IPC J-STD-001H
September 2020
Supersedes IPC J-STD-001G
October 2017

JOINT INDUSTRY STANDARD

Requirements for Soldered Electrical and Electronic Assemblies

IPC®
BUILD ELECTRONICS BETTER

The Principles of Standardization

In May 1995 the IPC's Technical Activities Executive Committee (TAEC) adopted Principles of Standardization as a guiding principle of IPC's standardization efforts.

Standards Should:

- Show relationship to Design for Manufacturability (DFM) and Design for the Environment (DFE)
- Minimize time to market
- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feedback system on use and problems for future improvement

Standards Should Not:

- Inhibit innovation
- Increase time-to-market
- Keep people out
- Increase cycle time
- Tell you how to make something
- Contain anything that cannot be defended with data

Notice

IPC Standards and Publications are designed to serve the public interest through elimination misunderstandings between manufacturers and purchasers, facilitating interchangeability and improvement of products, and assisting the purchaser in selecting and obtaining with minimum delay the proper product for his particular need. Existence of such Standards and Publications shall not in any respect preclude any member or nonmember of IPC from manufacturing or selling products not conforming to such Standards and Publication, nor shall the existence of such Standards and Publications preclude their voluntary use by those other than IPC members whether the standard is to be used either domestically or internationally.

Recommended Standards and Publications are adopted by IPC without regard to whether their adoption may involve patents on articles, materials, or processes. By such action, IPC does not assume any liability to any patent owner, nor do they assume any obligation whatever to parties adopting the Recommended Standard or Publication. Users are also wholly responsible for protecting themselves against all claims of liabilities for patent infringement.

IPC Position Statement on Specification Revision Change

It is the position of IPC's Technical Activities Executive Committee that the use and implementation of IPC publications is voluntary and is part of a relationship entered into by customer and supplier. When an IPC publication is updated and a new revision is published, it is the opinion of the TAEC that the use of the new revision as part of an existing relationship is not automatic unless required by the contract. The TAEC recommends the use of the latest revision. Adopted October 6, 1998

Why is there a charge for this document?

Your purchase of this document contributes to the ongoing development of new and updated industry standards and publications. Standards allow manufacturers, customers, and suppliers to understand one another better. Standards allow manufacturers greater efficiencies when they can set up their processes to meet industry standards, allowing them to offer their customers lower costs.

IPC spends hundreds of thousands of dollars annually to support IPC's volunteers in the standards and publications development process. There are many rounds of drafts sent out for review and the committees spend hundreds of hours in review and development. IPC's staff attends and participates in committee activities, typesets and circulates document drafts, and follows all necessary procedures to qualify for ANSI approval.

IPC's membership dues have been kept low to allow as many companies as possible to participate. Therefore, the standards and publications revenue is necessary to complement dues revenue. The price schedule offers a 50% discount to IPC members. If your company buys IPC standards and publications, why not take advantage of this and the many other benefits of IPC membership as well? For more information on membership in IPC, please visit www.ipc.org or call 847/597-2809.

Thank you for your continued support.

IPC J-STD-001H

Requirements for Soldered Electrical and Electronic Assemblies

If a conflict occurs between the English and translated versions of this document, the English version will take precedence.

Developed by the J-STD-001 Task Group (5-22A), J-STD-001 Task Group – Europe (5-22A-EU), J-STD-001 Task Group – China (5-22ACN) of the Assembly and Joining Committees (5-20) of IPC

Supersedes:
J-STD-001G - October 2017
J-STD-001F WAM1 - February 2016
J-STD-001F - July 2014
J-STD-001E - April 2010
J-STD-001D - February 2005
J-STD-001C - March 2000
J-STD-001B - October 1996
J-STD-001A - April 1992

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

Contact:

IPC
3000 Lakeside Drive, Suite 105N
Bannockburn, Illinois
60015-1249
Tel 847 615.7100
Fax 847 615.7105

