Policy Description

1. Purpose

This Policy defines Celestica's environmental requirements to our suppliers. The intent of the policy is to assist Celestica's customers in complying with RoHS (defined below) and WEEE (defined below) type directives, such as those promulgated by the European Union and the People's Republic of China, along with other similar existing or emerging legislation or regulations. It also defines minimum survivability standards for electronic components along with the manufacturability data that Celestica requires in order to use said parts. Upon customer request, Celestica may specify additional declaration requirements to supplier.

Celestica reserves the right to amend this Policy from time to time.

2. Scope

2.1. This Policy applies to all purchased goods intended for use in electronic products manufactured by Celestica, with the exception of chemicals and consumables[1]. It encompasses all of Celestica's sites and affects Celestica's entire global supply base.

2.2. Goods that must comply with a RoHS-type directive will be identified in the relevant QSPEC document (defined below). Furthermore, goods that must be lead (Pb)-free (defined below) will be identified by a reference to this effect in the QSPEC. Any exceptions to this Policy will be documented in the applicable QSPECs. These exceptions may add to the requirements for a particular part number.

2.3. This Policy applies to, but is not limited to, the following commodity categories:

- Actives
- Passives
- Optics
- IC's
- Magnetics
- Memory
- Logic
- Printed Wiring Boards
- Connectors
- Plastics
- Mechanicals
- Peripherals
- Sub-assemblies

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[1] Chemicals and consumables are covered by Celestica Environmental Requirements for Purchased Chemicals and – Consumables DOC0075099 (Legacy No: CELQ-033-POL-15)

3. Responsibilities

3.1. The supplier shall ensure that all goods supplied to Celestica fully comply with the requirements of this Policy.

3.2. Franchised Distributors

The requirements set out in this policy are applicable to original component manufacturers, and as such cannot reasonably be met by our Approved Component Distributors. However, Celestica does require our Distribution partners to assist in our compliance requirements through the following actions:

- Distributors must establish & maintain internal processes to identify segregate and store RoHS compliant components, so as to minimize the opportunity to mix compliant with non-compliant materials. Celestica encourages suppliers to demonstrate compliance capability through the use of external accreditation. (e.g. EIA/ECCB-954, BSI Kitemark)
- Distributors must take reasonable steps to pick & ship components that meet the requirements of Celestica quality Specifications (QSPECs). Where the QSPEC specifies date code restrictions, these *must* be adhered to, as some suppliers are not changing manufacturer part numbers when their components become compliant.
- The manufacturer's part number (& date code) referenced on Celestica's Purchase Order (P.O.) and QSPEC will take precedence over any conflicting information, although Celestica expects suppliers to make best endeavours to notify us of any discrepancies noted in our purchasing documentation.
- The P.O. will identify whether an ordered part needs to comply with this Policy. Should supplier have reason to believe a component does not meet the requirements of this Policy, they should immediately inform their Celestica purchasing contact for resolution.
- Distributors must take reasonable steps to provide Celestica with compliance documentation from the original part manufacturer, including material declarations and certificates of compliance, per the Documentation Requirements below.

4. Definitions

Bright Tin (Sn)	Bright Tin (Sn) has grain size less than 1µm and a carbon content of greater than0.2% in the plating.
Chemicals and Consumables	Items used in the manufacture of electronics which are not generally considered functional components of the final product. Examples include solder paste, flux, inks, etc.
C of C	Certificate of Compliance
Deviation Permit	Means a Celestica standard format used to document deviations from the specifications as written on the QSPEC. A valid deviation permit must be signed by the appropriate authorized Celestica representative
EIA	Electronic Industries Alliance

EU	European Union
Homogeneous	Means a good with uniform composition throughout
Homogeneous Material	Means a material that cannot be mechanically disjointed (separated) into different materials.
IEC 62474	Material Declaration for Products of and for the Electrotechnical Industry An International Standard for the electrical and electronics industry on material declaration. Since 21 Jan 2014, JIG 101 was officially declared obsolete and replaced by IEC 62474 Standard.
IEC 62474 DSL	IEC 62474 Declarable Substance List List of regulated substances and substance groups that a manufacturer should declare to downstream manufacturers if present in the product. Each substance or substance group entry in the list is accompanied with a reportable application and a reporting threshold level. Example of DSL is REACH Candidate List, Annex XVll of REACH, EU Batteries Directive, EU/RoHS Directive, California Prop 65 etc.
iNEMI	International Electronics Manufacturing Initiative, Inc
IPC	Institute for Interconnecting and Packaging Electronic Circuits
J-STD	Joint IPC/JEDEC standard document
JEDEC	Joint Electron Device Engineering Council
JESD	JEDEC standard document
Lead (Pb)-Free	Means that a good does not contain lead (Pb) above the material limit specified by RoHS
Lead (Pb)-Free Compatible	Means a good does not contain lead (Pb) and can withstand the lead-free processing requirements as documented in the Minimum Process Requirements section
Matte Tin (Sn)	Matte Tin (Sn) has grain size greater than 1µm and a carbon content of less than 0.05% in the plating layer. Thickness of the matte Tin (Sn) layer should be equal to or greater than 7.62 µm
MSL	Moisture Sensitivity Level (per J-STD-020)
PCN	Process Change Notification
QSPEC	Celestica's Quality Specifications applicable to each good
RoHS	Means the European Union's directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (Directive 2011/65/EU). May also be used to describe similar legislations from other jurisdictions, such as China, Korea, and California

