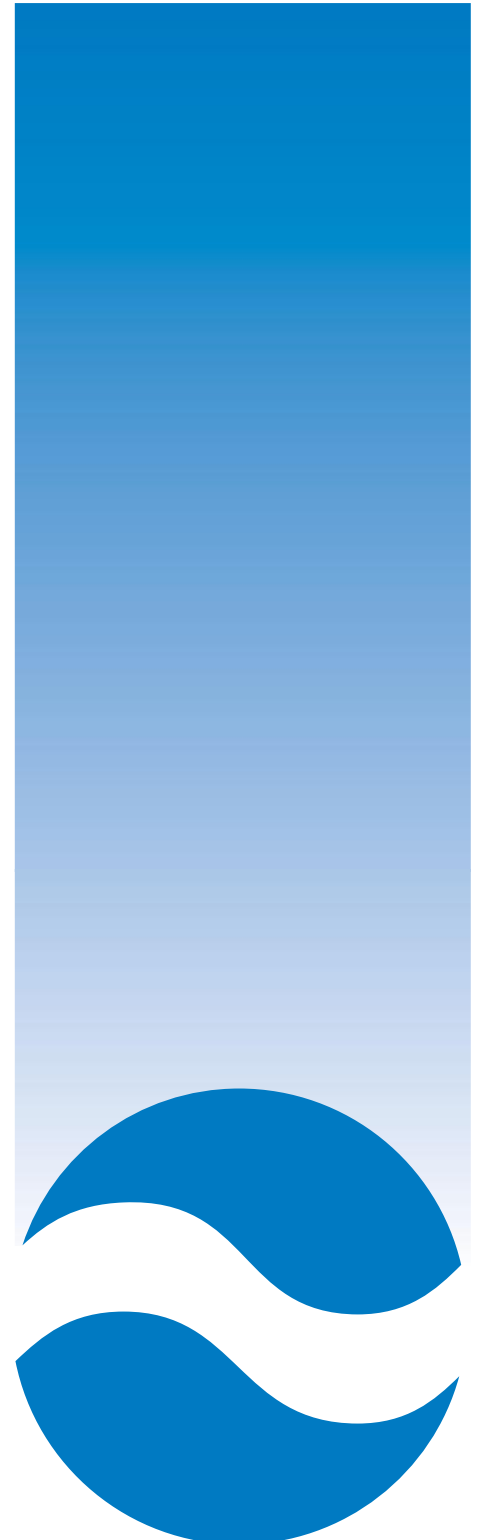


IPC J-STD-001FS
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JOINT INDUSTRY STANDARD

Space Applications
Electronic Hardware
Addendum to
IPC J-STD-001F
Requirements for
Soldered Electrical
and Electronic
Assemblies



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Space Applications Electronic Hardware Addendum to IPC J-STD-001F Requirements for Soldered Electrical and Electronic Assemblies

Developed by the Space Electronic Assemblies J-STD-001 Addendum Task Group (5-22as) of the Assembly & Joining Processes Committee (5-20) of IPC

Users of this publication are encouraged to participate in the development of future revisions.

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Acknowledgment

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Space Applications Electronic Hardware Addendum to IPC J-STD-001F Requirements for Soldered Electrical and Electronic Assemblies

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0.1 Scope This Addendum provides requirements to be used in addition to, and in some cases, in place of, those published in IPC J-STD-001F to ensure the reliability of soldered electrical and electronic assemblies that must survive the vibration and thermal cyclic environments getting to and operating in space.

0.1.1 Purpose When required by procurement documentation/drawings, this Addendum supplements or replaces specifically identified requirements of IPC J-STD-001, Revision F of July 2014.

0.1.2 Precedence The contract takes precedence over this Addendum, referenced standards and User-approved drawings. In the event of a conflict between this Addendum and the applicable documents cited herein, this Addendum takes precedence. Where referenced criteria of this Addendum differ from the published IPC J-STD-001F, this Addendum takes precedence. In the event of conflict between the requirements of this Addendum and the applicable assembly drawing(s)/documentation, the applicable User approved assembly drawing(s)/documentation take precedence. See Table 1 of this Addendum, clauses 1.7 Order of Precedence and 1.7.1 Conflict.

0.1.3 Existing or Previously Approved Designs This Addendum **shall not** constitute the sole cause for the redesign of previously approved designs. When drawings for existing or previously approved designs undergo revision, they should be reviewed and changes made that allow for compliance with the requirements of this Addendum.

0.1.4 Use This Addendum is not to be used as a stand-alone document.

Where criteria are not supplemented, the Class 3 requirements of IPC J-STD-001F **shall** apply. Where IPC J-STD-001F criteria are supplemented or new criteria are added by this Addendum, the clause is listed in J-STD-001FS, Table 1, Space Applications Requirements, and the entire IPC J-STD-001F clause is replaced by this Addendum except as specifically noted.