ADOPTION NOTICE

J-STD-001, "Requirements for Soldered Electrical and Electronic Assemblies", was adopted on 19-JUL-01 for use by the Department of Defense (DoD). Proposed changes by DoD activities must be submitted to the DoD Adopting Activity: Commander, US Army Tank-Automotive and Armaments Command, ATTN: AMSTA-TR-E/IE, Warren, MI 48397-5000. Copies of this document may be purchased from the The Institute for Interconnecting and Packaging Electronic Circuits, 2215 Sanders Road, Northbrook, IL 60062-6135. http://www.ipc.org/

Custodians:
Army - AT
Navy - AS

Adopting Activity:
Army - AT
(Project SCLD-0059)

Reviewer Activities:
Army - AV, MI

AREA SOLD

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

Acknowledgment

Any document involving a complex technology draws material from a vast number of sources across many continents. Shown below are the principal members of the J-STD-001 Task Group (5-22A), J-STD-001 Task Group – Europe (5-22A-EU), J-STD-001 Task Group – China (5-22ACN) of the Assembly and Joining Committees (5-20). It is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of IPC extend their gratitude.

Assembly and Joining Committee

Chair
Daniel Foster
Missile Defense Agency

Vice Chair
Karen Tellefsen
MacDermid Alpha Electronics Solutions

J-STD-001 Task Group (5-22A)

Co-Chairs
Milea Kammer
Honeywell International

Jonathon Vermillion
Ball Aerospace

Vice Chairs
Gaston Hidalgo
Toyota Motor North America

Jarrod Webb
Lockheed Missiles & Fire Control

J-STD-001 Task Group – Europe (5-22A-EU)

Co-Chairs
Tiberiu Baranyi
Flextronics Romania SRL

Debbie Wade
Advanced Rework Technology – A.R.T.

J-STD-001 Task Group – China (5-22ACN)

Co-Chairs
Ren Kang
AVIC Computing Technique Research Institute

Yabing Zou
The 5th Electronic Institute of MII

Vice Chair
Eric Li
TT Electronics Integrated Manufacturing Services (Suzhou) Limited

Technical Liaison of the IPC Board of Directors

Bob Neves
Microtek (Changzhou) Laboratories

Contributing J-STD-001 Task Group Members

Gianluca Esposito
Warren Harper
Bruce Hughes
Kathy Johnston
Evan Levy
Randy McNutt
Mary Muller
Sukhraj Takhar
Allen Thai
Arye Grushka, A. A. Training Consulting and Trade A.G. Ltd.
Douglas Schueler, AbelConn, LLC
Neil Wolford, AbelConn, LLC
Ross Dillman, ACI Technologies, Inc.
Constantino Gonzalez, ACME Training & Consulting
Pietro Vergine,* Advanced Rework Technology – A.R.T.
John Vickers, Advanced Rework Technology – A.R.T.
Debbie Wade,* Advanced Rework Technology – A.R.T.
Michael Wierleski, Aerojet Rocketdyne
Brandy Tharp, AeroTEC Inc.
Fernando Perez Gracia,* Airbus Defence & Space
Claus Molgaard,* ALPHA-elektronik A/S
Chris Stuber, American Hakko Products Inc.
Christopher Sewell, AMETEK
Leo Huang, APCB Electronics (Thailand) Co., Ltd
Stefan Hanigk,* Ariane Group GmbH
Rob Mullane,* Atek Training Services Ltd.
Bob Potysman, ATRON Group LLC
Arvind Karthikeyan, Auburn University
Marino Verderio,* Automotive Lighting SpA
Xin Chen,** AVIC ACTRI
Bingjin Liu,** AVIC ACTRI
Kang Ren,** AVIC Xi'an Aeronautics Computing Technical Research Institute
Liang Jia,** AVIC Taiyuan Aero-Instruments Co., Ltd.
Caroline Harris, Axis Electronics Ltd.
Chris Jukes,* Axis Electronics Ltd.
Erik Bjerke, BAE Systems
Ana Contreras, BAE Systems
Tim Gallagher, BAE Systems