RoHS Compatible	Means a good that complies with the materials restrictions specified by Directive 2011/65/EU, *and* can withstand the lead-free processing requirements as documented in the Minimum Process Requirements section
RoHS Compliant	Means a good that complies with the materials restrictions specified by RoHS
RoHS Exempt	Means a good that complies with Directive 2011/65/EU by qualifying for an exemption listed in the Annex of Directive 2011/65/EU; or where a goods' end application has been ruled exempt from RoHS or WEEE by an authority of competent jurisdiction
Substance	A chemical element and its compounds in the natural state or obtained by any manufacturing process, including any additive necessary to preserve its stability and any impurity deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition.
WEEE	Means the Waste Electrical and Electronic Equipment (Directive 2012/19/EU)

5. Qualification Requirements

5.1. Approved Environmentally Compliant Suppliers

Supplier will not supply any goods to Celestica unless it has confirmed with Celestica that it has been approved by Celestica as a supplier eligible to supply such goods to Celestica. Examples of such confirmation are appearing on the relevant QSPEC and\or purchase order (P.O.) for the part in question.

5.2. Qualification of Goods

The Supplier has the responsibility to perform internal qualification activities for each part number prior to sale to Celestica. Celestica will have the option, but not the obligation to take part in additional part or application-level qualification activities. This process may entail a review of applicable part information, part testing, application/product level testing, and compliance verification testing. Specific Supplier requirements for qualification will be detailed as needed. General informational items that will optionally be considered as part of Celestica's additional qualification activities are listed in the General section below, and upon request by Celestica will be made available by Supplier. Please note that Supplier part or process changes (documented as PCN's) may also require additional qualification activities by Celestica, therefore the following data must be available from the Supplier at the time the PCN is issued.

5.2.1. General

The Supplier will provide its internal qualification data to Celestica including, without limitation, information on the solder alloy used for testing, manufacturing process capability, and details on the termination metallurgy and structure of the part. The data should demonstrate both forward compatibility (ability to solder the parts using Lead (Pb)-free solders and the appropriate higher temperature profiles), and backward compatibility (ability to solder the parts using existing Tin/Lead (Sn/Pb) solder and profiles).

There are exceptions such as for area array packages with Lead (Pb)-free solder balls, which may not be backward compatible. If known to the Supplier, these exceptions must be pointed out in the documentation.

It is the Supplier's responsibility to ensure that the first level interconnect (i.e. within the component package) is compatible with known second level (i.e. board level) soldering processes (as defined by J-STD-020, current revision).

5.2.2.Test Methods

Any new or changed materials or processes used in manufacturing the component shall be evaluated by the Supplier as per JESD47 (current revision, where applicable), or a close approximation thereof approved for use by Celestica. The qualification report provided to Celestica should include testing to the following reference standards where relevant and applicable.

a) Solderability testing (per J-STD-002 (current revision documentation to be available upon request, but is not required to be provided to Celestica if the finish is listed as Acceptable for the corresponding package type in the Materials Requirements section below)
    - Both no-clean and aqueous clean solder paste and wave solder flux should be included.
b) Solder joint reliability testing (per IPC-9701)
c) Monotonic bend testing (per JS9702)
d) Mechanical shock and vibration (per AEC-Q100 (current revision) /Mil-Std 883)
e) High temperature storage (per AEC-Q100 (current revision)/JESD22-A103 (current revision)).
f) Tin (Sn) Whisker growth testing:
    - Tin (Sn) Whisker testing is required for any solderable finish containing greater than 95% Tin(Sn). This applies whether or not the finish appears on the Acceptable Termination Finish list contained in this specification. Solder balls are not considered to be a plated finish and are exempt from such testing.
    - Whisker Testing must follow the test method requirements documented in JESD22-A121 (Test Method for Measuring Whisker Growth on Tin and Tin Alloy Surface Finishes). Whisker test evaluation should follow the requirements laid out in the document Environmental Acceptance Requirements for Tin Whisker Susceptibility of Tin and Tin Alloy Surface Finished (JESD201). Celestica will utilize these acceptance criteria when evaluating the test results. Note that the required whisker testing Class requirement (per JESD201) will be documented on the Celestica QSPEC.
g) Moisture sensitivity level (per J-STD-020 (current revision), as applicable)
h) Maximum Package Classification Reflow Temperature (per J-STD-020 (current revision), Table 4-2)
i) Electrical Performance/Characteristics Requirements (per QSPEC)

6. Minimum Process Requirements

All Lead (Pb)-free or-RoHS compliant parts covered by this Policy must meet or exceed the requirements of the following specifications (as applicable) in order to be compatible with Celestica's Lead (Pb)-free manufacturing processes. There will be no exceptions to these requirements unless they are expressly stated in the applicable QSPEC.

The Supplier shall not provide a quotation for a non-complying part unless Celestica has provided an approved Deviation Permit (defined above) which documents that the deviation from these requirements is acceptable.

If a Deviation Permit is provided, the Supplier will provide the good with a revised part marking/labelling scheme permitting visual confirmation of non-compliant parts. The Revised Marking must be pre-approved by Celestica.

