



## GE-AVIATION JOINT AFFILIATES SUPPLIER REQUIREMENTS FOR CHARACTERISTIC ACCOUNTABILITY, VERIFICATION AND QUALITY PLANNING

**Specification Number: S-SPEC-5**

**aeDMS #: S-1007**

**Issue Date: Sep 21, 2023**

*This specification is in addition to and in no way limiting, superseding, or abrogating any contractual obligation as required by the applicable procurement document.*

### INTRODUCTION

This document establishes the minimum requirements for the part qualification and approval process of production pedigree goods and services for GE Aerospace Systems (GEAS). Chapter A is based on the elements of AS9102, and Chapter B is based on AS13100.

If the purchase document references AS13100, Chapter B shall be applicable, and Chapter A is not. [Follow this link to go directly to Chapter B.](#)

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### A. REFERENCED DOCUMENTS

AS9102	Aerospace First Article Inspection Requirements
<a href="#">S-1005</a>	GE-AJA Supplier Quality System Requirements
GT1005-2	Source Problem Report
GT1005-3	Supplier Nonconformance Material Report
GT1007-1	Part Number Accountability
GT1007-2	Product Accountability: Raw Material, Special Process, Functional Testing
GT1007-3	Characteristic Accountability, Verification and Compatibility Evaluation
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GT1007-5	Product Audit Proposal/Completion
GT1007-6	Product Validation Checklist



## B. PURPOSE

1. To ensure that all GE Aerospace Systems (hereinafter referred to as GEAS accountable characteristics of a product are addressed by the supplier in the manufacturing and quality plans and that planning includes controls adequate to ensure continued conformance of these characteristics.
2. To provide requirements for documenting the results of First Article Inspection (FAI) and evaluations of changes after initial FAI documentation.

## C. APPLICABILITY AND USE

1. This specification defines characteristic accountability and verification (CAV) and quality planning for initial approval and ongoing production. This applies to product supplied to GEAS by GEAS Suppliers (reference Appendix E for FAI applicability guidance),
  - a. Unless otherwise specified in the purchase order, this specification does not apply to:
    - i. Procured standard catalog items, COTS or deliverable software,
    - ii. Development and prototype parts that are not considered part of the first production run.
2. The supplier is responsible for performing characteristic accountability and verification and development of the quality plan in accordance with this specification. This shall be completed and GEAS SQE approved before shipment of production hardware. GEAS reserves the right to witness the supplier's inspections and/or tests to determine the degree of conformance.
3. FAI documentation shall contain the elements of forms GT1007-1, GT1007-2 and GT1007-3. Any exceptions shall be approved by the GEAS SQE. FAI documentation (and supporting elements as described in paragraph F) shall be considered a quality record and shall be retained in accordance with [S-1005](#). All forms shall be completed either electronically or in permanent ink. All forms and supporting FAI documentation shall be in English (native/non-English language may be included). In the event of any inconsistency between the supplier's native language and translations to or from English, the English language meaning shall control.
4. This specification applies to GEAS drawings and specifications for all levels of parts within an assembly, assemblies, sub-assemblies, and detail parts, including castings and forgings, modifications to standard catalog or Commercial-Off-the-Shelf (COTS) items, and to all Suppliers who are responsible for producing accountable characteristics of the product. Suppliers who receive the Purchase Order/Contract from GEAS are responsible for flow down of the applicable requirements of the latest issue of this specification to their sub-tier suppliers. If the FAI is completed by an



independent 3<sup>rd</sup> party, the GEAS supplier remains fully responsible for the completeness and accuracy of the FAI.

5. In the event of conflict, requirements in other sourcing specifications or quality documents referenced on the Purchase Contract take precedence over the requirements in this document.
6. Data shall be recorded in the Units of Measure specified on the drawing.
7. The Drawing Revision entry on form GT1007-1 is the revision applicable to the First Article part shipped. GT1007-2 and GT1007-3 do not need to be changed or submitted if a drawing revision does not affect accountable characteristics reported on those forms.
8. For any part or assembly with a lapse in manufacturing of 24 months or more (between the completion of the manufacturing cycle of the last part produced and the start of a new part), a new full FAI shall be completed per this specification. The FAI shall be approved by the GEAS SQE prior to shipment.
9. For any part or assembly with a lapse in manufacturing of less than 24 months that are ordered to a revision other than the revision listed on the FAI, a delta/partial FAI shall be completed per this specification to account for all drawing and Part List changes that have occurred. This FAI shall be approved by the GEAS SQE prior to shipment.
10. The supplier shall ensure secure transmission of FAI data package. Email is not an acceptable transmission method. Transmission via Digital Thread is preferred. Link to Digital Thread link: <https://digitalthread.geaviation.com/dd/createpackage/>.

## **D. ESTABLISHMENT OF ACCOUNTABLE CHARACTERISTICS**

1. Suppliers are responsible for all accountable characteristics, including those generated by their sub-tier suppliers (e.g., inspection data, test data, Acceptance Test procedures, etc.). If sub-tier suppliers do not account for their characteristics, the prime supplier is responsible for initiating a separate FAI document or including the characteristics in their FAI document.
2. A ballooned drawing shall be generated, and accountable characteristics numbered for the manufactured part. Suppliers are responsible for ballooning the drawing themselves using the guidelines in this Section. The supplier has the ultimate responsibility for ensuring completeness and accuracy of the Characteristic Accountability. Each ballooned characteristic shall be recorded on GT1007-3.
3. Characteristic numbers shall be assigned to each of the following drawing features (unless otherwise required or specified by GEAS SQE).
  - a. Dimensional features, with the following notes:



- i. Reference dimensions are not considered accountable characteristics and need not be ballooned.
- ii. Basic dimensions should be referenced in relation to the respective measurable characteristic. (See Figure 1 below for an example).

