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ICS 31.180; 49.140

Einsprüche bis 2014-08-06

Entwurf**Raumfahrtproduktsicherung –
Qualifizierung von Leiterplatten;
Englische Fassung FprEN 16602-70-10:2014**

Space product assurance –
Qualification of printed circuit boards;
English version FprEN 16602-70-10:2014

Assurance produit des projets spatiaux –
Qualification des circuits imprimés;
Version anglaise FprEN 16602-70-10:2014

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2014-06-06 wird der Öffentlichkeit zur Prüfung und Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses Entwurfes besonders zu vereinbaren.

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Die Empfänger dieses Norm-Entwurfs werden gebeten, mit ihren Kommentaren jegliche relevanten Patentrechte, die sie kennen, mitzuteilen und unterstützende Dokumentationen zur Verfügung zu stellen.

Gesamtumfang 97 Seiten

Normenausschuss Luft- und Raumfahrt (NL) im DIN

Nationales Vorwort

Dieses Dokument (FprEN 16602-70-10:2014) wurde vom Technischen Komitee CEN/CLC/TC 5 „Raumfahrt“ erarbeitet, dessen Sekretariat vom DIN (Deutschland) gehalten wird.

Dieses Dokument ist derzeit zum einstufigen Annahmeverfahren vorgelegt.

Dieses Dokument wurde speziell zur Behandlung von Raumfahrtsystemen erarbeitet und hat daher Vorrang vor jeglicher Europäischer Norm, da es denselben Anwendungsbereich hat, jedoch über einen größeren Geltungsbereich (z. B. Luft- und Raumfahrt) verfügt.

Das zuständige deutsche Normungsgremium ist der Arbeitsausschuss NA 131-10-01 AA „Interoperabilität von Informations-, Kommunikations- und Navigationssystemen“ im DIN-Normenausschuss Luft- und Raumfahrt (NL).

Nationaler Anhang NA (informativ)

3 Begriffe und Abkürzungen

3.1 Begriffe aus anderen Normen

Für die Anwendung dieses Dokuments gelten die Begriffe nach ECSS-S-ST-00-01.

3.2 Für diese Norm spezifische Begriffe

3.2.1

zugehöriges Prüfstück

kleines Stück einer PCB, das für die Durchführung eines speziellen begrenzten Satzes von Prüfungen vorgesehen ist

Anmerkung 1 zum Begriff Das zugehörige Prüfstück wird als Teil einer PCB hergestellt und auf der abschließenden Herstellungsstufe von dieser getrennt. Es ist daher zu der PCB gehörig, mit der es gleichzeitig hergestellt wurde.

3.2.2

Blase

Delaminierung in Form einer örtlich begrenzten Aufwölbung und Trennung zwischen jeglichen Schichten eines Basismaterials für die Laminierung oder zwischen dem Basismaterial und der leitfähigen Folie oder der Schutzbeschichtung

[Quelle: IEC 60194 (1999-04)]

3.2.3

Decklage

flexibler Schaltkreis

Schicht aus Isolierstoff, die so aufgebracht wird, dass sie ein Leiterbild auf den Außenflächen einer PCB vollständig oder teilweise bedeckt

[Quelle: IEC 60194 (1999-04)]

3.2.4

Gewebetrennung

Zustand im Inneren von verstärktem Basismaterial, bei dem sich Glasfasern an den Gewebekreuzungen vom Harz ablösen

Anmerkung 1 zum Begriff Dieser Zustand äußert sich in Form zusammenhängender weißer Punkte oder Kreuze unter der Oberfläche des Basismaterials. Er steht üblicherweise im Zusammenhang mit mechanischen Spannungen.

Anmerkung 2 zum Begriff Siehe auch „Maserung“.

[Quelle: IEC 60194 (1999-04)]

3.2.5**Delaminierung**

Trennung der Gewebelagen eines Basismaterials, zwischen dem Basismaterial und einer leitfähigen Folie oder jegliche sonstige planare Trennung in einer PCB

Anmerkung 1 zum Begriff Siehe auch „Blase“.