Greg Hurst, BAE Systems
Joseph Kane, BAE Systems
Maan Kokash, BAE Systems
Kelly Kovalovsky, BAE Systems
Andrew Leslie, BAE Systems
Agnieszka Ozarowski, BAE Systems
Brian Parliman, BAE Systems
Marie Parliman, BAE Systems
Marissa Pati, BAE Systems
Darrell Sensing, BAE Systems
Jonathon Vermillion, Ball Aerospace & Technologies Corp.
Sonny Villa, Ball Aerospace & Technologies Corp.
Gerald Bogert, Bechtel Plant Machinery, Inc.
Jenny Lee,** Beijing Hangxing Technologies Co.,Ltd.
Glory Yin,** Beijing Hangxing Technologies Co., Ltd.
James Barnhart, BEST Inc.
Jodi Johnson, BEST Inc.
Norman Mier, BEST Inc.
Kris Roberson, BEST Inc.
Dorothy Cornell, Blackfox Training Institute
Samuel Sorto, Blue Origin, LLC
David Lee, BMK Professional Electronics GmbH
Eric Harenburg, Boeing Company
Karl Mueller, Boeing Company
Ruby Lei,** BrainPower
Dawn Cabales, Carlisle Interconnect Technologies
Tawsha Cabales, Carlisle Interconnect Technologies
Vesna Delic, Carlisle Interconnect Technologies
Jason Keeping, Celestica International L.P.
Weiming Li,** CEPREI Laboratory
Jie Chen,** Chengdu Yaguang Electronics Co., Ltd
Changqing Feng,** China Household Electric Appliance Research Institute
Steven Perng, Cisco Systems Inc.
Sean Keating, Clonfert Solutions Ltd
Yeung Cheung,** CML EurAsia
David Adams, Collins Aerospace
William Cardinal, Collins Aerospace
Caroline Ehlinger, Collins Aerospace
David Hillman, Collins Aerospace
Scott Meyer, Collins Aerospace
Bonnie Pape, Collins Aerospace
Douglas Pauls, Collins Aerospace
Timothy Pearson, Collins Aerospace
David Rafson, Collins Aerospace
Debie Vorwald, Collins Aerospace
Dan White, Collins Aerospace
Alan Sun,** CommScope Telecommunications (China) Co. Ltd.
Andreas Gregor,* Consultronica, S.L.
Michael Haas, Conti Temic Microelectronic GmbH
Alain Le Grand, Continental Automotive France SAS
