



**GUIDELINES FOR PRE-ENCAPSULATION
CUSTOMER SOURCE INSPECTION
(PRECAP INSPECTION) OF EEE COMPONENTS**

ESCC Basic Specification No. 21002

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TABLE OF CONTENTS

1	PURPOSE	5
2	SCOPE	5
3	RELATED DOCUMENTS	5
3.1	APPLICABLE DOCUMENTS	5
4	TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS	5
5	INTRODUCTION	6
6	GENERAL	6
6.1	PRECAP INSPECTION TEST FACILITIES	7
6.2	REPORTING	7
6.2.1	During Precap Inspection	7
6.2.2	On Completion of Precap Inspection	8
6.3	PRECAP INSPECTION AND TESTS	8
6.3.2	Precap Inspection Documentation Review	9
6.3.3	Internal Visual Inspection during Precap Inspection	9
6.3.4	Additional Tests during Precap Inspection: Wire Bond Pull test	11
6.3.5	Additional Tests during Precap Inspection: Die Shear / Substrate Attach Strength	11

1 **PURPOSE**

This guideline document defines the minimum inspection requirements for the performance of Pre-Encapsulation Customer Source Inspection (Precap Inspection) of electrical, electronic and electro-mechanical components suitable for space application.

2 **SCOPE**

When stipulated in the Customer's Purchase Order, the guidelines of this specification may be applied for the particular component families specified in Para. 6.3.3.

Pre-Encapsulation Customer Source Inspection (Precap Inspection) shall be performed at the Manufacturer's facility under the responsibility of the Customer or other appropriate authority at a defined stage during manufacturing, as agreed with the component Manufacturer, prior to encapsulation or final assembly of the components.

Application shall be on an assembly lot or sub-lot basis.

Sampling shall be as specified herein.

3 **RELATED DOCUMENTS**

3.1 **APPLICABLE DOCUMENTS**

The following documents form part of this specification. The relevant issue shall be that in effect on the date of placing the Purchase Order.

- ESCC Basic Specification No. [21300](#), Terms, Definitions, Abbreviations, Symbols And Units.
- ESCC Basic Specification No. [21500](#), Calibration System Requirements.
- ESCC Basic Specification No. [20400](#), Internal Visual Inspection
- ESCC Basic Specification No. [24900](#), Minimum Requirements for Controlling Environmental Contamination of Components
- [MIL-STD-202](#), Test Method Standard, Electronic and Electrical Component Parts
- [MIL-STD-750](#), Test Method Standard, Test Methods for Semiconductor Devices
- [MIL-STD-883](#), Test Method Standard, Microcircuits
- IEC 60410, International Standard, Sampling Plans and Procedures for Inspection by Attributes.

4 **TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS**

The terms, definitions, abbreviations, symbols and units as specified in ESCC Basic Specification No. [21300](#) shall apply.

In addition, the following terms shall apply:

- Low Magnification (also low-mag): a minimum of x7; typical x7 to x40
- High Magnification (also hi-mag): a minimum of x100; typical x100 to x500

NOTE: ESCC Basic Specification No. [20400](#) and its ancillary specifications plus the various MIL-STD test method standards referenced above may introduce other technology-specific minimum magnification requirements which should be adhered to in order to be able to detect certain types of defects when performing internal visual inspection on the technologies or part types concerned.

5 INTRODUCTION

Pre-Encapsulation Customer Source Inspection comprises a series of inspections and, if stipulated, test witnessing performed by the Customer's or other appropriate authority's designated Precap Inspector, at the component Manufacturer's facility, prior to encapsulation or final assembly, on the assembly lot or sub-lot of components being processed to meet the Customer's Purchase Order.

Precap Inspection is performed in order to independently verify the build quality of the assembly lot or sub-lot of components and check that that it meets the applicable inspection requirements of the relevant specifications.

6 GENERAL

The minimum inspection requirements applicable to Precap Inspection, as applicable to the subject component family, are defined in Para. 6.3.

Precap Inspection may include additional inspections when required by the appropriate authority.

The full details and relevant specifications for all the inspections to be performed, together with the required period of notification to be provided by the Manufacturer to the Customer, shall be as stipulated in the Customer's Purchase Order.

All inspections required to be performed during Precap Inspection shall be performed directly by the Customer's designated Precap Inspector at the Manufacturer's manufacturing facility.

