TECHNICAL REPORT

GEIA-STD-0006™	REV. C
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Requirements for Using Robotic Hot Solder Dip to Replace the Finish on Electronic Piece Parts

RATIONALE

Revision necessary to address package types that do not clearly fall into existing definition and specify XRF thickness measurement locations and number of terminations.

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FOREWORD

This standard was prepared to standardize the requirements for using robotic hot solder dip to replace the finish on certain electronic piece parts. The requirements within this standard were derived from existing industry standards and a collaboration of suppliers and customers.

The intent of this standard is for suppliers and customers to incorporate these requirements into their operations to provide a consistent and well-controlled process. This standard does not apply to original piece part manufacturers who build piece parts with a hot solder dip finish.

The Hot Solder Dip Task Group, under the direction of the Government Electronics and Information Association (GEIA), prepared this standard. This revision was prepared by the G-24 committee of SAE. All addenda of this standard are informative in nature.

INTRODUCTION

There are two major reasons to solder dip piece parts: solderability concerns and tin whisker mitigation. Solder dip for tin-whisker mitigation differs from solder dip for solderability in that for tin whisker mitigation the termination needs to be coated over its entire length, right up to the package surface. During solder dip, the piece part experiences temperature differences significantly greater than those present during typical board-level assembly. In addition, the fluxes used during the dipping process can become trapped in a minor delamination, like that commonly found in plastic piece parts, which can lead to reliability issues. To avoid these concerns, the solder dip process needs to be qualified and carefully controlled. To decrease the possibility of failure of the piece part after being solder dipped and to ensure a quality process is performed each time, requirements for performing robotic hot solder dipping are presented in this standard.

This standard was designed for the replacement of pure tin and Pb-free tin alloy finishes with SnPb finishes for subsequent assembly with SnPb solder. Aspects of this standard may be applicable to other finish changes. Replacement finishes other than SnPb should be evaluated for tin whisker mitigation prior to implementation.

Due to the need to completely control the rates of immersion and emersion of the terminations and the dwell times in and between each process step, only Robotic Hot Solder Dip is addressed in this standard. Semi-automatic or purely manual solder dipping are processes that may not be capable of completely controlling the rates of immersion and emersion of the terminations and only providing an approximate dwell dipping time (time of total immersion to the required depth) in the solder bath. Greater variation in the process may cause a higher chance of damage, including latent reliability problems. At this time, it is felt that manual dipping, the types of piece parts that can be manually dipped successfully, and the controls needed on a manual dip process are not well enough understood to be included in an industry standard. Note that the manual dipping required for full finish replacement is different than manual dipping currently practiced for meeting solderability requirements because of the increased need of 100% coverage all the way to the body to prevent whisker growth.

Certain piece-part package styles may not lend themselves to robotic hot solder dipping and may require the use of a soldering iron, over-plating, or other methods to coat the termination. It is expected that some of the general requirements and testing requirements of this standard would apply to these operations. However, these methods have not been fully reviewed at this time. The application of aspects of this standard to other material replacement methods is considered to be a unique requirement and should be covered by separate customer and supplier agreements.

1. SCOPE

This standard defines the requirements for fully replacing undesirable surface finishes using robotic hot solder dip. Requirements for qualifying and testing the refinished piece parts are also included. This standard covers the replacement of pure tin and Pb-free tin alloy finishes with SnPb finishes with the intent of subsequent assembly with SnPb solder. This dipping is different from dipping to within some distance of the body for the purposes of solderability; solder dipping for purposes other than full replacement of pure tin and Pb-free tin alloy finishes are beyond the scope of this document. It covers process and testing requirements for robotic dipping process and does not cover semi-automatic or purely manual dipping processes.

This standard does not apply to piece-part manufacturers who build piece parts with a hot solder dip finish. It applies to refinishing performed by a robotic hot solder dip service supplier or production facilities at the customer, whenever the intent of the dipping is to have full coverage and replacement of Pb-free tin. Replacement of BGA spheres or CGA columns is not included in the scope of this standard. IEC TS 62647-4 may be used for replacement of BGA spheres.

