Revision G

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ENVIRONMENTAL ACCEPTANCE REQUIREMENTS FOR WHISKER SUSCEPTIBILITY OF Pb-FREE ALLOY SURFACE FINISHES

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EIA/ECA-CB23

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ENVIRONMENTAL ACCEPTANCE REQUIREMENTS FOR WHISKER SUSCEPTIBILITY OF Pb-FREE ALLOY SURFACE FINISHES

Foreword

This bulletin was generated under the auspices of the Steering Committee (S-1) of the EIA/ECA organization. It is intended to provide a uniform environmental acceptance testing and reporting methodology for whisker mitigation practices of Pb-free alloy surface finishes used in the Passive Electronics Industry.

Introduction

There are currently no known test method(s) that can be used to ease user's concerns with regards to whisker growth, or the potential of shorts occurring between components due to whisker growth. The purpose of this document is to assist customers in determining the typical whisker growth susceptibility of a supplier's termination finish, and showing the typical whisker growth on components under various conditions. Further testing is currently underway on whisker growth mitigation practices and the susceptibility of whiskers falling off components. The supplier in no way guarantees that passive components tested to these conditions will not cause failures due to whisker growth.

Many companies in the electronics industry have adopted Pb-free based surface finishes as one of the methods to comply with various legislative lead-free (Pb-free) initiatives, e.g. the European Union's RoHS directive. However, Pb-free surface finishes may be prone to whisker formation with associated possible reliability degradation. Appropriate mitigation practices may be incorporated for the reduction of whisker propensity to an acceptable level.

Some generally accepted mitigation practices include, but are not limited to: a) fusing of the tin plating above the tin melting point of 232°C, b) hot tin or tin alloy dip, c) a nickel underplate layer between the base metal and surface finish, and d) annealing of the Pb-free alloy finish within a short time after plating, e.g. 150°C for 1 hour within 24 hours. The testing described in this document does not guarantee that whiskers will or will not grow under field life conditions.

1. Scope

The methodology described in this document is applicable for environmental acceptance testing of Pb-free based surface finishes and mitigation practices for Pb-free whiskers. This methodology may not be sufficient for applications with special requirements, (i.e., military, aerospace, etc.). Additional requirements may be specified in the appropriate requirements (procurement) documentation.

This specification is intended for use in conjunction with JESD22A121, This specification does not apply to components with bottom-only terminations where the full plated surface is wetted during assembly (for example: Face Down and BGA components).

In the event of conflicting test methods or requirements occurring between this document and JESD22-A121 the requirements of this document shall take precedence.

2. Normative reference

JESD22A121, Test Method for Measuring Whisker Growth on Tin and Tin Alloy Surface Finishes
JESD22–A104, Temperature Cycling
JP002, Current Tin Whisker Theory and Mitigation Practices Guideline

3. Terms and definitions

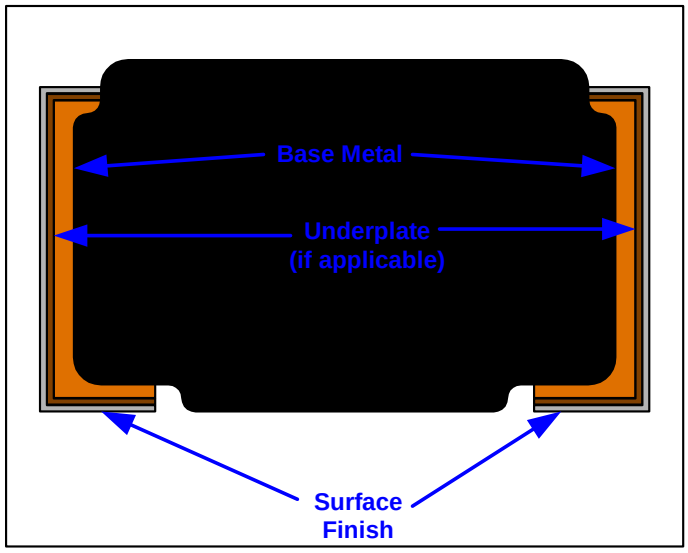


Figure 1 Cross-Sectional view of component surface finishes

Base Metal Metal alloy residing beneath all surface finish(es) and/or underplate.

minimum lead-to-lead gap: The minimum gap between leads (terminations) as shown in Figure 2.

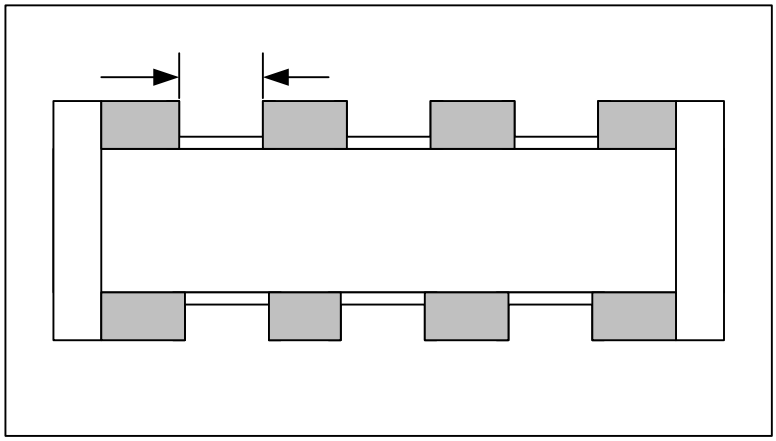


Figure 2 – minimum lead-to-lead gap

Process Acceptance, Surface Finish Acceptance testing of a change to a surface finish process already accepted by a Technology Acceptance.

Technology Acceptance, Surface Finish Acceptance testing of surface finish material set and processes that includes a defined set of base metals, underplating metals, surface finish alloy, surface finish bath chemistry, and process flow steps.

Total Axial Whisker Length The straight line distance from the point of emergence of the whisker to the most distant point on the whisker (i.e., the radius of a sphere containing the whisker with its center located at the point of emergence.) See Figure 3.