[Quelle: IEC 60194 (1999-04)]

3.2.6**Entnetzung**

Zustand, der auftritt, wenn geschmolzenes Lot eine Oberfläche bedeckt und sich dann zurückzieht und unregelmäßig geformte Lothügel zurücklässt, die durch Flächen mit dünner Lotschicht ohne freiliegendes Grundmetall getrennt sind

[Quelle: IEC 60194 (1999-04)]

3.2.7**flexible PCB**

einseitige, doppelseitige oder mehrschichtige PCB, bestehend aus einer gedruckten Schaltung oder einer gedruckten Verdrahtung, bei der ausschließlich flexible Basismaterialien zum Einsatz kommen

[Quelle: IEC 60194 (1999-04)]

3.2.8**Hofbildung**

mechanisch verursachte Rissbildung oder Delaminierung auf oder unter der Oberfläche eines Basismaterials, üblicherweise in Form von aufgehellten Bereichen um Löcher oder sonstige mechanisch bearbeitete Bereiche

[Quelle: IEC 60194 (1999-04)]

3.2.9**Hochfrequenz-PCB**

für Hochfrequenz-Anwendungen eingesetzte PCB, die spezielle Anforderungen an die dielektrischen Eigenschaften des Trägerschichtstoffs sowie spezielle maßbezogene Anforderungen an das elektrische Layout stellt

3.2.10**Einschlüsse**

metallische oder nichtmetallische Fremdkörper, die in einem Isolierstoff, einer leitfähigen Schicht, einem Überzug, einem Basismaterial oder einer Lötverbindung eingeschlossen sein können

[Quelle: IEC 60194 (1999-04)]

3.2.11**Schlüsselpersonal**

Personal, das über Fachwissen verfügt und für definierte Bereiche der Produktion oder Produktsicherung verantwortlich ist

3.2.12

Maserung

Zustand im laminierten Basismaterial, bei dem sich innenliegende Glasfasern an den Gewebekreuzungen vom Harz ablösen

Anmerkung 1 zum Begriff Dieser Zustand äußert sich in Form einzelner weißer Punkte oder „Kreuze“ unter der Oberfläche des Basismaterials. Er steht üblicherweise im Zusammenhang mit thermischen Spannungen.

Anmerkung 2 zum Begriff Siehe auch „Gewebetrennung“.

[Quelle: IEC 60194 (1999-04)]

3.2.13

Metallkern-PCB

PCB, deren Basismaterial aus einem Metallkern besteht

[Quelle: IEC 60194 (1999-04)]

3.2.14

Mehrschicht-PCB

PCB, die aus starren oder flexiblen Isolierstoffen sowie abwechselnd drei oder mehr Schichten aus gedruckter Verdrahtung und/oder gedruckter Schaltung besteht, die unter Bonden zusammengefügt und elektrisch miteinander verbunden wurden

[IEC 60194 (1999-04)]

3.2.15

Prepreg

Materialschicht, die mit einem Harz imprägniert wurde und auf eine Zwischenstufe ausgehärtet ist

Anmerkung 1 zum Begriff Harz im B-Zustand.

[Quelle: IEC 60194 (1999-04)]

3.2.16

Leiterplatte

PCB

en: printed circuit board

bedruckte Platte mit sowohl Punkt-zu-Punkt-Verbindungen als auch gedruckten Bauelementen in vorherbestimmter Anordnung auf einer gemeinsamen Basis

Anmerkung 1 zum Begriff Dies umfasst einseitige, doppelseitige und mehrschichtige PCBs mit starren, flexiblen und starrflexiblen Basismaterialien.

[Quelle: IEC 60194 (1999-04)]

3.2.17

starre doppelseitige PCB

doppelseitige PCB, entweder mit Schaltungen oder Verdrahtung bedruckt, bei der ausschließlich starre Basismaterialien zum Einsatz kommen

[Quelle: IEC 60194 (1999-04)]

3.2.18

starrflexible PCB

PCB mit sowohl starren als auch flexiblen Basismaterialien

[Quelle: IEC 60194 (1999-04)]

3.2.19**starrflexible doppelseitige PCB**

doppelseitige PCB, entweder mit Schaltungen oder Verdrahtung bedruckt, bei der Kombinationen aus starren und flexiblen Basismaterialien zum Einsatz kommen

[Quelle: IEC 60194 (1999-04)]

3.2.20**starrflexible mehrschichtige PCB**

mehrschichtige PCB, entweder mit Schaltungen oder Verdrahtung bedruckt, bei der Kombinationen aus starren mehrschichtigen und flexiblen ein- und doppelseitigen Basismaterialien zum Einsatz kommen

3.2.21**starre PCB**

PCB, bei der ausschließlich starre Basismaterialien zum Einsatz kommen

[Quelle: IEC 60194 (1999-04)]

3.2.22**starre einseitige PCB**

einseitige PCB, entweder mit Schaltungen oder Verdrahtung bedruckt, bei der ausschließlich starre Basismaterialien zum Einsatz kommen

[Quelle: IEC 60194 (1999-04)]

3.2.23**starre mehrschichtige PCB**

mehrschichtige PCB, entweder mit Schaltungen oder Verdrahtung bedruckt, bei der ausschließlich starre Basismaterialien zum Einsatz kommen

[Quelle: IEC 60194 (1999-04)]

3.2.24**Kratzer**

schmale Furche oder Nut in einer Oberfläche

Anmerkung 1 zum Begriff Er ist üblicherweise flach und durch das Markieren oder Schrammen der Oberfläche mit einem spitzen oder scharfen Gegenstand verursacht.

