Assembly and Cleaning

Prototype FDC Wire Boards

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23 January 2009

1. Introduction

Particle detectors employ printed circuit boards (PCB) to assemble and integrate a multitude of readout electronics functions in close proximity to the detecting sensors. Several detailed considerations are exercised, and in combination, during the design, manufacturing, installation and operation of these PCBs. Some key parameters are: circuit density, high voltage operation, low out gassing performance of the materials used, low susceptibility to radiation damage and restricted access. Therefore, it is imperative to follow high quality assurance and control plans that promote a high reliability product.

This note describes industry-standard procedures that envelope primarily the manufacturing cycle. Cleaning guidelines may well be extended to installation and operation of other electronics sub-systems and as part of a comprehensive approach to detector installations for high reliability operations.

2. Standards for Assembly and Cleaning of PCBs with SMT components

The most influential industry association connecting electronics industries is IPC. Its standards, and in collaboration with other associations, govern the assembly of PCBs. PCBs with surface mount components (SMT) are also described. For further information, refer to the IPC website www.ipc.org.

IPC-A-610D -Acceptability of Electronic Assemblies describes the acceptance criteria for soldered components, cleaning, marking and other topics of interest for assembly and QA & QC.

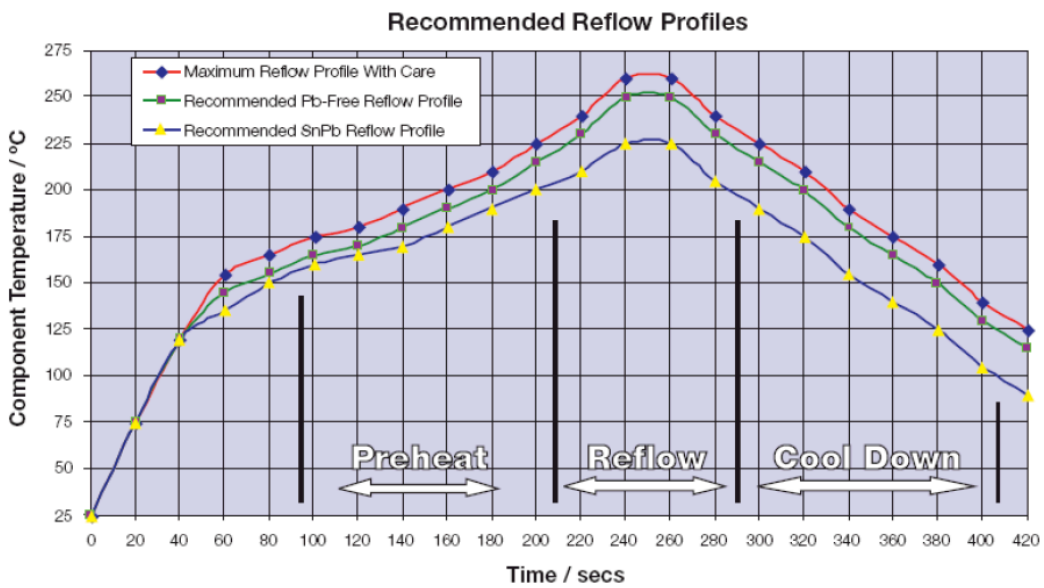
IPC J-STD-001D -Requirements for Soldered Electrical and Electronic Assemblies is a standard that complements IPC-A-610D. Addendum IPC J-STD-001DS is of particular importance to our applications.

There is also a standard that describes test techniques and procedures for chemical, mechanical, electrical, and environmental tests, and which is especially important if verification of cleanliness is necessary. Due to the constant development of newer test methodologies, the latest addenda to the IPC-TM-650 standard should be consulted.