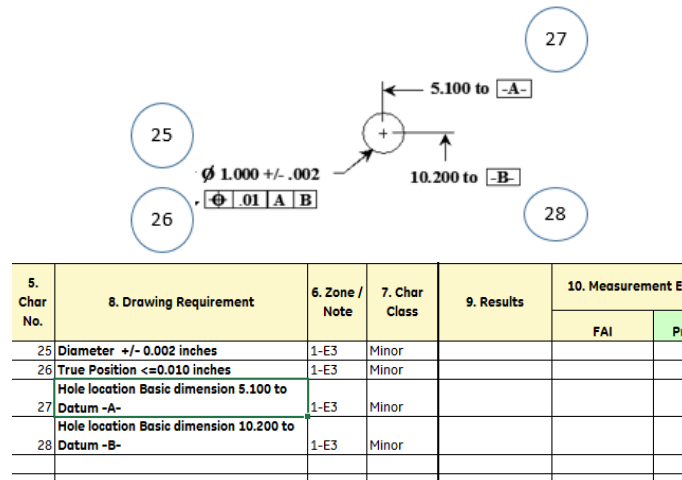


Figure 1 (for reference only)

b. Specifications

- i. Accountable characteristics produced by specification definition/requirements defined on the drawing shall be identified and listed for characteristic accountability and first article inspection on GT1007-3. However, the supplier shall evaluate any specifications that are referenced within those specifications listed on the drawing for additional accountable characteristics.
- ii. The supplier is responsible for verifying the revision, accuracy, completeness for characteristic breakout of the specification as they apply to their FAI.
- iii. Unless otherwise approved by GEAS SQE, specification characteristics and results shall be included as part of the FAI package.
- iv. Accountability requirements regarding characteristics identified within process/special process specifications (for example, processing parameters such as heat treat temperature) will be defined by the GEAS SQE.

c. Drawing Notes

- i. Measurable features within notes.
- ii. Non-measurable characteristics within notes.
- iii. Sequence of Operations.
- iv. Test/functional parameters. If a Test Procedure is defined, the document number/note will be ballooned and must be included on GT1007-2.

d. Tables (on drawing) – Except as follows



- i. Nondestructive Evaluation (NDE) tables can be ballooned as one characteristic unless otherwise requested by the GEAS SQE.
    - ii. Configuration control tables – Only cells associated with the part number being reported shall be ballooned.
    - iii. Information tables such as datum tables need not be ballooned.
  - e. Supplementary views, tabulated features, and alternate methods of manufacture views
    - i. When required for the part number being reported, all characteristics shall be ballooned.
    - ii. When not required for the part number being reported, a single characteristic may be used.
  - f. Find numbers (i.e. item numbers) called out on the drawing (in the notes and/or the body of the drawing)
4. When working to an issued drawing plus Changes in Design (CID), the CID number(s) shall be listed on GT1007-1.
5. When design requirements are in a DPD format and drawing information is not available or provided in the GEAS 2D drawing, the supplier shall establish a process to extract the accountable characteristics and extract, verify and include the DPD accountable characteristics in the CAV/FAI.

#### **E. FIRST ARTICLE INSPECTION**

The supplier shall have a process to plan for FAI activities prior to the first production run and activities to be performed through the FAI process. Those responsible for the FAI activities shall be identified. The First Article Inspection part or parts shall be representative of a production run.

- 1. When possible, the First Article Inspection shall be performed using an independent gaging method rather than the normal product acceptance plan. Production gaging and test equipment may be used for first article inspection in cases where it is the only method of accurately checking a characteristic.
- 2. Inaccessible characteristics: A characteristic inaccessible at final inspection may receive first article inspection when accessible during the process in lieu of disassembly/destruction. The supplier shall ensure that subsequent processing does not cause the characteristic to become nonconforming or unintentionally alter the characteristic.
- 3. Characteristics that cannot be evaluated non-destructively on a finished part may be re-evaluated using component parts prior to final assembly or by using hardware not useable because of reasons unrelated to the characteristic being re-evaluated.



4. Non-measurable characteristics – results such as or “Conform”, “Verified” or “For Information Only” shall be entered.
5. This paragraph is no longer used.
6. Multiple characteristics (e.g., bolt circle, dovetail slots, radii): Provide variable data for all occurrences of every characteristic or minimum/maximum readings along with the number of measurements taken unless additional data is required by the GEAS SQE.
7. Continuous characteristics (e.g., radius along circumference, weld seams, edge breaks, surface finish, slot dimension, wall thickness and continuous features invoked by specifications): Measure a sufficient number of locations over the total extent of the characteristic to ensure total conformity. Provide variable data for all measurements or minimum/maximum readings along with the number of measurements taken unless additional data is required by the GEAS SQE.
8. Characteristics that are identified as non-conforming during first article inspection shall be managed as follows:
  - a. Form GT1007-1 field 19 (“FAI has Nonconformance(s)”) shall be marked “Yes”.
  - b. The non-conformance shall be documented in accordance with [S-1005](#) and the non-conformance document number shall be referenced in the GT1007-3 results.
  - c. Any nonconforming characteristic found on the FAI shall be subject to 100% characteristic evaluation until justification for an alternate acceptance plan per Appendix A is approved by the GEAS SQE.
  - d. Corrective action(s) shall be implemented, and a partial FAI performed for all affected characteristics on the next production run, after implementation of the associated corrective action(s). If the partial FAI does not clear all identified non-conformances, the FAI still “has nonconformances” and the requirement to complete the FAI is still in effect. NOTE: A full FAI may be done in lieu of a partial FAI.
9. The supplier shall:
  - a. Review Manufacturing process documentation (e.g., routing sheets, work instructions, etc.) to ensure all operations are complete as planned
  - b. Review Material certifications for compliance
  - c. Verify approved Special Process sources are used, if applicable, and the correct specification(s) are documented
  - d. Verify that Key Characteristic requirements have been met, as applicable
  - e. Verify part specific gages and/or tooling is qualified and traceable, as applicable



- f. Verify all design characteristic requirements are accounted for, are uniquely identified and have inspection results traceable to each unique identifier
- g. Review completed GEAS approved test procedure data sheets, if applicable
- h. Verify test equipment (including any Special Test Equipment i.e. STE), if applicable, has been identified and if required, approved by GEAS SQE.

#### **F. SUPPORTING ELEMENTS OF FAI/CAV**

Items in this paragraph are required supporting elements of the FAI Data Package unless otherwise directed by the GEAS SQE (reference paragraph C.3).