[Quelle: IEC 60194 (1999-04)]

3.2.25**mehrschichtige PCB mit sequentieller Laminierung**

mehrschichtige PCB, die durch Laminierung durchkontaktierter doppelseitiger oder mehrschichtiger PCBs hergestellt wird

Anmerkung 1 zum Begriff Auf diese Weise sind einige ihrer leitfähigen Schichten über blinde oder vergrabene Kontaktlöcher miteinander verbunden.

[Quelle: IEC 60194 (1999-04)]

3.2.26**Prüfleiterbild**

Teil der PCB, der zu speziellen Prüfzwecken mit dem Kupferleiterbild auf dem und im PCB-Substrat im Zusammenhang steht

3.3 Abkürzungen

Für die Anwendung dieses Dokuments gelten die Abkürzungen in ECSS-S-ST-00-01 und die folgenden Abkürzungen:

Abkürzung	Bedeutung
CAD	Rechnergestütztes Design (en: computer aided design)
CAM	Rechnergestützte Fertigung (en: computer aided manufacturing)
M	wesentliche Nichtübereinstimmung (en: major nonconformance)
m	unwesentliche Nichtübereinstimmung (en: minor nonconformance)
n.a.	nicht anwendbar (en: not applicable)
NRB	Nichtkonformitäts-Untersuchungsausschuss (en: nonconformance review board)
PCB	Leiterplatte (en: printed circuit board)
PID	Prozessidentifizierungs-Dokument (en: process identification document)
PTH	metallisiertes Loch (en: platedthrough hole)
PTFE	Polytetrafluorethylen (en: polytetrafluoroethylene)
r.m.s.	Effektivwert (en: rootmeansquare)
TBD	festzulegen (en: to be defined)

— Leerseite —

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English version

Space product assurance - Qualification of printed circuit boards

Assurance produit des projets spatiaux - Qualification des
circuits imprimés

Raumfahrtproduktsicherung - Qualifizierung von
Leiterplatten

This draft European Standard is submitted to CEN members for unique acceptance procedure. It has been drawn up by the Technical Committee CEN/CLC/TC 5.

If this draft becomes a European Standard, CEN and CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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Table of contents

Foreword	7
1 Scope.....	8
2 Normative references	9
3 Terms, definitions and abbreviated terms.....	11
3.1 Terms from other standards.....	11
3.2 Terms specific to the present standard	11
3.3 Abbreviated terms.....	14
4 Principles	16
4.1 General.....	16
4.2 Roles	16
4.3 Specification of test requirements	17
5 Evaluation	18
5.1 General.....	18
5.2 Request for evaluation	18
5.3 Evaluation PCBs.....	18
5.4 Line audit.....	19
6 Qualification.....	20
6.1 General.....	20
6.2 Qualification programme definition and approval	20
6.3 Nonconformance criteria.....	21
6.4 Qualification programme implementation	21
6.5 Qualification PCBs.....	25
6.5.1 General	25
6.5.2 Test pattern A: Electrical test	27
6.5.3 Test pattern B: Mechanical test	27
6.5.4 Test pattern C: Electrical test	28
6.5.5 Test pattern D: Electrical test and visual aspect	28
6.5.6 Test pattern E: Electrical test	29
6.5.7 Test pattern F: Metal-plating test.....	30

6.5.8	Test pattern G: Metal-plating/coating test.....	30
6.5.9	Test pattern H: Electrical test	31
6.5.10	Test pattern J: Solderability test	31
6.5.11	Test pattern K: Physical test.....	32
6.5.12	Test pattern L: Demonstration of technological capability.....	32
6.5.13	Test pattern M: CAD/CAM criteria (on request by the qualification authority).....	33
6.5.14	Test pattern X: Resistance to bending cycles (for flexible parts only)	34
6.5.15	Test pattern Y: Electrical test (on request by the supplier).....	34
6.5.16	Test pattern W: Electrical test for high frequency circuits (on request by the supplier)	35
6.6	Qualification approval	35
6.7	Maintenance of qualification	35
7	Tests	37
7.1	General.....	37
7.2	Group 1 — Visual inspection and non-destructive test.....	37
7.2.1	General	37
7.2.2	Verification of marking.....	37
7.2.3	Visual aspects.....	38
7.2.4	External dimensions.....	41
7.2.5	Warp	41
7.2.6	Twist	42
7.2.7	Subgroup 1.1 — Specific dimensional check.....	42
7.2.8	Subgroup 1.2 — Electrical measurements	44
7.3	Group 2 — Miscellaneous tests	46
7.3.1	General	46
7.3.2	Subgroup 2.1 — Solderability test — Wettability on test pattern J	46
7.3.3	Subgroup 2.2 — Mechanical tests.....	47
7.3.4	Subgroup 2.3 — Coatings tests.....	49
7.3.5	Subgroup 2.4 — Electrical tests	56
7.3.6	Subgroup 2.5 — Physical tests on test pattern K	58
7.4	Group 3 — Thermal stress and thermal shock (on PCB)	59
7.4.1	General	59
7.4.2	Solder bath float and vapour phase reflow simulation (on board without test pattern F)	59
7.4.3	Rework simulation (thermal shock, hand soldering) on test pattern F.....	60
7.5	Group 4 — Thermal cycling (on PCB).....	61
7.6	Group 5 — Damp heat — Steam ageing (on PCB).....	62