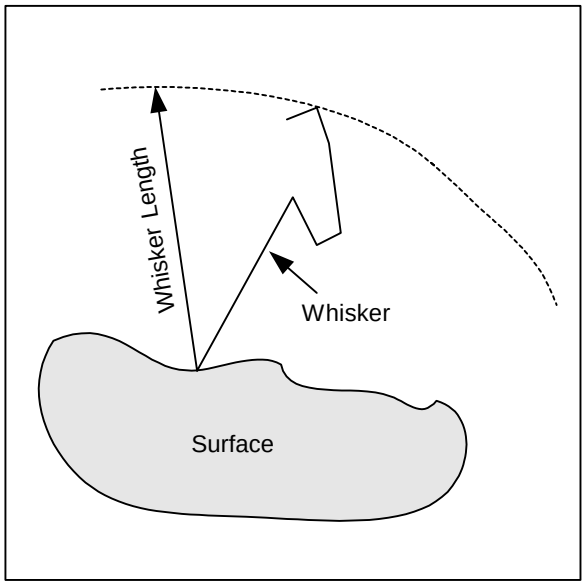


Figure 3 – Whisker length measurement

Underplate Plating layer(s) between the base metal and the outer surface finish.
Sometimes referred to as “Barrier Plate”.

Similarity Acceptance, Surface Finish Acceptance of a change to a surface finish process based upon similarity and data available from previous whisker mitigation Technology and Process Acceptance tests.

Surface Corrosion A visual surface degradation appearing optically as dark spots. Typical photos of termination corrosion are shown in Annex A.

Surface Finish Pb-free alloy based external package leads, terminations and body finishes.

Whisker A spontaneous columnar or cylindrical filament, usually of mono-crystalline metal, emanates from the surface of a finish. (See JESD22-A121)

Whisker Mitigation Practice Process(es) performed during the manufacture of a component to reduce the propensity for whisker growth by minimizing the surface finish internal compressive stress.

4. Test Method for Measuring Whisker Growth

Procedures for conducting stress testing and inspections for whisker growth as applicable to this specification are contained in JESD22-A121. In the event of conflicting tests or requirements occurring between this document and JESD22-A121 then the requirements of this document shall take precedence.

4.1 Test Samples

For some assembled packages with internal Pb-free plated surfaces that cannot be inspected optically, e.g. internal surfaces of cans and hybrid package lids, testing and inspection of piece parts may be necessary. Components with Pb-free alloy surface finishes used in press-fit, socketed applications, or with other compressive mechanical connections should be qualified in their end use configuration.

4.2 Handling Precaution

Careful test sample handling is important in order to avoid possible damage or detachment of whiskers from the test samples. Excessive vibration, impact, or physical contact with the device finish should be avoided. Test sample contamination as a result of improper handling or as a result of the application of a conductive material for SEM inspection should be avoided if the devices are to be returned to the test condition for further exposure.

5. Acceptance Procedure for Pb-free Whisker Mitigation

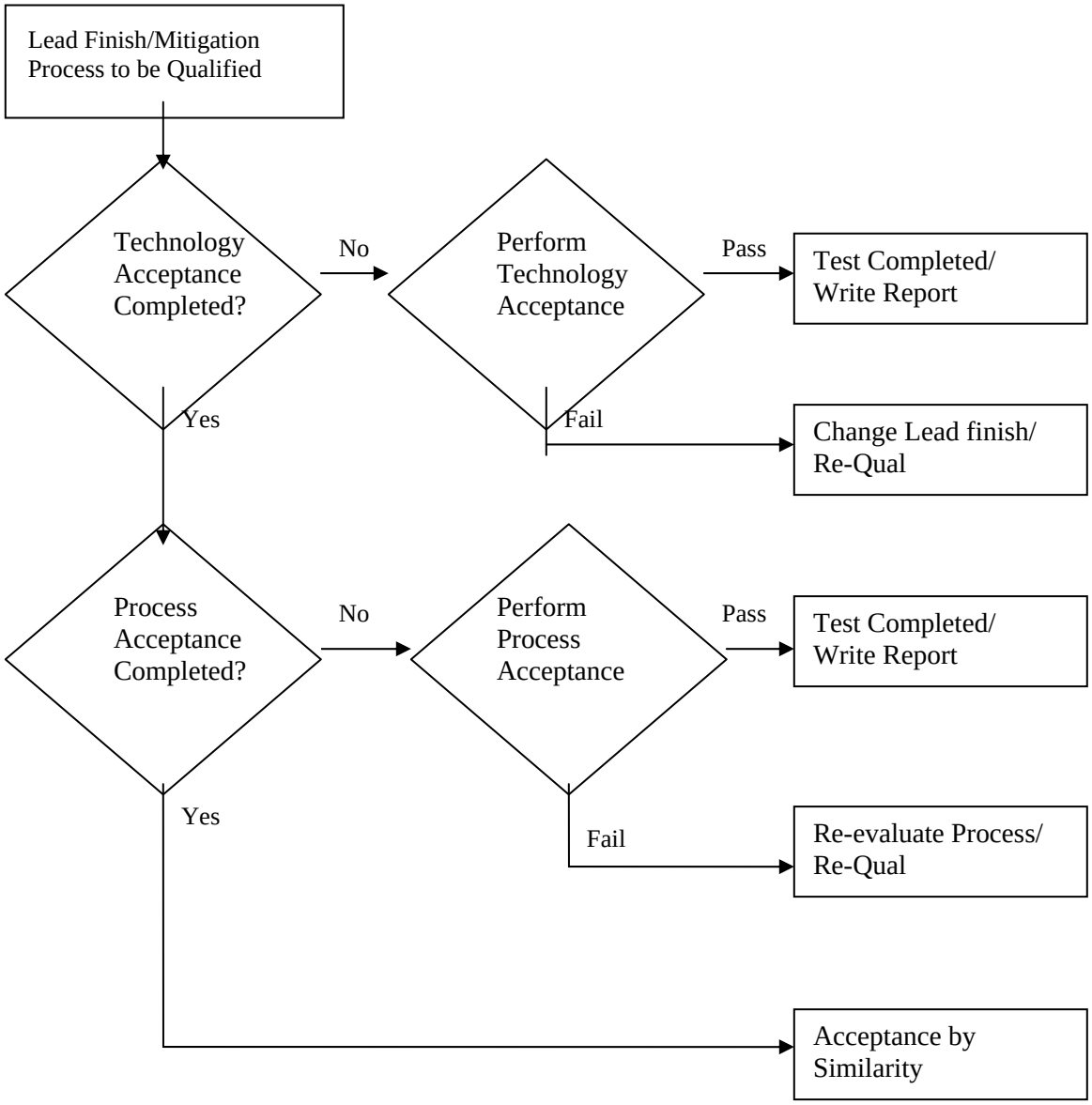
5.1 Determination of whether a Technology, Manufacturing Process, or Similarity Acceptance test is required

The acceptance procedure for Pb-free whisker mitigation practices should follow the procedural flow outlined in Figure 4. A specific Surface Finish / Mitigation process or change will necessitate a Technology or Process Acceptance unless the change is covered by Similarity. Annex B shows the Technology Acceptance test flow.