The Precap Inspector shall be completely independent from the component Manufacturer and act under the responsibility of the Customer.

In addition to performing the required inspections, when required by the appropriate authority and stipulated in the Customer's Purchase Order, the Precap Inspector shall also witness the Manufacturer performing specific testing on the lot. The full details and relevant specifications for the test witnessing shall be as stipulated in the Customer's Purchase Order.

Unless otherwise specified, Precap Inspection shall be performed at a suitable stage during manufacturing when all component manufacturing processes have been completed with the exception of package encapsulation or final assembly.

6.1 PRECAP INSPECTION TEST FACILITIES

The area dedicated to the performance of Precap Inspection shall be identified in the PID in the case of ESCC qualified manufacturers. The conformance of environmental control in the Precap Inspection area to the requirements of ESCC Basic Specification No. 24900, as suitable to the stage of manufacturing of the devices under inspection, shall be monitored by the ESCC Chief Inspector at the time of each Customer's Precap Inspection. The ESCC Executive shall verify the adequacy of the Precap Inspection area and the associated handling and inspection procedures as part of his survey of the qualified Manufacturer.

The following minimum requirements shall apply to the Manufacturer's facility where the Precap Inspection takes place and shall be verified during the Precap Inspection by the Precap Inspector:

- Inspection and test equipment used during the Precap Inspection shall be appropriate and suitable to the required inspections and tests.
- The facility shall have a quality assurance system which ensures:
 - the inspections and tests performed during the Precap Inspection are controlled, including recording of results.
 - inspection and test equipment used during Precap Inspection is calibrated in accordance with ESCC Basic Specification No. 21500 or an equivalent system, and the calibration period for each equipment is defined.
 - traceability of the assembly lot or sub-lot submitted to each inspection or test during Precap Inspection is maintained.
- The facility shall maintain environmental conditions, protection against electrostatic discharge, cleanliness and handling controls appropriate to the components, the inspection and test equipment, and to the inspections and tests performed.

6.2 REPORTING

6.2.1 During Precap Inspection

Immediately on conclusion of each inspection or test during the Precap Inspection, the Precap Inspector shall be responsible for recording the results and for notifying the Manufacturer of the findings.

For any rejects identified during any 100% inspection or test, the Precap Inspector shall specifically notify the Manufacturer of the rejects and ensure that they are permanently removed from the assembly lot or sub-lot.

For any rejects identified during any sample inspection or test, unless otherwise specified, the Precap Inspector shall immediately notify the Customer with the full details of the findings for resolution on how to proceed. At the same time, the Precap Inspector shall notify the Manufacturer of the details and ensure that the rejects are permanently removed from the assembly lot or sub-lot and that the lot is placed on hold in a suitable quarantine location at the Manufacturer's facility pending resolution by the Customer and definition of a final disposition and/or corrective actions.

On completion of the Precap Inspection, unless otherwise specified, the Precap Inspector shall report the results of the Precap Inspection to the Customer for final disposition on the release of the lot for further processing against the Customer's Purchase Order.

6.2.2 On Completion of Precap Inspection

On completion of the Precap Inspection, a Precap Inspection report shall be collated from the results, using a suitable format.

Unless otherwise specified, the report shall include as a minimum:

- A unique Precap Inspection report reference number.
- The component type number.
- The component Detail and Generic specification numbers and issues (as applicable).
- The Customer's Purchase Order number, references and quantities.
- The Precap Inspector's name and affiliation.
- The Manufacturer's name and the location of the Manufacturer's facility.
- Full traceability information for the assembly lot or sub-lot including all relevant lot identification information e.g.: piece part lot, wafer lot, package lot, etc. (as applicable).
- The particulars of each inspection and/or test including:
 - the inspection/test method, conditions and applicable specification
 - results attributes and variables data (where applicable) for the assembly lot or sub-lot inspected, including the quantity inspected and the quantity accepted.
- Full details of any rejects identified during the Precap Inspection including the reason for rejection.

6.3 PRECAP INSPECTION AND TESTS

Precap Inspection shall always include a verification on lot traceability and an Internal Visual Inspection, as specified in Paras. 6.3.2 and 6.3.3. The Precap Inspection may offer an opportunity to perform or witness the performance of other tests or verifications as described below.

