# REQUIREMENTS FOR PROCESS CAPABILITY APPROVAL OF ASSEMBLY AND TEST HOUSE (ATH) SERVICES

## ESCC Basic Specification No. 2567000


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## 1 PURPOSE AND SCOPE

The purpose of this specification is to define the requirements for the Process Capability Approval (PCA) of hermetic assembly, packaging and test services from assembly and test houses (ATH), for components intended for space applications.

This specification:

- addresses discrete, monolithic microcircuits, discrete semiconductor devices.
- shall be read in conjunction with ESCC Basic Specification No. 25600 which provides the general requirements for Process Capability Approval.

**EXCLUSIONS:**

ESCC PCA certification given to an ATH does not include nor enable the ESCC Qualification of their products. The Customer of the ATH services may achieve the qualification of the final product, which has been processed by the complete supply chain, through methodologies specified in ESCC Basic Specification Nos. 20100, 24300 and 25400.

Electrical test capabilities certified in accordance with this specification shall be limited to those required to verify the quality of workmanship of the assembly process. The electrical verification (characteristics, performance, parametric, functional, speed, etc.) of any devices manufactured within the certified domain is not part of the domain. Similarly, the verification by test of other device features like thermal dissipation or power handling are also excluded from the certified domain.

## 2 APPLICABLE DOCUMENTS

The following specifications form part of and shall be read in conjunction with this specification. The relevant issues shall be those in effect at the date of commencement of a particular task, as applicable, and as required for each stage of the sequence of activities which may lead to the PCA certification of the ATH services.

### 2.1 ESCC SPECIFICATIONS

- ESCC No. 5000, Generic Specification: Discrete Semiconductor Components, Hermetically Sealed and Die.
- ESCC No. 9000, Generic Specification: Integrated Circuits: Monolithic and Multichip Microcircuits, Wire-Bonded, Hermetically Sealed and Flip-Chip Monolithic Microcircuits, Solder Ball Bonded, Hermetically and Non-Hermetically Sealed and Die.
- ESCC No. 20100, Basic Specification: Requirements for Qualification of Standard Electronic Components for Space Application.
- ESCC No. 20200, Basic Specification: Component Manufacturer Evaluation.
- ESCC No. 2025000, Sectional Basic Specification: Checklist for Semiconductors Manufacturer and Line Survey.
- ESCC No. 2029000, Sectional Basic Specification: Checklist for Monolithic Microcircuit Manufacturer and Line Survey.
- ESCC No. 20600, Basic Specification: Preservation, Packaging and Despatch of ESCC Components.
- ESCC No. 21001, Basic Specification: Destructive Physical Analysis of EEE Components.
- ESCC No. 21300, Basic Specification: Terms, Definitions, Abbreviations, Symbols and Units.
- ESCC No. 22600, Basic Specification: Requirements for the Evaluation of Standard Electronic Components for Space Application.

- ESCC No. 2265000, Sectional Basic Specification: Evaluation Test Programme for Discrete Non-Microwave Semiconductors.
- ESCC No. 2269000, Sectional Basic Specification: Evaluation Test Programme For Integrated Circuits: Monolithic And Multichip Microcircuits, Wire-Bonded, Hermetically Sealed and Flip-Chip, Monolithic Microcircuits, Solder Ball Bonded, Hermetically and Non-Hermetically Sealed.
- ESCC No. 22700, Basic Specification: Requirements and Guidelines for the Process Identification Document.
- ESCC No. 24300, Basic Specification: Requirements for the Capability Approval of Electronic Component Technologies for Space Application.
- ESCC No. 24600, Basic Specification: Minimum Quality Management System Requirements.
- ESCC No. 25400, Basic Specification: Requirement for the Technology Flow Qualification of Electronic Components for Space Application.
- ESCC No. 25600 Basic Specification: Requirements for Process Capability Approval.

