

Printed Circuit Board Assembly Requirements for Watlow Suppliers

1. PURPOSE & SCOPE

The purpose of this document is to establish Watlow's requirements for the manufacture of Printed Circuit Board Assemblies (PCBAs) to be supplied to, or on behalf of Watlow.

The scope of this requirement applies to all suppliers manufacturing and/or supplying build per print PCBAs to, or on behalf of Watlow.

2. REFERENCE DOCUMENTS

- 10-14866 Watlow Supplier Change Control and Communication Requirements (aka QSP-7.4.10) <https://www.watlow.com/resources-and-support/Additional-Support/Supplier-Requirements>
- Applicable Watlow PCBA fabrication print/drawings, Bills of Materials/Approved Manufacturers
- IPC-A-610 (latest revision) Acceptability of Electronic Assemblies
- RoHS 3 Directive, 2015/863/EU (latest revision)
- ESD Mil standard MIL-PRF-87893 (latest revision)
- IPC J-STD-001 (latest revision) Requirements for Soldered Electrical and Electronic Assemblies
- IPC-J-STD-004 (latest revision) Requirements for Soldering Fluxes
- IPC-J-STD-005 (latest revision) Requirements for Soldering Pastes
- IPC-J-STD-006 (latest revision) Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications
- IPC-1782A (latest revision) Standard for Manufacturing and Supply Chain Traceability for Electronic Products
- IPC-7711/7721 (latest revision) Rework, Modification and Repair of Electronic Assemblies
- IPC/JEDEC J-STD-033 (latest revision) Handling, Packing, Shipping and Use of Moisture, Reflow, and Process Sensitive Devices
- United States Dodd-Frank Act – Conflict Minerals

In case of any requirement discrepancy, the following order shall be applied to define the requirement:

1. Highest Priority: Requirements noted in a Watlow Purchase Order
2. Requirements defined by an applicable Watlow PCBA print/drawing
3. Requirements defined in this document
4. Other documents referred to by this requirement
5. Common/Typical Industry Standards developed and applied by the PCBA Manufacturing Industry which establish the standard specifications/requirements of a manufactured Electronic Assembly
6. Lowest Priority: PCBA manufacturer's own Engineering and Manufacturing standards, only if they meet or exceed applicable industry standards

3. DEFINITIONS / ACRONYMS

PCB: Printed Circuit Board (bare board, no components)
PCBA: Printed Circuit Board Assembly (PCB with components)
MSL: Moisture Sensitivity Level

Printed Circuit Board Assembly Requirements for Watlow Suppliers

4. RESPONSIBILITY

Watlow:

- Responsible for ensuring this document is updated as requirements change
- Ensure the latest revision is communicated and available to Watlow's PCBA suppliers
- Provide all required PCBA fabrication prints/drawings, test requirements, special assembly instructions, Gerber files, etc. to the supplier

Supplier:

- Responsible for conforming to all requirements defined by this document or notification.
- Communicate and/or seek Watlow Approval of form, fit, function, and process changes and deviations to the manufacture of the PCBA, as defined by Watlow Supplier Change Control and Communication Requirements document 10-14866 (QSP-7.4.10).

5. REQUIREMENTS

HEALTH, SAFETY, ENVIRONMENT (HSE)

- PCBA manufacturers are expected to abide by all local, state, and federal HSE laws and regulations applicable to their business
- All Watlow suppliers are expected to operate and sustain a safety system/program, which shall include policies, procedures, training, audits, and maintaining a safe and orderly work environment
- Compliant to RoHS 3 Directive, 2015/863/EU (latest revision) when specified by Watlow
- Compliant to the United States Dodd-Frank Act regarding Conflict Mineral traceability
- Utilize a Perfluorooctanoic acid (PFOP) free manufacturing process

QUALITY

- All suppliers and their manufacturing locations of PCBAs for Watlow must have ISO9001 registered Quality Management Systems in operation, or similar QMS registration (ie., IATF16949, AS900X, etc.)
- PCBA Supplier shall comply to Watlow's Supplier Requirements Manual: <https://www.watlow.com/resources-and-support/Additional-Support/Supplier-Requirements>
- PCBA's supplied to, or on behalf of Watlow, are expected to conform to the requirements stated in this document, purchase orders, Watlow prints, specifications, and applicable industry standards
- Supplier shall only use Watlow approved components defined by the Bill of Material and any deviations shall be approved by Watlow
- Change Control: All PCBA suppliers are subject to Watlow's Supplier Change Control and Communication Requirements Process, document 10-14866, including the completion of training annually: <https://www.watlow.com/resources-and-support/Additional-Support/Supplier-Requirements>
 - The change control level for PCBA's is **Level 4**, unless otherwise noted on print or PO
- As required, the PCBA supplier and Watlow shall agree to a "Supplier Readiness Plan" for each Watlow part number or product family transferring from Watlow, which shall define the project schedule, timing of prototype sample builds, pre-production builds, audits, FAIR/PPAP builds, FAIR/PPAP approvals, etc.