Hans-Otto Fickenscher, Continental Automotive GmbH
Manuel Tabarez, Continental Automotive Nogales S.A. de C.V.
Mark Fulcher, Continental Automotive Systems
Stanton Rak, Continental Automotive Systems
Catalina Pamatmat, Continental Temic Electronics (Phils.)
Miguel Dominguez, Continental Temic SA de CV
Jose Servin Olivares, Continental Temic SA de CV
Kathleen Kouthong, Crane Aerospace & Electronics
Danqing Wen,** CSIC Xi'an DongYi Science Technology & Industry Group Co., Ltd
Robin Bridge, Curtiss-Wright Defense Solutions
Symon Franklin,* Custom Interconnect Ltd
Jacqueline Topple, Custom Interconnect Ltd
David Barastegui, DBMTech
Wallace Ables, Dell Inc.
Stuart Longgood, Delphi Technologies
Nicholas Castro, Delta Group Electronics Inc.
Tod Cummins, Delta Group Electronics Inc.
Irene Romero, Delta Group Electronics Inc.
Brent Wyatt, Delta Group Electronics Inc
Timothy McFadden, EEI Manufacturing Services
Emma Hudson, Emma Hudson Technical Consultancy Ltd
Melissa Holland, EPTAC Corporation
Leo Lambert, EPTAC Corporation
Marcia McLaughlin, EPTAC Corporation
Helena Pasquito, EPTAC Corporation
Ramon Koch, ITEC H-trainingen
Iain Macmillan,* Exmel Solutions Ltd
Cylin Zhang,** Flextronics Electronics Technology (Suzhou) Co. Ltd.
Tiberiu Baranyi,* Flextronics Romania SRL
Sasha Andreas, Flight Critical
Harald Olsen,* FMC Technologies AS
Nancy Deng,** Ford Motor Research Engineering Co., Ltd
Eric Camden, Foresite, Inc.
Francisco Fourcade,* Fourcad, Inc
Kurt McLain, Frontier Electronic Systems
Henrik Jensen,* Gaasdal Bygningsindustri A/S
Petrel Pang,** Ganzhou Kingsun Technology Co., Ltd.
Christopher Hunt, Gen3 Systems Limited
Graham Naisbitt, Gen3 Systems Limited
Richard Stadem, General Dynamics Mission Systems
Melby Thelakkaden, General Dynamics Mission Systems
Francesco Di Maio,* GESTLABS S.r.l.
Antonio Perna,* GESTLABS S.r.l.