At a minimum, Supplier will comply (if applicable) with the following requirements:

a) All parts as delivered must meet the requirements of the Handling, Packing, Shipping and Use specification J-STD-033 (current revision).
b) Marking and Labeling of parts and packaging materials shall meet the requirements of IPC/JEDEC J-STD-609 (as applicable).
c) Supplier will provide a minimum of 90 days prior notice of a Product Change Notification (PCN) before the planned change implementation date. Any changes related to environmental compliance or manufacturing process are considered to be Major Changes as defined in J-STD-046 (current revision). PCN approval will be performed as per the Celestica Notification of Product / Process Changes, Discontinued Availability and Product Alerts by Suppliers DOC0073917.
d) All components shall be capable of withstanding one dry rework condition (as defined in J-STD-020 (current revision)) at a process temperature of 260°C. The MSL rating at this temperature shall be determined using the method listed in J-STD-020 (current revision). This rating shall be clearly indicated on the barcode or MSL Caution Label.
e) All parts must be capable of withstanding, without damage, the manufacturing process temperatures applied to the part during the soldering process. Depending on the soldering method utilized, the parts must be capable of meeting the appropriate minimum requirement indicated below:

    - All non-hermetic integrated circuit parts intended to undergo a surface-mount reflow process shall meet the Pb-Free process package classification reflow temperatures as defined in J-STD-020 (current revision) Table 4-2. Conversely, hermetically-sealed integrated circuits or non-integrated circuit parts undergoing a surface-mount reflow process shall be capable of withstanding a maximum temperature of 260°C, and a sustained time of 150 seconds above 217°C.
    - All parts intended to undergo bottom-side full body wavesolder immersion shall be capable of withstanding immersion in 265°C solder for 10±1 seconds per JESD22-A111. Celestica preference is that small passive, discrete, and solid state devices be capable of withstanding immersion temperatures of up to 270°C for 5 seconds to be compatible with Pb-Free manufacturing processes.
    - All parts intended to undergo a manual soldering process shall be capable of withstanding a maximum temperature of 265°C for 10±1 seconds.

NOTE 1: All component temperatures listed above refer to component body temperatures, not lead/joint temperatures, unless stated otherwise.
NOTE 2: All soldered parts, regardless of soldering method used for attach, must be capable of withstanding a one-time dry rework condition using hot-air soldering as described in J-STD-020 (current revision) section 4.1. This applies to parts which are not normally covered in the scope of J-STD-020 (current revision) in lieu of an equivalent standard.

7. Logistical Requirements

7.1. PCN Submission

When any change occurs to parts possessing Environmental Requirements, it must be identified to Celestica through our documented Celestica Notification of Product / Process Changes, Discontinued Availability and Product Alerts by Suppliers DOC0073917 (Legacy No: CELQ-033-POL-2).

7.2. Part Identification

Part identification is critical for Lead (Pb)-free, RoHS compliance, or RoHS exemption conversions. The method used must be capable of distinguishing the revised parts from the prior versions of the same part.
Preference will be given to industry-standard methodologies as they are established. Existing standards for descriptive terminology and marking are as follows:

- Terminology – RosettaNet RNTD
- Marking, Symbols, and Labels of Leaded and Lead-Free Terminal Finished Materials Used in Electronic Assembly IPC/JEDEC J-STD-609.

Note: if a Lead (Pb)-free version of a part is followed by a RoHS compliant version, the method of identification must be able to distinguish the two variants. As such, when parts are converted to either or both of these compliance conditions, the PCN issued to Celestica must include the following information:

a) Method of Identification (see below for part numbering requirements)
b) Effective cutover date and date code (date and date code after which all parts shipped to Celestica will be converted, as indicated on the parts/packaging materials)
c) Lead (Pb)-free/RoHS logo usage, description, and location on part (refer to IPC/JEDEC J-STD-609)
d) Part Labeling usage, description, and location (refer to IPC/JEDEC J-STD-609)
e) Part technical specifications as required in the Qualification of Goods – Test Methods section
f) Part documentation as outlined in the Documentation Requirements section (below)

Note: If a supplier product/process change results in a PCN being issued to Celestica, and this PCN invalidates a Certificate of RoHS Compliance (C of C) previously issued to Celestica, the supplier shall notify Celestica of the status of the C of C. If the revised parts are RoHS compliant and subject to a new C of C, this document shall be made available to Celestica as part of this notification procedure.

7.2.1. New Orderable Supplier Part Numbers

Celestica’s preferred method of identification is for the creation of new orderable supplier part numbers for any compliance-related part conversions. New orderable supplier part numbers are required under either of the following conditions:

- The component change requires a modification to Celestica’s manufacturing processes – these are referred to as non-backwards compatible parts. Known non-backwards compatible scenarios include, but are not limited to, the following:
  a) Lead (Pb)-free Tin/Silver/Copper (Sn/Ag/Cu) solder balls used in eutectic Tin/Lead (Sn/Pb) assembly processes.
  b) Bismuth (Bi) contained in termination finishes of pin-through hole (PTH) components to be used in Tin/Lead (Sn/Pb) solder assembly processes.
  c) Bismuth (Bi) or Lead (Pb) contained in termination finishes of pin-through hole (PTH) components to be used in Lead (Pb)-free wave solder processes.