The intent of this standard is for suppliers and customers to incorporate these requirements into their operations to provide a consistent and well-controlled process for product applications that require significant control. Complete conversion of termination finishes from Pb-free tin to SnPb will allow use of piece parts for any of the Control Levels of GEIA-STD-0005-2 without mitigations. In addition to the elimination of tin whisker risks, piece parts processed to this standard will also exhibit enhanced solderability and solder joint reliability compared to most COTS finishes. Each customer shall determine the applicability of this standard and the need for full replacement of the existing termination finish. This standard does not guarantee a particular yield or reliability of piece parts going through solder dipping. Some applications may have unique requirements that exceed the scope of this standard and should be specified separately.

Pb-free tin piece parts which have been dipped in compliance with this standard are no longer considered to be Pb-free tin finished for the purposes of GEIA-STD-0005-2.

2. REFERENCES

2.1 Normative References

ANSI/NCSL Z540-1	Calibration Laboratories and Measuring and Test Equipment
ASTM B487	Standard Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of a Cross Section
ASTM B568	Standard Test Method for Measurement of Coating Thickness by X-Ray Spectrometry
EIA-595	Visual and Mechanical Inspection: Multilayer Ceramic Chip Capacitors
IPC-TM-650-2.3.25	Detection and Measurement of Ionizable Surface Contaminants by Resistivity of Solvent Extract (ROSE)
ISO 10012	Measurement Management Systems - Requirements for Measurement Processes and Measuring Equipment J-STD-001Requirements for Soldered Electrical and Electronic Assemblies
J-STD-001	Requirements for Soldered Electrical and Electronic Assemblies
J-STD-002	Solderability Tests for Component Leads, Terminations, Lugs, Terminals and Wires
J-STD-004	Requirements for Soldering Fluxes
J-STD-006	Requirements for Electronic Grade Solder Alloys and Fluxed and Non-fluxed Solid Solders for Electronic Soldering Applications
J-STD-020	Moisture/Reflow Sensitivity Classification for Non-hermetic Solid State Surface Mount Devices
J-STD-033	Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices

J-STD-075	Classification for Non-IC Electronic Components for Assembly Processes
JESD22-A101	Steady-State Temperature Humidity Bias Life Test
JESD22-A104	Temperature Cycling
JESD22-B101	External Visual
JESD22-B107	Mark Permanency
JESD46	Customer Notification of Product Process Changes by Semiconductor Suppliers
MIL-STD-883	Test Method Standard Microcircuits
MIL-STD-1580	Destructive Physical Analysis for Electronic, Electromagnetic, and Electromechanical Parts

2.2 Informative References

AMS-STD-595	Colors Used in Government Procurement
GEIA-STD-0005-2	Standard for Mitigating the Effects of Tin Whiskers in Aerospace and High Performance Electronic Systems
IEC TS 62647-4	Process management for avionics – Aerospace and defence electronic systems containing lead-free solder – Part 4 – Ball grid array (BGA) package reballing
J-STD-609	Marking and Labeling of Components, PCBs and PCBAs to Identify Lead (Pb), Pb-free and Other Attributes
MIL-PRF-19500	General Specification for Semiconductor Devices
MIL-PRF-38534	General Specification for Hybrid Microcircuits
MIL-PRF-38535	General Specification for Integrated Circuits (Microcircuits)

3. DEFINITIONS AND ACRONYMS

AM: Acoustic Microscopy

APPROVED TYPE: A type as listed in Table 1.

APPROVED PIECE TYPE: A piece part that can meet a type definition listed in Table 1.

CORROSION: The deterioration of a metal by a chemical or electro-chemical reaction with its environment.

CUSTOMER: The person or organization requesting to have piece parts robotic hot solder dipped.

DROSS: Oxide formed on the surface of solder, whether in still solder pots or wave soldering machines.

ESD: Electrostatic Discharge

FLUX: A material which reduces the oxides on the surface of solder, whether from a solder pot or a piece part. It also displaces oxygen on the surface of the solder, thereby preventing re-oxidation.

IONIC CONTAMINATION: Any foreign material such as salts, acids, inorganic materials, and organic residues, which conduct electricity in the presence of moisture.

LOT: A group of piece parts processed under the same manufacturing and inspection specifications and procedures, manufactured with the same type of equipment, and processed at the same time as one entity.

MSL: Moisture Sensitivity Level as per J-STD-020.