Alejandro Cruz Voost, GPV Americas S.A.P. I de C.V.
Jesper Djurhuus,* GPV Electronics A/S
Torben Kruse,* Grundfos Holding A/S
Svein Olav Kolbu,* Hapro AS
Beverley Christian, HDP User Group
Torsten Schmidt, HELLA GmbH & Co. KGaA
Thomas Lauer,* HENSOLDT Sensors GmbH
Keith Walker, Honeywell Aerospace
Phil Befus, Honeywell Aerospace
John Mastorides, Honeywell Aerospace
Christina Rutherford, Honeywell Aerospace
Richard Rumas, Honeywell Canada
Milea Kammer, Honeywell International
Elizabeth Benedetto, HP Inc.
Kristen Troxel, HP Inc.
Jennie Hwang, H-Technologies Group
Joe Hughes, Hughes Circuits, Inc.
Jens Andersen,* HYTEK
Alex Christensen,* HYTEK
Poul Juul, HYTEK
Jonathan Albrieux,* IFTEC
Jean-Luc Umbdenstock, IFTEC
Mirko Giannecchini,* IIS Progress SRL
Luca Moliterni,* IIS Progress SRL
Gianluca Parodi,* IIS Progress SRL
Robert Bowden, Impact Centre for Training & Staffing
Stephen Langdon, Impact Centre for Training & Staffing
Morgan Miller, Insight Software LLC
Ana Ferrari Felippe, Instituto de Pesquisas Eldorado
Ife Hsu, Intel Corporation
Jagadeesh Radhakrishnan, Intel Corporation
Jose Luis Gonella, INVAP S.E.
Jeffrey Lee, iST - Integrated Service Technology
Mitsuhiro Asaka, Japan Unix Co., Ltd.
Yusaku Kono, Japan Unix Co., Ltd.
Toshiyasu Takei, Japan Unix Co., Ltd.
Alan Young, Jet Propulsion Laboratory
Jose Delgado, Jet Propulsion Laboratory
Reza Ghaffarian, Jet Propulsion Laboratory
James Toth, Jim Toth Solutions, LLC
Neal Reek, Johns Hopkins University
Vicki Hagen, Justice Electronic Training Services
Kevin Boblits, K&M Manufacturing Solutions, LLC
Gerald Adams, KBRwyle
Sue Powers-Hartman, Killdeer Mountain Manufacturing, Inc.
Nancy Bullock-Ludwig, Kimball Electronics
Eileen Xiang,** Kimball Electronics (Nanjing) Co., Ltd.
Grunde Gjertsen,* Kitron ASA
Mike Bixenman, Kyzen Corporation
Thomas Forsythe, Kyzen Corporation
David Lober, Kyzen Corporation
Augustin Hamel, L&G Advice Serv SRL
Theodore Laser, L3Harris Communications
Frederick Beltran, L3Harris Communications
Shelley Holt, L3Harris Communications
Jared Spencer, L3Harris Communications
Keld Maaloee,* LEGO Systems A/S
Rebekah Kovarik, Lockheed Martin
Jeff Friedman, Lockheed Martin Corporation
Chris Newton, Lockheed Martin Corporation
James Erickson, Lockheed Martin Missiles & Fire Control
Julian Finlaw, Lockheed Martin Missiles & Fire Control
William Fox, Lockheed Martin Missiles & Fire Control
Josh Goolsby, Lockheed Martin Missiles & Fire Control
Ben Gumpert, Lockheed Martin Missiles & Fire Control
Alafio Hewitt, Lockheed Martin Missiles & Fire Control
Joshua Hudson, Lockheed Martin Missiles & Fire Control
Sharissa Johns, Lockheed Martin Missiles & Fire Control
Kyle Johnson, Lockheed Martin Missiles & Fire Control
Vijay Kumar, Lockheed Martin Missiles & Fire Control
Brian Llewellyn, Lockheed Martin Missiles & Fire Control
Owen Reid, Lockheed Martin Missiles & Fire Control
Ekaterina Stees, Lockheed Martin Missiles & Fire Control
Ann Marie Tully, Lockheed Martin Missiles & Fire Control
Jarrod Webb, Lockheed Martin Missiles & Fire Control
Pamela Petcosky, Lockheed Martin Mission Systems & Training
Tom Rovere, Lockheed Martin Mission Systems & Training
David Mitchell, Lockheed Martin Rotary & Mission Systems
Kimberly Shields, Lockheed Martin Rotary & Mission Systems
Paul Kirpes, Los Alamos National Laboratory
Linda Woody, LWC Consulting
Traian Cucu, MacDermid Alpha Electronics Solutions
Jason Fullerton, MacDermid Alpha Electronics Solutions
Karen Tellefsen, MacDermid Alpha Electronics Solutions
Zhaochen Xu,** Guangzhou C-Sem Electronics Technology Co., Ltd.
Michael Durkan, Mentor Graphics Corporation