- There is no date code traceability (note that date code information must be located on the component itself).
  Exception - components deemed by Celestica to be too small to permit marking or date code information changes to be printed on the part, in which case this information shall be applied to the lowest-level packaging labels.

8. Documentation Requirements

8.1. Required Environmental Information

The Supplier shall provide the following information (as applicable) to Celestica upon request, or at the time of any part changes communicated through PCN's.

a) MSL rating at classification temperature (Per J-STD-020 (current revision))
b) Maximum component temperature (Package Classification Reflow Temperature - per J-STD-020 (current revision), Table 4-2) for assembly
c) Maximum processing temperature for rework (Per J-STD-020 (current revision))
d) Component mass information
e) Component termination structural and finish compositional details
f) Component Leadframe or Underplating Material
g) Component marking location (Per IPC/JEDEC J-STD-609) and description/photo
h) Date code cutover information for Lead (Pb)-free or RoHS Compliant parts (whichever stage applies)
i) RoHS compliance certification (Celestica Inbound RoHS Certificate of Compliance Form DOC0078184 (Legacy No: CELQ-033-FORM-18 or per IPC-1752, see below)
j) Indication of requirements for any substance or part within the component to be selectively recycled according to WEEE Annex 2
k) Material composition details for IEC 62474 DSL above the listed threshold (Per IPC-1752, refer to Materials Requirements section)
l) Laboratory test results corroborating the materials declaration above (upon request from Celestica)

8.2. RoHS Compliance

RoHS Compliance within this policy encompasses both EU and China RoHS at the time of writing. The material and documentation requirements of this policy apply to both legislations for all parts. There may be related legal requirements placed upon the supplier that are not detailed within this policy. The supplier *must* meet all legal requirements of the jurisdiction to which their parts are shipped[2].

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[2] Including the marking and labelling requirements of China RoHS, along with the obligation to disclose the presence of hazardous substances present within the suppliers' products.

Celestica will communicate RoHS component requirements in the QSPEC, and/or on the purchase order, (P.O.), When Celestica orders a RoHS compliant or compatible component, or alternatively if, through the PCN process, the Supplier informs Celestica of their plan to convert a component to be compatible with RoHS (either full compliance or as an exempt[3] part), the Supplier shall provide part number-level documentation, as requested by Celestica. The documentation may include, but not be limited to, the items indicated below:

a) The first form of required documentation is a Certificate of RoHS Compliance, which must be generated upon requested by Celestica. This document is a legally binding declaration from the Supplier that the referenced parts meet all RoHS material requirements (refer to 2011/65/EU). The format of the Certificate of RoHS Compliance shall comply with IPC-1752 industry standard guidelines. Celestica recommends the use of the Certificate of Compliance format documented in DOC0078184, (which is in-line with IPC-1752 requirements).
b) The second form of documentation is a Materials Declaration, which states the location, content (by weight and ppm) of each substance present in the part at a homogeneous material level. Refer to the Materials Requirements section for more details. The reporting format to be used shall comply with IPC-1752 Class D industry standard guidelines. Materials Declarations to the appropriate IPC reporting class shall be provided to Celestica upon request.
c) In some cases, RoHS Compliance of a given part number may require verification through analytical testing, which may be performed by an internal or external laboratory. At Celestica's request, the Supplier shall provide Celestica with appropriate test data which demonstrates RoHS compliance of the part.

9. Materials Requirements

Celestica requires that all parts purchased with Environmental Compliance Requirements (as listed in the purchasing documentation) be fully compliant with the legal requirements of whichever indicated legislation applies, as they exist on the date of purchase. Materials declaration reports may be requested at any time from the supplier in order to determine whether the parts meet existing legal, customer, or market requirements.

Celestica's materials declaration reporting requirements for purchased components are derived from the RoHS Directive's Enforcement Guidelines Document (Updated – January 2007), IEC 62474 DSL, and the IPC-1752 reporting standard. When requested by Celestica, the supplier shall comply with IPC-1752 specifications' Class D requirements as a minimum, when this is not superseded by legal or customer-specific requirements as communicated within the request. All non-proprietary substances contained within the part must be declared at a ppm level within each homogeneous material, including the location and mass of the given substance. In specific cases, Celestica may specify additional requirements for the declaration, such as negative or ppm declarations for additional materials as specified in IEC 62474 DSL.

These reporting requirements apply to all parts covered by this Policy, unless specifically stated otherwise in the applicable Celestica QSPEC document
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[3] Refer to Directive 2011/65/EU for the list of part applications that are exempt from the requirements of Article 4(1) which covers the banned materials.

9.1. Solderable Part Compatibility

All Lead (Pb)-free, RoHS compliant, or RoHS exempt parts possessing Environmental Compliance Requirements as indicated on the QSPEC must be metallurgically compatible with Celestica's manufacturing processes, as well as with the other materials used on the final assembly. Celestica's termination finish recommendations are in line with iNEMI's for the purpose of mitigating tin whisker concerns, as outlined in the document: Interim Recommendations on Lead-Free Finishes for Components Used in High-Reliability Products version 3 (updated May 2005). Considerations for other reliability issues have also been incorporated into the requirements outlined below.