Printed Circuit Board Assembly Requirements for Watlow Suppliers

AGENCY

- All manufacturing facilities producing PCBA's for use in a Watlow Agency Approved Product shall comply to the following:
 - Supplier shall be an approved UL and/or CSA manufacturing site and...
 - subject to quarterly audits by all agencies as applicable
 - required to provide traceability of components used to auditors
 - add mark or label on assembly indicating the facility where manufactured for traceability

WORKMANSHIP STANDARDS

- PCBAs for Watlow shall be built in accordance with IPC J-STD-001 Class 2 requirements, unless otherwise specified in this document, Purchase Order, or Watlow PCBA print/drawing
- PCBAs for Watlow shall be inspected in accordance with IPC-A-610 Class 2 requirements, unless otherwise specified in this document, Purchase Order, or Watlow PCBA print/drawing
- Materials/PCBs used on Watlow products shall be stored and handled in accordance with J-STD-033 and their MSL level.

MANUFACTURING CAPABILITY

- PCBA manufacturers shall have the following capability available to Watlow:
 - SMT solder paste screening (Lead Free, no clean)
 - SMT glue application
 - AOI (not required but preferred)
 - SMT reflow oven
 - Wave Solder (Lead Free, no clean)
 - In Circuit Testing
 - X-Ray for BGA and hole fill requirement verification
 - Selective Solder Equipment
 - F-Terminal Inserter (dependent on PCBA)
 - Through Hole Part Preparation (dependent on PCBA)
 - Conformal Coater (dependent on PCBA)
 - Compliance to ESD Mil standard MIL-PRF-87893
 - Aqueous board cleaning (not required but may be considered an option for select PCBAs)

MANUFACTURING MATERIALS

- The following chart identifies the Watlow Approved No-Clean solder chemistries, no alternatives can be used unless approved by Watlow
- Once a First Article Inspection for a PCBA is approved by Watlow, any material changes, even if it is a change to an already approved material listed, a change request as defined by Watlow Supplier Change

Printed Circuit Board Assembly Requirements for Watlow Suppliers

Control and Communication Requirements document 10-14866 (QSP-7.4.10).must be submitted and approved by Watlow

Material Types (No Clean Only)	Approved by Watlow
Lead Free Solder Paste	Kester NXG1 AIM M8 SAC305 AIM SAC305
Lead Free Solder Bar	Indium SN995 Metallic Resources SAC305 AIM SAC305 AIM REL61 AIM - Sn100C
Lead Free Selective Solder	Indium SN995 Metallic Resources SAC305 AIM - Sn100C
Lead Free Wire Solder	Kester 275 Alpha Telecore Plus SAC305 AIM SAC305 Pb-Free Sn 100C glow core wire 2.5% AIM REL61
Lead Free Wave Solder Flux	Kester 979 Kester 959 AIM NC265 AIM FX16
Lead Free Selective Solder Flux	Kester Select 10 Flux Kester 959 AIM NC265
Lead Free Hand Applied Flux	Warton Metals Activ8 102 Liquid Flux AIM NC254 AIM NC265
Leaded Solder Paste	Kester EP256 AIM M8 Sn63/Pb37
Leaded Solder Bar	Indium 63/37 Metallic Resources Sn63 AIM Sn63/37
Leaded Wave Solder Flux	Kester 979 Kester 959 AIM NC265
Leaded Wire Solder	Kester 245 Multicore 64/37 AIM Sn63/Pb37 Glow Core Wire
Conformal Coatings <i>(will be defined on PCBA Final Assy Print)</i>	DOWSIL 3-1953 Humiseal 1A33
SMT Adhesive	Loctite 3261 Heraeus PD955PR Loctite 3616

Printed Circuit Board Assembly Requirements for Watlow Suppliers

- Any alternatives to the materials/chemistries listed above are expected to comply with following standards and be approved by Watlow prior to use:
 - IPC-J-STD-004 (latest revision) Requirements for Soldering Fluxes
 - IPC-J-STD-005 (latest revision) Requirements for Soldering Pastes
 - IPC-J-STD-006 (latest revision) Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications

CLEANLINESS

- PCBA – Finished Assembly Cleanliness shall be in accordance with IPC-A-610 and J-STD-001

REWORK

- All rework to a PCBA shall be done in accordance with IPC-7711/7721 and meet all stated requirements for the PCBA, including IPC-A-610 and J-STD-001 Class 2 requirements when completed
- If rework is not allowed or limited to certain components on a Watlow PCBA, this requirement will be defined on the part's final assembly print or Purchase Order
- Individual SMT component rework should be limited to no more than six (6) heating cycles (unless the part manufacturer specification defines otherwise) including SMT, wave, and Selective Solder operations, as well as heating up for part removal and part reattach.
- Repair (modified from original state) of PCB/PCBA's is not allowed

