

	<i>TECHNICAL SPECIFICATION</i>	
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TECHNICAL SPECIFICATION FOR EMS SUPPLIERS



Revision #	Date	Changes	Responsible(s)
00	28/09/2017	New release	F. Poggi
01	14/03/2018	Page 4 (Chap. 3): Added ZPSF-2018-0009 (PPAP Technical Specification); Page 5 (Chap. 7): Removed documents list (now referred to ZPSF-2018-0009); Page 6 (§ 8.1): Removed THT; Page 10 (§ 9.1): Added "3D AOI machines are preferred";	F. Poggi

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1. PURPOSE

The purpose of this specification is to report all the process and product requirements established by ZAPI GROUP, hereinafter called ZAPI, related to the electronic boards assembly.

2. APPLICABILITY

This document applies to all the ZAPI Electronics Manufacturing Services (EMS) Suppliers and/or Sub-Contractors (hereinafter called Supplier) independently by their technological level or type of substrate used for the assembly (FR4, IMS).

3. STANDARD REQUIREMENTS

All the following references must be intended at the latest revision available:

- ZAPI Supplier Quality Book
- ZAPI Silicone Deposition Procedure
- ZAPI Working Instruction IL 5.11.4 (Voids Control on IMS)
- ZAPI Working Instruction IL 5.11.1 (Traceability Labeling)
- ZAPI Technical Specification N° 273 (Column Strength Test on IMS)
- ZAPI Technical Specification N° 383 (List of Approved Components)
- ZAPI Technical Specification ZPSF-2014-0002 (Spot Market Components)
- ZAPI Technical Specification ZPSF-2018-0009 (PPAP Technical Specification)
- IPC-A-610 (Acceptability of Electronic Assemblies)
- IPC-7711 (Rework of Electronic Assemblies)
- IPC-J-STD-001 (Requirements of Soldered Electrical and Electronic Assemblies)
- IPC-J-STD-033 (Handling, Packing and Use of Moisture Sensitive Devices)
- IPC TM-650 (Test Methods Manual)
- IEC 61340-5-1 / 61340-5-2 / ANSI/ESD S20.20 (Protection of Electronic Devices from Electrostatic Discharge Phenomena)

4. TERMS

EMS = Electronics Manufacturing Services
SMT = Surface Mount Technology
SMD = Surface Mount Device
THT = Through Hole Technology
PTH = Plated Through Hole
PCB = Printed Circuit Board



IMS = Insulated Metal Substrate
PCBA = Printed Circuit Board Assembled
RoHS = Restriction of Hazardous Substances
IPC = Association Connecting Electronics Industries
PSW = Part Submission Warrant
KPI = Key Performance Indicators
PPAP = Production Part Approval Process
DFM = Design for Manufacturability
DFT = Design for Testability
PFMEA = Process Failure Mode and Effect Analysis
ESD = Electrostatic-Sensitive Device
MSL = Moisture Sensitivity Level
SMEMA = Surface Mount Equipment Manufacturers Association
AOI = Automated Optical Inspection

5. SPECIFIC REQUIREMENTS REFERENCE

When a new part is available or a modification of an existing part is released, ZAPI provides to the EMS Supplier the following files:

- Mounting Plan File (.pdf)
- Solder Paste File (.gbr)
- Placement File (.rpt)
- Bill of Materials
- List of Approved Components
- PCB Gerber Files
- Technical Specifications (e.g. for Silicone Deposition)

6. VALIDATION PLAN

The Supplier is responsible to define an *impact analysis* related to any change of the manufacturing process in order to guarantee the highest reliability level of the ZAPI products. Before any release of samples and PPAP documentation, the Supplier is asked to provide to ZAPI the DFM and DFT reports. For every *New Product Introduction* (NPI) a double check must be performed by the Supplier in order to prevent any kind of inconsistency from the original ZAPI *Bill of Materials* (BOM). The Supplier is also asked to redact, monthly, *Key Performance Indicators* (KPI) to be sent to ZAPI.

7. PPAP (PRODUCTION PART APPROVAL PROCESS)

The Production Part Approval Process (PPAP) suitable for an Electronics Manufacturing Service (i.e. PCBA) will include all the documents listed in the following Specification:

- ZAPI Technical Specification ZPSF-2018-0009 (PPAP Technical Specification)

8. PRODUCT REQUIREMENT

ZAPI considers, for its products, the set of IPC regulations with the highest quality level (IPC Class = 3). The main references to be used for the assembling and soldering product evaluation are IPC-A-610 and IPC-J-STD-001.