ORIGINAL PIECE PART MANUFACTURER: Original manufacturer of the piece part to be dipped.

PRODUCT LOT: One lot of Qualified Piece parts undergoing robotic hot solder dip.

QUALIFIED PIECE PART: An Approved Piece part that has been qualified with a solder dip service supplier's dipping process.

QUALIFICATION LOT: One lot of Approved Piece parts undergoing qualification but are not yet qualified. Parts processed through qualification testing are considered to have gone through destructive testing.

Pb-FREE TIN: Pure tin or any tin alloy with <3% lead (Pb) content by weight. This means that some Pb-free finishes other than pure tin, such as tin-bismuth and tin-copper, are considered to be "tin" for the purposes of this standard. Many of these alloys have not been assessed for whiskering behavior.

ROBOTIC: A process utilizing an articulated appendage to perform repetitive complex tasks. The method is highly repeatable and controlled with minimal operator involvement. In addition to the dipping being automated, other steps, such as fluxing, are also automated as are the movements between the steps.

SAC: Tin (Sn)/Silver (Ag)/Copper (Cu)

SnPb: Tin (Sn)/Lead (Pb)

SOLDER DIP SERVICE SUPPLIER (also referred to as SUPPLIER): The service or manufacturer performing the robotic hot solder dip.

SOLDERABILITY: The ability of a metal to be wetted by molten solder.

SUPPLIER: The service or manufacturer performing the robotic hot solder dip.

THB: Temperature/Humidity Bias

WETTING, SOLDER: The formation of a relatively uniform, smooth, unbroken, and adherent film of solder to a base metal.

4. TYPES AND CATEGORIES

4.1 Piece Part Types

Piece part types are defined in Table 1.

Table 1 - Piece part type

Type	Type Description	Type Examples
1	Hermetic piece parts	Piece parts that have a hermetically sealed cavity
2	Plastic encapsulated piece parts	Piece parts that use plastic or organic packaging material
3	All other devices not described in Type 1 or 2	Devices that do not have hermetic cavities and are not encapsulated

4.2 Qualification Categories

1A. Robotic Dip (Default) with Qualification and Production Testing

Processing shall comply with the requirements of Sections 5 through 10 of this Standard, excluding THB Life-test Qualification and Electrical Verification. This shall be the default qualification category unless otherwise specified by the customer.

1B. Robotic Dip without Qualification or Production Testing

Processing shall comply with the requirements of Sections 5, 6, 7, and 8 of this Standard, excluding requirements for Qualification and Production Testing (8.1.) Test Method 100 External Visual Inspection shall apply. This qualification category may be considered when piece parts are deemed robust and have extensive history of processing without rejects found in testing.

1C. Robotic Dip with Production Testing Only

Processing shall comply with the requirements of Sections 5, 6, 7, 8, and 10 of this Standard, excluding requirements for Qualification Testing. This qualification category may be considered when piece parts are deemed robust and have been processed multiple times previously without rejects found in testing.

1D. Robotic Dip with THB Life-Test Qualification and Production Testing

Processing shall comply with the requirements of Sections 5 through 10 of this Standard, including Additional THB Life-Test Qualification. This qualification category should be considered for highest levels of mission-critical applications.

1E. Robotic Dip with Qualification Testing including Electrical Verification and Production Testing

Processing shall comply with the requirements of Sections 5 through 10 of this Standard, excluding THB Life-test Qualification. This qualification category offers additional confidence in processed components without extent of THB Life-test Qualification.

5. GENERAL REQUIREMENTS

5.1 Supplier Responsibilities

The supplier is responsible for the development and implementation of requirements and procedures necessary to prevent damage and to control conditions that could degrade the performance and reliability of the piece parts as identified on the original piece part manufacturer's datasheet.

5.2 Requirements Flow Down

When this standard is contractually required, the applicable requirements of this standard shall be imposed on all applicable subcontracts, specifications, and purchase orders.

5.3 Departures and Deviations

The supplier shall ensure that any departures or deviations from this standard are evaluated by, coordinated with, and submitted in writing to the customer for approval prior to use or implementation.

5.4 Facility Requirements

Cleanliness, lighting, temperature, humidity, and environmental control requirements shall be in accordance with J-STD-001 for Class 3.

5.5 Electrostatic Discharge (ESD) Requirements

ESD requirements shall be in accordance with J-STD-001.