- 1. Photo of part marking,
- 2. Completed GT1005-3 Supplier Nonconforming Material Report approved by GEAS SQE as applicable,
- 3. Completed GT1005-2 Source Problem Report (SPR) approved by GEAS SQE for interpretation/specification options,
- 4. Certificates of conformance for all parts, material, tests and sub-tier special processes. Certificates shall be traceable to the documented information on GT1007-2 or GT1007-3 forms,
- 5. Ballooned drawing
- 6. Special Process Technical Plans (as required by specification)
- 7. Inspection Reports (if applicable)
- 8. Completed Test Procedure Data Sheets, if applicable
- 9. Completed FAI Checklist

#### **G. QUALITY PLANNING AND ACCEPTANCE PLANS**

- 1. Manufacturing and quality planning shall be in place before final acceptance of deliverable hardware to ensure that all accountable characteristics are included in the plans. See Appendix A for a recommended quality planning process map. Where supplier/sub-tier product and process drawings exist that contain GEAS accountable/design characteristics, the supplier shall complete a compatibility assessment. Reference paragraph J.
- 2. The adequacy of the measurement system shall be considered when selecting inspection equipment for first article inspection and ongoing production. See Appendix B for a recommended measurement and test equipment selection process.
- 3. The required acceptance plan is 100% inspection of each characteristic on every piece manufactured, except when implementing a Product Acceptance Plan per [Appendix A](#), Table 1.
  - a. Documented justification for less than 100% inspection is required and shall be available upon request by the GEAS SQE. The documented justification shall be referenced in the FAI.





4. Data utilized for process capability calculations shall be representative of the planned process and shall not include rework or work outside the normal process. Statistical methods defined in [Appendix C](#) are the preferred methods to use for Cpk calculations.
5. The operation where each characteristic is verified shall be recorded on the FAI. Consideration should be given as to whether subsequent operations could affect the final characteristic.
6. Measurement of characteristics for product acceptance, whether completed during manufacturing or at final inspection, shall be performed by qualified inspectors or certified operators. Certification of operators shall be achieved through a supplier certification program that meets the requirements of Appendix D.
7. Measurement of characteristics for product acceptance shall be performed using measurement and test equipment meeting the requirements of [S-1005](#).

## H. CHANGE MANAGEMENT

1. All requirements of this specification apply to accountable characteristics impacted by any of the changes listed below including those invoked by drawing specifications. The supplier shall notify the GEAS SQE when a change occurs (as defined in a-e below) to determine if a full/partial FAI must be submitted to and approved by GEAS. The FAI may require additional characteristic accountability as deemed necessary by the change. When the submission of a full/partial FAI is not required, the supplier shall conduct an internal full/partial FAI.
  - a. Changes to a configuration of a previously approved part (i.e. -001 to -002, P01 to P02, G01 to G02): Note, ALL changes; additions, deletions, and modifications of characteristics shall be accounted for and submitted to GEAS SQE for approval.
  - b. Drawing or specification changes that do not change the part or assembly number. Note, ALL changes; additions, deletions, and modifications of characteristics shall be accounted for.
  - c. Process changes (including sub tier changes): Inspection method and/or frequency for affected characteristics of any process change shall be evaluated for impact.
  - d. Product Acceptance Change:
    - i. Change in product acceptance plan. (see Appendix A)
    - ii. Change in production inspection equipment (e.g., from micrometer to functional gage).
    - iii. Changes to the point of inspection relative to the manufacturing process (e.g., move from final inspection to in-process).



- e. A repeat (full or partial) first article inspection shall be considered when any of the following events occur that could affect part characteristics: (This paragraph highlights some repeat FAI scenarios.)
  - i. A change in inspection methods or measurement equipment. Note: Refer to Appendix B, "Measurement and Test Equipment".
  - ii. Relocation of a process and equipment within a Source (for example, changing a printed circuit board assembly from one line to another; moving a reflow oven to another area/section of the building)
  - iii. A change to numerical control programs. Note: Refer to [S-1005](#).
  - iv. A natural or man-made event that adversely affects characteristics.
  - v. Any change in the process or process sequence (examples: tooling, fixtures) or material that could potentially affect part characteristics.
2. The most current approved quality plan shall match the inspection method and frequency being used at the supplier and/or sub-tier suppliers. Supplier shall develop a plan to update FAI when manufacturing plans or inspection plans are revised.
3. Supplier shall have a process to ensure all engineering and manufacturing changes to the manufacturing planning are reviewed against the current quality plan. Changes shall be submitted as required.

## I. PRODUCT/PROCESS AUDIT

Supplier Product/Process Audit: This section defines the minimum requirements of product audits. These requirements shall be incorporated into a Supplier Product Audit procedure.

1. The purpose of this audit is to verify that the established process controls and product acceptance plans continue to provide conforming material.
2. This audit is a full FAI for a fully processed production part. It is also an evaluation of the supplier's planning and procedures to ensure compliance with the requirements of this specification. Evaluation shall include variable results, inspection equipment, and the current acceptance plan per Appendix A. Use of GT1007-6 (Product Validation Checklist) is encouraged.
3. Whenever possible, the re-evaluation shall be performed using a method of acceptance measurement independent of the planned acceptance measurement method. In cases where the production method of acceptance is the most accurate (e.g. CMM), it may be used as long as program verification or an independent check is completed. Characteristics that cannot be evaluated non-destructively on a finished part may be re-evaluated using component parts prior to final assembly or hardware that is not useable because of reasons unrelated to the characteristic being re-evaluated.
4. The supplier shall handle Product Audit non-conforming findings per the current revision of [S-1005](#).