The accept/reject criteria for the Precap Inspection should be documented and agreed by the Manufacturer and the Precap Inspector, on behalf of the Customer, before the actual visual inspection is performed. The Precap Inspector is responsible for the acceptance/rejection of the assembly lot or sub-lot and would be expected to sign off or approve the Manufacturer's lot traveller, when available.

There are two types of rejection criteria:

- (a) Rejection of a complete lot because of a failure to meet the generally specified criteria. It is the responsibility of the Precap Inspector to initiate a non-conformance action and to ensure that the lot is quarantined
- (b) Rejection of individual components because of failure to meet specific criteria during optical inspection. Such failures shall be discussed with the Manufacturer's liaison QA/QC representative. It is the responsibility of the Manufacturer to repeat the in-line inspection and to resubmit the lot to the Customer's Precap Inspector. It is, jointly, the responsibility of the Manufacturer's QA/QC and the Customer's Precap Inspector to ensure that such rejects are removed from the lot and quarantined.

The processing of the assembly lot or sub-lot shall be considered to be "On Hold" in case that any non-conformance affects the manufacturing process. The lot shall be considered to be classified "Conditional Acceptance" in the case where any applicable activity has not been completed or test results are not available.

6.3.2 Precap Inspection Documentation Review

A documentation review shall verify and keep records of the identification and traceability of the assembly lot(s) or sub-lot(s) presented for Precap Inspection.

This element of Precap Inspection may comprise:

- Confirmation of the homogeneity of the assembly lot or sub-lot based on the applicable Manufacturer's practice.
- Identification of the lot traceability.
- Verification that the Manufacturer has performed all manufacturing steps, intermediate tests and inspections as defined in the PID or in the appropriate specification.
- Verification that any special in-process controls have been performed and that the results are acceptable.
- Review of records of production control activities as specific to the component technology. These may include:
 - Add-on part evaluation results, for hybrid (chip and wire) devices.
 - SEM, WLAT or Radiation test results at wafer level, for semiconductor-based parts.
 - Microsections, plating thickness verifications, as pertinent for some passive parts or for packages, headers, lids or caps as used in the assembly of the components.

EEE component manufacturers typically use lot travellers and the review of such a document may cover several elements of traceability mentioned in this paragraph.

If agreed between the Customer and the Manufacturer, the records of the occurrence of non-conformances in the manufacturing operations, possibly related to reworks, repetition of operations, re-screening or resubmission to tests, should be available on request to the Precap Inspector.

6.3.3 Internal Visual Inspection during Precap Inspection

The implementation of internal visual inspection during Precap Inspection may follow guidelines expressed in this paragraph with regards to sampling and recommended technique(s).

The Precap Inspector, and the Manufacturer and/or Customer representatives at this inspection shall respect the Manufacturer's approved rules and procedures as applicable in the Precap Inspection area when handling and manipulating the components under inspection, with regards to cleanliness, contamination control and ESD controls.

Regarding the criteria for acceptability during the internal visual inspection, the use of ESCC Basic Specification No. [20400](#) and its ancillary specifications, as applicable, is recommended. Alternative inspection criteria as found in [MIL-STD-202](#), [MIL-STD-750](#) and [MIL-STD-883](#), as suitable, may also be used.

The Manufacturer should provide the Precap Inspector with lay-out drawings, bonding diagrams, lists and/or schematics that allow him to understand the design of the components under inspection and the desired position and type of its constituents.

