IEC/PAS 62647-21

Edition 1.0 2011-07

PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

Process management for avionics – Aerospace and defence electronic systems containing lead-free solder –
Part 21: Program management – Systems engineering guidelines for managing the transition to lead-free electronics

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

IEC/PAS 62647-21

Edition 1.0 2011-07

PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

Process management for avionics – Aerospace and defence electronic systems containing lead-free solder –
Part 21: Program management – Systems engineering guidelines for managing the transition to lead-free electronics

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE V

ICS 03.100.50; 31.020; 49.060

ISBN 978-2-88912-600-2

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PROCESS MANAGEMENT FOR AVIONICS – AEROSPACE AND DEFENCE ELECTRONIC SYSTEMS CONTAINING LEAD-FREE SOLDER –

Part 21: Program management – Systems engineering guidelines for managing the transition to lead-free electronics

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

A PAS is a technical specification not fulfilling the requirements for a standard, but made available to the public.

IEC-PAS 62647-21 has been processed by IEC technical committee 107: Process management for avionics.

The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
107/130/PAS	107/138A/RVD

Following publication of this PAS, which is a pre-standard publication, the technical committee or subcommittee concerned may transform it into an International Standard.

This PAS shall remain valid for an initial maximum period of 3 years starting from the publication date. The validity may be extended for a single 3-year period, following which it shall be revised to become another type of normative document, or shall be withdrawn.

This PAS is based on GEIA-HB-0005-1 and is published as a double logo PAS. GEIA, Government Electronics and Information Technology Association, has been transformed into TechAmerica Association.

This document is intended to be used in concert with IEC/PAS 62647-1 (GEIA-STD-0005-1) and IEC/PAS 62647-2 (GEIA-STD-0005-2).

It should be noted that suppliers who have been qualified in compliance with IEC/PAS 62647-1 (GEIA-STD-0005-1) and IEC/PAS 62647-2 (GEIA-STD-0005-2) and utilizing IEC/PAS 62647-22 (GEIA-HB-0005-2) will have adequately addressed the concerns and issues delineated in Clauses 5 through 14 of this PAS.

INTRODUCTION

Due to a variety of real and potential health issues, many constituent materials used in the production of electronic products have come under scrutiny. The European Union (EU) has enacted two directives; 2002/95/EC Restriction of Hazardous Substances (RoHS) and 2002/96/EC Waste Electrical and Electronic Equipment (WEEE) that restrict or eliminate the use of various substances in a variety of products that are produced after July 2006. One of the key materials restricted is lead (Pb), which is widely used in electronic solder and electronic piece part terminations. While these regulations may appear to only affect products for sale in the EU, due to the reduced market share of the aerospace and high performance industry in electronics, many of the lower tier Suppliers will change their products because their primary market is consumer electronics. Additionally, several U.S. states have enacted similar “green” laws and many Asian electronics manufacturers have recently announced completely green product lines.

Since the aerospace industry is one of the few major industrial sectors that still repair Circuit Card Assemblies (CCAs) and since Pb-free materials and processes are relatively immature and poorly understood, an aerospace-wide approach to the transition was deemed to be highly valuable.

PROCESS MANAGEMENT FOR AVIONICS – AEROSPACE AND DEFENCE ELECTRONIC SYSTEMS CONTAINING LEAD-FREE SOLDER –

Part 21: Program management – Systems engineering guidelines for managing the transition to lead-free electronics

1 Scope

This PAS is designed to assist program management and/or systems engineering management in managing the transition to lead-free (Pb-free) electronics to assure product reliability and performance.

Programs may inadvertently introduce Pb-free elements (including piece part finish, printed wiring board (PWB) or printed circuit board (PCB) finish, or assembly solder) if careful coordination between buyer and Supplier is not exercised. For example, piece part manufacturers may not always change part numbers to identify Pb-free finishes, especially if the previous tin-lead (Sn/Pb) finished piece part has been discontinued. Detailed examination of piece parts and documents at receiving inspection while crucial may not be sufficient to identify Pb-free piece parts.

NOTE Pb-free technology can impact any program regardless of whether the program itself is exempt or bound by environmental regulations. The industry conversion to Pb-free solder technology may affect an aerospace program in one or both of the following ways:

1) if the program is required to implement Pb-free technology (contract requirement, environmental regulation, etc), then the Program Manager/lead systems engineer will need to assess the impact of in-house transition with respect to design (performance of products using Pb-free) and process (processes to build Pb-free products);

2) if the program purchases COTS (Commercial-off-the-Shelf) items for its products/systems, then there is a very good chance that these items will contain Pb-free solder or Pb-free finishes on parts, printed wiring boards (PWBs), printed circuit boards (PCB), or circuit cards assemblies (CCA).

The basic principles delineated in this PAS can be used for program management and/or systems engineering management of any aerospace and/or high performance program. The annexes in the PAS describe tools that can be used in conjunction with this handbook.

1) Annex A describes a matrix of product tier level versus associated risks with respect to a Pb-free transition.
2) Annex B contains links to the European Union Directives and Executive Order 13148.
3) Annex C contains a General Program Manager Checklist for Dealing with Pb-free Issues that summarizes the content of this document.
4) Annex D contains a General Manufacturing Process Assessment Checklist to assess Supplier compliance to IEC/PAS 62647-1 (GEIA-STD-0005-1).
5) Annex E describes recommended program language to assure performance, reliability, airworthiness, safety, and certifiability of Pb-free product(s).