5. Acceptance Procedure for Pb-free Whisker Mitigation (cont'd)

5.1 Determination of whether a Technology, Manufacturing Process, or Similarity Acceptance test is required (cont'd)

Figure 4 Technology and Process Acceptance Flowchart



5. Acceptance Procedure for Pb-free Whisker Mitigation (cont'd)

5.1 Determination of whether a Technology, Manufacturing Process, or Similarity Acceptance test is required (cont'd)

Table 1 establishes the parameters that define a specific Mitigation Technology. These parameters are fixed for a specific Technology Acceptance program. Any change to a Technology parameter is subject to re-acceptance testing. Likewise, Table 1 establishes Process Variables. Any change to a Process Variable requires a Process Acceptance program or reacceptance testing. In the event that a family of component types, ranging in size from 01005 and up to 2512, and if the terminations are of likeness, than the supplier is only required to perform testing on 2 sizes of the components family, so long as the size differential is 2x. Example: test 0603 and 1206 sized components. Based upon the results of the tests for these two sized components the rest of the family shall be pass/fail upon the results of the whisker tests.

Table 1 Surface finish technology and manufacturing process change acceptance parameters

Parameter	Technology Parameters	Process Variables
Base Metal	Base Metal Composition	Type e.g. Etched or Stamped
Surface Finish Composition	Surface Finish Alloy Composition Surface Finish Thickness Underplate Composition Underplate Thickness	
Surface Finish Chemistry or Process	Surface Finish Plating Process Process Chemistry Underplate Process Underplate Process Chemistry Dip Process Dip Process Chemistry Post Bake Process Parameters Plating Bath Vendor Major Plating Process Control Parameters	Minor Plating Process Control Parameters Dip Process Control Parameters
Assembly Process and Package Type		Lead Forming Process
Factory or Surface Finish Line	Startup New Factory	New Plating Equipment New Line

Table 2 defines the Technology and Process Acceptance Test Requirements for parameter changes to a specific Mitigation practice. Table 2 also defines those changes that may be qualified by Similarity if sufficient Technology and Process Acceptance data are available. Similarity includes but is not limited to: same base metal, same plating process (chemistry, current density, etc.), same lead forming process and duplicate plating lines within the same factory. See Table 2 for examples. The process and supplier(s) used for the Pb-free surface finish to be qualified shall be the production plating process and supplier proposed for Technology Acceptance test.

Table 2. Pb-free Whisker Mitigation Acceptance Test Matrix

Technology or Process Parameter	Examples	Qual Type 1,2	Acceptance Test Req'd		
			TC3	Ambient/ T & H	High/ T & H
Base Metal					
Base Metal Alloy	Base Metal, e.g. Cu Alloy, FeNi42	T	x	x	x
Base Metal Vendor	Supplier A vs B, same Metal	S	-	-	-
Leadframe Type	Etch vs Stamped	P	x	x	x
Surface Finish Composition					
Surface finish Alloy	Sn, SnAgCu, SnBi etc…	T	x	x	x
Surface Finish Thickness	Change in Thickness parameters	T	x	x	x
Underplate Composition	Change in Underplate composition	T	x	x	x
Underplate Thickness	Change in thickness parameters	T	x	x	x
Surface Finish Chemistry or Process					
Surface Finish Plating Process	In-Line vs Rack Vs Barrel, Bright vs Matte Sn	T	x	x	x
Underplate Process	Change in Underplate Process	T	x	x	x
Process Chemistry	Mixed acid vs MSA	T	x	x	x
Plating Bath Vendor	Supplier A vs B, same chemistry	T	x	x	x
Major Plating Process Control Window Limits	Change beyond vendor recommended for additive levels of Metal content, Acid Content, Current Density, temperature, impurity levels	T	x	x	x
Minor Plating Process Control Window Limits	Change within vendor recommended for additive levels of Metal content, Acid Content, Current Density, temperature, impurity levels	S	-	-	-
Dip Process	Change in flu, impurity levels, immersion rate etc…	T	x	x	x
Post Bake Process	Change in bake process parameters	T	x	x	x
Assembly Process and Package Style					
Lead Form	J-lead vs Gull wing	S	-	-	-
Lead Count	Different Lead Count	S	-	-	-
Lead Dimension	e.g. 0.25mm wide vs 0.18 mm wide	S	-	-	-
Factory or Surface Finish Line					
Startup New Factory	New Factory	P4 T	x x	x x	x x
New Plating Line	Accepted Technology/Factory/Vendor	S	-	-	-
New Plating Equipment	New plating line, type or vendor	P	x	x	x

5. Acceptance Procedure for Pb-free Whisker Mitigation (cont'd)

5.1 Determination of whether a Technology, Manufacturing Process, or Similarity Acceptance test is required (cont'd)

Table 2. Pb-free Whisker Mitigation Acceptance Test Matrix (cont'd)
NOTE 1 T = Technology Acceptance; P = Manufacturing Process Change Acceptance; S = Similarity Acceptance

NOTE 2 For Manufacturing Process Change Acceptance, TC test may be omitted if the CTE (coefficient of thermal expansion) of the base metal is >15 ppm/K. If an underplate is used, TC may be omitted only if the CTE of both the underplate and base metal is >15 ppm/K.

NOTE 3 Technology Acceptance testing is not required for changes to copper alloys if an underplate sufficient to limit copper diffusion into the tin surface finish is used.

NOTE 4 Same base metallurgy/chemistry including any flash metal surface plating.

NOTE 5 Precautions should be taken in regards to maintenance practices, which can result in a change in manufacturing process parameters, which may result in more susceptibility to whisker growth.

NOTE 6 New Factory interim release may be granted based on Manufacturing Process Change Acceptance completion upon agreement between supplier and user. Full factory release will be after successful completion of the technology acceptance testing.

NOTE 7 Definitions of Matte vs. Bright Tin are found in JP002 with regard to grain size and carbon content.

5.2 Samples

5.2.1 Sample requirements

Table 3 recommends the quantity of plating lots and sample size requirements per Readpoint per Stress Test. Supplier may increase/decrease the sample size at their own discretion or as agreed upon between the user requesting the test. Surface Finishes for Technology Acceptance shall be representative of the actual production process and products to which the finish shall be applied. Acceptance lots shall be plated at one-week intervals or different plating lines within the same factory using the same Technology. Component samples for applications with mechanical connections, i.e. press-fit or socketed, etc, should be qualified in the end use configuration.

