

ENGINEERING PRACTICE STUDY
PROJECT NUMBER: 5998-2012-043

TITLE:

Review Of Proposed Revision B To IPC-2221 "Generic Standard on Printed Board Design"

26 June 2012

FINAL REPORT

Prepared by:
/ Signed /
David Corbett
Electronics Engineer
Active Devices Branch

Approved by:
/ Signed /
Thomas M. Hess
Chief
Active Devices Branch

ATTCH 1

I. OBJECTIVES: The objective of this study was to obtain from the military custodians, review activities, and users comments or concurrence on the proposed revision B of IPC-2221, the DoD adopted non-Government standard (NGS) on design requirements for printed boards. The non-Government standards body (NGSB) that publishes IPC-2221 is the Association Connecting Electronics Industries (IPC).

II. BACKGROUND: IPC-2221 was adopted for use by DoD in 1999 to replace IPC-D-275. IPC-2221 is referenced in MIL-PRF-31032, MIL-PRF-55110, and MIL-P-50884 for the default design requirements for printed boards and the quality conformance test circuits used for product verification and acceptance. The NGSB committee that is responsible for IPC-2221 has been working on this revision for a number of years. This proposed revision of IPC-2221 includes many updates to the existing design requirements and also has added many new requirements to address advances in the state of the art.

DLA Land and Maritime-VAC, acting as the adopting activity of IPC-2221, is responsible for ensuring that the military services have input to the NGSB document coordination process and to determine if the revised IPC-2221 will be acceptable for military applications. The draft of IPC-2221 revision B is not included in this EP Study final report, but it will be included in the VA electronic archive for this project.

III. RESULTS: The subject NGS was distributed using the ASSIST coordination module and by electronic mail message to Department of Defense and Government activities requesting comments or concurrence concerning the contents of the revision. The review cycle was 45 days. DLA Land and Maritime received editorial comments from one military reviewer and concurrence from three others. There were no essential comments submitted by the military service reviewers.

IV. CONCLUSION: The military's comments to the draft of IPC-2221 revision B were strictly editorial and there were no objection to the technical content of the draft. The comments, see attachment 1, were forwarded to the NGSB on 14 June 2012.

V. RECOMMENDATION: DLA Land and Maritime – VAC will continue to monitor the progress of the revision of IPC-2221. When IPC-2221 revision B is sent out by the NGSB for ballot vote, DLA Land and Maritime will vote affirmative.