5.6 Handling of Moisture Sensitive or Process Sensitive Piece Part Requirements

Moisture sensitive piece parts, as classified by J-STD-020, process sensitive piece parts, as classified by J-STD-075, or as identified by the customer, shall be handled in accordance with J-STD-033. The cumulative bake time limits of J-STD-033 shall not apply to baking prior to refinishing and shall be reset to "zero" upon final packaging.

5.7 Handling and Storage

The supplier is responsible for the development and implementation of requirements and procedures necessary to ensure proper handling and storage while at the supplier's facility.

5.8 Personnel Proficiency

All instructors, operators, and inspectors shall be proficient in accordance with J-STD-001 Class 3. Training records shall be made available to the customer upon request.

5.9 Tool and Machine Calibration Requirements

Inspection, measurement, and test equipment used to meet the requirements of this standard shall be maintained and controlled in accordance with ANSI/NCSL Z540-1, ISO 10012, or equivalent.

6. DOCUMENTATION

6.1 Documentation of Processes

The supplier shall document the methods and procedures that incorporate the requirements of this standard into the design, process, inspection, and verification of solder finish on piece parts involved in each contract or purchase order.

6.2 Documentation of Process and Results

The supplier shall document all process methods, parameters, materials, lot traveler, inspection, and test results, and all other metrics required to complete the requirements of this Standard. These records shall be made available to the customer upon request.

6.3 Record Retention

The supplier shall retain quality assurance records pertaining to process verification, manufacture, and inspection for a minimum of 5 years unless otherwise specified by the customer. These records shall be made available to the customer upon request.

6.4 Traceability and Configuration Control

6.4.1 Material Traceability

Traceability for processing and packaging materials by manufacturer, part number, and date code used in the order shall be retained and provided upon request by the customer.

6.4.2 Change Notification

The supplier shall have a documented system for change management in accordance with JESD46. An appropriate customer notification methodology shall be in place.

6.4.3 Part Number, Lot Traceability, and Remarking

Changing plating materials of lead-frames is considered a major change per JESD46. A new part number, via an altered item drawing or other process, is required. Process lot traceability shall be maintained and documented on all relevant paperwork and the smallest unit container.

The customer shall define the refinished part and/or package identification marking requirements including the obliteration of any original marking. If it is not practical to remark the refinished part with the new identification, the part shall be marked on the body with an orange dot of color chip 12250 per AMS-STD-595, unless impractical due to size or interference with part function. The ink dot mark shall be capable of meeting the requirement of JESD22-B107. Only devices that have passed all required inspections steps shall be marked with new identification or ink dot.

All Pb-free icons shall be removed or crossed out from any reused original packaging (e.g., tubes, reels, etc.) or may be remarked in accordance with J-STD-609.

6.5 Unpackaging

In cases where piece parts have been unpackaged (e.g., de-reeled) and the original packaging is not used again, all markings on the original packaging shall be saved or electronically copied for piece parts traceability records. Piece parts shall be maintained in the same lots as received. There shall be no mixing of lots.

7. EQUIPMENT, TOOLS, AND MATERIALS

7.1 Dry Bake Oven

Ovens used for dry bake shall comply with the requirements of J-STD-033.

7.2 Robotic Hot Solder Dipping Apparatus

Robotic Hot Solder Dipping Apparatus shall:

- Feature a vacuum or mechanical pickup mechanism
- Not damage the piece part or its terminations
- Not utilize metal surfaces that may scratch or cause solder smears
- Be capable of controlling the dwell time in the pre-heat and solder pot within ±0.1 second
- Be capable of controlling the exit speed out of the solder pot to within ±0.12 inch (0.3 cm)/s
- Be capable of controlling the depth of immersion to within ±0.004 inch (0.01 cm)
- Ensure dipping of the full termination or other tin or Pb-free tin finished surface into the solder pot including the side of the package (if applicable)

7.2.1 Apparatus for Gull-Wing Formed Leads

In addition to those requirements above, the dipping apparatus used for robotic hot solder dipping gull-wing formed leads shall also be capable of edge dipping the piece parts with the following controls:

- Solder dip immersion angle and direction of travel
- Solder dip withdrawal angle and direction of travel
- Ability to rotate piece part to allow each side to be solder dipped independently

7.2.2 Apparatus for J-Leaded Formed Leads

In addition to those requirements above, the dipping apparatus used for robotic hot solder dipping J-lead formed leads shall be capable of edge and planar dipping the piece parts to cover neighboring termination surfaces not obstructed by the package body.