5. Acceptance Procedure for Pb-free Whisker Mitigation (cont'd)

5.2.1 Sample requirements (cont'd)

Table 3a. Pb-free Whisker Mitigation Acceptance Test Sample Size Recommendations for Multi-Leaded passive devices

Stress Type	Recommended Sample Inspection Requirements*				
	Lots per Stress	Samples per Lot	Components Inspected Per Readpoint1	Screening Inspection Terminations per Readpoint2	Detailed Inspection Terminations per Readpoint3
Temperature Cycling	3	2	6	96	18
Ambient Temperature/ Humidity Storage	3	2	6	96	18
High Temperature/ Humidity Storage	3	2	6	96	18

* Any unique reliability tests, conditions or sample quantities requested by the user and not specified in this document shall be negotiated between the supplier and user requesting the test.

Table 3b. Pb-free Whisker Mitigation Acceptance Test Sample Size Recommendations for passive devices with less than 4 terminations

Stress Type	Recommended Sample Inspection Requirements*				
	Lots Per Stress	Samples per Lot	Components Inspected Per	Screening Inspection	Detailed Inspection Terminations per

			Readpoint1	Terminations per Readpoint2	Readpoint2
Temperature Cycling	3	3	9	18	18
Ambient Temperature/ Humidity Storage	3	3	9	18	18
High Temperature/ Humidity Storage	3	3	9	18	18

* Any unique reliability tests, conditions or sample quantities requested by the user and not specified in this document shall be negotiated between the supplier and user requesting the test.

NOTE 1. Components should be drawn equally from the Manufacturing lots, to the extent where practical.

NOTE 2. If whiskers are detected in the Screening Inspection, then the terminations with longest whiskers are to be measured in the Detailed Inspection. The longest whisker is measured and recorded for each termination. If no whiskers are detected in the Screening Inspection, then no Detailed Inspection is required.

5. Acceptance Procedure for Pb-free Whisker Mitigation (cont'd)

5.2.2 Sample whisker measuring

The same samples shall be used at each inspection readpoint. For example, consider beginning the high temperature/humidity storage test with 6 samples. At the 1000-hour readpoint, these 6 samples would be removed from the chamber, 96 leads would be inspected, and the 18 longest whiskers measured. These 6 samples then would be returned to the thermal chamber and exposed for another 1000 hours. Then, these same 6 samples would be removed at the 2000- hour readpoint, the same 96 leads would be inspected, and the 18 longest whiskers (not necessarily the same as at the previous readpoint) would be measured. This process would repeat until the test is complete.

The time that samples are out of the chamber for inspection and whisker measurement should be kept to a minimum in order to minimize the overall test time and to avoid inducing contamination or inaccuracies in whisker measurements.

5.2.3 Surface Corrosion Observed

• If surface corrosion is observed, the lead showing corrosion may be removed from the whisker inspection, any lead removed must be replaced with another lead to maintain the total required sample size and inspection points.

• If one sample part shows evidence of massive corrosion, that part may be removed as invalid for the test and replaced with another part. Therefore, an additional sample beyond the minimum required in Table 3 might be required to account for the possibility of removing a corroded part(s) from the test.

• Any elimination or substitution of sample parts or leads removed due to corrosion must be documented with appropriate technical justification. It is therefore recommended that testing be performed with extra samples, in the event that surface corrosion is observed.
See Annex A for examples of corrosion.

5.3 Test procedures and durations

Tables 4a and 4b list the stress tests, test conditions, inspection intervals and total durations required for the Pb-free Whisker Mitigation Technology and the Process Acceptance- tests, respectively. Product classes shall be agreed to between supplier and user. General guidelines for product classes follow, in section 5.4, but may not apply in all cases.

5. Acceptance Procedure for Pb-free Whisker Mitigation (cont'd)

Table 4a. Recommended Technology Acceptance Tests and Durations

Stress Type	Test Conditions	Precon-ditioning	Inspection Intervals	Total Duration	
				Class 1, 2, & 3 products5	Class 1A products6
Temperature Cycling1	-55 +0/-10oC to +85 +10/-0oC, air to air; 10 minutes soak; ~3.0 cycles/h (typ)	Per table 4c	500 Cycles	1500 Cycles	1000 Cycles
	-40 +0/-10oC to +85 +10/-0oC, air to air; 10 minute soak; ~3 cycles/h (typ)			1500 Cycles	1000 Cycles
	-40o +0/-10oC to +125o +10/-0oC, air to air; 30 minute soak; ~1 cycles/h (typ)			1500 Cycles	1000 Cycles
Ambient Temperature/ Humidity Storage	30± 2oC and 60± 3% RH2	Per table 4c	1000 hours	4000 Hours minimum4	1000 hours
High Temperature/ Humidity Storage	60± 5oC and 87 +3/-2% RH3	Per table 4c	1000 hours	4000 Hours minimum4	1000 hours

Table 4a. Recommended Technology Acceptance Tests and Durations (notes)
NOTE 1 Either Temperature Cycling Test Condition may be used.

NOTE 2 Previous data generated under uncontrolled ambient conditions may be substituted for this condition.

NOTE 3 Previous data generated under higher humidity conditions, e.g., 60 °C and 90-95% relative humidity (RH), are substitutable for this condition.

NOTE 4 Whisker length data for all inspection intervals shall be recorded and be available, upon request, for all Technology Acceptance tests. The length of the longest whiskers at each inspection interval, from the 18 termination detailed inspection, shall be plotted against the inspection time interval.

NOTE 5 See section 5.4 for definitions of Class levels.

NOTE 6 For Class 1A products, using low CTE (<15 ppm/K , e.g., Alloy 42) leadframe, only the Temperature Cycling test is required for Technology Acceptance.

5. Acceptance Procedure for Pb-free Whisker Mitigation (cont'd)

5.3 Test procedures and durations (cont'd)

Table 4b. Recommended Process Acceptance Tests and Durations

Stress Type	Test Conditions	Precon-ditioning	Total Duration	
			Class 1, 2, & 3 products	Class 1A products4
Temperature Cycling1	-55 +0/-10oC to +85 +10/-0oC, air to air; 20 minutes soak; ~1.5 cycles/h (typ)	Per table 4c	500 Cycles	500 Cycles
	-40 +0/-10oC to +85 +10/-0oC, Air to air;10 minute soak; ~3 cycles/h (typ)		500 Cycles	500 Cycles
	-40o +0/-10oC to +125o +10/-0oC, air to air; 30 minute soak; ~1 cycles/h (typ)		1000 Cycles	1000 Cycles
Ambient Temperature/ Humidity Storage	30± 2oC and 60± 3% RH2	Per table 4c	1500 hours	1000 hours
High Temperature/ Humidity Storage	60± 5oC and 87 +3/-2% RH3	Per table 4c	1500 hours	1000 hours

NOTE 1 Either Temperature Cycling Test Condition may be used.