Caitlin Samples, Methods Automation
Matt Garrett, Microsemi
Donald Tyler, Micross Components, LLC
William Pfingston, Miraco, Inc.
Daniel Foster, Missile Defense Agency
Bill Kasprzak, Moog Inc.
Edward Rios, Motorola Solutions
Jungu Zhang,** Nanjing Future Mobility New Energy Vehicle Technology Development Co., Ltd.
Alvin Boutte, NASA Goddard Space Flight Center
Chris Fitzgerald, NASA Goddard Space Flight Center
Bhanu Sood, NASA Goddard Space Flight Center
Robert Cooke, NASA Johnson Space Center
James Blanche, NASA Marshall Space Flight Center
Charles Gamble, NASA Marshall Space Flight Center
Adam Gowan, NASA Marshall Space Flight Center
Garry McGuire, NASA Marshall Space Flight Center
Zackary Fava, NAVAIR
Kim Mason, Naval Surface Warfare Ctr
William May, Naval Surface Warfare Ctr
Joseph Sherfick, Naval Surface Warfare Ctr
Nicholas Walton, Naval Surface Warfare Ctr
Scott Wise, Navy Special Emphasis Operations, EXTAD
Qiuju Yan,** Ningbo CRI[illegible] Transducer Technique Co., Ltd.
Russell Nowland, Nokia
Torgrim Nor[illegible], Norautron AS
Randy Bre[illegible]er, Northrop Grumman
Steven D[illegible]is, Northrop Grumman
Stepha[illegible]e Stork, Northrop Grumman
La[illegible] Landseadal, Northrop Grumman Corporation
Adi Lang, Northrop Grumman Corporation
Doris McGee, Northrop Grumman Corporation
Kaitlyn Skillman, Northrop Grumman Corporation
Tana Soffa, Northrop Grumman Corporation
Ryan Staffen, Northrop Grumman Corporation
Carlo Viola, Northrop Grumman Corporation
LaKia Williams, Northrop Grumman Corporation
Luke Bycroft, Northrop Grumman Innovation Systems
Daniel Morin, Northrop Grumman Innovation Systems
Patrick Phillips, Northrop Grumman Innovation Systems
Ceferino Reyes, Northrop Grumman Innovation Systems
Mark Shireman, Northrop Grumman Innovation Systems
Mahendra Gandhi, Northrop Grumman Space Systems
Rene Martinez, Northrop Grumman Space Systems
Bernard Ecker, Northrop Grumman Systems Corporation
Callie Olague, Northrop Grumman Systems Corporation
Chen Ya[illegible]i, WEEK Kunshan Testing Co., Ltd.
Wil[illegible]Graver, NTS - Baltimore
[illegible]gela Pennington, NuWaves Engineering
Joshua Huang, Nvidia Corporation
Hoa Nguyen, OK International
Ken Moore, Omni Training Corp.
Toshiyuki Sugiyama, Omron Corporation-Inspection Systems Business Division
Tristan Campbell, Out of the Box Manufacturing
Gustavo Arredondo, PARA TECH Parylene Services
Jose de Jesus Montanez Ortiz, Phoenix Industrial Supply
Wim Bodelier, PIEK International Education Centre (I.E.C.) BV
Ron Fonsaer, PIEK International Education Centre (I.E.C.) BV
Frank Huijsmans, PIEK International Education Centre (I.E.C.) BV
Rob Walls,* PIEK International Education Centre (I.E.C.) BV
Kirk Van Dreel, Plexus Corp.
James Taylor, Plexus Corp.
See Thao, Plexus Corp.
Joseph Russeau, Precision Analytical Laboratory, Inc.
Catherine Hanlin, Precision Manufacturing Company, Inc.
Steven Corkery, Raytheon Company
James Daggett, Raytheon Company
Michael Javitz, Raytheon Company
David Mayer, Raytheon Company
Anthony Martinelli, Raytheon Company
James Saunders, Raytheon Company
Fonda Wu, Raytheon Company
Matthew Abbott, Raytheon Missile Systems
Lance Brack, Raytheon Missile Systems
Maria Colon, Raytheon Missile Systems
George Millman, Raytheon Missile Systems
Mark Northrup, Raytheon Missile Systems
Martin Scionti, Raytheon Vision Systems
Nichole C. Thilges, Raytheon Missile Systems
Pascal Dumontet,* RENAULT
Marcin Sudomir,* Renex Electronics Education Center
Rama Murthy, PBV Research Centre Imarat, DRDO, Ministry of Defence
Gunter Gera, Robert Bosch GmbH
Lothar Henneken, Robert Bosch GmbH
Norbert Holle, Robert Bosch GmbH