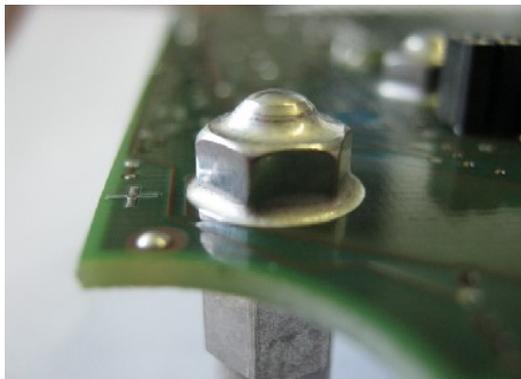
8.1 SPECIAL CHARACTERISTICS

SMT

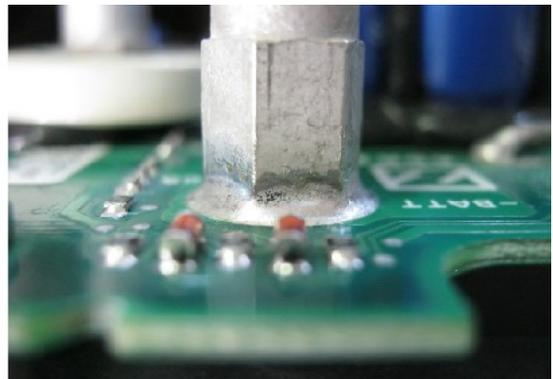
Unless otherwise specified, solder paste with ROLO flux formulation must be used in order to reduce halides concentration on the boards.

ODD COMPONENTS

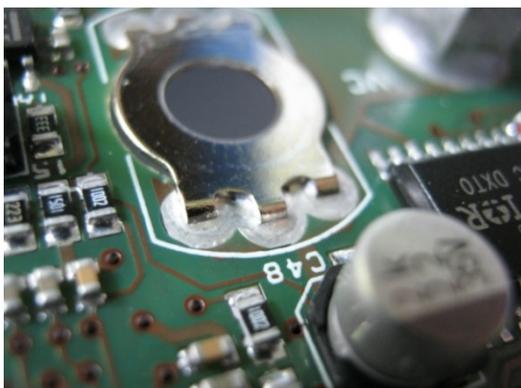
A full meniscus must be ensured on both top and bottom sides for odd mechanical parts, see *pictures 1 to 3* below.



picture 1



picture 2



picture 3

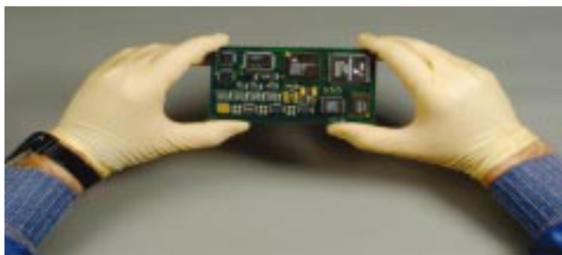
9. PROCESS REQUIREMENT

To reach the quality level that ZAPI requires, the following requirements must be intended as mandatory.

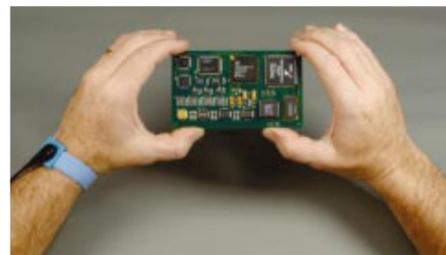
ESD

Considered by ZAPI an high risk concern, ESD management must be carried out according to the following requirements:

- Access to the ESD-Sensitive production rooms confirmed only with an automatic check (e.g. through electronic turnstile or door) connected to the informatics system.
- Handling must be performed using ESD gloves or otherwise keeping the boards by the outer edges (see *picture 4 and 5* below).



picture 4



picture 5

- Proper garments and ESD shoes (environmental Class = 1) must always be used at the ESD-Sensitive production rooms.
- ESD equipment and garments must be verified at least on a six-monthly base.
- Working environment must be kept controlled in terms of temperature and relative humidity. A safety range must be defined for both the parameters (T/RH) and also a *Reaction Plan* in case those parameters, unexpectedly, don't meet the established safety range.
- In general, all the requirements reported in the standards IEC 61340-5-1 / 61340-5-2 / ANSI/ESD S20.20 shall be used as a main reference.

MSL

Moisture sensitive devices must be handled and used according to IPC-J-STD-033. A dry-cabinet is mandatory in order to perform a backing process whenever the *floor life* exceeds the values reported in the mentioned regulation.