5. Any finding during product audit will subject the supplier to additional audits at the GEAS SQE's discretion.
6. Product Audit Family designations and parts assigned shall be submitted to the GEAS SQE for review and approval using form GT1007-4 (Product Audit Part Family Designation). Product audit Planning and Family designations will be reported to GEAS SQE through the Support Central Workflow on an annual basis. If the Support Central Workflow cannot be used by the supplier, GT1007-4 must be submitted to the GEAS SQE at the beginning of the audit year. NOTE: Families defined either too broadly or too restrictively can defeat the purpose of a product audit, which is to evaluate effectiveness of the processes used to manufacture parts.
7. A minimum of one part per part family shall be audited annually. The supplier part selection for audits shall be reviewed and approved by the GEAS SQE through the workflow. Any changes to the plan shall be approved by the GEAS SQE. Once the audits are complete, audit completion information shall be reported through the workflow. If the workflow cannot be used by the supplier, GT1007-5 must be submitted to the GEAS SQE by the end of the audit year or when all product audits are complete.
8. Parts that have been audited should not be re-audited until all parts in the family have been completed. (Exception may be made for parts with quality issues, high volume parts or for parts not in production when the audit is performed).
9. The supplier shall retain Product Audit documentation including the completed FAI package. If the workflow was not used by the supplier, the Product Audit documentation must also include forms GT1007-4 and GT1007-5.
10. Exception to Product/Process Audit Requirements: 100% lot-by-lot testing performed by a certified Test Laboratory may satisfy the requirements of the product audit. This applies to raw material and to processes that generate a certification of conformance for every manufacturing lot. Processes that are verified by a certified Test Laboratory but do not get a certification for every manufacturing lot (e.g. EDM, Laser, Heat Treat) require a re-certification and shall meet the requirements of this specification.

## **J. SUPPLIER DESIGNED PRODUCTS**

1. All requirements of this specification apply to the characteristics defined by the GEAS or GEAS Customer drawings unless specifically noted below.
2. Where supplier/sub-tier product and process drawings exist that contain GEAS accountable characteristics, the supplier shall complete a compatibility evaluation.
3. Product design specification documentation shall be completed only on the following:
  - a. Acceptance/Inspection Tests defined in the Quality Assurance Provisions section of the design specification.



- b. Identification and Part Marking requirements of the design specification or specifications referenced therein.
- 4. As a minimum, the Supplier's system shall assure that characteristics defined by the Supplier/Sub-tier drawings are accounted for, documented, and controlled. The format(s) shall be defined by the Supplier and may be subject to review and disapproval by GEAS Quality Representative. The system shall include the following:
  - a. The documented format(s), defined by the Supplier, shall include the same elements as shown on form GT1007-3 under the headings; Characteristic Accountability, Inspection/Test Results, and Product Acceptance.
  - b. Changes to supplier's or sub-tier's drawing, manufacturing or quality plan shall be documented and approved under requirements defined by the supplier system for their characteristics.
- 5. First Article Inspection Package (FAI) Requirements for characteristics defined by GEAS Supplier/Sub-tier drawing(s).
  - a. GEAS Drawing(s) and Characteristics: FAI package shall include all items required by Section F and the following items:
    - i. Results from product acceptance test and inspection requirements.
    - ii. Evidence of GEAS engineering approval of applicable Test Procedures.
- 6. Supplier/Sub-tier Drawing(s) and Characteristics: First Article Inspection package shall include the following items that are to be retained at the Supplier facility unless otherwise directed by the procurement document:
  - a. First Article Inspection results.
  - b. Nonconformance document(s) referenced for accepting nonconforming characteristic(s).
  - c. Referenced exhibits, e.g., functional test reports, evidence of part marking, certifications, etc.

NOTE: A copy of all GEAS approved Test Procedures shall accompany first article data.

**K. REMOVED**

**L. DEFINITIONS (See SAE AS9102 and [S-1005](#) for additional definitions)**

ACCOUNTABLE CHARACTERISTICS (equivalent to Design Characteristic as defined in AS9102): Those dimensional, visual, functional, mechanical, and material features or properties, which describe and constitute the engineering definition of the article and can be measured, inspected, tested, or verified to determine conformance to the engineering definition or Digital Product Definition (DPD) requirements. Dimensional features shall include those features defined by the engineering definition such as target-machined (or



forged/cast) dimensions on forgings, castings, and weld/braze joint preparation necessary for acceptance of finished joint. Material features or properties shall include processing variables and sequences that are specified by the engineering definition (e.g., heat treat temperature, fluorescent penetrant class, ultrasonic scans, sequence of welding, heat treat, etc.).

**ACCURACY RATIO:** The ratio between the total M&TE (Measurement & Test Equipment) Accuracy and the total part tolerance.

**CALIBRATION TOLERANCE:** Total permissible variation or limits allowed for calibration of M&TE (Measuring and Test Equipment).

**CERTIFIED OPERATOR** – An operator who has fulfilled all the qualifications, training and testing requirements for their assigned job description per the supplier OAP (Operator Acceptance Plan). Certified Operators may verify characteristics which are inspected at the point of generation. See [Appendix D](#).

**CERTIFIED TEST LABORATORY-** a GEAS approved independent test laboratory facility.

**CHARACTERISTIC TOLERANCE:** Difference between upper and lower limits of a part characteristic.

**CHANGE IN DESIGN (CID)-** an engineering document which changes the content of the product definition. Could also be known as NOR (Notice of Revision), ECO (Engineering Change Order, RN (Revision Notice) or other names.

**COMPATIBILITY EVALUATION:** An evaluation of supplier/sub-tier product and process drawings containing GEAS engineering definition, to ensure that they specify the same engineering definition as the GEAS engineering definition.

**CORRELATION:** A characteristic that has been verified by an operator is re-verified by a different operator/inspector using the same gage type and results are equivalent within acceptable tolerance band.

**CUSTOMER:** The term customer, as used in this procedure, can mean external end users or internal customers.

**DIGITAL PRODUCT DEFINITION (DPD) REQUIREMENTS:** requirements of any digital data files that disclose, directly or by reference, the physical or functional design requirements. Reference AS9102 for additional information on DPD.

**ENGINEERING DEFINITION:** Design engineering requirements as documented within the drawing, drawing notes, specifications on the drawing, or referenced specifications including digital product definition (DPD) requirements, if applicable.

**FEASIBLE:** Capable of being performed, within constraints (e.g., delivery, cost, technical) as agreed between GEAS and the Supplier.

**FIND NUMBER:** Find number or item number refers to the ordinal number that gives an ID tag to one of the constituents in a parts list (list of materials, bill of materials). Thus



"fasten using Find Number 7 (or item number 7)" refers to a fastener that is listed as number 7 in the parts list or bill of material (BOM).