7.3 Preheat Equipment

A corrosion-free container capable of preheating piece parts to achieve the desired temperature profile shall be used for preheating.

The preheat equipment shall have the capability of maintaining temperatures of 70 °C (158 °F) minimum.

7.4 Fluxes, Flux Apparatus, and Controls

The fluxes used shall be per J-STD-004. Inorganic acid (type IN) fluxes shall not be used.

The flux apparatus shall be compatible with the fluxes used.

Flux specific gravity or titration testing, for low solids fluxes, shall be controlled and monitored a minimum of once per shift. Controls shall include flux replacement schedule.

7.5 Solder

The solder used shall be Sn63Pb37 and shall meet the requirements of J-STD-006.

7.6 Solder Pot and Solder Pot Maintenance

The solder pot shall be of adequate dimension to accommodate the piece part termination area. The solder level within the pot shall be maintained to ensure consistent immersion depth of piece parts into the molten solder. The solder pot shall be capable of maintaining the desired temperature within ±5 °C (±9°F). A provision shall be made for the control of solder dross and burnt flux. The solder pot shall be grounded for electrical shock and ESD.

There shall be a documented control system to ensure solder bath purity and alloy composition does not exceed specified limits in accordance with J-STD-001.

8. OVERALL PROCESS FLOW

The process flow requirements for piece parts within a production lot are defined in the following sections. The parameters for each of the processes shall be those determined during Qualification for the piece part being dipped (see 6.3 and Section 9). The customer shall be notified by the supplier if additional piece parts are required for process setup and profiling. Any deviation or change to the parameters or other specifications beyond the limits defined in 9.6 shall require process re-qualification.

8.1 Qualification of Process

Prior to production, qualification of the refinishing process shall be performed in accordance with Section 9.

8.2 Dry Bake

The MSL of piece parts shall be obtained/verified from/by the customer. All piece parts with MSL 2 or greater shall be dry baked before refinishing in accordance with J-STD-033. Dry bake is not required for piece parts received in labeled dry bags with desiccant and humidity indicators reading less than 5% RH or for Piece Part Type 1. Once the packaging has been opened they shall be handled in accordance with J-STD-033. Moisture sensitive piece parts received in unknown condition shall be dry baked in accordance with J-STD-033. The cumulative bake time limits of J-STD-033 shall not apply to baking prior to refinishing.

8.3 Fluxing

The flux used shall be in accordance with 7.4 and shall be applied to the piece parts in a consistent and repeatable manner. Flux may be applied before or after preheat.

8.4 Preheat

Piece parts shall be preheated prior to robotic hot solder dipping. Preheat ramp-up rates shall not exceed the original piece part manufacturer's specifications, J-STD-020, J-STD-075, or as specified on engineering documentation.

8.5 Application of Solder

After flux and preheat, the piece part terminations shall be immersed in the molten solder by a robotic hot solder dipping apparatus meeting the requirements of 7.2. The total time in solder shall not exceed 5 seconds per immersion. A dynamic wave or other method which removes solder dross shall be used.

8.6 Cool Down, Cleaning, and Drying Methods

Cooling rates shall not exceed the piece part manufacturer's specifications, J-STD-020, J-STD-075, or as specified on engineering documentation. Cleaning shall be performed within 1 hour of solder dipping in accordance with the flux manufacturer's recommendations or in accordance with J-STD-033, J-STD-075, where applicable. Drying shall be accomplished in a manner to prevent re-deposition of ionic material onto the piece part or reduction of solderability of the piece part.

8.7 Rework

Piece parts within the production lot shall not be reworked more than TWICE. A single rework process is defined as one complete throughput through the robotic hot solder dipping process for any combination of package side(s) after the initial robotic hot solder dip. Any piece parts damaged shall be segregated, marked as defective, and returned to the customer; this includes piece parts dropped into the solder pot or on the floor or exhibiting physical damage after a fall.