ASSEMBLY LINES

The production lines must be organized as automatically as possible, using SMEMA communication protocol.

ADDITIONAL PROCESSES

The following additional processes are retained essentials by ZAPI in order complete the whole manufacturing flow:

X-Ray analysis

X-Ray equipment is required in order to guarantee the best quality of the soldering: plated through holes filling and in particular the evaluation of hidden soldering for components like QFN or DPACK/D²PACK. For IMS assembly the most important topic is the *voids* evaluation beneath the DPACK/D²PACK components. The criteria for the required *voids* inspection and evaluation are listed in the following document:

- ZAPI Working Instruction IL 5.11.4 (Voids Control on IMS)

Silicone deposition

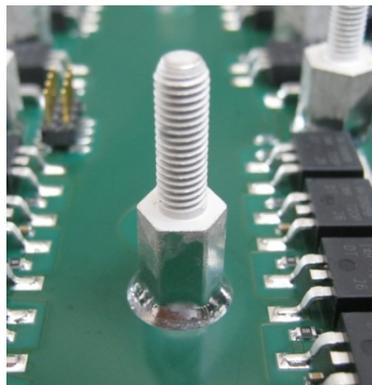
ZAPI requires, for the most of its parts, a silicone deposition that should be performed, by the Supplier, with a Robot. In case of unavailability of an adequate Robot, a manual deposition is also acceptable but a double check must be performed on the deposition itself. ZAPI has only approved the following Silicone:

- CAF®530 BLUESTAR SILICONES

ZAPI also provides to the Supplier, for each part number to be manufactured for the first time (e.g. sampling) a Silicone Deposition Procedure where all the areas to be covered with Silicon are highlighted with drawings and photographs.

Screwing

In many cases, ZAPI boards require a soldering process also for special mechanical parts like terminals (see *picture 6*).



picture 6

To guarantee a reliable mechanical strength of such a kind of components, a strength test is required according to the following document:

- ZAPI Technical Specification N° 273 (Column Strength Test on IMS)

Cleaning

IMS soldering leads to a high concentration of solder paste flux residues that must be removed by the Supplier with a water-based detergent approved by ZAPI only after an *Ionic Contamination Report* (see IPC TM-650) issued by the Supplier himself.

9.1 CONTROL PLAN

The following requirements must be intended to define the main guide line to the process control plan filling.

PCB INCOMING CHECK

The Supplier is required to perform, with an agreed timely base, a PCB incoming check on a part number considered critical, by ZAPI, in terms of quality and purchasing volumes. Below a list that shall be intended as a general guide line for the test to be performed by the Supplier:

- Wettability test refer to IPC-TM-650 / IPC-A-600
- Via micro-section refer to IPC-TM-650 / IPC-A-600
- Soldering strain test refer to ZAPI Technical Specification N° 273
- Voids X-Ray analysis refer to ZAPI Working Instruction IL 5.11.4

The checks to be performed will be agreed with ZAPI in function of the technology of the PCB (e.g. FR4 or IMS). The outcomes of the inspections must be submitted to ZAPI that shall:

- Accept the conformity of the PCB batch, or
- Accept in derogation the PCB batch (if the non-conformance doesn't affect the reliability of the assembly), or
- Reject the PCB batch.

SOLDER PASTE

Stored into a temperature-controlled fridge. Electrical power continuity must be ensured with a UPS system. RoHS or Leaded technologies are defined by ZAPI and must be mandatory respected.

SCREEN PRINTING

A 3D check 100% of the solder paste deposition is preferred. If such a system, usually carried out by a Solder Paste Inspection machine (SPI), is not available, a 2D check 100% shall be performed.

PLACEMENT

The feeder loading into the correct position of the Pick & Place machine must be verified with an automatic confirmation (e.g. barcode scanning system):

- Component/Feeder VS Pick & Place position

If no automatic scanning system is available, a double check (two operators) is mandatory.

REFLOW/WAVE SOLDERING PROFILES

Soldering profiles must be checked weekly, comparing a standard profile in which a range of acceptability has been defined.

AOI

Automated Optical Inspection is required by ZAPI for 100% of the parts. Verification outcomes (both PASSED and FAILED) must be stored and kept available in case of request. Only people IPC- A-610 trained must be in charge to evaluate the FAIL results. 3D AOI machines are preferred.