Patrick Leidich, Robert Bosch GmbH
Theresia Richter, Robert Bosch GmbH
Udo Welzel, Robert Bosch GmbH
Alisha Asbell, SAIC
Gary Latta, SAIC
Xingquan Dong,** SAIC Motor
Rodney Doss, Samtec, Inc.
Jon Roberts, Sanmina Corporation
Mark Kostinovsky, Schlumberger Well Services
Henry Rekers, Schneider Electric Systems USA, Inc.
Norma Low, SCI Technology, Inc.
Robert Jackson, Semi-Kinetics
Jie Yuan,** Shanghai Quick Turn Electronics Co., Ltd.
Jiong (Crystal) Dai,** Shennan Circuits Co. Ltd.
Chengyan Cui,** Shenyang Railway Signal Co., Ltd.
Suzhong Liu,** Shenzhen Hengzhiyuan Technology Corporation Ltd
Yangchun Zhang,** Shintech
Kevin Syverson, Silicon Forest Electronics, Inc.
Vern Solberg, Solberg Technical Consulting
Gerard O'Brien, Solderability Testing & Solutions, Inc.
Fatima Johnson, Solve Direct Electronics
Neil Johnson, Solve Direct Electronics
Lamar Young, Specialty Coating Systems Inc.
Paul Pidgeon, STEM Training
Robert Fornefeld, STI Electronics, Inc.
Frank Honyotski, STI Electronics, Inc.
Mark M. Meer, STI Electronics, Inc.
Patrick Scott, STI Electronics, Inc.
Qin Chen,** Suzhou Eunow Co., Ltd.
Yanqi Chen,** Suzhou Meixin Testing Technology Co., Ltd.
Rainer Taube, Taube Electronic GmbH
Lynda Pelley, Teledyne Dalsa
Monica Tucker, Teledyne Electronic Manufacturing Services
Michael Collier, Teledyne Leeman Labs
Angelica Joson-Eltanal, Teradyne Philippines Ltd
Marian Johnson, Thales Defense & Security, Inc.
Julien Vieilledent, Thales Global Services
Ying Yang,** The Fifth Research Institute of MIIT, P.R. China
Yabing Zou,**The Fifth Electronics Research Institute of Ministry of Industry and Information Technology
James Parke, The Aerospace Corporation
Gildardo Jimenez-Mungia, The Chamberlain Group, Inc.
John O'Neill,* The Electronics Group Ltd
Doug Wilson, The Electronics Group Ltd.
Satoshi Kasniwabara, Toyota Motor Corporation
Shoji Mishima, Toyota Motor Corporation
Kazunori Nishihara, Toyota Motor Corporation
Ken Yamamoto, Toyota Motor Corporation
Joaquin Cuevas, Toyota Motor North America
Gaston Hidalgo, Toyota Motor North America
Eric Li,** TT Electronics Integrated Manufacturing Services (Suzhou) Limited
Taylor Abrahamian, TTM Technologies, Inc.
Marc Emmons, TTM Technologies, Inc.
Daniel Koss, TTM Technologies, Inc.
Ryan Mastriani, TTM Technologies, Inc.
James Monarchio, TTM Technologies, Inc.
John Wood, TTM Technologies, Inc.
Tapas Yagnik, TTM Technologies, Inc.
Paul Zutter, U.S. Army Aviation & Missile Command
Irving Lee, UL LLC
Crystal Vanderpan, UL LLC
Alan Christmas, Ultra Electronics Communication & Integrated Systems
Barrie Dunn, University of Portsmouth
Rachel Grinvalds, UTC Aerospace
Russell Kaunas, UTC Aerospace Systems
Jason Nipper, UTC Aerospace Systems
Constantin Hudon, Varitron Technologies Inc.
Jack Zhu,** Veoneer China Co., LTD
Dave Harrell, Viasat Inc.
Stephen Meeks, ViaSat
Gerjan Diepstraten, Vitronics Soltec
Luis Dias,* West Control Solutions
Jeffrey Black, Westinghouse Electric Co., LLC
Andrew Goddard, ZF Automotive UK Limited
Colin Wang,** Zestron
Zhiman Chen,** Zhuzhou CRRC Times Electric Co., Ltd.
Mingsheng Long,** Zhuzhou CRRC Times Electric Co., Ltd
Zhe (Jacky) Liu,** ZTE Corporation