2.2 OTHER APPLICABLE DOCUMENTS

- ECSS-Q-ST-70-08, Manual Soldering of High-Reliability Electrical Connections.
- ECSS-Q-ST-70-38, High-Reliability Soldering for Surface-Mount and Mixed Technology.
- ECSS-S-ST-00-01, Glossary of Terms.
- DIN EN 61340-5.1, DIN Standard: Protection of Electronic Devices from Electrostatic Phenomena - General Requirements.

## 3 TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

The terms, definitions, abbreviations, symbols and units defined in ESCC Basic Specification No. 21300 and ECSS-S-ST-00-01 apply. In addition the following shall apply:

- **Assembly and Test House**: a company which assembles discrete or integrated Semiconductor dice from the semiconductor manufacturer in the needed quality and at agreed standards into packages and performs all relevant and required inspections, testing and measurements at chip and package level.
- **Supply Chain**: all entities involved in the design, production and supply of components including design house, wafer fab, ATH, etc.
- **Capability Abstract**: Summary description of the ATH portfolio of services and capabilities included under the evaluation phase described in this specification.
- **Abbreviated Terms**
  The following abbreviations are used within this specification:
  - ATH: Assembly and Test House(s) supplier
  - PCA: Process Capability Approval
  - PID: Process Identification Document

## 4 DEFINITION OF THE PROCESS CAPABILITY APPROVAL FOR ATH

The ESCC Process Capability Approval (PCA) programme for ATH services shall include 3 stages based on those specified in ESCC Basic Specification No. 25600, namely:

- Definition of the Process Capability Domain and its boundaries.
- Evaluation Phase of the Process Capability Domain and the ATH.
- PCA Testing Phase.

The successful completion of these stages requires, therefore, the definition of the PCA and its boundaries, the preparation, review and approval of the relevant PID, and the actual completion of test sequences specified for PCA testing.

## 5 DEFINITION OF THE PROCESS CAPABILITY DOMAIN AND ITS BOUNDARIES

In addition to the requirements of ESCC Basic Specification No. 25600, the following requirements are specific and applicable to the definition of the Process Capability Domain for ATH services for the purpose of PCA.

### 5.1 GENERAL

The ATH shall define the Process Capability Domain for which Process Capability Approval is sought, as required in ESCC Basic Specification No. 25600. This definition shall result in the Capability Abstract and the Process Identification Document (PID).

The Capability Abstract and the PID have to demonstrate that the Process Capability Domain represents a structured, properly controlled and monitored assembly, packaging and test process for discrete semiconductor components and/or monolithic microcircuits, as applicable.

The Capability Abstract shall describe, in a comprehensive manner, the scope and extent of the Process Capability Domain for the assembly, packaging and test services for which approval is sought. The document shall be prepared to the satisfaction of the ESCC Executive. It shall contain no commercially sensitive material information and shall be suitable for publication by ESCC on the ESCIES website.

The definition of the Process Capability Domain shall address the areas listed in this paragraph at least to the extent detailed. Additional information shall be supplied whenever required by the particular Process Capability Domain under approval.

When existing, discrete semiconductor components and/or monolithic microcircuits design, qualification and manufacturing activities shall be presented in order to define the capability abstract. Existing PID and data evidence shall be considered.

Within the definition of the Process Capability Domain, the following areas are of particular concern and are therefore the object of specific requirements in the remainder of this paragraph:

- The range of dice technologies and (passive) add-on parts that can be assembled
- Package types
- Assembly processes and materials
- Inspection and testing capabilities
- Traceability

5.1.1 Dice Components and Passive Add-On Parts

The range of dice technologies that can be assembled under the Process Capability Domain shall be described in a comprehensive and exhaustive manner. The following information shall be included (the information could differ depending on the individual dice technology):

- Die material/metallization/passivation
- Die minimum and maximum size and thickness.
- Die back surface material and type.
- Bond pads / bumps / intermediate layer (materials, plating materials, plating thickness, dimensions and spacing, configuration)
- Manufacturer (foundry) and supplier