Note that since a full understanding of the tin whisker growth mechanism is still lacking, collecting data on the characteristics of tin platings is critical to help increase the knowledge level on parameters affecting tin whisker growth. Celestica requires tin whisker test data be provided for any new/changed solderable finishes which utilize greater than 95% tin by weight. Solder balls are not included in this requirement. When required, Celestica mandates that the tin whisker testing shall be performed in accordance with the JEDEC standard JESD22-A121. Note that the required whisker testing Class (per JESD201) for the particular part will be documented on the Celestica QSPEC. Refer to Current Tin Whisker Theory and Mitigation Practices Guideline (JP002) for more information on control of tin whiskers.

10. Recommended Termination Finishes

The following sections document Celestica's current termination finish recommendations based on type of part (package style & technology). Commonly used finishes have been categorized as either Acceptable or Unacceptable. Celestica will neither recommend to our customers, nor to our own design community, any part bearing an Unacceptable finish for use in RoHS Compliant products. Furthermore, Celestica will make every effort to eliminate the use of such parts in cases where they are already specified. Neither classification implies that supplier or Celestica qualification or reporting requirements have been waived based on this categorization, in all cases the governing Celestica purchasing specifications apply. Relevant data may be requested for any finish in order to confirm compatibility with Celestica's product or process requirements.

10.1. Electronic Components

Acceptable termination finish formulations (subject to customer approval):

- Non-tin plating: Nickel/Palladium/Gold or Nickel/Palladium (Ni/Pd/Au or Ni/Pd).
- Matte tin (Sn) plating over a Nickel (Ni) underlayer. Components that use Nickel underplating should have a minimum porosity-free Nickel thickness of 0.5 µm with 1.27 µm or greater thickness recommended. (Tin thickness over Ni must be > 2 µm).
- Matte Tin (Sn) over a Silver (Ag) underlayer is a potentially acceptable finish with acceptable test results. Minimum required Silver underlayer thickness is 2 µm. (Tin thickness over Ag must be > 2µm).
- Fused Tin (Sn) plating. Fusing is a reflowing operation usually done by dipping the Tin-plated surfaces into a hot oil bath shortly after plating. Preferred over nickel barrier (2µm recommended nickel thickness).
- Hot dipped Tin/Silver (Sn/Ag), Tin/Copper (Sn/Cu), or Tin/Silver/Copper (Sn/Ag/Cu). This is a molten tin bath process generally used for structural steel parts, connectors or relays.
- Matte Tin (Sn) plating over Copper (Cu) which has been annealed/heat treated (150°C for 1 hour after plating) - acceptable whisker test results required.

- Tin/Bismuth (Sn/Bi) alloy finishes with 2-5% Bi by weight for use in Lead (Pb)-Free solder reflow processes, or Tin/Bismuth (Sn/Bi) alloy finishes with 2-5% Bi over Copper (Cu) leadframes for Sn/Pb reflow processes.
- Plated Tin/Silver (Sn/Ag) with 2-4% Ag – acceptable test results required.
- Solder-dipped components (> 1.27mm pitch) using Tin/silver/copper (Sn/Ag/Cu), or Tin/Silver (Sn/Ag).
- Gold (Au) based finishes, and other noble-metal based finishes with the exception of Silver (Ag)-based alloys.
- Plated Nickel/Palladium/Gold (Ni/Pd/Au) over Alloy 42 (Fe-42Ni) leadframes - with acceptable test data.
- Tin/Silver/Copper (Sn/Ag/Cu) alloys used for solder balls are acceptable for Lead (Pb)-Free assembly processes only.
- Tin/Lead (Sn/Pb) is acceptable for Tin/Lead (Sn/Pb) assembly processes, and where specifically allowed by legislation, only.

Unacceptable Termination finish formulations:

- Tin/Copper (Sn/Cu) alloys over any base metal except when applied by hot dip process.
- Tin/Silver/Copper (Sn/Ag/Cu) alloys used for solder balls are not acceptable for Tin/Lead (Sn/Pb) eutectic assembly processes.
- Bright Tin (Sn) plating over any base metal.
- Tin/Bismuth (Sn/Bi) alloy finishes used for Lead (Pb)-Free wave soldering processes (PTH parts) or Sn/Bi over Alloy 42 leadframes used for any eutectic Tin/Lead (Sn/Pb) assembly processes. (Unless approved by both the customer and Celestica process engineering). In addition, any Tin/Bismuth alloys with less than 2% Bi or greater than 5% Bi are not acceptable.
- Tin (Sn) deposits that are compressive during service life are not acceptable.
- Any Tin (Sn)-based plating over Alloy 42 (Fe-42Ni) leadframes without acceptable test data (solderability testing, tin whisker testing, and solder joint reliability testing)
- Any Tin (Sn)-based plating over Copper (Cu) leadframes without approved mitigation practice applied and acceptable test data provided.
- Any Tin (Sn) finishes over copper (no underlayer) with Sn thickness less than 7.62 µm minimum, or 10 µm preferred.
- Any Tin (Sn) finishes over steel.
- Tin/Zinc/Aluminum (Sn/Zn/Al) alloys
- Zinc (Zn)-bearing alloys.
- Indium (In)-bearing alloys.
- Nickel (Ni) – pure nickel finish.
- Silver (Ag) based finishes.
- Hot dipped pure Tin (Sn) finishes.
- Tin/Lead (Sn/Pb) is not acceptable for Lead (Pb)-Free assembly processes, except where specifically allowed by legislation.