7.6.1	General	62
7.6.2	Damp heat (on entire PCB excluding test pattern F)	62
7.6.3	Steam ageing on test pattern F	62
8	Quality assurance for manufacturing	64
8.1	General.....	64
8.2	Data.....	64
8.3	Incoming inspection of raw materials	64
8.4	Traceability	64
8.5	Calibration	65
8.6	Workmanship standards	65
8.7	Inspection	65
8.8	Operator and inspector training.....	65
8.9	Quality test specimen	65
8.10	Microsection	66
8.11	Final inspection and tests	66
8.12	Delivery	66
9	Requirements for PCBs	67
9.1	Rigid single-sided and double-sided PCBs	67
9.2	Rigid single-sided and double-sided PCBs for high frequency application	69
9.3	Flexible PCBs	72
9.4	Rigid-flex PCBs	74
9.5	Rigid multilayer PCBs	74
9.6	Sequential rigid multilayer PCBs.....	77
Annex A	(normative) Evaluation test report – DRD	80
Annex B	(normative) Qualification test report – DRD	82
Annex C	(normative) PCB manufacturing/assembly process identification document (PID) – DRD	83
Annex D	(normative) Qualification status report – DRD	84
Annex E	(informative) Example of check-list.....	85
Annex F	(informative) Example of plated-through hole microsection.....	88
Bibliography		89
 Figures		
Figure 6-1:	Test sequence.....	22

Figure 6-2: Example of a qualification PCB layout with patterns for testing and a pattern for demonstration of the technological capability	26
Figure 6-3: Example of test pattern for intralayer insulation resistance and dielectric withstanding voltage testing	27
Figure 6-4: Example of test pattern for testing peel strength of conductors and pull-off strength of pads	28
Figure 6-5: Example of test pattern for internal short circuit testing.....	28
Figure 6-6: Example of test pattern for etching definition evaluation and continuity testing	29
Figure 6-7: Example of test pattern for interconnection resistance and current overload testing	29
Figure 6-8: Example of test pattern for microsectioning and metal plating evaluation	30
Figure 6-9: Example of test pattern for plating adhesion testing and analysis of SnPb coating composition after reflow	30
Figure 6-10: Example of test pattern for interlayer insulation resistance and dielectric withstanding voltage testing	31
Figure 6-11: Example of test pattern for solder wettability and rework simulation testing	31
Figure 6-12: Example of test pattern for water absorption and outgassing testing	32
Figure 6-13: Example of test pattern for evaluation of the technological capability	33
Figure 6-14: Example of test pattern for evaluation of CAD/CAM capability.....	34
Figure 6-15: Example of test pattern for testing resistance to bending cycles	34
Figure 6-16: Example of test pattern for controlled impedance testing.....	34
Figure 7-1: Arbitrary defects on conductors	40
Figure 7-2: Arbitrary defects on spacing between conductors.....	40
Figure 7-3 Misalignment of cover layer (for flexible PCBs)	41
Figure 7-4: Warp	42
Figure 7-5: Twist.....	42
Figure 7-6 Example of a presentation of measurements in tabular form	43
Figure 7-7: Wettability of terminal pads and plated-through holes	47
Figure 7-8: Dimensional parameters to be measured	51
Figure 7-9: Microsection of a PTH	53
Figure 7-10: Undercut for PCBs with fused SnPb finish.....	53
Figure 7-11: Undercut for PCBs with Au/Ni or Au finish	54
Figure 7-12: Overhang for PCBs with Au/Ni or Au finish.....	54
Figure 7-13: Microsection in PTH: Possible defects.....	55
Figure 7-14: Microsection of PTH: Possible defects	55
Figure 7-15: Voids in resin inside buried vias	56
Figure 7-16: Test for internal short circuit	57
Figure A-1 : Example of a test report	81
Figure E-1 : Example of Check-list for double sided and multilayer PCBs	85

Figure F-1 : Example of plated-through hole microsection.....	88
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Tables

Table 6-1: Test specification.....	23
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Foreword

This document (FprEN 16602-70-10:2014) has been prepared by Technical Committee CEN/CLC/TC 5 "Space", the secretariat of which is held by DIN (Germany).