The identification of passive add-on parts (capacitors and resistors only, if mounted in and electrically connected to an IC die as part of its hermetic assembly) shall include:

- Generic Part type
- Procurement specification
- Dimensions, terminations, materials and finishes
- Manufacturer and supplier

5.1.2 Package and substrate Types

The range of package types that are included within the Process Capability Domain shall be described in a comprehensive and exhaustive manner. The following information shall be included (the information could differ depending on the component technology):

- Manufacturer and supplier(s)
- External dimensions.
- Cavity dimensions.
- Body materials
- Body plating (materials, thickness)
- Bond pads (materials, plating materials, plating thickness, dimensions and spacing, configuration)
- Lead-frame/terminals (quantities, base materials, plating materials, dimensions and spacing, configuration)
- Lid (Materials, plating materials, plating thickness, seal material, dimensions and spacing)
- Substrate material, specification, dimensions, plating materials and thickness
- Marking processes and materials

All materials and finishes used in the assembly shall comply with the restrictions on materials specified in ESCC Basic Specification No. 22600.

5.1.3 Assembly Processes and Materials

The range of assembly processes and associated materials that are included within the Process Capability Domain shall be described in a comprehensive and exhaustive manner. The following information shall be included as a minimum (the information could differ depending on the component technology):

- Assembly materials.
- List of equipment used for the assembly
- Die attach method.
- Interconnection method.
- Cleaning processes
- Seal/encapsulation technique (material, sealing process, gas composition, vacuum level).

All materials and finishes used in the assembly shall comply with the restrictions on materials specified in ESCC Basic Specification No. 22600.

5.1.4 Inspection and Testing Capability

The range of environmental and mechanical tests and inspections that are included within the Process Capability Domain shall be described in a comprehensive and exhaustive manner.

5.1.5 Traceability

The ATH shall describe their methods for assuring traceability of materials, mechanical parts, dice components, and test and manufactured items. At least the following points shall be covered:

- The use of purchase orders and specifications
- The use of route sheets and travellers
- The traceability of materials, mechanical parts and dice components
- The traceability of test vehicles
- The traceability of manufactured items

5.2 THE PID OF AN ATH

5.2.1 General

A PID for the Process Capability Domain to be approved shall be based on ESCC Basic Specification No. 22700 in terms of general content, lay-out and configuration control.

The PID shall detail the requirements applicable to the following:

(a) Wafer/die source and procured component technology:
- The relationship and interface between wafer/die manufacturer and the ATH, and the tools in place for the procurement of the wafer/die from the semiconductor manufacturer, when applicable.
- Detail of source(s), identity, location and points of contact.
- Type of source (e.g. fabrication plant, authorised distributor).
- Procured component technology.
- Quality status of procured wafer/die.
- Statement of the relationship between the wafer/die manufacturer and the ATH.
- Wafer/die procurement specification.
- Verification performed during the ATH incoming inspection of procured wafer/die.
- Control of the documentation.
- Possible testing
- Handling and storage.

(b) Package:
- Details from the package vendor.
- Documentation.
- Procurement specification.
- Procedure for incoming inspection verification.
- Design tools.

(c) Assembly:
- Assembly flow.
- Scribing and die separation methods.
- Die back surface preparation.
- Selection and specification of assembly materials.
- Quality control of incoming materials.
- Inspection procedures.
- Implementation procedure for internal and other test methods.
- Traceability and control of stored materials, especially limited shelf life items.
- Physical location of assembly operation.
- Device marking process.

(d) Testing:
- Listing of the equipment for environmental and mechanical testing.
- Calibration of the equipment.
- Test procedures.
- Reporting process.

(e) Quality system:
- Overall quality management system and its conformance with ESCC Basic Specification No. 24600.
- Precautions taken with ESD according to DIN EN 61340-5.1.
- Handling and storage of the dice components in accordance with ESCC Basic Specification No. 20600.