FIRST ARTICLE INSPECTION (FAI): A complete, independent, and documented physical and functional inspection process to verify that prescribed production methods have produced an acceptable item as specified by engineering drawings, DPD, planning, purchase contract, engineering specifications, and/or other applicable design documents

FIRST ARTICLE INSPECTION (FAI) REPORT: The forms and package of documentation for a part number or assembly, including FAI results, per this specification

GE AEROSPACE SYSTEMS SUPPLIER QUALITY ENGINEER (GEAS SQE): A GE employee or authorized representative with the authority to represent GEAS Sourcing Quality.

INSPECTOR – An individual who inspects and verifies characteristics but does not generate the characteristics.

INTERPRETATION OR SPECIFICATION OPTION: A documented process by the manufacturing source to submit a request for a drawing interpretation, specification interpretation, selection of a specification option, or report a possible drawing error, or a producibility proposal.

KEY CHARACTERISTIC (KC): The select few, measurable features of a specific part/drawing/specification/process where variation can significantly impact customer satisfaction, manufacturability, durability or performance.

MEASURING AND TEST EQUIPMENT (M&TE): All devices used to measure, gage, test, inspect or otherwise examine items to determine compliance with drawing or specification requirements.

MEASUREMENT SYSTEM ANALYSIS (MSA): Method to define and document the amount of variation in the process due to the measurement system. It is a tool that evaluates the measurement system's performance on specific characteristics in the process and under conditions that occur in the process.

NONCONFORMANCE DOCUMENT: A document used for disposition of nonconforming characteristics, entered into a Nonconformance Report (NCR) System or similar system.

OPERATOR ACCEPTANCE PLAN (OAP): Supplier plan which defines the requirements, procedures and individual responsibilities for the certification of operators. See [Appendix D](#).

OPERATOR – The individuals who physically perform the process. These individuals can be referred to as 'Individual Process Owners', 'Technicians', 'Process Team Members', or by other terminology suitable for the organization's program focus and cultural and customer environment.

PART FAMILY – A group of parts with similar processes, materials, complex form, and tolerances, which have been produced by similar manufacturing methods.



**PROCESS CAPABILITY:** The performance of which a process is capable, with all the effects of assignable cause variation removed. Process capability is typically quantified as + or – 3 standard deviations about the process mean.

**PROCESS STABILITY:** A process that is operating with only chance causes of variation present is said to be statistically stable.

**PRODUCT ACCEPTANCE:** Verification that characteristics of a part meet the engineering definition.

**PRODUCT/PROCESS AUDIT:** Evaluation of any or all accountable characteristics for conformance, independent of Product Acceptance evaluation. Also includes an appraisal of the Supplier's system to ensure stable processes are in place that continually generates conforming characteristics.

**PURCHASE CONTRACT:** Purchase Order, Purchase Agreement or other Purchase document

**SIGMA VALUE:** A statistical measurement, indicating the probability of producing a part characteristic within the drawing limits. The sigma value represents “Z”, the number of process standard deviations between the process mean and the nearest specification limit.

**SINGLE PURPOSE M&TE/GAGE:** Gage which is designed to accommodate specific part configurations (e.g. airfoil guillotine gages).

**SOURCE CHANGE:** A change in manufacturing source or the addition of an alternate manufacturing source for a complete part.

**SPECIAL PROCESS TECH PLANS:** A technical plan is a part-specific, process-specific document required by a Drawing Specification, used to demonstrate source capability to meet the technical requirements of the special process.

**STANDARD M&TE/GAGE:** M&TE that is not controlled by a tool drawing, i.e., commercially available.

**STATISTICAL CONTROL:** A quantitative condition which describes a process that is free of assignable/special causes of variation, e.g., variation in the central tendency and variance. Such a condition is most often evidenced on a control chart.

**SUPPLIER:** Sources (including distributors, warehouses,) other than GEAS, who supply material, parts, processes, or services for incorporation into GEAS products.

**TEST PROCEDURE:** Documented procedure describing the functional test methodologies, environmental conditions, equipment, specified values and tolerances.

**VERIFICATION** – Confirmation through objective evidence that specified requirements have been fulfilled.





## Appendix A: QUALITY PLANNING and ACCEPTANCE PLANS

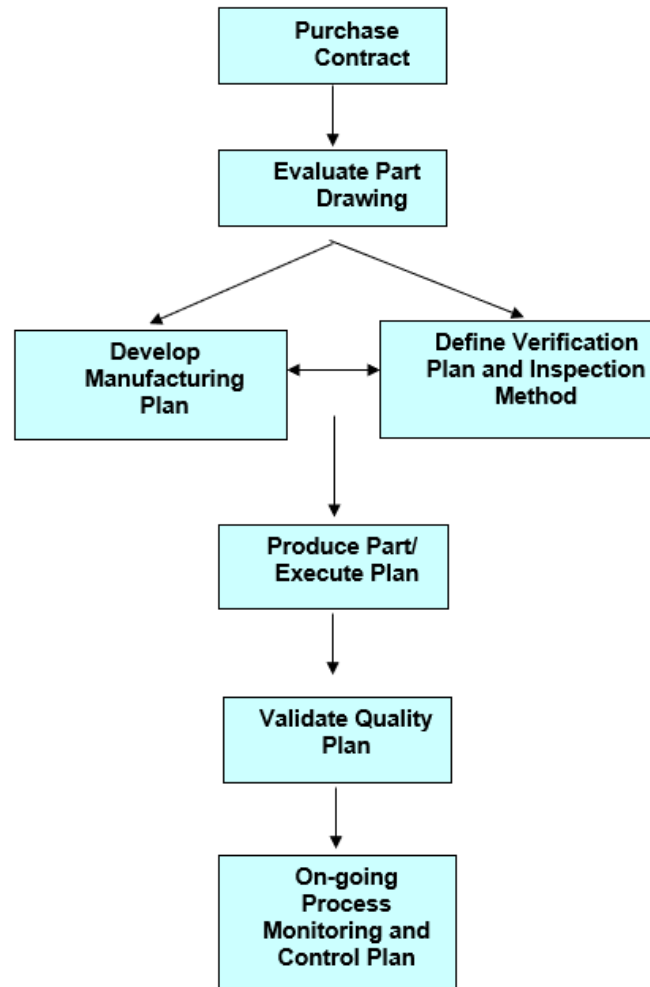
### GENERAL GUIDELINES

- A1. Supplier product engineering and manufacturing should be involved in quality planning. Collaboration of quality, engineering and manufacturing is expected at the following times:
- PO review
  - Initial product development
  - Initial quality plan development
  - Supplier engineering, inspection, process and/or manufacturing changes (including sub-tier changes)
  - A change of inspection frequency is being substantiated
  - GEAS drawing revision
  - 24-month lapse in production
- A2. Key, Critical and/or Major characteristics should be considered for continued 100% inspection.
- A3. It is recommended that accountable characteristics be inspected at the earliest possible step in the manufacturing process if subsequent process steps will not alter the characteristic.
- A4. Following is a recommended map for the Quality Planning process followed by recommended checklist items for each step.
- A5. Table 1 shall be followed when selecting Acceptance plans.