Table 1 – IPC Standards

Standard	Description	Application
IPC-A-610D	Acceptability of Electronic Assemblies	Assembly, Cleaning
IPC J-STD-001D	Requirements for Soldered Electrical and Electronic Assemblies	Assembly, Cleaning
IPC J-STD-001DS	Addendum to IPC J-STD-001D for Space Applications	Assembly, Cleaning
IPC-TM-650	Test Methods	Verification, only if necessary

SMT Reflow Profile



Maximum Temperature Gradient (Heating and Cooling) = 4°C/sec.

Source: AVX

3. Materials and Methods

3.1 Solder Formulations

Solder formulations of Sn63Pb37 of type R and RMA, rosin and resin are recommended. These formulations may also conform to aqueous and semi-aqueous cleaning processes. Under no circumstances shall No-clean type formulations be used.

3.2 Fluxes

Use Rosin Flux type RMA #186 by Kester.

3.3 Cleaning

Proper and thorough cleaning of the PCB assembly after component assembly is the most important step towards long term reliability of the finished product. Subsequent handling of the finished PCBs must also be confined to clean environments and follow procedures conducive to the minimization of contaminants.

Ionic and organic contaminants or residues, which are normal by-products of the assembly process, must be removed from the surfaces of the PCB and components. If not entirely removed, long term reliability will be negatively impacted due to corrosion. This has been extensively demonstrated and documented in the electronics industry.

Several studies have demonstrated that a combination of de-ionized (DI) water and a diluted saponifier remove most of the ionic and organic residues. Any aqueous cleaning process must be followed by a final DI water rinse step. Note that several saponifiers are available from different manufacturers and qualification may be necessary.

Cleaning Process Steps:

1. Bathe in solution of Vigon 101 and LCW water at 40 ºC for 20 minutes

2. Rinse with LCW water

3. Inspect for surface contaminants at X4 to X10 magnifications

4. Storage in Anti-Static bags

3.4 Handling

It is recommended that gloves, preferably sterile, be used when handling PCB assemblies to avoid contamination by oily deposits or from silicones. Gloves must be discarded often.

Handling of the PCB assemblies must also conform to ESD best practices. PCB assemblies must be stored and sealed in clean and unused ESD bags.

4. QC & QA Plans

Every step of any of the processes described in this document must be well documented and labeled for each PCB assembly. Such documentation, or traveler, must be part of an overall QC & QA plan to be implemented throughout the fabrication and installation processes. These plans are also crucial to understanding possible failure modes and optimizing and validating control and inspection checks.

5. Further Recommendations

This document presented a set of guidelines that need to be considered when implementing a comprehensive plan for the assembly, installation and operation of high reliability PCB assemblies. It is imperative that QA and QC plans be developed and detailed for each assembly

unit or process. It must be understood that these guidelines are just a summary of best practices demonstrated by the experience gained in the electronics industry covering a multitude of applications. The reader is also encouraged to refer to the most up-to-date standards and publications available.

6. Appendix – IPC Standards

IPC Specification Tree

Electronic Assembly

TERM AND DEFINITIONS
- IPC-T-50

ACCEPTANCE
- IPC-DRM-40
- IPC-A-610
- IPC-9191
- IPC-DRM-SMT
- POSTERS

ASSEMBLY
- J-STD-001
- IPC-HDBK-001
- IPC-9261
- IPC-7912

SOLDERABILITY
- IPC-WP-001
- J-STD-002
- J-STD-003
- IPC-WP-005
- IPC-TR-461
- IPC-TR-462
- IPC-TR-464
- IPC-TR-465-1
- IPC-TR-465-2
- IPC-TR-465-3
- IPC-TR-466
- IPC-TR-585