NOTE 2 Previous data generated under uncontrolled ambient conditions may be substituted for this condition.

NOTE 3 Previous data generated under higher humidity conditions, e.g., 60 °C and 90-95% RH, are substitutable for this condition.

NOTE 4 For Class 1A products, using low CTE (<15 ppm/K , e.g., Alloy 42) leadframe, only the Temperature Cycling test will be performed for Manufacturing Process Change Acceptance.

Table 4c. Preconditioning for Technology/Process Acceptance Testing

Base Metal Alloy	Mitigation Technique	Precondition Condition1,2,3&4
Copper Alloys	None	A (no preconditioning)
		B&C (storage + SnPb reflow)
		B&D (storage + Pb-free reflow)
	Underplate Process or Post Bake Process	A (no precondition)
		C (SnPb reflow)
		D (Pb-free reflow)
FeNi42	None	A (no precondition)
		C (SnPb reflow)
		D (Pb-free reflow)

Table 4c (Notes)
NOTE 1 Preconditioning treatments per JESD22A121 prior to indicated stresses in Tables 4a and 4b.

NOTE 2 Reflow assembly is optionally allowed for conditions C and D using the optional preconditioning reflow temperatures from JESD22A121 Table 3. If reflow assembly is used, the number of sample terminations inspected may need to be increased due to the reduction of termination area wetted by the board solder. The inspection increase should be based on achieving approximately the same area as an unwetted termination. Annex C describes the details for the reflow assembly process.

NOTE 3 The + symbol indicates sequential preconditioning in the order listed.

NOTE 4 If underplate/post bake process does not conform to JP002 sections 5.3 or 5.4.3 then condition B (4weeks room ambient storage) must be used before conditions C and D.

5. Acceptance Procedure for Pb-free Whisker Mitigation (cont'd)

5.4 Determination of Class levels

Class 3: Mission/Life critical applications such as military, aerospace and medical applications
- -Pure tin and high tin content alloys are not acceptable

Class 2: Business application such as Telecom Infrastructure equipment, High-end Servers, etc.
- -Long product lifetimes and minimal downtime
- -Products such as disc drive's typically fall into this category
- -Breaking off of whisker is a concern

Class 1: Industrial Products
- -Medium product lifetime
- -No major concerns with whiskers breaking off

Class 1A: Consumer products
- -Short product lifetime
- -No major concerns with whiskers breaking off

6. Acceptance Criteria

At each inspection interval listed in the Table 4, the test samples are to be removed from the stress chamber(s) and inspected by optical microscope and/or SEM per the procedures specified in JESD22-A121. If optical microscopy is used for screening and measurement of whisker length, then validation of the optical equipment must be performed per JESD22-A121, or equivalent method, prior to inspection of whisker samples. Table 5 defines the maximum allowable whisker length observed in test samples after environmental acceptance testing. Any sample with a whisker exceeding these limits constitutes a failure of the surface Technology or Process under test.

Generic data on long established Pb-free surface finish processes with reliable field histories may be substituted with agreement between supplier and user.

Table 5. Technology Acceptance Maximum Allowable Whisker Lengths

Device considerations (Package Type, Lead Pitch)	Maximum Allowable Total Axial Whisker Length			
	Class 3	Class 2	Class 1	Class 1A
SMD devices	Pure tin and high tin content are typically not allowed.	40 µm	67 µm	67 µm
SMD Array/ IPD devices (multi-leads)		40 µm	67 µm	67 µm
Through-hole devices (straight or formed)		40 µm	67 µm	67 µm

7. Suggested Reporting of Results

At the conclusion of Acceptance testing, a report of background information and findings shall be published and could include, but not limited to the following:

• Details of the Mitigation process used on the test samples (per JESD22-A121 Annex E).

• Reflow profile.

• Type of qualification being performed (technology vs. process).

• Component package type, base metal, under layer plating (if any), and surface finish material(s).

• Plating and under layer plating (if any) thickness's.

• Date of plating of each lot and lot identification.

• Preconditioning temperature profile details, including date of preconditioning.

• Stress conditions (including inspection intervals and duration) and sample sizes utilized in acceptance testing.

• Acceptance criteria utilized.

• Inspection equipment details including magnifications used (if applicable, the optical inspection qualification data per JESD22-A121 Annex B).

• Inspection results for optical and/or SEM inspections per stress condition and interval, including whisker length results for each test at the specified intervals (per JESD22-A121 Annex E).

• Identification of any part and/or leads discounted due to corrosion.

• At a minimum final test results shall be reported with interim results maintained on file.

8. Ongoing Whisker Monitoring

Supplier will establish a system to periodically monitor the performance of the surface finish manufacturing processes for whisker generation. The specifics of this system are left to the supplier, however the following minimum guidelines are suggested:

• A representative sample of components, as determined by the supplier, should be taken for each designated time period.

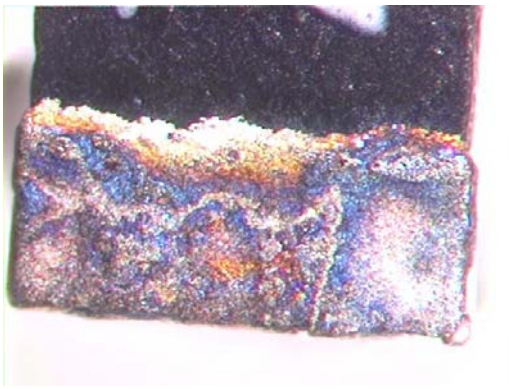
• Recertification of existing results is allowed, as long as no changes have been made to the component terminations and/or their processing.

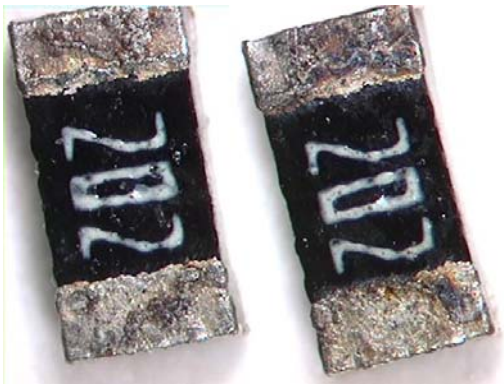
• The storage conditions for these components should include a relative humidity of 60% or greater. Using the ambient test conditions of Table 4 is preferred.