## Appendix A: Quality Planning Process Map





## Appendix A: Checklist associated with each step of Process

### Purchase Contract Issued

- ☐ Verify PO matches the quote
- ☐ Review PO, quality requirements, engineering requirements, remarks, and Customer specific requirements.
- ☐ Verify if the part is new or previously manufactured
- ☐ Verify current revision of drawing
- ☐ Identify if any Change in Design (CID) are issued but not included within the drawing.
- ☐ Obtain engineering parts list
- ☐ Is Ballooned drawing available

### Evaluate Part Drawing

- ☐ Review engineering part list
- ☐ Review latest revision of drawings, CID's as applicable
- ☐ Identify required specifications and verify current revisions
- ☐ Identify any drawing or manufacturing issues
- ☐ Identify stack-up concerns
- ☐ Review part quality history and discuss with GE-AJA QR nonconformance and escape history
- ☐ For an existing PN, review internal and sub-tier quality history
- ☐ Review lessons learned for similar parts with similar manufacturing processes
- ☐ Request engineering models, Mylar etc. as needed
- ☐ Extract accountable characteristics from DPD
- ☐ Identify education and training needs for applicable supplier personnel
- ☐ Submit Interpretation/Specification option as required (based on issues identified)



**Appendix A: Checklist (cont.)**

**Develop Manufacturing  
Plan**

- ☐ After receiving responses to Interpretation/Specification option, identify risk abatement plans for open issues. Discuss with GEAS SQE.
- ☐ Initiate FAI
- ☐ Balloon the drawing
- ☐ Verify ballooned drawing includes all accountable characteristics
- ☐ Request specifications not available on site (as needed)
- ☐ Review datum/transfer datum system.
  - Does the datum system control movement?
  - Is the datum system repeatable?
  - Is order of precedence maintained
- ☐ Identify key manufacturing characteristics
- ☐ Develop proposed manufacturing plan sequence. Ensure operation sequence complies with engineering drawing
- ☐ Develop sequence of steps within each operation
- ☐ Identify operation step where each characteristic is generated
- ☐ Verify special processes sources are current and approved (whether performed in house or at sub-tier)
- ☐ Ensure fixture has needed controls: fixture height, size, tolerances, etc. Error proofing should be considered.
- ☐ Ensure fixture set-up has needed controls. Error proofing should be considered.

**Define Verification Plan  
and Inspection  
Method**

- ☐ Determine where each accountable characteristic is verified. If an accountable characteristic is verified 'in process', evaluate the effect of subsequent processing (including manual benching).
- ☐ Select appropriate acceptance plan for each accountable characteristic: 100% Evaluation, special process, process parameter, variable data charting, die/mold, fixture/tool, software/numeric, & component/accountable characteristic stack-up. (See Table 1)
- ☐ Enter the acceptance plan for each characteristic into FAI or equivalent.
- ☐ Evaluate need for MSA on new gaging techniques. Refer to Appendix B
- ☐ For single purpose gages or functional gages, error-proof the gage and verify the gage meets the engineering requirements.
- ☐ Develop detailed inspection process sheets, including visual cell techniques
- ☐ Verify an Operator Acceptance Plan exists if applicable (See Appendix D)
- ☐ Define and execute necessary training for operators



**Appendix A: Checklist (cont.)**

**Produce Part/  
Execute Plan**

- ☐ Ensure raw material, processes, equipment, and operators are production ready
- ☐ Verify gaging method meets minimum requirements of Appendix B
- ☐ Verify selected gage can be used with geometry / fixture combination
- ☐ Verify gaging method is understood by those performing the inspection.
- ☐ Ensure each accountable characteristic is verified by an inspector or certified operator (See appendix D)
- ☐ For accountable characteristics requiring CMM inspection, verify CMM set-up and routines/programs satisfy engineering requirements
- ☐ Where single purpose or functional gages are used, perform independent inspections of accountable characteristics. Ensure that the gage correlates to the independent inspection.
- ☐ Apply statistical analysis if applicable

**Validate  
Quality Plan**

- ☐ Ensure all accountable characteristics are included in the quality plan
- ☐ Ensure FAI part is representative of the defined production process
- ☐ Complete FAI and quality plan
- ☐ Ensure quality plan is reconciled to final engineering drawing
- ☐ If required, complete the "Frozen Process" package
- ☐ Evaluate the manufacturing/inspection process for improvements (evaluation to be done by product engineering, manufacturing, and quality)
- ☐ Select appropriate acceptance plan for each accountable characteristic: 100% Evaluation, special process, process parameter, variable data charting, die/mold, fixture/tool, software/numeric, & component/accountable characteristic stack-up. (See Table 1)

**On-going Monitoring  
and Control Plan**

- ☐ Maintain On-going monitoring for reduced inspection per Table 1
- ☐ Evaluate quality plan periodically. Correct /update quality plan as required
- ☐ Update FAI as the process or quality plan changes (including sub-tier changes)
- ☐ Execute product audit plan per S-1007



**Table 1 –Acceptance Plans**

Product Accept Plan/Description	Application	Requirements	
		Initial Approval	On-going Monitoring
<b>1. 100% Evaluation</b>  Control by 100% EVALUATION OF ACCOUNTABLE CHARACTERISTICS Measure all occurrences of every accountable characteristic on every piece manufactured. This plan ensures accountable characteristic conformance through direct measurement of the characteristic on all parts to determine the conformance requirements.	Plan required when justification does not exist for another plan.	No additional approval data is required to justify this plan.	Consider independent verification of the characteristic and the measurement technique.  Consider Error-proofing.
<b>2. Special Process Control/Evaluation</b>  This plan ensures accountable characteristic conformance through the control of the input of parameters as generated by a special process.	Applies to special processes when the characteristic is entirely controlled by the process.	Some Processes may require GE – AJA Certifying Agent Approval.  Establish control parameters through specific correlation studies, i.e. part or specimen cut-up, or through historical process knowledge.  If a specimen is used, provide evidence that the specimen, represents the product as processed.	Evaluation may entail lot by lot or periodic testing proposed by the supplier in the justification for less than 100% evaluation.  Plan shall be in compliance with the applicable engineering specification/s.  Lot traceability shall be maintained through the manufacturing cycle.