Component Family	Precap Inspection: Internal Visual Inspection Requirements
Capacitors	Sample internal visual inspection in accordance with the relevant specifications. Sampling: General Inspection Level II, AQL 0.65% per IEC 60410.
Crystals	100% internal visual inspection in accordance with the relevant specifications.
Crystal Oscillators	<p>(a) Prior to crystal mounting: 100% high and low magnification internal visual inspection in accordance with the relevant specifications.</p> <p>(b) After crystal mounting: 100% high and low magnification internal visual inspection in accordance with the relevant specifications.</p> <p>Note: The double precap should only be required in the event that that crystal element prevents the internal visual inspection of other constructive elements.</p> <p>Note: It is preferable to begin the inspection with the high magnification step due to the risk to damage inner wires which would be later on detected through the low-mag inspection</p>
Discrete Semiconductors (including Diodes and Transistors) (Including Microwave) (Excluding Glass Diodes)	<p>(a) Sample high magnification internal visual inspection. Sampling: General Inspection Level II, AQL 0.65% per IEC 60410.</p> <p>(b) 100% low magnification internal visual inspection.</p> <p>Inspections to be performed in accordance with the relevant specifications.</p> <p>Note: It is preferable to begin the inspection with the high magnification step due to the risk to damage inner wires which would be later on detected through the low-mag inspection</p>
Glass Diodes	100% internal visual inspection in accordance with the relevant specifications.
Filters	20 part sample internal visual inspection in accordance with the relevant specifications.
Fuses	Sample internal visual inspection in accordance with the relevant specifications. Sampling: General Inspection Level II, AQL 0.65% per IEC 60410.
Inductors	100% internal visual inspection in accordance with the relevant specifications.
Microcircuits	<p>(a) Sample high magnification internal visual inspection. Sampling: General Inspection Level II, AQL 0.65% per IEC 60410.</p> <p>(b) 100% low magnification internal visual inspection.</p> <p>Inspections to be performed in accordance with the relevant specifications.</p> <p>Note: It is preferable to begin the inspection with the high magnification step due to the risk to damage inner wires which would be later on detected through the low-mag inspection.</p>
Hybrids	<p>(a) Sample high magnification internal visual inspection. Sampling: to be decided on a case by case basis.</p> <p>(b) 100% low magnification internal visual inspection.</p> <p>Inspections to be performed in accordance with the relevant specifications.</p> <p>Note: It is preferable to begin the inspection with the high magnification step due to the risk to damage inner wires which would be later on detected through the low-mag inspection.</p>
Relays	100% internal visual inspection in accordance with the relevant specifications.

Component Family	Precap Inspection: Internal Visual Inspection Requirements
Passive Microwave Components (Mixers, Couplers, Isolators, Switches, Ferrites, Filters)	100% internal visual inspection in accordance with the relevant specifications only when built using hybrid technologies.
Resistors	<p>Sample low magnification internal visual inspection in accordance with the relevant specifications. Sampling: General Inspection Level II, AQL 0.65% per IEC 60410.</p> <p>For RNC90 style: additional high magnification internal visual inspection in accordance with the relevant specifications. Sampling: General Inspection Level II, AQL 0.65% per IEC 60410.</p>
Switches (including mechanical and thermal)	100% internal visual inspection in accordance with the relevant specifications.
Optoelectronic devices (e.g. opto-couplers, LEDs, CCDs, sensors)	<p>(a) Sample high magnification internal visual inspection. Sampling: General Inspection Level II, AQL 0.65% per IEC 60410.</p> <p>(b) 100% low magnification internal visual inspection.</p> <p>Inspections to be performed in accordance with the relevant specifications.</p> <p>Note: It is preferable to begin the inspection with the high magnification step due to the risk to damage inner wires which would be later on detected through the low-mag inspection.</p>

6.3.4 Additional Tests during Precap Inspection: Wire Bond Pull test

Wire bond strength testing is routinely performed by semiconductor and hybrid manufacturers as an in-line quality monitor. Wire bond strength testing, or the witnessing of the test performed by the Manufacturer, may be part of the Precap Inspection of components which have internal bonds.

During Precap Inspection, the Precap Inspector may review the Manufacturer's in-line process results and may also witness the test being performed on samples drawn from the inspection lot, if applicable. The test is typically performed as a destructive test and the samples so tested will not form part of the assembled delivery lot.

Unless otherwise specified, [MIL-STD-750 Method 2037](#) or [MIL-STD-883 Method 2011](#) shall be used for the bond pull test.

The calibration of the test equipment shall be verified.

6.3.5 Additional Tests during Precap Inspection: Die Shear / Substrate Attach Strength

Die shear/substrate attach strength testing is routinely performed by semiconductor and hybrid manufacturers as an in-line quality monitor.

During Precap Inspection, the Precap Inspector may review the Manufacturer's in-line process results and may also witness the test being performed on samples drawn from the inspection lot, if applicable. The test is destructive so the samples so tested will not form part of the assembled delivery lot.

Unless otherwise specified, [MIL-STD-750 Method 2017](#), or [MIL-STD-883 Method 2019](#) or [2027](#) shall be used.

The calibration of the test equipment shall be verified.