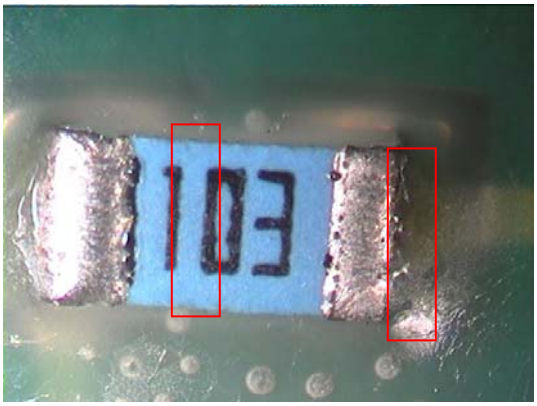
• The samples should be inspected for whiskers 6 months from the date of plating.

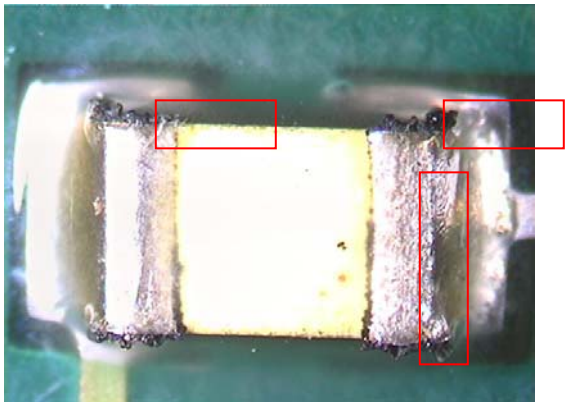
• Results should be compared to baseline measurements. If these are exceeded, supplier should take appropriate corrective actions.