(f) Relation with the procurer of the service:
- Traceability of the packaged devices.
- PO, procurement specification, management.
- Procedure for precap inspection.
- Documentation.
- Storage.
- Shipping.

5.2.2 Review and Approval of the PID

The PID shall contain the complete definition of the Process Capability Domain and its boundaries and will be updated into a stable state at the end of the Evaluation Phase; accordingly, its review and approval by the ESCC Executive becomes a mandatory prerequisite for the commencement of the PCA testing phase.

The complete PID, comprising all called-up specifications, shall be kept by the ATH at their facility. It shall be made available to the ESCC Executive or its designated representative for review and consultation.

Any deviation from the PID, once approved, shall be subjected to the ESCC Executive for approval.

A condensed PID, comprising all basic information, e.g. flow-charts, lot travellers, lists of specifications, materials (with an identification of the materials' suppliers), processes, organization/responsibility, equipment and layouts but complemented by copies of only the agreed specifications, shall be kept by the ESCC Executive and treated as proprietary information.

## 6 EVALUATION PHASE OF THE PROCESS CAPABILITY DOMAIN AND THE ATH

In addition to the requirements of ESCC Basic Specification No. 25600, the following requirements are specific and applicable to the evaluation phase of the assembly, packaging and test services of an ATH for the purpose of PCA.

The purpose of the evaluation of an ATH is to assess the capability and the adequacy of their organisation, plant and facilities and to ascertain the ATH ability to provide assembly, packaging and test services for discrete semiconductor components and/or monolithic microcircuits, as applicable, in accordance with the PID and the applicable current ESCC specifications.

During this phase, the capability of the ATH to provide the assembly, packaging and test services as described within the Process Capability Domain will be assessed by reviewing the capability of the facilities, the quality management system in place, and already existing manufacturing and test results.

Evaluation testing is, in principle, not required; instead, additional assessment activities, to be performed by the Manufacturer, and supervised by and agreed with the ESCC Executive, shall be included as an initial stage in the process of achieving PCA certification.

The verification of the completeness and adequacy of data related to the preliminary assessment specified here below will be performed by the ESCC Executive as part of a Manufacturer Data Review, to be conducted in accordance with ESCC Basic Specification Nos. 20200, 2029000, 2025000 and the rest of this document

The assessment of the capability and adequacy of the ATH shall be performed during an ATH audit performed by the ESCC Executive.

Upon completion of the evaluation phase, the final definition of the Process Capability Domain and its boundaries shall be agreed between the ATH and the ESCC Executive, and the Capability Abstract shall be issued.

### 6.1 ATH AUDIT AND MANUFACTURER DATA REVIEW

The ATH audit shall assess the ATH quality management system and their ability to successfully execute a contract for the supply of assembly, packaging and test services for discrete semiconductor components and/or monolithic microcircuits. The ATH shall have in place a Quality System according to ESCC Basic Specification No. 24600.

The ATH audit shall check the adequacy of following:

- the ATH overall quality management system according to ESCC Basic Specification No. 20200.
- the assembly of components according to the relevant sections of ESCC Basic Specification Nos. 2025000, 2029000.
- the precautions taken with respect to ESD in according to DIN EN 61340-5.1.
- the handling and storage requirements for dice components in accordance with ESCC Basic Specification No. 20600.

- the capability of the ATH to provide the assembly, packaging and test services in accordance with the Process Capability Domain. In this respect, a Manufacturer Assessment and a Component Assessment shall be implemented as described in the rest of this paragraph:

  (a) Manufacturer Assessment
  The Manufacturer shall provide the following information for the ATH PCA domain, to the ESCC Executive for review:

  - Detailed conformance matrix to general PCA requirements included in ESCC Basic Specification No. 25600.
  - Information explicitly indicating full details on the compliance, or otherwise, of the Manufacturer's quality management system to the requirements of ESCC Basic Specification No. 24600.
  - A completed ESCC Manufacturer Checklist in accordance with ESCC Basic Specification No. 20200.
  - The draft Process Identification Document (PID).