Other materials sets and combinations will be considered if they are provided along with strong technical arguments, and are backed up with acceptable test data as per Celestica's requirements.

Note: Any finishes plated over Alloy 42 (Fe-42Ni) leadframes must demonstrate acceptable test results in solderability testing, tin whisker testing, and solder joint reliability testing before they can be considered acceptable by Celestica.

10.2. Separable Connectors

Acceptable termination finish formulations (subject to customer approval):

- Non-tin plating: Nickel/Palladium/Gold or Nickel/Palladium (Ni/Pd/Au or Ni/Pd).
- Non-tin plating: Nickel/Gold (Ni/Au).
- Matte tin (Sn) plating over a Nickel (Ni) underlayer. Components that use Nickel underplating should have a minimum porosity-free Nickel thickness of 0.5 µm with 1.27 µm or greater thickness recommended. (Tin thickness over Ni must be > 2 µm).
- Matte Tin (Sn) over a Silver (Ag) underlayer is a potentially acceptable finish with acceptable test results. Minimum required Silver underlayer thickness is 2 µm. (Tin thickness over Ag must be > 2µm).
- Fused Tin (Sn) plating. Fusing is a reflowing operation usually done by dipping the Tin-plated surfaces into a hot oil bath shortly after plating. Preferred over nickel barrier (2µm recommended nickel thickness).
- Hot dipped Tin/Silver (Sn/Ag), or Tin/Silver/Copper (Sn/Ag/Cu). This is a molten tin bath process generally used for structural steel parts, connectors or relays.
- Matte Tin (Sn) plating over Copper (Cu) which has been annealed/heat treated (150°C for 1 hour after plating) - acceptable whisker test results required.
- Tin/Bismuth (Sn/Bi) alloy finishes with 2-5% Bi by weight over a Nickel (Ni) underlayer for surface mounted connectors. Minimum porosity-free Nickel thickness of 0.5 µm with 1.27 µm or greater thickness recommended.
- Plated Tin/Silver (Sn/Ag) with 2-4% Ag over a Nickel (Ni) underlayer. Minimum porosity-free Nickel thickness of 0.5 µm with 1.27 µm or greater thickness recommended.
- Gold (Au) based finishes, other noble-metal based finishes with the exception of silver-based types.
- Tin/Lead (Sn/Pb) is acceptable for Tin/Lead (Sn/Pb) assembly processes, and where specifically allowed by legislation, only.

Unacceptable Termination finish formulations:

- Tin/Copper (Sn/Cu) alloys (unless applied via hot-dip process and with acceptable test data).
- Bright Tin (Sn) plating over any base metal.
- Tin/Bismuth (Sn/Bi) alloy finishes with less than 2% Bi or greater than 5% Bi are not acceptable. This finish is not recommended for wave-soldered parts.
- Tin (Sn) deposits that are compressive during service life are not acceptable.
- Any Tin (Sn)-based plating over Alloy 42 (Fe-42Ni) leadframes without acceptable test data.
- Any Tin (Sn)-based plating (matte or bright) over Copper (Cu) leadframes without approved mitigation practice applied and acceptable test data provided.
- Hot dipped pure Tin (Sn) finishes.
- Tin/Lead (Sn/Pb) is not acceptable for Lead (Pb)-Free assembly processes.

Other materials sets and combinations will be considered if they are provided along with strong technical arguments, and are backed up with acceptable test data as per Celestica's requirements.

10.3. Bus Bars

Acceptable bus bar finish formulations (subject to customer approval):

- Unplated (no applied finish) is acceptable for aluminum or copper alloys. Note this is not a solderable finish.
- Nickel (Ni) is acceptable for copper alloys or for aluminum if used over copper strike plating. Note this is not a solderable finish.

- Chromium (Cr) (excluding hexavalent chromium Cr VI, Cr^{6+}) is acceptable for copper alloys or for aluminum if used over copper strike plating. Note this is not a solderable finish.
- Solder-dipped Tin/Silver/Copper (Sn/Ag/Cu) is acceptable for copper alloys or for aluminum if used over copper strike plating. This is a solderable finish.
- Silver (Ag) applied by immersion or electroplate method is acceptable for copper alloys or for
- aluminum if used over copper strike plating. This is a solderable finish.

Unacceptable bus bar finish formulations:

- Nickel (Ni) over aluminum if used without copper strike plating. Note this is not a solderable finish.
- Chromium (Cr) (excluding hexavalent chromium Cr VI, Cr^{6+}) over aluminum if used without copper strike plating. Note this is not a solderable finish.
- Solder-dipped Tin/Silver/Copper (Sn/Ag/Cu) over aluminum if used without copper strike plating. This is a solderable finish.
- Silver (Ag) applied by immersion or electroplate method over aluminum if used without copper strike plating. This is a solderable finish.
- Matte Tin (Sn) used over copper or aluminum alloys. This is a solderable finish.

Other materials sets and combinations will be considered if they are provided along with strong technical arguments, and are backed up with acceptable test data as per Celestica's requirements.