**Table 1 –Acceptance Plans**

Product Accept Plan/Description	Application	Requirements	
		Initial Approval	On-going Monitoring
<b>3. Process Parameter Control</b>  This plan ensures characteristic conformance through the control of the input parameters as generated by a non-special process.	Examples (setup, feeds, and speeds) For example, surface finish on a grinder where feeds and speeds are not software controlled and areas of features that may be inaccessible without destructive evaluation.	Establish control parameters through specific correlation studies, i.e. part or specimen cut-up, on-part evaluation, or through historical process knowledge.  If a specimen is used, provide evidence that the specimen represents the product as processed.	A monitoring plan shall be proposed by the supplier in the justification for less than 100% evaluation.  Periodic evaluation or additional testing may be required.
<b>4. Variable Data Charting/ SPC (e.g. Process Maintenance through Statistical Process Control)</b>  The output of a process is statistically monitored to ensure characteristic conformance through verification of the process stability. Generally graphical output is used.	This method may be employed when it can be shown that the output from a process is stable and the capability is sufficient.	<ul style="list-style-type: none"> <li>- Use standard SPC techniques (Appendix C) to establish control limits. Data should include normal variation that is characteristic of routine production such as different operators and work shifts</li> <li>- Define a data collection and plotting plan that ensures the ability to capture process shifts or other indications of loss of process stability. The classification of characteristics, rate of production, stability and complexity of process and method of control should be considered in selecting the frequency</li> </ul>	If the process gives evidence of violating statistical stability, investigation and corrective action shall be performed. 100% evaluation shall be put in place until stability is revalidated.  - Stability measures such as control limits, limits on first/last piece, etc. shall be reevaluated whenever substantive changes are made to the process. When such limits are modified, the associated capability measure shall also be recalculated.  See Appendix C for signs of process drift or instability



**Table 1 –Acceptance Plans**

Product Accept Plan/Description	Application	Requirements	
		Initial Approval	On-going Monitoring
<p><b>5. Die/Mold Control</b></p> <p>This plan ensures accountable characteristic conformance through the control of the geometry and wear factors for the Die/Mold used to generate the characteristic.</p>	<p><b>Appropriate</b> where a relationship exists between the geometry of Die/Mold being used to generate the accountable characteristics and the final product.</p> <p><b>Not appropriate</b> if there are removable parts on the die/mold for which assembly cannot be error proofed.</p>	<p>Validate the ability of the Die/Mold to generate the characteristic through verification of the characteristic in the first run of the process.</p> <p>Per process in Appendix C, ensure process is statistically capable of producing characteristics in conformance with Engineering Requirements.</p>	<ul style="list-style-type: none"> <li>-Verify correct Die/Mold is being used</li> <li>-For each set-up of operation, first piece verification shall be completed to ensure proper setup.</li> <li>- Periodically verify pieces and/or the die or mold to identify wear or shifts that could impact part conformity. Interval shall be documented as justification for less than 100% inspection along with Cpk Value.</li> <li>-Where rework/repair of the Die/Mold affects product conformance, re-verification shall be performed</li> <li>-When wear of the Die/Mold is a factor, monitoring shall include periodic inspection of the part.</li> <li>-Visually Inspect the Die/Mold periodically for damage and wear.</li> </ul> <p><b><u>For Sheet Metal Forming:</u></b></p> <p>In addition</p> <ul style="list-style-type: none"> <li>- The last piece of a lot, run, or work shift (whichever occurs first) shall be verified to ensure no change has occurred that would affect conformity.</li> <li>-Ensure parts are identified to the lot, run or work shift until last piece has passed verification.</li> </ul>



**Table 1 –Acceptance Plans**

Product Accept Plan/Description	Application	Requirements	
		Initial Approval	On-going Monitoring
<b>6. Fixture/Tool Control</b>  This plan ensures characteristic conformance through the control of the cutting tool and/or the fixture.	<p><b>Appropriate</b> where a relationship exists between the geometry of Fixture/Tool being used to generate the characteristics and the final product.</p> <p><b>Not appropriate</b> if the feature is related to datums.</p> <p><b>Not appropriate</b> if there are removable parts on the fixture for which assembly cannot be error proofed.</p>	<p>Conduct first article inspection for the established cutting tool/fixture combination. Inspection of the cutting tool is not an acceptable alternative to inspecting hardware for FAI.</p> <p>Planning should include identification of Fixture/Tool including ancillary parts</p> <p>Per process in Appendix C, ensure process is statistically capable of producing characteristics in conformance with Engineering Requirements.</p> <p><b>Fixture:</b></p> <p>Establish a plan for on-going monitoring. (e.g. periodic calibration of fixture)</p>	<p>Inspect all potentially affected part accountable characteristics after any modifications or rework to the fixture.</p> <p>Visually check Fixture/Tool for wear, distortion, damage, loose parts, etc. on a periodic basis.</p> <p>Changes to the Fixture, Tool, or Process require re-verification of capability.</p> <p><b>Cutting Tool:</b></p> <p>Verify first and last characteristic controlled by the Tool/Process.</p> <p>Verify characteristics on the first piece of a new work shift/operator change.</p> <p>NOTE: If it is not feasible to inspect actual part features during production (e.g. inaccessible characteristics), inspection of the cutting tool may be an accepted alternative</p>