The clauses modified by this Addendum do not include subordinate clauses unless specifically stated, e.g., 1.4 does not include 1.4.1. Clauses, Tables, Figures, etc., in IPC J-STD-001F that are not listed in this Addendum are to be used as-published.

0.1.5 Lead-Free Tin For the purpose of this document, lead-free tin is defined as tin containing less than 3 percent lead by weight as an alloying constituent. Solder alloy SnAg3.7 is exempt from this requirement. See Table 1 of this Addendum, clause 3.2.

0.1.6 Use of Lead-Free Tin The use of components, assemblies, packaging technology, mechanical hardware,

and materials meeting any of the following conditions **shall** be prohibited unless documented and controlled through a User approved Lead Free Control Plan (LFCP) incorporating either a replating or hot solder dip (HSD) process that completely replaces the lead-free tin finish, or a minimum of two mitigation measures.

- Lead-free tin plating, metallization, etc., on external surfaces of parts, mechanical parts, etc., or in internal cavity surfaces, i.e.: hybrid, relay crystal cans, MEMS, etc.
- Any components, printed circuit assemblies (PCAs), etc., assembled with lead-free tin solder alloys except SnAg3.7, see paragraph 3.2.

0.1.6.1 Lead Free Control Plan The Lead Free Control Plan (LFCP) **shall** document controls and processes that assures that assemblies containing lead-free tin solder alloys and/or component finishes will perform as intended within the expected parameters of the mission, e.g., environment, duration, etc. At a minimum, the LFCP **shall**:

- a. Document the use of lead-free tin technology and prevent its use without review and approval by the User prior to implementation.
- b. Incorporate a minimum of two mitigation measures when the lead-free tin finish is not completely replaced through a replating or HSD process.
- c. Include any special design requirements, mitigation measures, test and qualification requirements, quality inspection and screening, marking and identification, maintenance, and repair processes.
- d. Require review and approval by the User prior to implementation.

The following documents may be helpful when developing the LFCP:

- GEIA-STD-0005-1, Performance Standard for Aerospace and High Performance Electronic Systems Containing Lead-free Solder
- GEIA-STD-0005-2, Standard for Mitigating the Effects of Tin Whiskers in Aerospace and High Performance Electronic Systems
- 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 and Finishes
- GEIA-STD-0006, Requirements for Using Solder Dip to Replace the Finish on Electronic Piece Parts

0.1.6.2 Mitigation Components, sub-assemblies, assemblies, and mechanical hardware identified as having lead-free tin surfaces, plating, metallization, etc., but which by package design or engineering decision are not prohibited

by SnPb replating or HSD, **shall** be protected by at least two process or design mitigation techniques to reduce or eliminate the risks created by metallic whisker formation in the expected end-use application/environment. Use of all mitigation methods **shall** require technical review and approval by the User prior to implementation. Mitigation measures that may be used are:

- a. Design – Components, sub-assemblies, assemblies, and mechanical hardware identified as having external surfaces, plating, metallization, etc., with a lead-free tin finish **shall** be physically positioned or mechanically isolated to ensure the growth of conductive whiskers does not adversely affect performance or reliability. Direct line-of-sight spacing between electrically uncommon conductive surfaces **shall** be sufficient to ensure whisker growth rates (1 mm [0.04 in]/yr. nominal) over the life of the mission do not violate minimum electrical clearance requirements.
- b. External surfaces, plating, metallization, etc., with a lead-free tin finish **shall** be fully coated with conformal coating with a total cured finish of not less than 100 µm [0.004 in].
- c. Embedment/Encapsulation – Embedment or encapsulant material **shall** fully wet and cover all surfaces of parts and areas specified by the approved engineering documentation. Cured material **shall** be compatible with the hardware and mission environment, and **shall not** adversely affect hardware performance or reliability.
- d. Other mitigation techniques approved by the User prior to implementation.

0.1.7 Red Plague (Cuprous Oxide Corrosion) Red Plague can develop in silver-coated soft or annealed copper conductors (component leads, single and multistranded wires and PCB conductors) when a galvanic cell forms between the copper base metal and the silver coating in the presence of moisture (H₂O) and oxygen (O₂). Once initiated, the sacrificial corrosion of the copper base conductor can continue indefinitely in the presence of oxygen. The color of the corrosion by-product (cuprous oxide crystals)

may vary depending on the different levels of oxygen available, but is commonly noted as a red/reddish-brown discoloration on the silver coating surface.

0.1.7.1 Red Plague Control Plan – Minimum Requirements The use of silver-coated copper conductors **shall** require the implementation of a User-approved Red Plague Control Plan (RPCP) to reduce and control exposure to environmental conditions and contamination that promote the development of cuprous oxide corrosion (Red Plague) and latent damage. The minimum requirements are as outlined below:

0.1.7.1.1 Shipping and Storage Wire and cable **shall** be shipped and stored in sealed water-vapor-proof packaging (i.e.: Moisture Barrier Bag, dry pack, etc.), with capped ends, activated desiccant, and humidity indicator card. Silver-coated copper wire and cable **shall** be segregated and dispositioned if the humidity indicator card registers 70% or more RH.