This document (FprEN 16602-70-10:2014) originates from ECSS-Q-ST-70-10C.

This document is currently submitted to the Unique Acceptance Procedure.

This document has been developed to cover specifically space systems and will therefore have precedence over any EN covering the same scope but with a wider domain of applicability (e.g. : aerospace).

1

Scope

This Standard defines the requirements for evaluation, qualification and maintenance of qualification of PCB manufacturers for different types of PCBs.

This Standard is applicable to the following type of PCBs:

- Rigid PCBs (single-sided, double-sided, multilayer, sequential-laminated multilayer, metal core)
- Flexible PCB (single-sided and double-sided)
- Rigid-flex PCBs (multilayer and sequential-laminated multilayer)
- High frequency PCBs
- Special PCBs.

PCBs are used for the mounting of components in order to produce PCB assemblies performing complex electrical functions. The PCBs are subjected to thermal and mechanical shocks during their assembly such as mounting of components by soldering, rework and repair under normal terrestrial conditions, and in addition the complex PCB assembly are subjected to the environment imposed by launch and space flights.

This standard may be tailored for the specific characteristics and constraints of a space project in conformance with ECSS-S-ST-00.

2

Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revision of any of these publications do not apply. However, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the more recent editions of the normative documents indicated below. For undated references, the latest edition of the publication referred to applies.

EN reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system — Glossary of terms
EN 16602-10-09	ECSS-Q-ST-10-09	Space product assurance — Nonconformance control system
EN 16602-20	ECSS-Q-ST-20	Space product assurance — Quality assurance
EN 16602-70	ECSS-Q-ST-70	Space product assurance — Material, mechanical parts and processes
EN 16602-70-02	ECSS-Q-ST-70-02	Space product assurance — Thermal vacuum outgassing test for the screening of space materials
EN 16602-70-08	ECSS-Q-ST-70-08	Space product assurance — Manual soldering of high-reliability electrical connections
EN 16602-70-11	ECSS-Q-ST-70-11	Space product assurance — Procurement of printed circuit boards
EN 16602-70-21	ECSS-Q-ST-70-21	Space product assurance — Flammability testing for the screening of space materials
EN 16602-70-22	ECSS-Q-ST-70-22	Space product assurance — Control of limited shelf-life materials
EN 16602-70-29	ECSS-Q-ST-70-29	Space product assurance — Determination of offgassing products from materials and assembled articles to be used in a manned space vehicle crew compartment
	IEC 60068-2-3 (1969-01)	Environmental testing. Part 2: Tests. Test Ca: Damp heat, steady state
	IEC 60068-2-14-am 1 (1986-01)	Environmental testing. Part 2: Tests. Test N: Change of temperature

	IEC 60068-2-20-am 2 (1987-01)	Environmental testing. Part 2: Tests. Test T: Soldering
	IEC 60249-1-am 4 (1993-05)	Base materials for printed circuits. Part 1: Test methods
	IEC 60326-2-am 1 (1992-06)	Printed boards. Part 2: Test methods
	IEC 60326-5-am 1 (1989-10)	Printed boards. Part 5: Specification for single and double sided printed boards with plated-through holes
	IEC 60326-8 (1981-01)	Printed boards. Part 8: Specification for single and double sided flexible printed boards with through connections
	IEC 60326-11 (1991-03)	Printed boards. Part 11: Specification for flex-rigid multilayer printed boards with through connections
	IEC 62326-4 (1996-12)	Printed boards. Part 4: Rigid multilayer printed boards with interlayer connections - Sectional specification
	IPC-4101	Specification for base materials for rigid and multilayer printed boards
	MIL-P-50884C	Printed wiring, flexible and rigid-flex

3

Terms, definitions and abbreviated terms

3.1 Terms from other standards

For the purpose of this Standard, the terms and definitions from ECSS-S-ST-00-01 apply.

3.2 Terms specific to the present standard

3.2.1 associated test coupon

small piece of PCB designated to have a limited specific set of tests performed

NOTE The associated test coupon is manufactured as part of a PCB and at the final manufacturing stage it is separated from it. The associated test coupon is thus associated with the PCB, with which it was simultaneously manufactured.

3.2.2 blister

delamination in the form of a localized swelling and separation between any of the layers of a lamination base material, or between base material and conductive foil or protective coating

[IEC 60194 (1999-04)]

3.2.3 cover layer (flexible circuit)

layer of insulating material that is applied covering totally or partially over a conductive pattern on the outer surfaces of a PCB

[IEC 60194 (1999-04)]

3.2.4 crazing

internal condition that occurs in reinforced base material whereby glass fibres are separated from the resin at the weave intersections

NOTE 1 This condition manifests itself in the form of connected white spots or crosses that are below the surface of the base material. It is usually related to mechanically induced stress.