Annex A. Typical Examples of Termination Corrosion

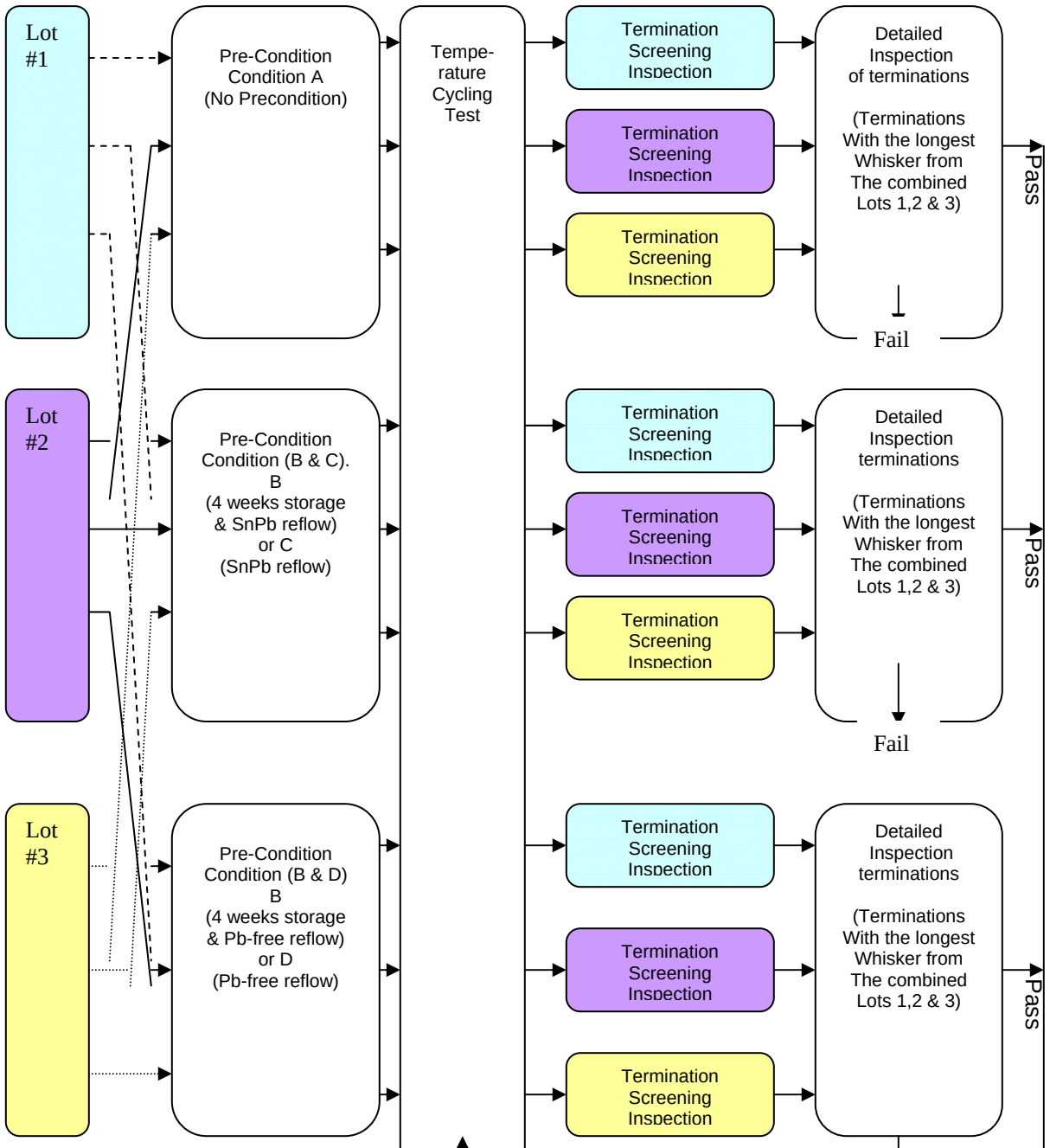




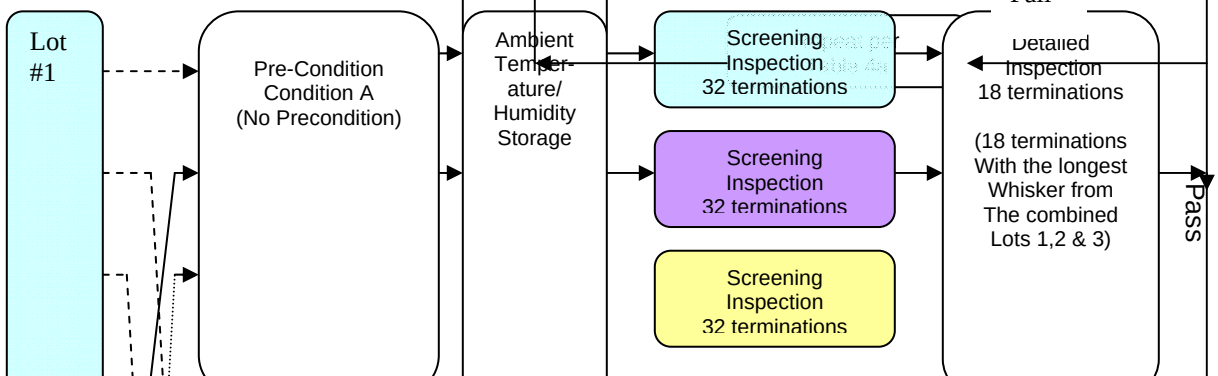


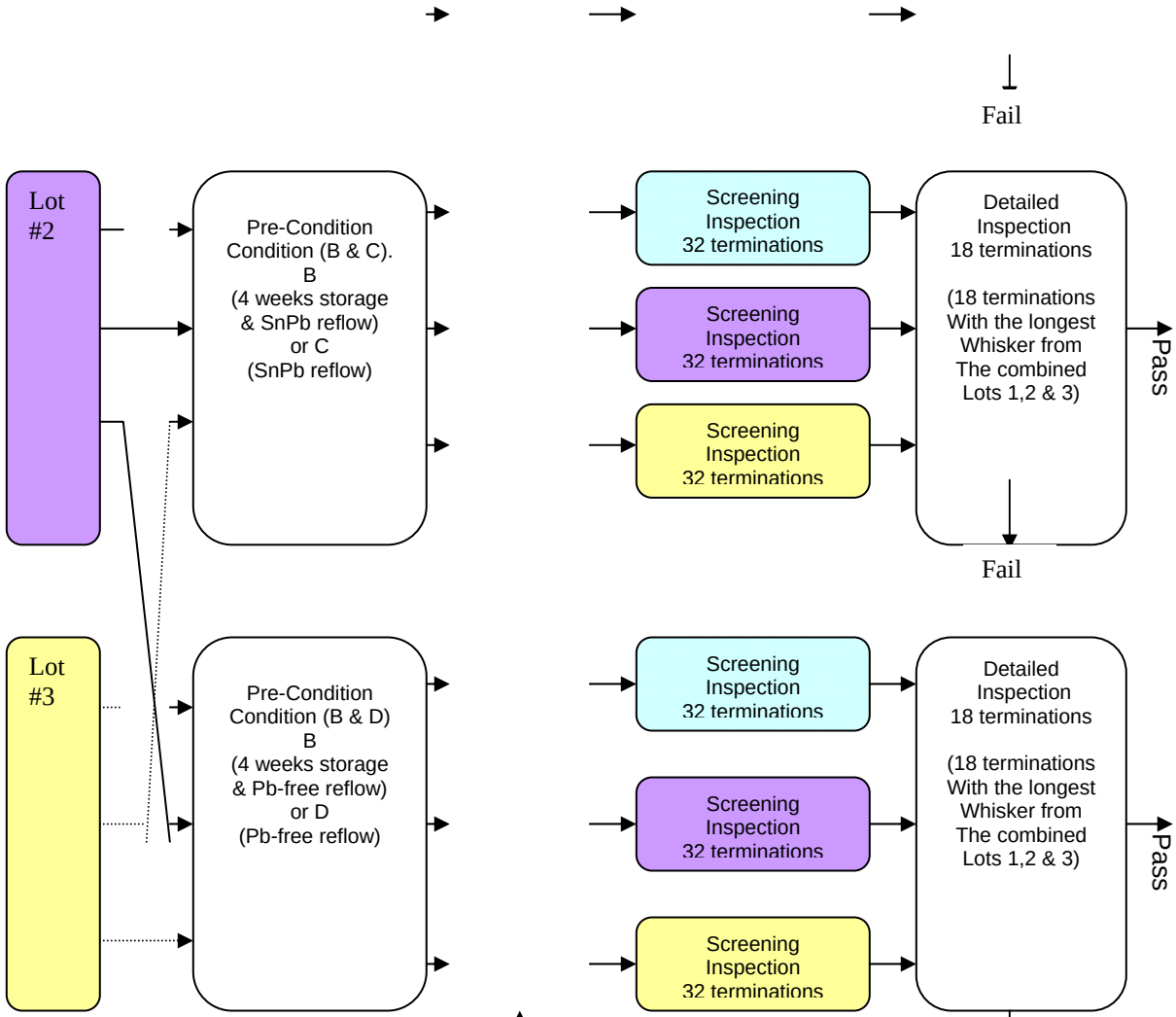


Annex B. Technology Acceptance Test Flow

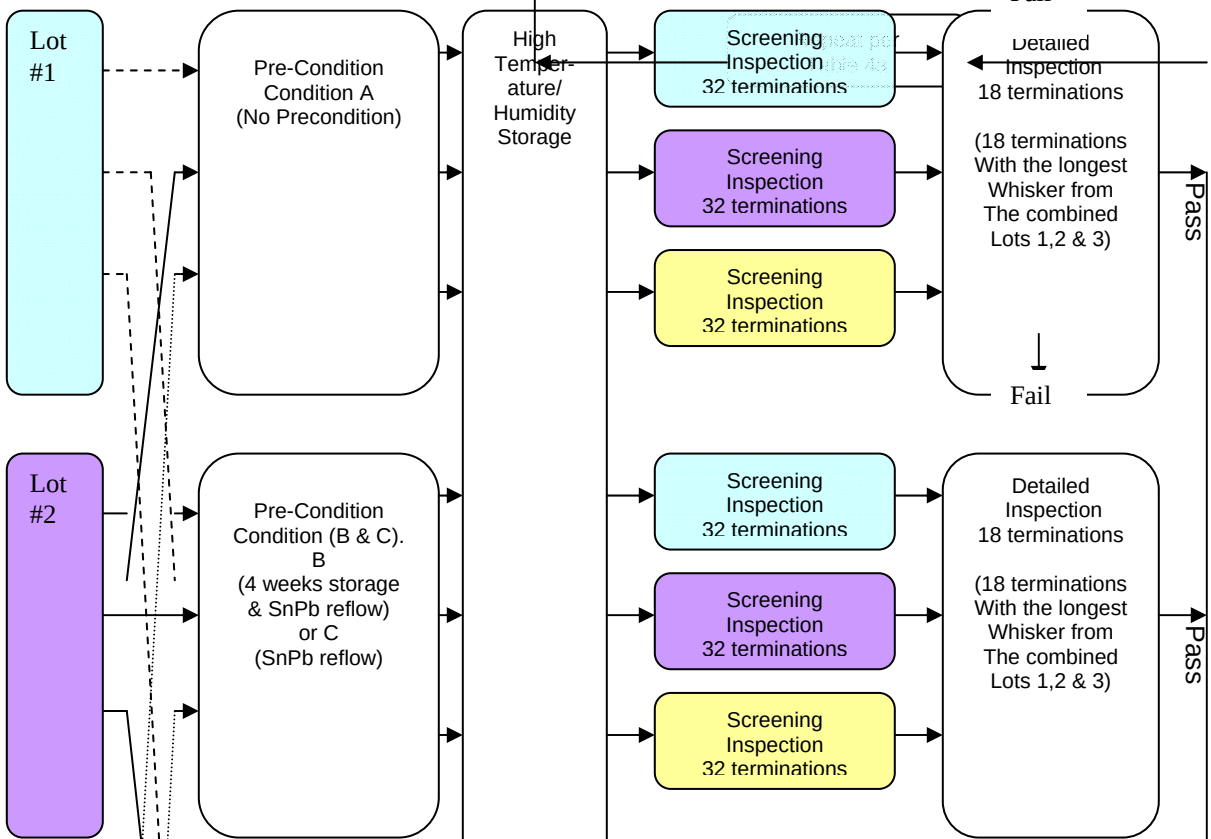


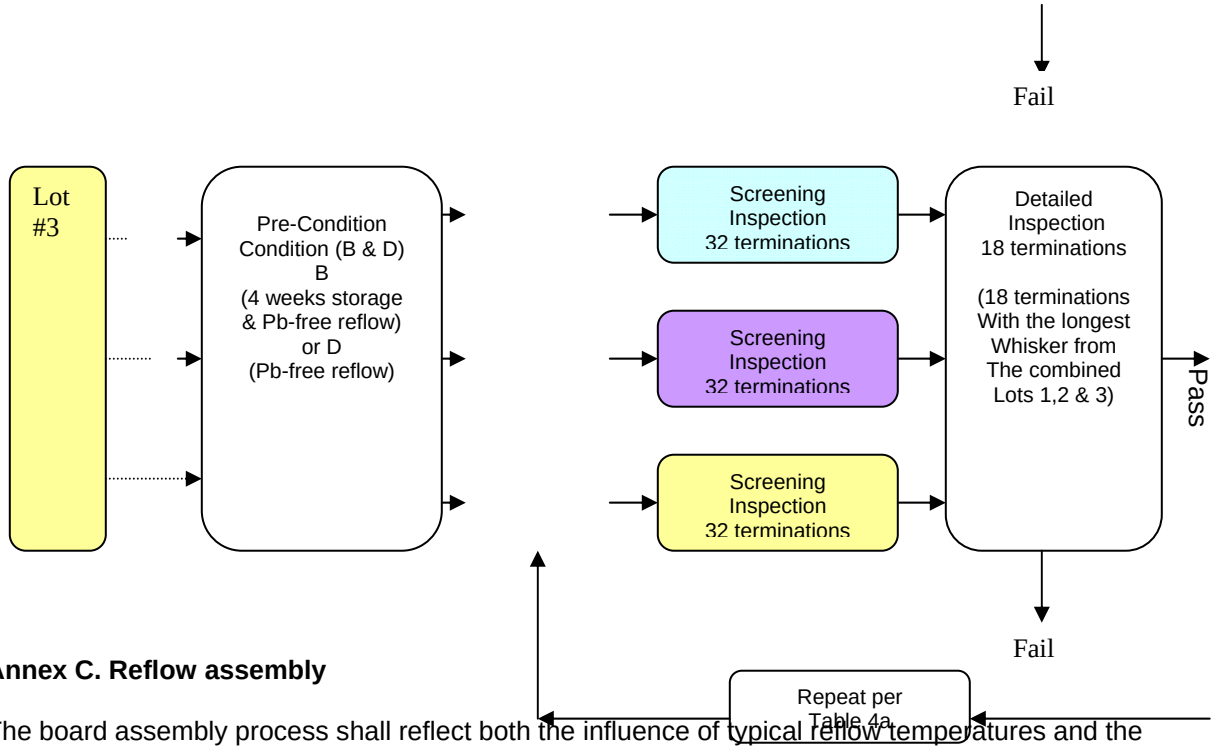
Annex B. Technology Acceptance Test Flow (continued)





Annex B. Technology Acceptance Test Flow (continued)





Annex C. Reflow assembly

The board assembly process shall reflect both the influence of typical reflow temperatures and the metallurgical effects of a typical solder material. Components for which the terminations are usually fully wetted, even with a board assembly process at the lower process window limits, are exempted from this test. For example, this applies to:
- nonleaded components
- flat leaded components.

Since whiskers usually grow only from the unwetted surface finish, it is essential that there is some unwetted area left after the board assembly process. This area shall represent at least 1/3 of the termination surface. Technical justification (documentation) shall be provided that the 1/3 minimum unwetted area requirement has been met, for example statistical EDX analysis, etc. The number of sample terminations inspected needs to be increased due to the reduction of termination area wetted by the board solder. The inspection increase should be based on achieving approximately the same area as an unwetted termination. For example, if only 1/3 of the termination area is unwetted, 3 times as many terminations must be inspected than for unassembled components, i.e. 96 x 3 = 288 per stress test.

The board assembly process will likely be somewhat different than typical production assembly processes because of the requirement for minimum termination wetting. In cases where the acceptance of multiple component types is being assessed by Similarity (Tables 1 and 2), it is recommended that board assembly be performed on the component type with the longest terminations in order to promote the presence of unwetted surface. The following table provides some further guidance for the board assembly process that may help to minimize termination wetting. Finally, it is recommended to clean the test board of flux residues before acceptance testing due to the unknown effect of flux residues on whisker growth.

SMT Board Assembly Process Guidance for Minimum Termination Wetting	
Reflow Atmosphere	Air
Flux Type	Low activity
Paste Alloy	Precondition C: SnPb Precondition D: SnAgCu
Stencil	Substantial cut backs from production opening and/or thickness may be required
Reflow Profile[1]	SnPb and Pb-free reflow profiles per JESD22A121 table 3 and figure 1
NOTE 1 In some cases it may be necessary to use a peak temperature at the low end of the range in order to avoid substantial wetting of the terminations.	

NOTE 2 Boards do not need to be electrically functional.

EIA Document Improvement Proposal

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