This PAS is designed to assist a program in assuring the performance, reliability, airworthiness, safety, and certifiability of product(s), in accordance with IEC/PAS 62647-1 (GEIA-STD-0005-1). Please note that the Program Manager and systems engineer (along with their respective organizations), and the appropriate enterprise authority work together in ensuring that all impacts of Pb-free technology insertion are understood and risks mitigated accordingly. Herein “Program Management (or Manager) and/or Systems Engineering Management (or Manager) and/or the appropriate enterprise authority” shall be defined as “Program Manager” throughout the remaining document (see Clause 3, Terms and Definitions).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Industry Standards

IEC/PAS 62647-1, (GEIA-STD-0005-1),	*Process management for avionics – Aerospace and defence electronics systems containing lead free solder – Part 1: Lead-free management*
IEC/PAS 62647-2 (GEIA-STD-0005-2),	*Process management for avionics – Aerospace and defence electronics systems containing lead-free solder – Part 2: Mitigation of the deleterious effects of tin*
GEIA-STD-0005-1,	*Performance Standard for Aerospace and High Performance Electronic Systems Containing Lead-free Solder*
GEIA-HB-0005-1,	*Program Management/Systems Engineering Guidelines For Managing The Transition To Lead-Free Electronics*
GEIA-HB-0005-2,	*Technical Guidelines for Aerospace and High Performance Electronic Systems Containing Lead-free Solder*
IPC-A-610,	*Acceptability of Electronic Assemblies*
AS/EN/JISQ9100,	*Quality Systems – Aerospace – Model For Quality Assurance In Design, Development, Production, Installation And Servicing*
ANSI/ASQC Q9000 ARINC Project Paper 671	*Quality Management and Quality Assurance Standards Guidance for Lead-Free Soldering, Repair and Rework*

3 Terms and definitions

For purposes of this document, the following terms and definitions apply.

3.1
assemblies
are electronic items that require electrical attachments, including soldering of wires or piece part terminations; examples include circuit card assemblies and wire harnesses.

3.2
COTS
is defined as “commercial off the shelf”. It can apply to a piece part, assembly, or unit.

3.3
critical
item or function, if defective, will result in the system’s inability to retain operational capability, meet primary objective, or affect safety.

3.4
customer
refers to an entity or organization that (a) integrates a piece part, soldered assembly, unit, or system into a higher level system, (b) operates the higher level system, or (c) certifies the system for use. For example, this may include end item users, integrators, regulatory agencies, operators, original equipment manufacturers (OEMs), and subcontractors.

3.5
High performance system or product
requires continued performance or performance on demand, or equipment down time cannot be tolerated, or end-use environment may be uncommonly harsh, and the equipment must function when required, such as life support or other critical systems

3.6
lead-free
is defined as less than 0,1 % by weight of lead in accordance with Waste Electrical and Electronic Equipment (WEEE) guidelines

3.7
Lead-free Control Plan (LFCP)
refers to an aerospace or defence system Supplier’s document that defines the processes that assure the plan owners, their Customers, and all other stakeholders that aerospace and high performance high-reliability electronics systems containing Pb-free solder will continue to be reliable, safe, producible, affordable, and supportable. An acceptable LFCP, per IEC/PAS 62647-1 (GEIA-STD-0005-1), will fulfill all intentions of the standard. ANSI/ASQC Q9000 documentation may provide a strong basis for the control plan. Technical guidance on evaluating an adequate LFCP can be found in IEC/PAS 62647-1 (GEIA-STD-0005-1).

3.8
may
indicates a course of action that is permissible within the limits of this PAS, but not required.

3.9
Pb-free Tin
is defined to be pure tin or any tin alloy with < 3 % lead (Pb) content by weight. This means that some Pb-free finishes other than pure tin, such as tin-bismuth and tin-copper, are considered to be “tin” for the purposes of this handbook. Many of these alloys have not been assessed for whiskering behavior.

3.10
Pb-free tin finish
is defined to be Pb-free tin final finish or under-plate either external or internal to a piece part, printed wiring board (PWB), printed circuit board (PCB), circuit card assembly (CCA) or other hardware. This includes all leads and surfaces, even those coated, encapsulated, or otherwise not exposed. It may include finishes on electrical piece parts, mechanical piece parts, and printed wiring boards (PWB) printed circuit board (PCB) or circuit card assembly (CCA). It does not include Pb-free bulk solders, assembly materials, ball-grid-array terminations, or those devices where the Pb-free tin finish has been completely replaced.

3.11
PCB
stands for Printed Circuit Board, which is also commonly referred to as a Printed Wiring Board (PWB)

3.12
piece part
is defined as an electronic component that is not normally disassembled without destruction and is normally attached to a printed wiring board (PWB), printed circuit board (PCB) or circuit card assembly (CCA), to perform an electrical function

3.13
program manager
for purposes of this PAS (and this PAS only), refers to program management (or manager) and/or systems engineering management (or manager) and/or the appropriate enterprise authority. The reason for this is to streamline this PAS. The implications are that the program manager and systems engineer (along with their respective organizations) and the appropriate enterprise authority work together in ensuring that all impacts of Pb-free technology insertion are understood and risks mitigated accordingly.

3.14
PWB
stands for Printed Wiring Board, which is also commonly referred to as a Printed Circuit Board (PCB)

3.15
repair
is the act of restoring the functional capability of a defective article in a manner that precludes compliance of the article with applicable drawings or specifications.

3.16
rework
is the act of reprocessing non-complying articles, through the use of original or equivalent processing in a manner that assures full compliance of the article with applicable drawings or specifications

3.17
should
indicates that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain course of action is discouraged but not prohibited.

3.18
sub-contractor
refers to an organization, within the given high-reliability industry, that supplies, maintains, repairs, or supports electronic systems, and is not the direct Supplier to the Customer or user of those systems