NOTE 2 See also “measling”.

[IEC 60194 (1999-04)]

3.2.5 delamination

separation between plies within a base material, between base material and a conductive foil, or any other planar separation with a PCB

NOTE See also “blister”.

[IEC 60194 (1999-04)]

3.2.6 dewetting

condition that results when molten solder coats a surface and then recedes to leave irregularly-shaped mounds of solder that are separated by areas that are covered with a thin film of solder and with the basis metal not exposed

[IEC 60194 (1999-04)]

3.2.7 flexible PCB

PCB either single, double sided or multilayer consisting of a printed circuit or printed wiring using flexible base materials only

[IEC 60194 (1999-04)]

3.2.8 haloing

mechanically-induced fracturing or delamination, on or below the surface of a base material, that is usually exhibited by a light area around holes or other machined features

[IEC 60194 (1999-04)]

3.2.9 high frequency PCB

PCB used for high frequency applications, that has specific requirements to the dielectric properties of the base laminates as well as special dimensional requirements to the lay-out for electrical purposes

3.2.10 inclusions

foreign particles, metallic or non-metallic, that may be entrapped in an insulating material, conductive layer, plating, base material or solder connection

[IEC 60194 (1999-04)]

3.2.11 key personnel

personnel with specialist knowledge responsible for defined production or product assurance areas

3.2.12 measling

condition that occurs in laminated base material in which internal glass fibres are separated from the resin at the weave intersection

NOTE 1 This condition manifests itself in the form of discrete white spots or “crosses” that are below the surface of the base material. It is usually related to thermally-induced stress.

NOTE 2 See also “crazing”.

[IEC 60194 (1999-04)]

3.2.13 metal core PCB

PCB using a metal core base material

[IEC 60194 (1999-04)]

3.2.14 multilayer PCB

PCB that consist of rigid or flexible insulation materials and three or more alternate printed wiring and/or printed circuit layers that have been bonded together and electrically interconnected

[IEC 60194 (1999-04)]

3.2.15 prepreg

sheet of material that has been impregnated with a resin and cured to an intermediate stage

NOTE B-staged resin.

[IEC 60194 (1999-04)]

3.2.16 printed circuit board (PCB)

printed board that provides both point-to-point connections and printed components in a predetermined arrangement on a common base

NOTE This includes single-sided, double sided and multilayer PCBs with rigid, flexible, and rigid-flex base materials.

[IEC 60194 (1999-04)]

3.2.17 rigid double-sided PCB

double-sided PCB, either printed circuit or printed wiring, using rigid base materials only

[IEC 60194 (1999-04)]

3.2.18 rigid-flex PCB

PCB with both rigid and flexible base materials

[IEC 60194 (1999-04)]

3.2.19 rigid-flex double-sided PCB

double-sided PCB, either printed circuit or printed wiring, using combinations of rigid and flexible base materials

[IEC 60194 (1999-04)]

3.2.20 rigid-flex multilayer PCB

multilayer PCB, either printed circuit or printed wiring, using combinations of rigid multilayer and flexible single and double-sided base materials

3.2.21 rigid PCB

PCB using rigid base materials only

[IEC 60194 (1999-04)]

3.2.22 rigid single-sided PCB

single-sided PCB, either printed circuit or printed wiring, using rigid base materials only

[IEC 60194 (1999-04)]

3.2.23 rigid multilayer PCB

multilayer PCB, either printed circuit or printed wiring, using rigid base materials only

[IEC 60194 (1999-04)]

3.2.24 scratch

narrow furrow or groove in a surface

NOTE It is usually shallow and caused by the marking or rasping of the surface with a pointed or sharp object.

[IEC 60194 (1999-04)]

3.2.25 sequentially laminated multilayer PCB

multilayer PCB that is formed by laminating together through hole plated double-sided or multilayer PCBs

NOTE Thus, some of its conductive layers are interconnected with blind or buried vias.

[IEC 60194 (1999-04)]

3.2.26 test pattern

part of the PCB that refers to the copper pattern on and within the PCB substrate for a specific test

3.3 Abbreviated terms

For the purpose of this Standard, the abbreviated terms from ECSS-S-ST-00-01 and the following apply:

Abbreviation	Meaning
CAD	computer aided design
CAM	computer aided manufacturing
M	major nonconformance
m	minor nonconformance
n.a.	not applicable
NRB	nonconformance review board
PCB	printed circuit board
PID	process identification document
PTH	plated-through hole

PTFE	polytetrafluoroethylene
r.m.s.	root-mean-square
TBD	to be defined

4 Principles

4.1 General

This Standard details the steps to obtain from the PCB manufacturer the qualification for supplying PCBs of an identified technology.