CRITICAL FEATURES

- If there are critical features, operations, assembly methods, etc., applicable to a PCBA, these requirements shall be identified in the part's final assembly print or on a Purchase Order

MEDIA ACCESS CONTROL IDENTIFIER (MAC ID)

- If MAC ID is required, specific details will be defined in the assembly print/drawing document or Purchase Order for the product being manufactured

PROGRAMMING

- If programming is required, details shall be agreed upon prior to submitting first prototype samples being manufactured and supplied

TESTING

- Testing of all PCBA's supplied to Watlow is expected (ie. In Circuit Testing (ICT), Flying Probe, Hi-Pot, functional, etc.) or as otherwise agreed
 - For reference only: Watlow uses KEYSIGHT 3070 ICT equipment
- Test result status shall be identifiable on the PCBA and on each individual PCBA if in multiple up panel form, using a stamp, label, or other method and location of mark as approved by Watlow

Printed Circuit Board Assembly Requirements for Watlow Suppliers

- X-OUT boards in a multiple up panel are NOT allowed to be shipped to Watlow without Watlow approval and if allowed, shall be clearly identified visually as non-conforming

TRACEABILITY/LABELING/SERIALIZATION

- The PCBA supplier shall comply to IPC-1782A Standard for Manufacturing and Supply Chain Traceability for Electronic Products, Class/Level 1 (Basic) unless otherwise defined
- Each individual PCBA delivered to Watlow shall have a date code and manufacturer identification and serialization label, or other as approved by Watlow applied to each PCBA and each individual PCBA if supplied in panel form, conforming to the following:
 - Date Code shall be in the year-week format: (YY/WW), ie, a date code of 2133 would be the 33rd week of 2021
 - The location of the manufacturer label shall be defined on the Watlow PCBA print

CERTIFICATE of COMPLIANCE

- Certificate of Compliance shall be provided with each lot and shall include:
 - Watlow part number and quantity
 - Manufacture Lot/Date Code
 - Watlow revision of Bill of Material produced
 - Factory address/location of manufacturing facility
 - UL File information
 - Name and signature of person certifying

PACKAGING REQUIREMENTS

- Each PCBA (panel or single board form) shall each be contained in a clean, dry, sulfur-free, ESD shielded package and secured in an outer shipping container which is able to withstand common carrier shock, drops, and handling without damage
- Quantity of PCBA's per shipping container will vary and will be mutually agreed between supplier and Watlow
- Each package shall be labeled with Watlow part number, date code/date of manufacture, supplier name, Purchase Order, and quantity
- Reusable packaging to eliminate the need for shielded ESD bags, corrugated cardboard, and other dunnage typical of packing is recommended whenever possible, but shall be approved by Watlow prior to implementing

Printed Circuit Board Assembly Requirements for Watlow SuppliersFIRST ARTICLE INSPECTION REPORTS (FAIR's) and/or PRODUCTION PART APPROVAL (PPAP's)

- FAIR's shall be submitted and approved for all part numbers prior to starting mass production, unless a Watlow print or Purchase Order indicates a PPAP is required
- FAIR's and PPAP's submitted to Watlow shall include the following:
 - Design Records/Requirements documentation
 - Bill of Materials (BOM) comparison; Supplier's BOM compared to Watlow's BOM, including component manufacturers used
 - Process Flow Diagrams and Process Failure Mode and Effects Analysis (PFMEA)
 - Control Plan, Work Instructions, and applicable Manufacturing Records
 - In Circuit Testing (ICT) and other test/inspection records (Gage R&R)
 - Balloon/bubble drawing, all print dimensions and notes
 - Certificate of Compliance
 - Change Records
 - Customer Approval Form or Part Submission Warrant (PSW)
 - Other documents or data (if specified)
- FAIR/PPAP Approval
 - Watlow interim or full approval of a FAIR or PPAP indicates the manufacturing process "lock in" is in effect, change control requirements in effect, and the manufacturer is approved to begin mass production
 - Interim approval indicates there are additional conditions needing to be satisfied, which shall require a completion plan be submitted by the supplier
 - Watlow will determine the deliverables necessary, which may include a new FAIR or PPAP, prior to granting full approval
- Following "lock in", a FAIR or PPAP shall be submitted to Watlow if a change requiring approval by Watlow (see document 10-14866 aka QSP-7.4.10) is initiated by Watlow or the supplier, prior to implementation of the change into mass production



Printed Circuit Board Assembly Requirements for Watlow Suppliers

6. REVISION HISTORY

Revision	Date	Changes
-	1/11/2022	Initial Release
A	5/11/22	Updated approved manufacturing materials list

7. Document Approvals

- Manufacturing (Winona)
- Quality (Winona)
- Compliance (Winona)
- Reliability (Winona)
- Supplier Quality (Enterprise PCBA)