  (b) Component Assessment
  The Manufacturer shall provide to the ESCC Executive sufficient information to enable the full assessment of the suitability of the PCA Domain under the following criteria:

  - constituent materials
  - construction
  - characterisation and performance over the full operating and storage temperature ranges

  Specific requirements to be addressed shall include the following (the relevant requirements specified in ESCC Basic Specification Nos. 22600, 2265000, 2269000, as applicable, may be used for guidance):

  i. Construction Analysis
  Construction analysis shall be performed on a minimum of 3 samples. The content and extent of the Construction Analysis shall be agreed by the ESCC Executive. ESCC Basic Specification No. 21001 may be used as a guideline

  ii. Package Assessment
  Suitable information on the following specific package assessment details for the component(s) shall be provided (as applicable):

  - Assessment of the component(s) capability to withstand typical mounting in accordance with ECSS-Q-ST-70-08 and/or ECSS-Q-ST-70-38.
  - Lid Torque or Lid Pull
  - Resistance to Soldering Heat
  - Pin-to-Pin Isolation
  - Thermal Resistance Characterisation
  - Ability to withstand thermal cycling and thermal shock
  - Ability to withstand environmental loads as vibration and mechanical shock

6.1.1 Review Existing Test Results
When possible, the ATH shall provide for review during the ATH audit all available test results for any previous discrete semiconductor component and/or monolithic microcircuit lots processed by the ATH that:

(a) were manufactured fully within the same Process Capability Domain that is under evaluation.

(b) employ assembly processes and/or packaging techniques relevant to the Process Capability Domain under evaluation.

# 7 PROCESS CAPABILITY APPROVAL (PCA) TESTING PHASE

## 7.1 GENERAL

The PCA testing phase for ATH services shall be as specified in ESCC Basic Specification No. 25600 with the additional requirements set in this paragraph.

The objective of the PCA testing phase is to demonstrate, on the operational assembly line, the ability of the ATH to assemble, package and test high reliability components suitable for space applications.

To this end, the following prerequisites shall be satisfied:

- The evaluation phase has been completed successfully and the Process Capability Domain with its boundaries has been agreed between the ATH and the ESCC Executive.
- The materials and processes, and related specifications and documentation have been frozen in a PID agreed by the ESCC Executive.
- The facilities, equipment and tools are operational and under control.
- The training and certification of personnel is completed and surveyed.
- All corrective actions derived from the ATH audit shall have been correctly and completely implemented.
- An ESD control plan, meeting the minimum requirements of DIN EN 61340-5.1 is frozen.

The ESCC Executive shall verify the completion of the prerequisites listed above at the time of the PCA readiness review.

## 7.2 PROCESS CAPABILITY APPROVAL TESTING

Process Capability Approval testing to be performed in accordance with the contents of the PID, shall conform to ESCC Basic Specification No. 25600 and this paragraph.

PCA testing shall be performed in accordance with a PCA test plan prepared by the ATH, which shall fully detail the requirements of the testing programme to be performed on a range of test vehicle types fully representative of the range of dice technologies and package types covered by the Process Capability Domain defined in the PID.

The PCA test plan shall be based on the test and inspection requirements of Chart I.

Samples to be submitted to PCA testing shall be test vehicles as defined in Para. 7.2.1. The sample size and accept/reject criteria per test subgroup is given in Chart I. Unless otherwise agreed with the ESCC Executive, when different types of test vehicles are being tested, each type shall be represented in each subgroup.

All test vehicles shall be serialised after encapsulation, prior to testing.

Unless otherwise specified, the test methods and conditions, applicable to the tests and inspections in Chart I, are as specified in either ESCC Generic Specification No. 5000 or 9000 as applicable to the test vehicles being tested.

Prior to the start of PCA testing, the ATH shall prepare and submit the PCA test plan to the ESCC Executive for approval.