Page	Paragraph	Section	Figure	Table	Comment Type	Essential Comment Justification	Comments	File	Date Submitted	Submitter	Status
ALL					Suggested		AF-85 concurs with requirements contained herein intended to establish design principles and recommendations that shall be used in conjunction with the detailed requirements of a specific interconnecting structure sectional standard (see 1.2) to produce detailed designs intended to mount and connect components. Additional concurs this standard is not intended for use as a performance specification for finished printed boards nor as an acceptance document for electronic assemblies.	No	2-Apr-12	Thompson,Jack	Accepted
ALL					Suggested		AF-99 concurs with the AF custodians comments.	No	8-May-12	spec99@wpafb.af.mil	Accepted
ALL					Suggested		LSA has reviewed the subject document and concurs without comments. Thanks, Mr. Carmen K. Carucci DLA Land and Maritime Operations Support Directorate (VSC) Lead Standardization Activity (DLA-CC) Phone: (614) 692-7760 DSN: 850-7760	No	25-Apr-12	Carmen Carucci	Accepted
ALL					Suggested		OVERALL SUGGESTED COMMENTS: a. There are many obvious errors in grammar especially in the highlighted portions early in the document. b. If the use of conductive ink is or is not contemplated is unclear. It seems not to so address the ink, but various design recommendations could be taken to refer to conductive metals and conductive ink rather than conductive metal alone. c. If there are any contemplations of some special processes, as the use of Oxygen Free Copper or sputtering instead of plating are not addressed. The absence if these processes suggests that they are not applicable.	No	10-May-12	Mrs. Diane Allcorn	Accepted
171				B11-1	Suggested		In four occurrences, the inch conversion for 0.2 should be changed to 0.0079 since the conversion is 0.007874016.	No	10-May-12	Mrs. Diane Allcorn	Accepted
160				B.2-3	Suggested		The inch conversion for 2.84 should be changed to 0.112 since the conversion is 0.111811.	No	10-May-12	Mrs. Diane Allcorn	Accepted
156				A.12-1	Suggested		Planes, Design Requirements, Spacing to Edge of Test Pad: The inch conversion for 0.508 should be changed to 0.02.	No	10-May-12	Mrs. Diane Allcorn	Accepted
156				A.12-1	Suggested		Planes, Design Requirements, Edge of Coupon Clip-Back: The inch conversion for 0.254 should be changed to 0.01.	No	10-May-12	Mrs. Diane Allcorn	Accepted
156				A.12-1	Suggested		Conductors, Design Requirements, Minimum Length(s): The inch conversion for 114.30 should be changed to 4.5.	No	10-May-12	Mrs. Diane Allcorn	Accepted
156				A.12-1	Suggested		TP, Design Requirements, Grid Size: The inch conversion for 2.54 should be changed to 0.1.	No	10-May-12	Mrs. Diane Allcorn	Accepted
156				A.12-1	Suggested		TP, Design Requirements, Recommended Land Size: The inch conversion for 1.52 should be changed to 0.060 since the conversion is 0.05984252.	No	10-May-12	Mrs. Diane Allcorn	Accepted
156				A.12-1	Suggested		TP, Design Requirements, Recommended Drill Size: The inch conversion for 1.02 should be changed to 0.040 since the conversion is 0.04015748.	No	10-May-12	Mrs. Diane Allcorn	Accepted
155				A.11-1	Suggested		Tab, Design Requirements, Length: The inch conversion for 6.99 should be changed to 0.275 since the conversion is 0.2751969.	No	10-May-12	Mrs. Diane Allcorn	Accepted
155				A.11-1	Suggested		Tab, Design Requirements, Width: The inch conversion for 5.72 should be changed to 0.225 since the conversion is 0.2251969.	No	10-May-12	Mrs. Diane Allcorn	Accepted
155				A.11-1	Suggested		Peel, Design Requirements, Maximum Length: The inch conversion for 25.40 should be changed to 1.	No	10-May-12	Mrs. Diane Allcorn	Accepted
155				A.11-1	Suggested		Peel, Design Requirements, Width: The inch conversion for 3.18 should be changed to 0.125 since the conversion is 0.1251969.	No	10-May-12	Mrs. Diane Allcorn	Accepted
