Testing	19-11
Table 19-11	Pull Force Testing Minimum Requirements	19-14
Table 19-12	Pull Test Force Values.	19-15
Table 19-13	Pull Test Force Values (Classes 1 & 2) For UL, SAE, GM and Volvo	19-16
Table 19-14	Pull Test Force Values (Classes 1 & 2) For IEC.	19-17
Table 19-15	RF Connector Shield Pull Force Testing.	19-19
Table A-1	Electrical Clearance	A-2
Table 19-1	Electrical Test Requirements	B-2
Table 19-2	Continuity Test Minimum Requirements . .	B-3
Table 19-3	Shorts Test (low voltage isolation) Minimum Requirements.	B-4
Table 19-4	Dielectric Withstanding Voltage Test (DWV) Minimum Requirements	B-5
Table 19-5	Insulation Resistance (IR) Test Minimum Requirements	B-6
Table 19-6	Voltage Standing Wave Ratio (VSWR) Test Parameters.	B-7
Table 19-7	Insertion Loss Test Parameters.	B-8
Table 19-8	Reflection Coefficient Test Parameters . .	B-9
Table 19-9	Mechanical Test Requirements.	B-10
Table 19-10	Crimp Height Testing	B-11
Table 19-11	Pull Force Testing Minimum Requirements	B-12
Table 19-15	RF Connector Shield Pull Force Testing.	B-13

1.0 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. For X-ray guidelines, see Appendix D X-Ray Guidelines.

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. 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 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) [foot-candles] 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 words “**shall**” or “**shall not**” are 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 words “**shall**” or “**shall not**” indicates a requirement for at least one Class, the requirements for each Class are in brackets next to the “**shall**” or “**shall not**” requirement.

N = No requirement has been established for this Class

A = Acceptable

P = Process Indicator

D = Defect

Examples:

[A1P2D3] is Acceptable Class 1, Process Indicator Class 2 and Defect Class 3

[N1D2D3] is Requirement Not Established Class 1, Defect Classes 2 and 3

1.0 General (cont.)

[A1A2D3] is Acceptable Classes 1 and 2, Defect Class 3

[D1D2D3] is Defect for all Classes.

Unless specifically stated otherwise, a defect for a Class 1 product means that the characteristic is also a defect for Class 2 and 3. A defect for a Class 2 product means that the characteristic is also a defect for a Class 3 product, but may not be a defect for a Class 1 product where less demanding criteria may apply.

The word “should” reflects recommendations and is used to reflect general industry practices and procedures for guidance only.

Many of the examples (figures) shown are grossly exaggerated to clearly depict the condition being described. Line drawings and illustrations are depicted herein to assist in the interpretation of the written requirements of this standard, many of these examples (figures) are grossly exaggerated to clearly depict the condition being described.

In the case of a discrepancy, the written description or written criteria always takes precedence over the illustrations.

1.5.1 Inspection Conditions The inspector **shall not [D1D2D3]** select the Product Class for the assembly under inspection. Documentation that specifies the applicable Class for the assembly under inspection **shall [D1D2D3]** be provided to the inspector. Criteria are given for each Product Class in three conditions: Acceptable, Defect or Process Indicator.

1.5.1.1 Acceptable This characteristic indicates a condition that, while not necessarily perfect, will maintain the integrity and reliability of the assembly in its service environment.

1.5.1.2 Defect A defect is a condition that fails to meet the acceptance criteria of this document or negatively affects the form, fit or function of the assembly in its end use environment. The Manufacturer **shall [N1D2D3]** document and disposition each defect.

It is the responsibility of the Manufacturer to identify defects that are unique to the assembly process. It is the responsibility of the User to define unique defect categories applicable to the product.

1.5.1.2.1 Disposition Disposition is the determination of how defects should be treated. Dispositions include, but are not limited to, rework, use as is, scrap or repair.

User concurrence **shall [N1D2D3]** be required for use as is and **shall [N1N2D3]** be required for repair dispositions.

1.5.1.3 Process Indicator A process indicator is a condition that identifies a characteristic that does not affect the form, fit, function or reliability of a product. A process indicator is not a defect.

- Such condition is a result of material, design and/or operator/machine related causes that create a condition that neither fully meets the acceptance criteria nor is a defect.
- Process indicators should be monitored as part of the process control system. If the number of process indicators indicates an abnormal variation in the process, identifies an undesirable trend, or displays other conditions that indicate the process is (or is approaching) out of control, the process should be analyzed. This may result in action to reduce the variation and improve yields.
- Disposition of individual process indicators is not required and affected product should be used as is.
- Not all process indicators are specified by this standard.
- It is the responsibility of the Manufacturer to identify process indicators that are unique to the assembly process.

1.5.1.4 Conditions Not Specified Conditions that are not specified are considered acceptable unless it can be established that the condition affects end user defined form, fit, function or reliability.

1.5.1.5 Uncommon or Specialized Designs IPC/WHMA-A-620, as an industry consensus document, cannot address all of the possible product design combinations. However, the standard does provide criteria for commonly used technologies. Where uncommon or specialized technologies are used, it may be necessary to develop unique acceptance criteria. The development should include User involvement. The acceptance criteria **shall [N1N2D3]** have User agreement. Requirements for specialized processes and/or technologies not specified herein **shall [N1D2D3]** be performed in accordance with documented procedures which are available for review.

Whenever possible, new criteria or criteria on specialized products should be submitted, using the Standard Improvement Form included in this standard, to the IPC Technical Committee to be considered for inclusion in upcoming revisions of this standard.