8.8 Inspection and Testing

Piece parts shall be tested in accordance with applicable test methods in Section 10. If there are any failures during applicable test methods of the production lot testing then the customer shall be notified. Failed tested piece parts shall be segregated, marked as defective, and returned to the customer. Production piece parts of failed lots shall be identified and returned unless screened for the defect found in the sample devices.

8.9 Post-Process Baking

After all processing and inspection, piece parts that were dry baked per 8.2 shall be dry baked again in accordance with J-STD-033 and dry packaged in moisture barrier bags. The cumulative bake time shall be reset to "zero" upon final packaging.

9. PROCESS QUALIFICATION

Every supplier shall qualify Approved Piece Types with their robotic hot solder dip process.

9.1 Qualification by Similarity

The process shall be qualified for specific Piece part types. Qualification by similarity shall apply to other piece parts with the same package type as the Approved Piece Type and shall require written approval by the customer.

9.2 Process Qualification Test Requirements

The robotic hot solder dip process qualification test requirements for a given qualification lot are defined in Table 2. The parameters for each of the processes shall be those as documented in 6.1. Small lot sizes may require quantity adjustments that shall be agreed upon with the customer.

The qualification samples shall be dipped three times prior to Post Application Screening to simulate the maximum number of rework cycles allowed.

Test methods listed below are described in Section 11.

Table 2 - Required process flow for robotic hot solder dip qualification

	Test Method (see Section 11)	Qty to Be Tested		
	Piece part Type (see Table 1)	**1**	**2**	**3**
Pre Application	Test Method 100 (Visual Ins.)	100%	100%	100%
	Test Method 200 (Hermeticity)	100%	N/A	N/A
	Test Method 300 (AM)	N/A	100%	N/A
Post Application	Test Method 100 (Visual Ins.)	100%	100%	100%
	Test Method 200 (Hermeticity)	100%	N/A	N/A
	Test Method 300 (AM)	N/A	100%	N/A
	Test Method 400 (Thick/Comp.)	3	3	3
	Test Method 500 (Ionic Cleanliness)	10	10	10
	Test Method 600 (Solderability)	3	3	3

9.3 Process Qualification Lot Sample Size

The Qualification lot shall be 50 pieces. The customer shall be notified by the supplier if additional piece parts are required for process setup and profiling. Small lot sizes may require quantity adjustments that shall be agreed upon with the customer. Parts processed through Qualification are considered destructively tested and shall not be used for production without customer approval. Unless specified by the customer, disposition of the qualification parts ***shall*** be at discretion of the supplier.

9.4 Additional THB Life-Test Qualification Requirements

For Qualification Category 1D, additional testing is defined in Table 3. Test methods listed are described in Section 11.

Table 3 - Additional requirements for qualification category 1D

	Test Method (see Section 11)	Qty to Be Tested		
	Piece part Type (see Table 1)	**1**	**2**	**3**
Post Application	Test Method 800 (Temperature Cycling + Electrical)	22	22	22
	Test Method 900 (THB + Electrical)	N/A	22	22

Parametric electrical tests should be based on original piece part manufacturer's published test requirements and shall be agreed upon with the customer. This requirement may be waived by the customer if their assessment of next level testing supports it.

9.5 Electrical Verification Qualification Requirements

For Qualification Category 1E, additional testing is defined in Table 3A. Test Methods are described in Section 11.

Table 3A - Electrical Verification requirements for qualification category 1E

	Test Method (see Section 11)	Qty to Be Tested		
	Piece part Type (see Table 1)	**1**	**2**	**3**
Pre Application	Test Method 1100 (Electrical Verification testing)	22	22	22
Post Application	Test Method 1100 (Electrical Verification testing)	22	22	22

DC (only) tests should be based on original piece part manufacturer's published test requirements and shall be agreed upon with the customer.

9.6 Process Re-Qualification

If any of the following process parameters are changed, re-qualification shall be required.

- Preheat temperature ramp-up rate shall not exceed the qualification profile by more than 1 °C per second
- Cool down rate shall not exceed that of the qualification profile by more than 1 °C per second
- Piece part body temperature immediately before solder dip shall be within ±15 °C of the qualification profile
- Dwell time of piece part terminations in the solder pot shall not exceed 2 seconds of the qualification profile, providing that maximum limit of 8.5 is met.
- Temperature of the solder pot shall be within ±10 °C of the qualification profile
- Flux activity or composition shall not change from those used during qualification
- Piece part body temperature immediately before cleaning shall not exceed that of the qualification profile by more than 15 °C.
- Temperature of the cleaning process shall be within ±10 °C of the qualification profile
- Any major change in accordance with JESD46.