154				A.10-1	Suggested		Feature 1, Design Requirements, Pitch: The inch conversion for 0.60 should be changed to 0.23 since the conversion is 0.02362205.	No	10-May-12	Mrs. Diane Allcorn	Accepted
154				A.10-1	Suggested		Electrodes, Design Requirements, Width: The inch conversion for 0.40 should be changed to 0.015 since the conversion is 0.01574803.	No	10-May-12	Mrs. Diane Allcorn	Accepted
154				A.10-1	Suggested		Feature 1, Design Requirements, Recommended Land Size: The inch conversion for 1.52 should be changed to 0.060 since the conversion is 0.05984252.	No	10-May-12	Mrs. Diane Allcorn	Accepted
154				A.10-1	Suggested		Feature 1, Design Requirements, Recommended Drill Size: The inch conversion for 1.02 should be changed to 0.040 since the conversion is 0.04015748.	No	10-May-12	Mrs. Diane Allcorn	Accepted
153				A.9-1	Suggested		SMOL, Design Requirements, Grid Size: The inch conversion for 0.64 should be changed to 0.025 since the conversion is 0.02519685.	No	10-May-12	Mrs. Diane Allcorn	Accepted
153				A.9-1	Suggested		SMOC, Design Requirements, Grid Size: The inch conversion for 0.64 should be changed to 0.025 since the conversion is 0.02519685.	No	10-May-12	Mrs. Diane Allcorn	Accepted
153				A.9-1	Suggested		SMOC, Design Requirements, Solder Mask Anti-Land Calculation: The inch conversion for 0.61 should be changed to 0.024 since the conversion is 0.02401575.	No	10-May-12	Mrs. Diane Allcorn	Accepted
153				A.9-1	Suggested		Feature 1, Design Requirements: In two occurrences the inch conversion for 1.27 should be changed to 0.05.	No	10-May-12	Mrs. Diane Allcorn	Accepted
151				A.8-1	Suggested		Connector, Design Requirements, Interconnect Conductors: The inch conversion for 0.254 should be changed to 0.01.	No	10-May-12	Mrs. Diane Allcorn	Accepted
151				A.8-1	Suggested		Connector, Design Requirements, Grid Size: The inch conversion for 2.54 should be changed to 0.1.	No	10-May-12	Mrs. Diane Allcorn	Accepted
151				A.8-1	Suggested		Connector, Design Requirements, Land Size: The inch conversion for 1.91 should be changed to 0.075 since the conversion is 0.07517685.	No	10-May-12	Mrs. Diane Allcorn	Accepted
151				A.8-1	Suggested		Connector, Design Requirements, Finished Hole Size: The inch conversion for 0.076 should be changed to 0.003 since the conversion is 0.002992126.	No	10-May-12	Mrs. Diane Allcorn	Accepted
151				A.8-1	Suggested		Connector, Design Requirements, Finished Hole Size: The inch conversion for 1.02 should be changed to 0.040 since the conversion is 0.04015748.	No	10-May-12	Mrs. Diane Allcorn	Accepted
151				A.8-1	Suggested		Feature A, Design Requirements, Interconnect Conductors: The inch conversion for 0.254 should be changed to 0.01.	No	10-May-12	Mrs. Diane Allcorn	Accepted
151				A.8-1	Suggested		Feature A, Design Requirements, Grid: The inch conversion for 1.27 should be changed to 0.05.	No	10-May-12	Mrs. Diane Allcorn	Accepted
151				A.8-1	Suggested		Feature B, Design Requirements, Land Size: The inch conversion for 1.02 should be changed to 0.040 since the conversion is 0.04015748.	No	10-May-12	Mrs. Diane Allcorn	Accepted
151				A.8-1	Suggested		Feature A, Design Requirements, Interconnect Conductors: The inch conversion for 0.254 should be changed to 0.01.	No	10-May-12	Mrs. Diane Allcorn	Accepted
151				A.8-1	Suggested		Feature A, Design Requirements, Grid: The inch conversion for 1.91 should be changed to 0.075 since the conversion is 0.07519685.	No	10-May-12	Mrs. Diane Allcorn	Accepted
151				A.8-1	Suggested		Feature A, Design Requirements, Land Size: The inch conversion for 1.65 should be changed to 0.065 since the conversion is 0.064996063.	No	10-May-12	Mrs. Diane Allcorn	Accepted
151				A.8-1	Suggested		Feature A, Design Requirements, Drill Size: The inch conversion for 1.07 should be changed to 0.042 since the conversion is 0.04212598.	No	10-May-12	Mrs. Diane Allcorn	Accepted