10.4. Heat Sinks

Acceptable heat sink finish formulations (subject to customer approval):

- Unplated (no applied finish, or anodizing for aluminum) is acceptable for aluminum, copper, or graphite base materials. Note this is not a solderable finish.
- Nickel (Ni) is acceptable for copper base materials. Note this is not a solderable finish.
- Tin/Silver/Copper (Sn/Ag/Cu) is acceptable for copper base material or aluminum if used over copper strike plating. This is a solderable finish.
- Matte Tin (Sn) over Nickel (Ni) is acceptable for copper base material or aluminum if used over copper strike plating. This is a solderable finish. Acceptable tin whisker test results are required for this finish.

Unacceptable heat sink finish formulations:

- Matte Tin (Sn) used over copper or aluminum base materials. This is a solderable finish.

Other materials sets and combinations will be considered if they are provided along with strong technical arguments, and are backed up with acceptable test data as per Celestica's requirements

10.5. Printed Circuit Boards (PCB's)

Acceptable PCB finish formulations (subject to customer approval):

- Immersion Tin (Sn). Acceptable tin whisker test results are required for this finish.
- Electroless Nickel (Ni) / Immersion Gold (Au) (ENIG).
- Electroless Nickel (Ni) / Electroless Palladium (Pd) / Immersion Gold (Au) (ENEPIG).
- Electroplated Nickel (Ni) / Electroplated Gold (Au).
- Immersion Silver (Ag).
- OSP.

Unacceptable PCB finish formulations:

- Copper (Cu).
- Tin/Copper (Sn/Cu) HASL. Acceptable tin whisker test results are required for this finish.

10.6. Non-Soldered Part Compatibility

10.7. Metal Finishing

Note that all passivation finish recommendations listed below are based primarily on chemical compatibility with RoHS material restrictions. Any formulations to be used for Celestica products require full testing and approvals to be completed prior to shipment to Celestica.

Acceptable Fastener (Nuts, bolts, screws, lugs) passivation finish formulations *(subject to customer approval):*

- Passivation methods must not utilize RoHS restricted materials above the thresholds as defined in the Directive 2011/65/EU. Potential options:
  - Stainless Steel
  - Clear/Blue finish – Trivalent Chromium
  - Green finish – Trivalent Chromium
  - Yellow finish – Trivalent Chromium
  - Black finish – Trivalent Chromium
  - Black finish – Silver/Nickel
  - Thick Film – Trivalent Chromium
  - Thin Film – Trivalent Chromium
- Finishes should also be able to withstand 96 hours salt spray test (per ASTM B117), and have a maximum surface resistivity of 5 mohms/in^2.

Unacceptable Fastener (Nuts, bolts, screws, lugs) passivation finish formulations:

- Any finishes containing Hexavalent Chromium are unacceptable. Known types include:
  - Yellow finish / Spectrum finish – Zinc Chromate – Hexavalent Chromium
  - Bronze finish – Zinc Chromate – Hexavalent Chromium
  - Olive Drab finish – Zinc Chromate – Hexavalent Chromium
  - Black finish – Zinc Chromate – Hexavalent Chromium
  - Clear/Blue finish – Zinc Chromate – Hexavalent Chromium

Acceptable Sheet Steel passivation finish formulations (subject to customer approval):

- Passivation methods must not utilize RoHS restricted materials above the thresholds as defined in the Directive 2011/65/EU. Potential options:
  - Stainless steel
  - Clear/Blue finish – Trivalent Chromium
  - Thick Film – Trivalent Chromium
- Finishes should also be able to withstand 96 hours salt spray test (per ASTM B117), and have a maximum surface resistivity of 5 mohms/in^2.

Unacceptable Sheet Steel passivation finish formulations:

- Any finishes containing Hexavalent Chromium are unacceptable. Known types include:
  - Yellow finish / Spectrum finish – Zinc Chromate – Hexavalent Chromium
  - Clear/Blue finish – Zinc Chromate – Hexavalent Chromium

Acceptable Aluminum (Sheets, Extrusions, and Castings) passivation finish formulations (subject to customer approval):

- Passivation methods must not utilize RoHS restricted materials above the thresholds as defined in the Directive 2011/65/EU. Potential options:
  - Alodine 5200
  - Alodine 5700
  - Alodine 4595 – Trivalent Chromium
  - Chemetall AL-0500 – Trivalent Chromium
  - APS TCP-HF – Trivalent Chromium
- Passivation methods which result in a color change to the aluminum are preferred by Celestica Inc. Finishes should also be able to withstand 168 hours salt spray test (per ASTM B117).

Unacceptable Aluminum (Sheets, Extrusions, and Castings) passivation finish formulations:

- Any finishes containing Hexavalent Chromium are unacceptable. Known types include:
  - Alodine 1000 – Hexavalent Chromium
  - Alodine 1200 – Hexavalent Chromium

10.8. Plastic Parts

Note that all plastic material recommendations listed below are based primarily on chemical compatibility with RoHS material restrictions. Any formulations to be used for Celestica products require full testing and approvals to be completed prior to shipment to Celestica.