These steps are:

- a. Evaluation (see clause 5);
- b. Qualification (see clause 6):
 - Test and inspections (see clause 7),
 - Qualification approval (see clause 6.6);
- c. Maintenance of qualification (see clause 6.7).

4.2 Roles

For the need of this Standard the roles “PCB manufacturer”, “supplier”, “customer” and “qualification authority” have been explicitly introduced to allow proper allocation of requirements:

- a. The “PCB manufacturer” is the entity that manufactures the PCB.
- b. The “supplier” is the entity that uses the PCB for an instrument, for instance a subcontractor that delivers an electronics box. The supplier procures the PCB from the PCB manufacturer.
- c. The “customer” is the entity that uses the supplier’s product for a project, for instance a prime contractor that integrates an electronics box into a spacecraft payload. The role of supplier can coincide with the one of customer. The term customer does not refer to being the customer of the PCB manufacturer but refers to being the (prime) contractor of a space organisation initiating a space project.
- d. The “qualification authority” is the entity that reviews and accepts the qualification programme, evaluates the test results and grants the final approval. The role of customer can coincide with the one of qualification authority.

4.3 Specification of test requirements

Clause 7 describes the tests within the qualification programme in which the following three levels of requirement specifications are used:

- a. The requirement specifications that are generic for all types of PCBs are listed in clause 7.
- b. The requirement specifications that are specific to a particular type of PCB are listed in clause 9 and are referred to with the term “requirement” in clause 7.
- c. The requirement specifications that are determined by the supplier are referred to with the term “supplier’s specification” in clause 7.

5

Evaluation

5.1 General

- a. The PCB manufacturer who applies for the qualification of his PCB manufacturing line shall:
 - 1. request for an evaluation in conformance with clause 5.2;
 - 2. supply evaluation PCBs in conformance with clause 5.3;
 - 3. have a manufacturing line audit performed in conformance with clause 5.4.

NOTE If the result is satisfactory, the qualification authority can authorize the go-ahead of the qualification programme for each of the technologies that have been accepted.

- b. The PCB manufacturer and the qualification authority shall agree on the evaluation tests to be performed.

NOTE The evaluation tests can be an appropriate subset of the tests performed within the qualification programme.

5.2 Request for evaluation

- a. The PCB manufacturer's request for evaluation shall contain:
 - 1. a description of the technology for which the PCB manufacturer wishes to be evaluated;
 - 2. a description of the manufacturing line;
 - 3. past experience.
- b. Applications shall be signed by the person responsible for production and product assurance.
- c. Applications shall be addressed to the qualification authority.

5.3 Evaluation PCBs

- a. The PCB manufacturer shall produce three evaluation PCBs of each type with the materials, processes and equipment that are intended for use in subsequent production.

- b. The evaluation PCBs shall be representative in terms of technology for which the PCB manufacturer applies for qualification.

NOTE The term technology refers, among others, to:

- Dimensions of the boards, vias, pads and tracks
- Number of layers
- Pattern design.

- c. The evaluation PCBs shall represent the highest technological capability for which the PCB manufacturer applies for qualification.

- d. The PCB manufacturer shall perform the evaluation test and document it in conformance with Annex A.

NOTE The evaluation PCBs can be inspected at an independent certified test house.

- e. The evaluation PCBs shall be provided with associated test coupons.

5.4 Line audit

- a. Provided that the evaluation PCBs are accepted, the qualification authority shall audit the manufacturing line when PCB production is in progress.

- b. Before or during the audit, the PCB manufacturer shall make the following documents available to the customer:

1. Company organigram related to PCB production and control, including names and functions of all key personnel involved.
2. Identification of the parameters of the technologies that they wish to qualify.

NOTE See note in requirement 5.3b.

3. List of materials and equipment (including types and names of companies) used for production of PCBs.
4. List of process and control specifications with number, issue number, and date of issue.
5. Production flow-chart, including quality-assurance inspection point and relevant process specification.
6. Outline of test capabilities.

NOTE 1 Examples of test capabilities are metallographic examination, chemical analysis, failure analysis, mechanical and electrical test including functional testing of PCBs.

NOTE 2 These six documents can be gathered in a preliminary process identification document (PID).

6 Qualification

6.1 General

- a. A qualification programme shall be initiated in the following cases:
 - 1. Initial qualification.
 - 2. When previous qualification is more than two years ago and maintenance of qualification was not assured.
 - 3. Interruption of the manufacturing of the type of PCBs for more than two years.
 - 4. New technology.
 - 5. Change in the manufacturing line.
 - NOTE For example, any changes in material, chemical products, mechanical processing parameters, equipments.
 - 6. The manufacturing line was moved to another location.
 - 7. Changes in key personnel.