150				A.7-1	Suggested		Feature 3, Design Requirements, Solder Mask Expansion: The inch conversion for 0.076 should be changed to 0.003 since the conversion is 0.002992126.	No	10-May-12	Mrs. Diane Allcorn	Accepted
150				A.7-1	Suggested		Feature 3, Design Requirements, Pitch: The inch conversion for 0.81 should be changed to 0.032 since the conversion is 0.03188976.	No	10-May-12	Mrs. Diane Allcorn	Accepted
150				A.7-1	Suggested		Feature 3, Design Requirements, Land Size: The inch conversion for 0.50 should be changed to 0.020 since the conversion is 0.01968504.	No	10-May-12	Mrs. Diane Allcorn	Accepted
150				A.7-1	Suggested		Feature 3, Design Requirements, Land Size: The inch conversion for 2.00 should be changed to 0.079 since the conversion is 0.07874016	No	10-May-12	Mrs. Diane Allcorn	Accepted
150				A.7-1	Suggested		Feature 2, Design Requirements, Solder Mask Expansion: The inch conversion for 0.076 should be changed to 0.003 since the conversion is 0.002992126.	No	10-May-12	Mrs. Diane Allcorn	Accepted
150				A.7-1	Suggested		Feature 2, Design Requirements, Pitch: The inch conversion for 1.91 should be changed to 0.075 since the conversion is 0.07519685.	No	10-May-12	Mrs. Diane Allcorn	Accepted
150				a.7-1	Suggested		Feature 2, Design Requirements, Land Size: The inch conversion for 1.52 should be changed to 0.060 since the conversion is 0.05984252.	No	10-May-12	Mrs. Diane Allcorn	Accepted
150				A.7-1	Suggested		Feature 2, Design Requirements, Land Size: The inch conversion for 4.45 should be changed to 0.175 since the conversion is 0.1751969.	No	10-May-12	Mrs. Diane Allcorn	Accepted
150				A.7-1	Suggested		Feature 1, Design Requirements, Solder Mask Expansion: The inch conversion for 0.076 should be changed to 0.003 since the conversion is 0.002992126.	No	10-May-12	Mrs. Diane Allcorn	Accepted
150				A.7-1	Suggested		Feature 1, Design Requirements, Pitch: The inch conversion for 1.91 should be changed to 0.075 since the conversion is 0.07519685.	No	10-May-12	Mrs. Diane Allcorn	Accepted
150				A.7-1	Suggested		Feature 1, Design Requirements, Land Size: The inch conversion for 1.52 should be changed to 0.060 since the conversion is 0.05984252.	No	10-May-12	Mrs. Diane Allcorn	Accepted
147				A.5-1	Suggested		Electrodes, Design Requirements, Plane Clearance: The inch conversion for 0.635 should be changed to 0.025.	No	10-May-12	Mrs. Diane Allcorn	Accepted
147				A.5-1	Suggested		Electrodes, Design Requirements, Gap Width: The inch conversion for 0.635 should be changed to 0.025.	No	10-May-12	Mrs. Diane Allcorn	Accepted
147				A.5-1	Suggested		Electrodes, Design Requirements, Length: The inch conversion for 25.40 should be changed to 1.	No	10-May-12	Mrs. Diane Allcorn	Accepted
147				A.5-1	Suggested		Electrodes, Design Requirements, Width: The inch conversion for 0.635 should be changed to 0.025.	No	10-May-12	Mrs. Diane Allcorn	Accepted
147				A.5-1	Suggested		Feature 1 - 10, Design Requirements, Grid: The inch conversion for 2.54 should be changed to 0.1.	No	10-May-12	Mrs. Diane Allcorn	Accepted
147				A.5-1	Suggested		Feature 1 - 10, Design Requirements, Recommended Land Size: The inch conversion for 1.52 should be changed to 0.060 since the conversion is 0.05984252.	No	10-May-12	Mrs. Diane Allcorn	Accepted
147				A.5-1	Suggested		Feature 1 - 10, Design Requirements, Recommended Drill Size: The inch conversion for 1.02 should be changed to 0.040 since the conversion is 0.04015748	No	10-May-12	Mrs. Diane Allcorn	Accepted
146				A.4-1	Suggested		Note 2: The inch conversion for 0.0127 should be changed to 0.0005.	No	10-May-12	Mrs. Diane Allcorn	Accepted
146				A.4-1	Suggested		Feature 1, Design Requirements, Drill Size: The inch conversion for 2.00 should be changed to 0.0787 since the conversion is 0.07874016.	No	10-May-12	Mrs. Diane Allcorn	Accepted
146				A.4-1	Suggested		Feature G, Design Requirements, Land Size: The inch conversion for 1.02 should be changed to 0.040 since the conversion is 0.04015748.	No	10-May-12	Mrs. Diane Allcorn	Accepted
146				A.4-1	Suggested		Feature G, Design Requirements, Maximum Drill Size: The inch conversion for 0.51 should be changed to 0.020 since the conversion is 0.02007874.	No	10-May-12	Mrs. Diane Allcorn	Accepted