The PCA test plan shall include the following, as a minimum:

(a) The range of test vehicles to be assembled and submitted to PCA testing. Traceability of all assembly and packaging, materials and processes to each test vehicle shall be maintained.

(b) The tests and inspections to be performed. Full details of all tests and test sequences, sample sizes, accept/reject criteria, and conditions for all test vehicles to be tested shall be provided.

(c) Accept/reject criteria for each test vehicle.

(d) A cross-reference relating each test vehicle serial number and test to the relevant areas and boundaries of the Process Capability Domain, in order to verify that the test vehicles being tested and the tests and inspections being performed are representative of the full scope of the Domain.

(e) A schedule covering the production and testing of the test vehicles. This schedule shall show by date and duration when all major processing operations, and all tests and inspections are to take place.

7.2.1 Definition and Requirements for Test Vehicles for PCA Testing

The test vehicles (or suitable test structures) used for PCA testing shall be selected to fully represent the range of dice technologies, and processes and materials of the assembly and packaging services covered by the Process Capability Domain, as defined in the PID.

A Test Vehicle Specification shall be prepared by the ATH and agreed by the ESCC Executive for each test vehicle, which shall define the mechanical and material characteristics of the test vehicle together with the electrical testing requirements as necessary. Electrical test capabilities certified in accordance with this specification shall be limited to those required to verify the quality of workmanship of the assembly process(es).

The number of components selected for testing will depend on whether a single component type or a family of parts is being tested, the number of component types chosen to represent the family and the availability of the appropriate, suitable information. The component types chosen to represent a family shall cover the range of components to be certified within the PCA domain and be representative of the different package and pin configurations. They shall also be the most suitable for highlighting those characteristics and parameters that are pertinent to an investigation into failure modes and weaknesses. The number of samples shall be as agreed with the ESCC Executive.

7.3 PCA TEST REPORT

On completion of the PCA testing programme, the ATH shall collect all the relevant data and documentation in the form of a PCA test report. This report shall be sent to the ESCC Executive for review and acceptance.

The report shall contain the following information:

- Description of the Process Capability Domain tested, including relevant assembly and packaging processes (including the associated equipment), die technologies, materials and sub-techniques and how these were implemented in the test vehicles.
- The Detail Specification for each test vehicle.
- Production data for the test vehicles including details of any failures during production.
- The PCA test plan giving details of all test methods and conditions and the number of test vehicles tested.
- Detailed test results referred to test vehicle serial number, and any non-conformance reports.

- Reference to ATH alternative test data accepted as satisfying part or all of the PCA test programme (as applicable).
- PCA testing summary and conclusions.

## 8 PROCEDURES SPECIFIC TO PCA OF ATH SERVICES

The following provisions are specific to PCA of ATH services and supplement related requirements in ESCC Basic Specification No. 25600.

### 8.1 VALIDITY OF PROCESS CAPABILITY APPROVAL

The PCA shall be valid for a period of 2 years from the date of certification, or for such period as determined by the ESCC Executive and approved by the Certification Body, ESA, if the related requirements for validity of PCA in ESCC Basic Specification No. 25600 are met.

### 8.2 EXTENSION OF PROCESS CAPABILITY APPROVAL VALIDITY

A valid PCA may have the validity extended for a further period of 2 years from the date of certification expiry, or for such period as determined by the ESCC Executive and approved by the Certification Body, if the related requirements for extension of PCA validity in ESCC Basic Specification No. 25600 are met.

When there has been no major process or material change to the PID since the previous approval of the PCA was granted, the PCA test plan (see Para. 7.2) shall be considered as already approved for the purpose of extension of PCA validity.

The range of various test vehicles used during PCA testing (see Para. 7.2.1) for extension of PCA validity, may be reduced on a case by case basis, subject to justification being presented to and accepted by the ESCC Executive prior to the start of PCA testing.