Acceptable Plastic part formulations (subject to customer approval):

- Any formulations which do not utilize RoHS restricted materials above the thresholds as defined in the Directive 2011/65/EU, and also meet the flammability requirements of UL 94V-0

Unacceptable Plastic part formulations:

- Any formulations which utilize RoHS restricted materials above the thresholds as defined in the Directive 2011/65/EU

10.9. General Note

Other materials sets and combinations will be considered if they are provided along with strong technical arguments, and are backed up with acceptable test data as per Celestica's requirements

References

External Celestica Specifications can be found on the Celestica internet site:
http://www.celestica.com/SupplyChain/SupplyChain.aspx?id=798

Questions or concerns relative to these references should be highlighted to the appropriate Celestica contact for clarification. In cases where newer published revisions of the industry standards listed in this Policy are available, the newest revision shall be utilized by both Celestica and the Supplier. Celestica does not specify reference revision levels in this Policy unless required for clarity where a significant change has occurred as compared to the previous revision. In case of conflict between Celestica requirements, the following order of precedence shall apply:

- Deviation Permit
- QSPEC

- OEM Specification / Drawing
- This Policy
- Referenced Industry Standards

Internal References

Document Name	Document Number	Current Revision
Celestica Bar Coding Standard for Procured Production Goods	DOC0078257 (CELQ-033-STD-51)	See ETQ Reliance
Celestica Notification of Product/Process Changes, Discontinued Availability and Product Alerts by Suppliers	DOC0073917 (CELQ-033-POL-2)	See ETQ Reliance
Celestica RoHS Certificate of Compliance Form	DOC0078184 (CELQ-033-FORM-18)	See ETQ Reliance
Printed Wiring Board Specification	DOC0085989 (CELQ-001-SPEC-2)	See ETQ Reliance
Celestica Packaging and Handling Specification (PK0763)	PK0763-1 (available on the Celestica website www.celestica.com/supplierresources)	
QSPEC		

External References

Document Name	Document Number	Current Revision
Restriction of the use of certain hazardous substances in electrical and electronic equipment - EU RoHS		http://ec.europa.eu/environment/waste/rohs_eee/legis_en.htm
	Directive 2002/95/EC	http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002L0095&from=EN
	Directive 2011/65/EU	http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011L0065&from=EN
	Directive (EU) 2015/863	http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2015.137.01.0010.01.ENG
Waste electrical and electronic equipment – EU WEEE	Directive 2002/96/EC	http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32002L0096
	Directive 2012/19/EU	

		http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32012L0019
IEC 62474 Material Declaration for Products of and for the Electrotechnical Industry.	IEC 62474 IEC 62474 Declarable Substance List (DSL) & Reference Substance List	http://std.iec.ch/iec62474 http://std.iec.ch/iec62474/iec62474.nsf/MainFrameset
RoHS Enforcement Guidance Document	UK's Department of Trade and Industry (DTI)	1 (updated January 2007)
Management Methods for Control of Pollution Caused by Electronic Information Products	Ministry of Information Industry Order #39 (China RoHS), and related documents	http://www.chinarohs.com/
RosettaNet Technical Dictionary		
JOINT IPC/JEDEC Standard Moisture/Reflow Sensitivity Classification for Non-hermetic Surface Mount Devices (SMDs)	J-STD-020	See standards agency
JOINT IPC/JEDEC Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices	J-STD-033	See standards agency
Evaluation Procedure for Determining Capability to Bottom Side Board Attach by Full Body Solder	JEDEC	See standards agency
Evaluation Procedure for Determining Capability to Bottom Side Board Attach by Full Body Solder Immersion of Small Surface Mount Solid State Devices	JESD22-A111	See standards agency
Stress Test Driven Qualification Specification	JESD47	See standards agency
Customer Notification Standard for Product/ Process Changes by Electronic Product Suppliers	J-STD-046	See standards agency
Measuring Whisker Growth on Tin and Tin Alloy Surface Finishes	JESD22-A121	See standards agency
iNEMI Tin Whisker Acceptance Test Requirements (July 28, 2004)		
Environmental Acceptance Requirements for Tin Whisker	JESD201	See standards agency

Susceptibility of Tin and Tin Alloy Surface Finished		
Current Tin Whisker Theory and Mitigation Practices Guideline	JP002	See standards agency
Marking, Symbols, and Labels of Leaded and Lead-Free Terminal Finished Materials Used in Electronic Assembly	IPC/JEDEC J-STD-609	See standards agency
Solderability Tests for Component Leads, Terminations, Lugs, Terminals and Wires	J-STD-002	See standards agency
Thermal Cycling Test Method for Fatigue Life Characterization of Surface Mount Attachments	IPC-9701	See standards agency
IPC/JEDEC-9702: Monotonic Bend Characterization of Board-Level Interconnects	JS9702	See standards agency
High Temperature Storage Life	JESD22-A103	See standards agency
IPC Materials Declaration Management	IPC-1752	See standards agency
Failure Mechanism Based Stress Test Qualification for Integrated Circuits	AEC - Q100	See standards agency
Lead-Free Finishes for Components Used in High-Reliability Products (May 2005)	iNEMI Tin Whisker User Group Recommendations	
Telecom/Hi-End Computing Tin Whisker Concerns & Test Requirements for Components Specification		
EIA Electrical and Electronic Components and Products Hazardous Substance Free Standard and Requirements	EIA/ECCB-954	
BSI Kitemark	BSI Group	
ASTM Standard Practice for Operating Salt Spray (Fog) Apparatus	ASTM B117	

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