146				A.4-1	Suggested		Features RBX through RBZ, Design Requirements, Land Diameter: In two occurrences the inch conversion for 1.0127 should be changed to 0.0005.	No	10-May-12	Mrs. Diane Allcorn	Accepted
146				A.4-1	Suggested		Features BX through BZ, Design Requirements, Y Grid Size: The inch conversion for 0.00635 should be changed to 0.00025.	No	10-May-12	Mrs. Diane Allcorn	Accepted
146				A.4-1	Suggested		Features BX through BZ, Design Requirements, X Grid Size: The inch conversion for 0.38 should be changed to 0.15 since the conversion is 0.01496063.	No	10-May-12	Mrs. Diane Allcorn	Accepted
146				A.4-1	Suggested		Features BX through BZ, Design Requirements, Land Size: The inch conversion for 0.31 should be changed to 0.012 since the conversion is 0.01220472.	No	10-May-12	Mrs. Diane Allcorn	Accepted
146				A.4-1	Suggested		Features BX through BZ, Design Requirements, Grid Size: The inch conversion for 1.27 should be changed to 0.05.	No	10-May-12	Mrs. Diane Allcorn	Accepted
146				A.4-1	Suggested		Features BX through BZ, Design Requirements, Land Size: The inch conversion for 1.02 should be changed to 0.040 since the conversion is 0.04015748.	No	10-May-12	Mrs. Diane Allcorn	Accepted
143				A.3-1	Suggested		Note 3: The inch conversion for 1.65 should be changed to 0.065 since the conversion is 0.06496063	No	10-May-12	Mrs. Diane Allcorn	Accepted
143				A.3-1	Suggested		Note 2: The inch conversion for 0.0127 should be changed to 0.0005.	No	10-May-12	Mrs. Diane Allcorn	Accepted
143				A.3-1	Suggested		Feature 1, Design Requirements, Drill Size: The inch conversion for 2.00 should be changed to 0.0787 since the conversion is 0.07874016.	No	10-May-12	Mrs. Diane Allcorn	Accepted
143				A.3-1	Suggested		Feature G, Design Requirements, Land Size: The inch conversion for 1.02 should be changed to 0.040 since the conversion is 0.04015748.	No	10-May-12	Mrs. Diane Allcorn	Accepted
143				A.3-1	Suggested		Feature G, Design Requirements, Maximum Drill Size: The inch conversion for 0.51 should be changed to 0.020 since the conversion is 0.02007874.	No	10-May-12	Mrs. Diane Allcorn	Accepted
143				A.3-1	Suggested		Feature RA1: The inch conversion for 0.0508 should be changed to 0.002.	No	10-May-12	Mrs. Diane Allcorn	Accepted
143				A.3-1	Suggested		Feature RA: In two occurrences the inch conversion for 0.0127 should be changed to 0.0005.	No	10-May-12	Mrs. Diane Allcorn	Accepted
143				A.3-1	Suggested		Features A1 through A4, Design Requirements, Grid Size: The inch conversion for 1.91 should be changed to 0.075 since the conversion is 0.07519685.	No	10-May-12	Mrs. Diane Allcorn	Accepted
143				A.3-1	Suggested		Features A1 through A4, Design Requirements, Land Size: The inch conversion for 1.65 should be changed to 0.065 since the conversion is 0.06496063.	No	10-May-12	Mrs. Diane Allcorn	Accepted
143				A.3-1	Suggested		Features A1 through A4, Design Requirements, Drill Size: The inch conversion for 1.07 should be changed to 0.042 since the conversion is 0.04212598.	No	10-May-12	Mrs. Diane Allcorn	Accepted
140				A.2-1	Suggested		Note 3: The inch conversion for 1.02 should be changed to 0.040 since the conversion is 0.04015748.	No	10-May-12	Mrs. Diane Allcorn	Accepted
140				A.2-1	Suggested		Note 2: The inch conversion for 0.0127 should be changed to 0.0005.	No	10-May-12	Mrs. Diane Allcorn	Accepted
140				A.2-1	Suggested		Feature 1, Design Requirements, Drill Size: The inch conversion for 2.00 should be changed to 0.0787 since the conversion is 0.07874016.	No	10-May-12	Mrs. Diane Allcorn	Accepted
140				A.2-1	Suggested		Feature G, Design Requirements, Land Size: The inch conversion for 1.02 should be changed to 0.040 since the conversion is 0.04015748.	No	10-May-12	Mrs. Diane Allcorn	Accepted
140				A.2-1	Suggested		Feature G, Design Requirements, Maximum Drill Size: The inch conversion for 0.51 should be changed to 0.020 since the conversion is 0.02007874.	No	10-May-12	Mrs. Diane Allcorn	Accepted
140				A.2-1	Suggested		Feature RB1: The inch conversion for 0.0508 should be changed to 0.002.	No	10-May-12	Mrs. Diane Allcorn	Accepted