0.1.7.1.2 Assembly All assembly processes, including receiving inspection and kitting, **shall** be conducted in an environmentally-controlled and monitored area where dew point is not attained and the relative humidity is less than 70% RH.

- a. Wire and cable **shall not** be removed from its protective packaging until it has reached thermal equilibrium with the assembly environment to prevent condensation.
- b. Aqueous solvents **shall not** be used for cleaning and flux removal.

0.1.7.1.3 Limited Life Article

- a. Silver-coated copper conductors that have exceeded a shelf life of 10 years from manufacturing date **shall not** be used on assemblies fabricated to this standard.
- b. Completed assemblies incorporating silver-coated copper conductors with a storage or use life exceeding 10 years from date of assembly **shall** be identified and tracked as a limited-life article.

J-STD-001FS Table 1 Space Applications Requirements

J001F Reference	Space Applications Requirement (as changed by this Addendum)
1.1	NOTE: This clause is unchanged from J-STD-001F. It is included here to clarify that the Scope of the space Addendum does not replace nor alter Scope of the base document. Scope This standard prescribes practices and requirements for the manufacture of soldered electrical and electronic assemblies. For a more complete understanding of this document's recommendations and requirements, one may use this document in conjunction with IPC-HDBK-001 and IPC-A-610.
1.2	NOTE: This clause is unchanged from J-STD-001F. It is included here to clarify that the Purpose of the space Addendum does not replace nor alter Purpose of the base document. Purpose This standard describes materials, methods and acceptance criteria for producing soldered electrical and electronic assemblies. The intent of this document is to rely on process control methodology to ensure consistent quality levels during the manufacture of products. It is not the intent of this standard to exclude any procedure for component placement or for applying flux and solder used to make the electrical connection.
1.5.1	Hardware Defects When the word “shall” is used it expresses a requirement that is mandatory. Hardware characteristics or conditions that do not conform to the requirements of this specification that are detectable by inspection or analysis shall be classified as hardware defects. Hardware defects shall be identified, documented and dispositioned, e.g., rework, scrap, use as is, or repair. It is the responsibility of the User (see 1.8.12) to define additional defect categories applicable to the product. It is the responsibility of the Manufacturer (see 1.8.5) to identify defects that are unique to the assembly process (see 1.13.2).
1.7	Order of Precedence The contract shall take precedence over this Addendum, J-STD-001F, referenced standards and User-approved drawings (see IPC J-STD-001FS 1.7.1). See clause 0.1.2 of this Addendum.
1.7.1	Conflict In the event of conflict between the requirements of this standard and the applicable assembly drawing(s)/documentation, the applicable User approved assembly drawing(s)/documentation govern. Some examples of documentation include the contract, purchase order, technical data package, engineering specification or performance specification. In the event of a conflict between the text of this standard and the applicable documents cited herein, the text of this standard takes precedence. In the event of conflict between the requirements of this standard and an assembly drawing(s)/ documentation that has not been User approved, this standard governs. See clause 0.1.2 of this Addendum. When IPC J-STD-001 is cited or required by contract, the requirements of IPC-A-610 do not apply unless separately or specifically required. When IPC-A-610 or other related documents are cited along with IPC J-STD-001 the order of precedence shall be defined in the procurement documents. The User (customer) has the responsibility to specify acceptance criteria. If no criteria is specified, required, or cited, criteria shall be established and agreed upon between the Manufacturer and User.
1.10	Personnel Proficiency All instructors, operators, and inspection personnel shall be proficient in the tasks to be performed. Objective evidence, e.g., records of training to the applicable job functions being performed, work experience, testing to the requirements of this standard, or results of periodic reviews of proficiency, of that proficiency shall be maintained and be available for review. Training shall be in accordance with the IPC J-STD-001 Training and Certification Program or a Manufacturer developed program that shall be made available for review and approval upon request by the User. All training shall be traceable to a J-STD-001 Master IPC Trainer (MIT).
1.10.1	Vision Requirements All instructors, operators and inspection personnel shall meet the following vision requirements as a condition of proficiency. The vision requirements may be met with corrected vision. The vision tests shall be administered by a qualified examiner, accepted by the User, using standard instruments and techniques. Results of the visual examinations shall be maintained and available for review. The following are minimum vision requirements; alternate industry recognized vision tests may be used. Binocular vision is not required: Near Vision. Jaeger 1 at 355.6 mm [14 in] or reduced Snellen 20/20, or equivalent. Color Vision. Ability to distinguish red, green, blue, and yellow colors. Note: A practical test using color coded wires and/or color coded electrical parts, as applicable, is acceptable for color vision testing.
1.11	Acceptance Requirements All products shall meet the requirements of the assembly drawing(s)/documentation and the requirements specified herein. Manufacturers shall perform 100% inspection using either visual inspection or nondestructive evaluation (NDE). Nondestructive verification techniques shall be approved by the User prior to use.