6.2 Qualification programme definition and approval

- a. After successful evaluation, the PCB manufacturer shall submit a qualification programme to the qualification authority for approval, after which the programme shall be initiated.
- b. The qualification programme shall identify:
 - 1. the key personnel involved;
 - 2. the test houses;
 - 3. the test procedure and test sequence;
 - 4. the proposed schedule of testing.
- c. Each test house shall have the approval of the qualification authority prior to commencement of the programme.
- d. The PCB manufacturer shall agree with the qualification authority on the monitoring during the qualification programme.

6.3 Nonconformance criteria

- a. The nonconformances shall be dispositioned in conformance with ECSS-Q-ST-10-09.
- b. Major nonconformances (M) shall be dispositioned at a nonconformance review board (NRB) established by the qualification authority and the PCB manufacturer.

NOTE This is because any major nonconformance (M) can result in the failure of qualification.

- c. Minor nonconformances (m) shall be:
 - 1. processed through an internal NRB of the PCB manufacturer to determine the causes and consequences;
 - 2. reported in the qualification test report in conformance with Annex B;
 - 3. assessed by the qualification authority;
- d. Nonconformance criteria ranked “m/M” shall be further classified by the PCB manufacturer, the supplier and the qualification authority.

6.4 Qualification programme implementation

- a. The qualification programme shall be performed by the PCB manufacturer or one or more independent test houses.
- b. The qualification programme shall be performed on six qualification PCBs.
- c. One additional qualification PCB shall be made for reference.
- d. The qualification programme shall be performed in conformance with the test sequence specified in Figure 6-1 and the test specification in Table 6-1 and explained in detailed in clause 7.
- e. A qualification test report shall be prepared in conformance with Annex B and submitted to the qualification authority for review and approval together with all prepared microsections.

NOTE The qualification authority can request the delivery of the inspected qualification PCBs.

- f. If the PCBs are used for manned space programmes the customer shall assure the PCB base material is tested for the following items:
 - 1. Flammability in conformance with ECSS-Q-ST-70-21.
 - 2. Offgassing (toxicity) and odour according to ECSS-Q-ST-70-29.

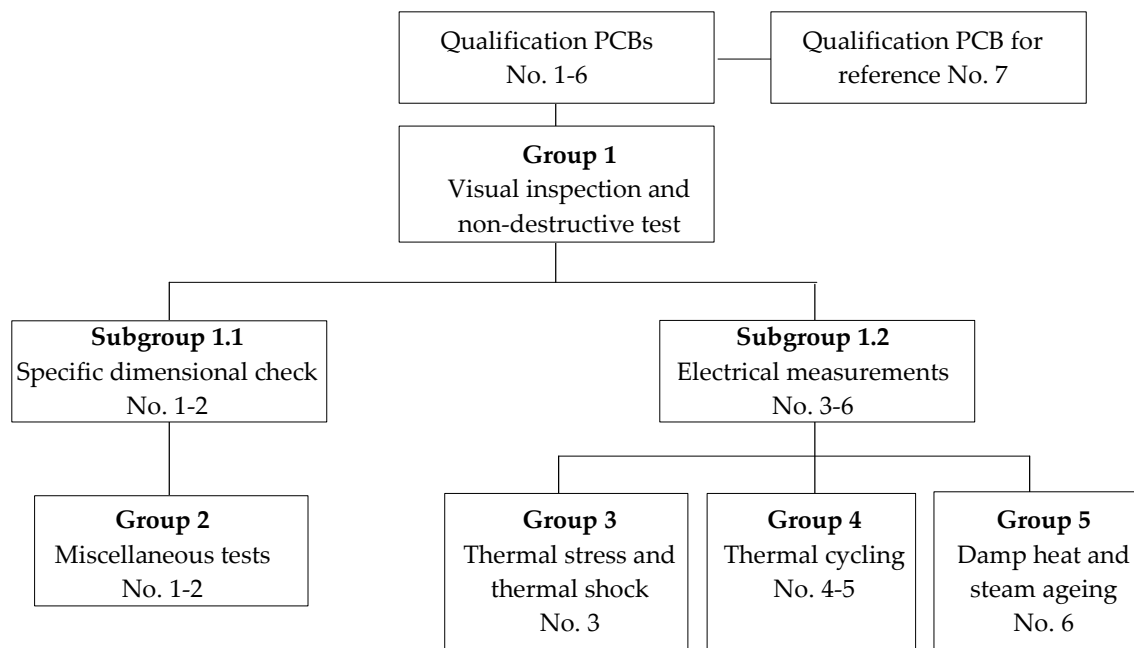


Figure 6-1: Test sequence