140				A.2-1	Suggested		Feature C, Design Requirements, Drill Size: The inch conversion for 1.07 should be changed to 0.042 since the conversion is 0.04212598.	No	10-May-12	Mrs. Diane Allcorn	Accepted
140				A.2-1	Suggested		Features B1 through B4, Design Requirements, Grid Size: The inch conversion for 1.27 should be changed to 0.05.	No	10-May-12	Mrs. Diane Allcorn	Accepted
140				A.2-1	Suggested		Features B1 through B4, Design Requirements, Land Size: The inch conversion for 1.02 should be changed to 0.040 since the conversion is 0.04015748.	No	10-May-12	Mrs. Diane Allcorn	Accepted
140				A.2-1	Suggested		Feature A, Design Requirements, Land Size: The inch conversion for 1.65 should be changed to 0.065 since the conversion is 0.06496063.	No	10-May-12	Mrs. Diane Allcorn	Accepted
120	9.2.5.1				Suggested		9.2.5.1.1 Tooling holes:(continued) Specific definitions need to be given for both terms. The adequacy of coupons for determining and maintaining registrations through use of the tooling holes may have limitations that should be discussed or explained. If coupons are to be used, specific controls to assure that the coupon is actually representative may need to be specified, such as tolerance from normal of drill and the board, flex conditions of the parts of the board represented by one or more coupons. The tolerances are so tight that ambiguity that may be harmful needs to be considered. Specific methods, such as heat, which may be acceptable or unacceptable for interference fitting, need to be stated. If press fit is to be permitted, it needs to be specifically defined in terms acceptable to the use for this purpose.	No	10-May-12	Mrs. Diane Allcorn	Accepted
120	9.2.5.1				Suggested		9.2.5.1.1 Tooling holes: The term Interference Fit used in this paragraph indicates the opposite meaning of normal use in mechanical devices. The normal use is the pin larger than the hole. This paragraph indicates the hole larger than the pin. The intent is unclear. It is also unclear if the interference fit is to be to the board layers severally (more or less averaged) or individually, with each layer having the indicated fit. The expression line-to-line conditions which is apparently used as a sufficiency for assurance of the interference fit is unclear.	No	10-May-12	Mrs. Diane Allcorn	Accepted
45	4.6.2				Suggested		Conformal Coating: Default provision that conformal coating need not be applied where there are no conductors should be examined for reliability impact particularly on multilayer and hygroscopic boards. (Pertains to military or space use.)	No	10-May-12	Mrs. Diane Allcorn	Accepted
25	4.2.2				Suggested		Adhesives: Chemical incompatibilities of types of adhesives, as some Silicon adhesives (as some RTVs) to some kinds of ether may be inserted here if justified. Uses and limitations of photosensitive adhesives, attacked by light or light used to cure, in terms of adhesives and other board components before and after population may be advisable. This may have special considerations for military or space environments in which UV-C is possible as well as other energies.	No	10-May-12	Mrs. Diane Allcorn	Accepted
140				A.2-1	Suggested		Feature C, Design Requirements, Land Size: The inch conversion for 1.65 should be changed to 0.065 since the conversion is 0.06496063.	No	10-May-12	Mrs. Diane Allcorn	Accepted
140				A.2-1	Suggested		Feature A, Design Requirements, Drill Size: The inch conversion for "1.07" should be changed to "0.042" since the conversion is 0.04212598.	No	10-May-12	Mrs. Diane Allcorn	Accepted
54			4-May		Suggested		The inch conversion for "0.06" should be changed to "0.00236" since the conversion is 0.002362205.	No	10-May-12	Mrs. Diane Allcorn	Accepted
153				A.9-1	Suggested		SMOL, Design Requirements, Solder Mask Anti-Land Calculation: The inch conversion for 0.61 should be changed to 0.024 since the conversion is 0.02401575.	No	10-May-12	Mrs. Diane Allcorn	Accepted
140				A.2-1	Suggested		Features RA through RC: In two occurrences the inch conversion for 0.0127 should be changed to 0.0005.	No	10-May-12	Mrs. Diane Allcorn	Accepted