ADVANCED
- IPC-TR-001
- IPC-WP-003
- J-STD-012
- J-STD-013
- J-STD-026
- J-STD-028
- IPC-SM-784
- IPC-MC-790

CABLE AND WIRE HARNESS
- IPC-DRM-WHA
- IPC-WHMA-A-620

OPTOELECTRONICS
- IPC-0040
- IPC-8413-1

ASSEMBLY SUPPORT
- SMC-WP-002
- IPC-DRM-18
- IPC-DW-426
- IPC-TR-581
- IPC-TA-722
- IPC-TA-723
- IPC-CM-770
- IPC-SM-780
- IPC-SM-785
- IPC-S-816
- IPC-AJ-820
- IPC-TP-1115
- IPC-1720
- IPC-7095
- IPC-7525
- IPC-7526
- IPC-7530
- IPC-7711/7721
- IPC-9701
- IPC/JEDEC-9702
- IPC/JEDEC-9704
- IPC-9850
- IPC-9851

ASSEMBLY MATERIALS

Flux/Solder
- J-STD-004
- IPC-HDBK-005
- J-STD-005
- J-STD-006
- IPC-TP-1043
- IPC-TP-1044

Adhesives
- IPC-SM-817
- IPC-CA-821
- IPC-3406
- IPC-3408

Coat/Mask
- IPC-CC-830
- IPC-HDBK-830
- IPC-HDBK-840
- IPC-SM-840

PRINTED BOARD/ ACCEPTANCE
- IPC-DW-425
- IPC-TR-486
- IPC-A-600
- IPC-QE-605
- IPC-OI-645
- IPC-TF-870
- IPC-ML-960
- IPC-1710
- IPC-4761
- IPC-6011
- IPC-6012
- IPC-6013
- IPC-6015
- IPC-6016
- IPC-6018
- IPC/JPCA-6202
- IPC/JPCA-6801
- IPC-9151
- IPC-9191
- IPC-9194
- IPC-9199
- IPC-9252
- IPC-9691

COMPONENTS
- J-STD-020
- J-STD-027
- J-STD-032
- J-STD-033
- J-STD-035
- IPC-9501
- IPC-9502
- IPC-9503
- IPC-9504
- IPC-9591

FABRICATION
- IPC-DR-572
- IPC-TA-724
- IPC-4552
- IPC-4553
- IPC-4554

EMBEDDED TECHNOLOGIES
- IPC-2316
- IPC-4821

CLEANING/ CLEANLINESS
- IPC-SC-60
- IPC-SA-61
- IPC-AC-62
- IPC-CH-65
- IPC-TR-468
- IPC-TR-476
- IPC-TR-580
- IPC-TR-581
- IPC-TR-582
- IPC-TR-583
- IPC-SM-839
- IPC-5701
- IPC-5702
- IPC-9201

EHS
- IPC-WP/TR-584
- IPC-1065
- J-STD-609
- IPC-1331
- IPC-1751
- IPC-1752

FOIL
- IPC-CF-148
- IPC-CF-152
- IPC-1731
- IPC-4562

LAMINATE

Rigid
- IPC-1730
- IPC-4101
- IPC-4103

Flex
- IPC-FC-234
- IPC-4202
- IPC-4203
- IPC-4204

HDI
- IPC-DD-135
- IPC-4104

REINFORCEMENT
- IPC-S6-141
- IPC-A-142
- IPC-QF-143
- IPC-1731
- IPC-4110
- IPC-4121
- IPC-4130
- IPC-4411
- IPC-4412

Design Track

ASSEMBLY
- IPC-D-279
- IPC-D-326
- IPC-C-406
- IPC-C-408
- IPC-7351

INTERFACES
- IPC-D-310
- IPC-A-311
- IPC-D-356
- IPC-2501
- IPC-2511
- IPC-2531
- IPC-2541
- IPC-2546
- IPC-2547
- IPC-2571
- IPC-2581
- IPC-2582
- IPC-2583
- IPC-2584
- IPC-2588

PRINTED BOARD
- SMC-WP-004
- IPC-D-859
- IPC-1902
- IPC-2141
- IPC-2221
- IPC-2222
- IPC-2223
- IPC-2224
- IPC-2225
- IPC-2226
- IPC-2251
- IPC-2252
- IPC-2315
- IPC-2615

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November 2007