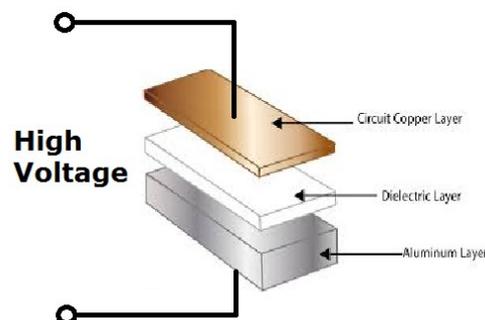
ELECTRICAL TEST

Mandatory for 100% of the ZAPI parts. According to ZAPI requirements, this test can be performed with In-Circuit machines (Bed Nails or Flying Probe) and/or Functional Test equipment. The test reports must be stored and kept available in case of request. Below the minimum coverage required by ZAPI for In-Circuit test:

	NETS	COMPONENTS
LOGIC BOARDS (FR4)	95%	95%
POWER BOARDS (IMS)	100%	100%

HI-POT TEST

ZAPI requires, for 100% of the IMS boards, an additional *High Voltage Test* in order to guarantee the expected dielectric strength of the ceramic substrate (see *picture 7*).



picture 7

The following procedure must be fulfilled by the Supplier in order to guarantee an adequate *High Voltage Test*.

- place the IMS to be tested onto an aluminum base.

- short-connect all the outlets of the IMS board (terminals and connectors) with a fixture specifically designed for that part number.
- apply, between aluminum base and shorted-outlets, an High Voltage according to the following tables:

Duty Current Test

V Spec. of the IMS	High Voltage Test (DC)	Delay (seconds)
≤ 48V	800 V	1
> 48V	1600 V	1

Alternating Current Test

V Spec. of the IMS	High Voltage Test (AC)	Delay (seconds)
≤ 48V	600 V	1
> 48V	1100 V	1

- if no shorts are detected, the High Voltage Test is considered PASSED.

VISUAL INSPECTION

This verifications is also mandatory 100% of the parts in order to detect any defects downstream of the wave/hand soldering or silicone deposition. Only people IPC- A-610 trained must be in charge of this inspection.

SPECIAL INSPECTIONS

In special and extreme cases, electronic components may be supplied by not controlled/usual purchasing sources (the so-called "*Spot Market*"). It's therefore necessary to introduce a reinforced incoming inspection in order to exclude, prior to use, possible risks/malfunctions due to counterfeit or deteriorated components. The following specification must be fulfilled by the Supplier for this kind of additional inspections:

- ZAPI Technical Specification ZPSF-2014-0002 (Spot Market Components)

9.2 REWORK

Rework is only accepted if performed according to IPC-7711. The Supplier is asked to trace all the repairs and keep stored the data in case of request. Each part is accepted to be repaired no more than *one time*, in order to avoid risks in terms of reliability of the solder joints. Only people IPC-7711 trained must be in charge of rework operations.

10. TRACEABILITY

BASIC REQUIREMENTS

Product traceability required by ZAPI must be, at least, according to the following criteria:

COMPONENT	TRACEABILITY LEVEL
Surface Mount Devices (SMD, odd components)	Component Batch VS PCBA Batch
Plated Through Holes Components (PTH)	Component Batch VS PCBA Batch
Consumable Materials (e.g. solder paste, flux)	Material Batch VS PCBA Batch
Other Mechanical Parts (e.g. screws, rivets, etc.)	Part Batch VS PCBA Batch
Printed Circuit Boards (date-code)	PCB Batch VS PCBA Batch

OTHER REQUIREMENTS

- Warehouse traceability performed using an automatic check between original manufacturing label of the parts and internal (Supplier) label. Otherwise, a double check (two operators) is mandatory.
- A datamatrix must be applied on each single board, reporting: p/n name, revision number, date of manufacturing, serial number. See ZAPI Working Instruction IL 5.11.1 (Traceability Labeling).
- The Supplier must trace the production line and the operator(s) involved for each p/n assembled. This information must be available in case of request.
- Each process step must be automatically checked at the beginning of the following one in order to guarantee a backwards PASSED outcome (e.g. In-Circuit Test routine can't start if the system doesn't have an AOI Test PASSED outcome).
- All the electrical test log files must be regularly sent to ZAPI (e.g. FTP) according to an established periodicity.

11. PACKAGING

PCBA packaging must be performed according to one of the following systems:

- **ESD Box** (kept regularly cleaned, shielding bags are not mandatory)



picture 8

- **Carton Box** (mono-use, shielding bags are mandatory)



picture 9

Each box (case or carton) must be properly identified with a label reporting:

- Supplier name
- Customer name (ZAPI)
- ZAPI p/n
- Quantity
- Supplier's manufacturing batch identification
- Shipment date