10. PRODUCTION LOT TEST REQUIREMENTS

The test methods required for piece parts within a production lot are defined in Table 4 . Small lot sizes may require quantity adjustments that shall be agreed upon with the customer. Test methods listed below are described in Section 11.

10.1 Test Requirements for Robotic Hot Solder Dip

Table 4 - Test methods required for robotic hot solder dip during production

	Test Method (see Section 11)	Qty to Be Tested		
	Piece Part Type (see Table 1)	**1**	**2**	**3**
Pre Application	Test Method 100 (Visual Ins.)	45	45	45
	Test Method 300 (AM)	N/A	10	N/A
Post Application	Test Method 100 (Visual Ins.)	100%	100%	100%
	Test Method 200 (Hermeticity)	100%	N/A	N/A
	Test Method 300 (AM)	N/A	10[/1]	N/A
	Test Method 400 (Thick/Comp.)	3	3	3
	Test Method 500 (Ionic Cleanliness)	10	10	10
	Test Method 600 (Solderability)	3	3	3

NOTE 1: Use the same piece parts that underwent TM 300 (AM) during Pre Application.

11. TEST METHODS

Table 5

Test Method	Test Name	Criteria	Destructive?	Accept on # Failed
100	External Visual	For multilayer ceramic chip capacitors, use EIA-595. For all other devices, use JESD22-B101. In addition to the failure criteria of this JEDEC Test Method. Circular Coverage around the lead shall be uniform and contain ZERO voids or pits. Length Coverage of the final finish shall extend 100% of the lead up to the package body. Piece parts that contain physical barriers preventing 100% coverage shall be approved by the customer.	NO	For qualification: 0 failures For production: Parts must pass for acceptability. Maximum yield loss for lot acceptability shall be agreed to with the customer.
200	Hermeticity	Select appropriate method for the component processed based on scope of the following standards: • MIL-STD-883, Method 1014 • MIL-STD-750, Method 1071 • MIL-STD-202, Method 112	NO, unless cross-section option selected	For qualification: 0 failures For production: Parts must pass for acceptability. Maximum yield loss for lot acceptability shall be agreed to with the customer.
300	AM (Acoustic Microscopy)	AM shall be used to detect delamination to the acceptance criteria of MIL-STD-1580. Verification of suspect locations can be verified by dye penetrant and cross-section of a minimum of two pieces from the AM qualification lot. Verification shall be performed per MIL-STD-883, Method 1034, except pressure conditions of 93 ± 5 PSIA for 5 minutes, in lieu of vacuum. Failure criteria of Method 1034 do not apply.	NO	0
400	Finish Thickness and Composition	ASTM B487, ASTM B568, or equivalent. THICKNESS: Thickness shall be not less than 60 µin (1.524 µm.) Lead finish thickness measurements ***shall*** be taken at the crest of the seating plane on surface mount leads, the crest of the endcaps for chip/MELF devices, or approximately halfway between the seating plane and the tip of the lead on other lead types. Finish thickness measurements for package elements other than leads ***shall*** be taken at the crest of the major flat or center of castellation, if present. COMPOSITION: Final finish composition shall have greater than 3% Pb by weight. Composition measurements for leaded devices ***shall*** be taken at the lead/package interface. For leadless devices, composition measurements ***shall*** be taken on the crest of the major flat, the crest of endcaps for chip/MELF devices, or center of castellation. SAMPLE SELECTION: Finish thickness and composition measurements ***shall*** be taken on a minimum of two opposing terminations from each piece part tested.	ASTM B487: YES ASTM B568: NO	0
500	Ionic Cleanliness	IPC-TM-650-2.3.25 For ionic cleanliness testing limit 1.56 µg/cm^2 or 10 µg/in^2. At least 1 in^2 of piece parts area is needed for testing. When multiple piece parts are required to meet the minimum square area, the sample size shall be satisfied based on total pieces tested, not number of tests performed.	NO	0