### 8.3 RE-SCOPE OF PROCESS CAPABILITY APPROVAL

The re-scope of PCA for an ATH may be a consequence of an addition of, or change to, materials and /or processes and/or boundaries that were included in the previous PID,

Changes of the PCA domain are categorized into two classifications:

- Major change (new materials, new processes, new production equipment, move of line location, new or modified inspection criteria, change of process parameters beyond PID limits)
- Minor change (addition of already-existing production equipment to the line, addition of a second supplier for an already-used material, addition of a new supplier for test services)

Upon application for change of PCA domain by the ATH concerned, the ESCC Executive will decide whether the change is major or minor.

Major changes shall be validated by test programmes according to the test plan reviewed and approved by the ESCC Executive (see Table I for testing guidelines). A reduced testing may be used in case of minor changes. Inspection test after environmental tests shall be adapted in accordance with the changes.

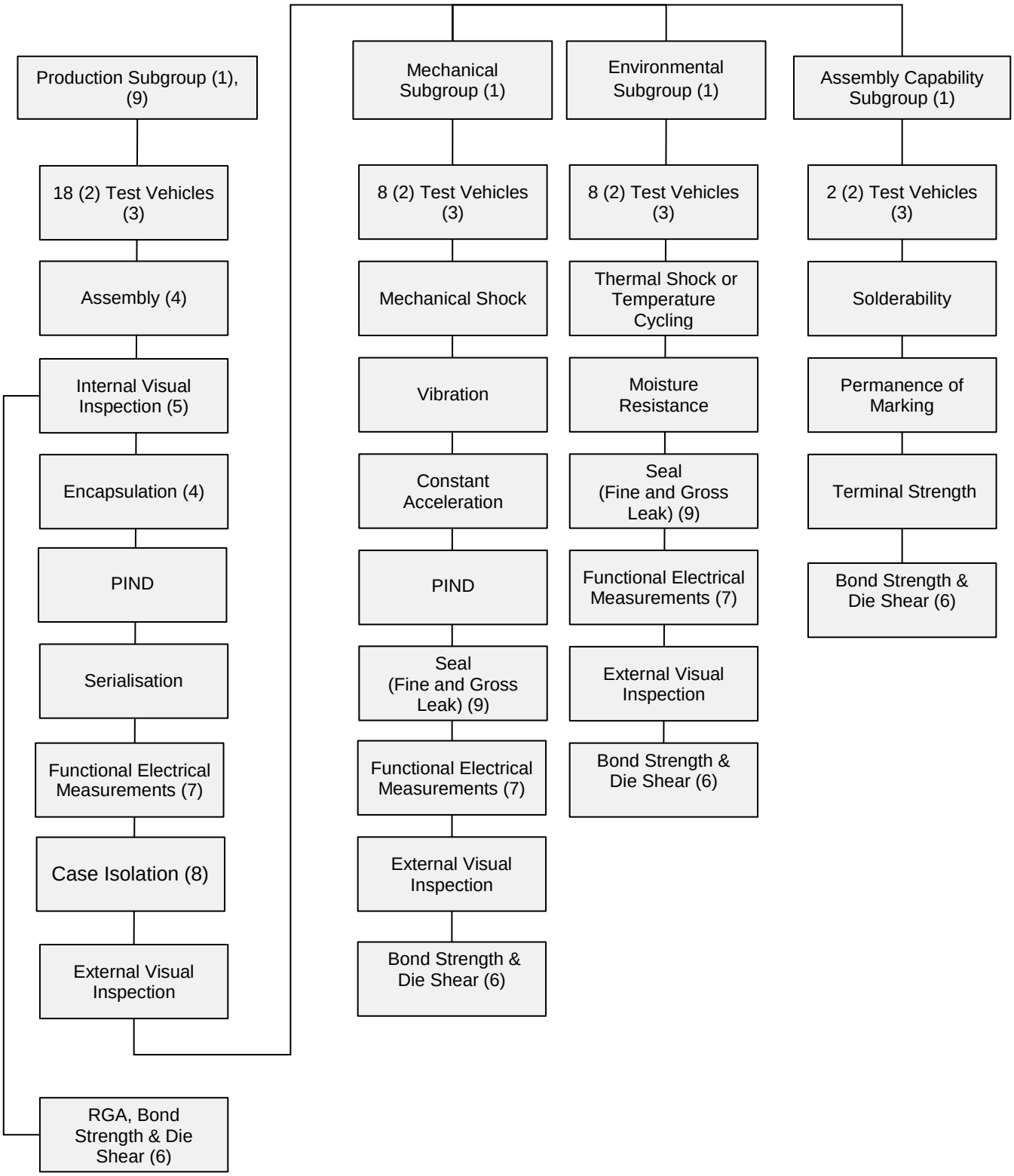
**TABLE I - TESTING GUIDELINES FOR MAJOR CHANGES (NON-EXHAUSTIVE)**

| Major Change | Chart I | | | | |
|---|---|---|---|---|---|
| | Construction Analysis | Production Subgroup | Environmental Subgroup | Mechanical Subgroup | Assembly Capability Subgroup |
| Die changes (Note 1) | Y | Y | Y (Note 2) | Y (Note 2) | N |
| New passive add-on | N | Y (Note 2) | Y (Note 2) | Y (Note 2) | N |
| Change of die attach material or attachment method | Y | Y | Y | Y (Note 2) | Y |
| Change of wire bond process, or wire material/dimensions | N | Y | Y | Y (Note 2) | N |
| Change in lead frame material or dimension | Y | N | Y | Y | Y |
| Change of internal substrate or materials | N | Y | Y | Y | N |
| Change of seal method, seal material, lid base material | Y | Y | Y | Y | Y |
| Change of leads materials or finish | N | N | N | N | Y (Note 3) |
| New package | Y | Y | Y | Y | Y |
| Assembly move | Y | Y | Y | Y | Y |