Thank you to the 5-22a J-STD-001 Team Skeleton for their efforts in developing the x-ray criteria for this document.

David Bernard
Kathy Johnston
David Hillman, Collins Aerospace
Timothy Pearson, Collins Aerospace
Tiberiu Baranyi, Flextronics Romania SRL
John Mastorides, Honeywell Aerospace

Vijay Kumar, Lockheed Martin Missiles & Fire Control
Jarrod Webb, Lockheed Martin Missiles & Fire Control
Daniel Foster, Missile Defense Agency
Bhanu Sood, NASA Goddard Space Flight Center
Robert Cooke, NASA Johnson Space Center
James Blanche, NASA Marshall Space Flight Center
James Daggett, Raytheon Company
Maria Colon, Raytheon Missile Systems
Thorsten Rother, YXLON International GmbH

A special thank you to the 5-22A J-STD-001 A-Team for their dedication and commitment to this effort. Their support and time during the development of this document is greatly appreciated.

Jonathon Vermillion, Ball Aerospace & Technologies Corp.
Scott Meyer, Collins Aerospace
Symon Franklin, Custom Interconnect Ltd
Milea Kammer, Honeywell International
Sue Powers-Hartman, Killdeer Mountain Manufacturing, Inc.
Shelley Holt, L3Harris Communications
Josh Goolsby, Lockheed Martin Missiles & Fire Control
Ben Gumpert, Lockheed Martin-Missiles & Fire Control
Jarrod Webb, Lockheed Martin Missiles & Fire Control
Chris Fitzgerald, NASA Goddard Space Flight Center
Garry McGuire, NASA Marshall Space Flight Center
William May, Naval Surface Warfare Ctr
James Parke, The Aerospace Corporation
Gaston Hidalgo, Toyota Motor North America

* Members of 5-22A and 5-22A-EU
**Members of 5-22A and 5-22ACN

1. Figure 7-12A Image Credit: NASA
2. Figure 4-4 is © Omni Training, used by permission.

Table of Contents

Figures

Tables

Requirements for Soldered Electrical and Electronic Assemblies

1.0 GENERAL

1.1 Scope 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, such as for component placement or for applying flux and solder used to make the electrical connection.

The soldering operations, equipment, and conditions described in this document are based on electrical/electronic circuits designed and fabricated in accordance with the specifications listed in Table 1-1.

Table_1-1 Design, Fabrication and Acceptability Specifications

Board Type	Design	Fabrication/Acceptability Specification
Generic Requirements	IPC-2221	IPC-6011
Rigid Printed Boards	IPC-2222	IPC-6012 IPC-A-600
Flexible Circuits	IPC-2223	IPC-6013
Rigid Flex Board	IPC-2222 IPC-2223	IPC-6013

1.2 Purpose This standard prescribes material requirements, process requirements, and acceptability 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, IPC-AJ-820 and IPC-A-610. Standards may be updated at any time, including with the addition of amendments. The use of an amendment or a newer revision is not automatically required.

1.3 Classification This standard recognizes that electrical and electronic assemblies are subject to classifications by intended end-item use. Three general end-product classes have been established to reflect differences in manufacturability, complexity, functional performance requirements, and verification (inspection/test) frequency.

Use of this standard requires agreement on the class to which the product belongs. The User has the responsibility for identifying the class to which the assembly is produced. The product class should be stated in the procurement documentation package. If the User does not establish and document the acceptance class, the Manufacturer may do so.

CLASS 1 General Electronic Products
Includes products suitable for applications where the major requirement is function of the completed assembly.

CLASS 2 Dedicated Service Electronic Products
Includes products where continued performance and extended life is required, and for which uninterrupted service is desired but not critical. Typically the end-use environment would not cause failures.

CLASS 3 High Performance/Harsh Environment Electronic Products
Includes products where continued high performance or performance-on-demand is critical, equipment downtime cannot be tolerated, end-use environment may be uncommonly harsh, and the equipment must function when required, such as life support or other critical systems.

1.4 Measurement Units and Applications This standard uses International System of Units (SI) units per ASTM SI10, IEEE/ASTM SI 10, Section 3 [Imperial English equivalent units are in brackets for convenience]. The SI units used in this standard are millimeters (mm) [in] for dimensions and dimensional tolerances, Celsius (°C) [°F] for temperature and temperature tolerances, grams (g) [oz] for weight, and lux for illuminance.

Note: This standard uses other SI prefixes (ASTM SI10, Section 3.2) to eliminate leading zeroes (for example, 0.0012 mm becomes 1.2 µm) or as alternative to powers-of-ten (3.6×10^3 mm becomes 3.6 m).