National Aeronautics and
Space Administration

MSFC-STD-3425
BASELINE
December 12, 2006

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EI42

MULTIPROGRAM/PROJECT COMMON-USE DOCUMENT

Design Standard for Rigid Printed Circuit Boards and Assemblies

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DOCUMENT HISTORY LOG

Status (Baseline/ Revision/ Canceled)	Document Revision	Effective Date	Description
Baseline	-	12/12/06	Baseline Release

FORWARD

This standard sets forth MSFC tailoring requirements for both the IPC-2221A and IPC-2222 documents. These requirements shall be invoked by drawings and specifications for flight hardware and critical support equipment.

1. SCOPE/PURPOSE

This process standard establishes Marshall Space Flight Center (MSFC) exceptions to the use of the IPC-2221A and IPC-2222 requirements for the design of rigid printed boards and assemblies. This standard is intended for use on contracts and for in-house work.

2. APPLICABLE DOCUMENTS

IPC-2221A "Generic Standard on Printed Wiring Board Design"

IPC-2222 "Sectional Design Standard for Rigid Organic Printed Boards"

3. DEFINITIONS/ACRONYMS

3.1 Classification of Printed Wiring Boards.

a. Type 1 – Single-sides board
b. Type 2 – Double-sided board
c. Type 3 – Multilayer board without blind or buried vias
d. Type 4 – Multilayer board with blind or buried vias
e. Type 5 – Multilayer metal-core board without blind or buried vias
f. Type 6 – Multilayer metal-core board with blind and/or buried vias

4. PROCESS VERIFICATION

All rigid printed board designs shall comply with IPC-2221A and IPC-2222 using a Performance Class of 3, "High Reliability Electronic Products". Exceptions to these two documents are detailed in this section.

4.1 Exceptions to IPC 2221A

Requirement Attribute	IPC 2221A Section	MSFC Exception	Remarks
Presentation	1.3	Preferred design units are English	The units shall be given in English with hard metric

			units in parentheses.
Requirement Attribute	**IPC 2221A Section**	**MSFC Exception**	**Remarks**
Performance Class	1.6.2	Performance class shall be IPC Class 3, "High Reliability Electronic Products	All flight hardware designed by MSFC is to Class 3 requirements.
Parts List	3.4	End item identifiable items shall appear in a parts list separate from the face of the drawing.	Placement of parts list on face of drawing conflicts with MSFC-STD-555.
Material Selection	4.1	All materials used in vacuum or low-pressure compartments shall not release greater than 1.0 percent total mass loss (TML) or 0.1 percent collected volatile condensable material (CVCM) when tested in accordance with ASTM-E-595. Materials used shall be subjected to NASA approval. All material shall be selected to conform to the project contamination control requirements plan.	Outgassing concern for all Class 3 flight hardware.
Conductive Materials	4.4	Modify Table 4-3 as follows. Remove references to following material codes; TLU, N, NB, ENIG, IT.	These finishes are not applicable to space flight hardware.
Solder Resist (Solder Mask) Coatings	4.5.1	Vias connected to pads (i.e., interstitial BGA vias) shall be isolated from the pad by either plating closed, filling with a polymer or conductive epoxy, or tenting by solder mask.	This addition will prohibit solder mask dams for BGA vias and will ensure that solder does not flow thru vias.
Conformal Coatings	4.5.2	Replace reference to IPC-CC-830 with J-STD-001DS.	New standard for staking and conformal coating.
Bow and Twist	5.2.4	Maximum bow and twist shall be **0.50%** for boards that use surface mount components and 1.5% for all other board technologies.	This requirement needs to be consistent with the IPC-6012 specification, which calls for 0.50% max for SMT boards.

Requirement Attribute	IPC 2221A Section	MSFC Exception	Remarks
Dimensions and Tolerances	5.4.1	All dimensions and tolerances shall be per ASME Y14.5M-1994.	This a standard note that is added to face of drawing.
Conductive Material Requirements	6.2	Use 20 degree rise line in Figure 6-4 when determining current carrying capacity and sizing for copper conductors.	Not specific as is.
Automatic Assembly	8.1.1	Automatic insertion is not allowed for through hole parts	
Component Mounting Techniques for Shock and Vibration	8.1.9.1	Axial-leaded components weighing 5 grams or more per lead shall be secured to the board such that the solder joints are not the only means of mechanical support.	
Stress Relief	8.1.11	Remove phrase "When designing for stress relief,".	All design involves stress relief, not just for certain cases.
Terminal Mounting – Mechanical	8.2.9.1	Swage type terminals that are mounted in a Plated Through Hole (PTH) shall be secured to the PWB by a V-funnel swage or an elliptical funnel swage. The elliptical funnel swage is the preferred method of attachment.	Requirement per NASA-STD-8739.3, to ensure proper solder flow into the hole.
Eyelets	8.2.10	Eyelets shall not be used flight hardware .	
Jumper Wires	8.2.11.1	Jumper wires shall be staked every 2.54 cm (1 inch), at a minimum, and at every change of direction outside of the radius of curvature.	
Annular Ring	9.1.2	Unsupported holes – 0.015 in [0.38 mm] minimum Internal/External Plated-Through Holes – 0.002 in [0.051 mm] minimum	Requirement per IPC-6012.
Requirement	**IPC**	**MSFC Exception**	**Remarks**

Attribute	2221A Section		
Aspect Ratio	9.2.8	Aspect Ratio (AR) shall not exceed 8:1	An AR of 6:1 or less is preferred.
Conductor Width and Thickness	10.1.1	Conductor width and spacing shall not be less than 0.004 inches	Difficult to manufacture, drives up costs.
Conductor Spacing	10.1.4	Conductor spacing shall not be less than 0.005 inches	Difficult to manufacture, drives up costs.
Documentation	11	IPC-D-325 shall be used for reference document only. The printed board documentation shall meet the requirements of MSFC-STD-555.	MSFC-STD-555 is currently levied against all documentation that will be released to the MSFC repository.

4.2 Exceptions to IPC-2222

There are no exceptions levied against the IPC-2222 specification.