**NOTES:**

1. Die changes in the PCA domain may be due to the selection of new die (a die part number not previously listed within the PCA domain) or changes that affect previously-approved die, if affecting die structure, changes in metallization or passivation/glassivation, die size, active element's design, die thickness or original wafer diameter;
2. Environmental and Mechanical subgroups need not be performed if similarity with already-approved dice, passive add-on part or approved combinations of materials can be demonstrated and agreed by the ESCC Executive.
3. Bond pull and die shear need not be performed in this case.

CHART I – PCA TESTING REQUIREMENTS (REF. PARA. 7.2)



**NOTES:**

1. Test methods and conditions for each test and inspection shall be as specified in either ESCC Generic Specification No. 5000 or 9000 as applicable to each test vehicle being tested.
2. Quantity of test vehicles for each test vehicle type selected to be representative of the range of dice technologies and package types covered by the Process Capability Domain. See also Note 6 and Para. 7.2.1.
3. Unless otherwise specified, accept/reject criteria for all tests in the subgroup: accept = 0, reject ≥ 1.
4. Assembly/encapsulation of test vehicles (see Para. 7.2.1).
5. Internal visual Inspection only of the assembly and packaging aspects of the test vehicles.
6. RGA is only required at the time of initial PCA testing but needs not to be repeated for maintenance of approval certification. Bond Pull and Die Shear during the Production Subgroup shall be performed on an additional 2 or 3 test vehicles in accordance with ESCC Generic Specification No. 5000 or 9000 as applicable to the test vehicles being tested.
7. Functional test in accordance with the Detail Specification for each test vehicle. Only failures directly attributable to the assembly/encapsulation/packaging shall be counted. Electrical test capabilities certified in accordance with this specification shall be limited to those required to verify the quality of workmanship of the assembly process(es).
8. As applicable.
9. It may be required to implement a screening sequence on test vehicles before the test lot is submitted to PCA testing. The content of such screening sequence shall be agreed with the ESCC Executive