Table 1 –Acceptance Plans

Product Accept Plan/Description	Application	Requirements	
		Initial Approval	On-going Monitoring
<p><b>7. Software/Numerical Control</b></p> <p>(All aspects of Software Control apply per <a href="#">S-1005</a>)</p> <p>This plan ensures conformance of accountable characteristics through programmed aspects of a machine (i.e., control of the cutter path of a machine tool.)</p>	<p><b>Appropriate</b> for those characteristics that are generated through software/numerical control</p> <p><b>Not appropriate</b> if the characteristic is affected by fixture/part set up and the fixture set up is not controlled.</p> <p><b>Note:</b> If operator offset is required, the characteristics affected by the offset shall be verified on the first part produced after the offset adjustment.</p>	<p>Per process in Appendix C, ensure process is statistically capable of producing characteristics in conformance with Engineering Requirements.</p> <p>Verify and approve the NC program using an independent method.</p> <p>Assign unique program numbers and list the controlled program in the manufacturing planning.</p> <p>Identify the characteristics that will be accepted by the NC program.</p> <p>Establish a plan for on-going monitoring</p>	<p>Once software program has been proven to generate conforming hardware, all changes to the program shall be under revision control.</p> <p>Whenever the program is revised, process shall be re-qualified in accordance with the Initial Approval. Monitoring may have to be adjusted based on the change being made.</p> <p>Verify correct setup for each use, including cutting tool/probe.</p> <p>Periodically verify pieces to identify process shifts that could impact part conformity.</p>
<p><b>8. Component/Characteristic Stack-Up</b></p> <p>This plan ensures characteristic conformance through control and verification of engineering characteristics at lower drawing levels such that assembly of the components into the product result in conformance to the next higher-level engineering characteristics.</p>	<p>Plan is employed for the acceptance of characteristics generated by assembly of two or more components</p>	<p>Functional or engineering analysis showing that the higher-level characteristic will meet print given lower level characteristics are sufficiently controlled</p>	<p>Provide for periodic confirmation that the higher-level characteristics are meeting print requirements.</p> <p>Changes to sub-components, sub-component processes or sub-component control plans require re-evaluation.</p>



## Appendix B: MEASUREMENT AND TEST EQUIPMENT

- B1. The supplier is required to have a system in place to evaluate their measurement and test equipment (M&TE) through Measurement Systems Analysis (MSA). This system shall ensure that the M&TE utilized effectively evaluates part characteristics.
- B2. The purpose in conducting a MSA is to estimate the variation in the measurement system. Once quantified, it can determine if the level of variation can be tolerated or if actions must be taken to improve the measurement system or control effects of this variation.
- B3. A MSA should be considered for situations such as the following:
- B3.1 A characteristic is defined as a key, major or critical on the Engineering Drawing.
  - B3.2 A major process improvement effort is being initiated.
  - B3.3 The characteristic being evaluated has failed a product audit due to gage concern.
  - B3.4 The characteristic has experienced an inspection escape, such as a delivered nonconformance to an internal or external customer.
  - B3.5 The known process capability (+/- 3 sigma spread) exceeds the engineering requirement.
  - B3.6 Recent changes in gage design, measurement method or measurement personnel.
- B4. The M&TE accuracy ratio for single purpose measurement equipment for effective characteristic evaluation is minimally 10:1. The M&TE accuracy ratio for standard measurement equipment is minimally 4:1. If the MSA or other knowledge of a gage's accuracy ratio proves this equipment does not meet this ratio, action is required. To assure characteristic conformance, typical actions could entail (particularly for part characteristics near a tolerance limit):
- B4.1 Use of a different, more accurate type of gage.
  - B4.2 Reducing the part characteristic acceptance limits to be tighter than the drawing tolerance.
  - B4.3 Conducting redundant evaluation of the characteristic with an alternate means of inspection.



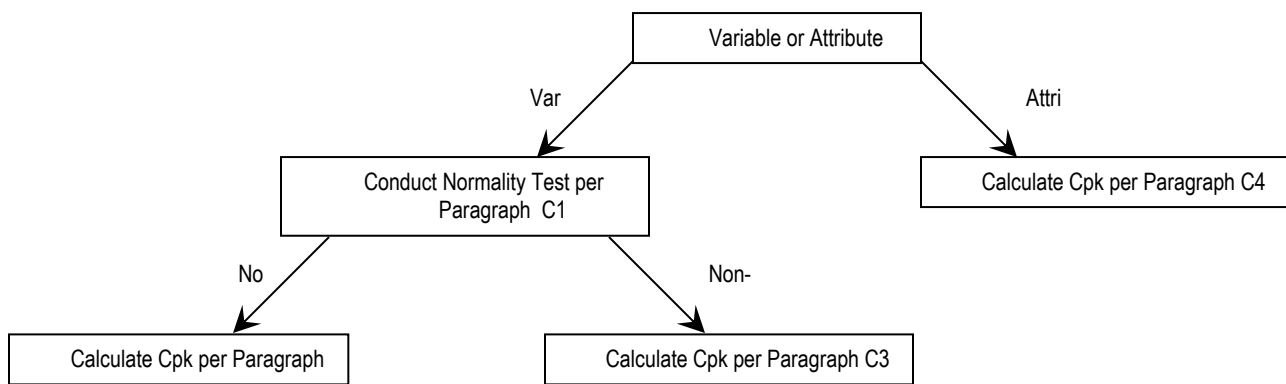
- B4.4 Modification of the part manufacturing process to reduce the characteristic variability.
- B4.5 Analysis of the results of inadequate or questionable MSA studies to determine root cause and action to take. NOTE: Typical root causes are wrong gage for task, operator not following planning, inadequate planning, work area not suitable, material relaxes or changes due to environment, method changes when shift changes, etc.
- B5. Exceptions to paragraph B4 requirements must be supported by data and/or studies to assure effective control of production parts. The GE-AJA QR must be notified if gaging cannot meet paragraph B4 requirements above.
- B6. It is recommended that equipment used for measurement purposes be of sufficient accuracy to measure one decimal point beyond Engineering requirements (i.e. if the drawing requires 3 decimal points (.000), the equipment should be capable of reading to 4 decimal points (.0000)). All significant digits beyond the required accuracy capability should be truncated.
- B7. Other Recommendations:
  - B7.1 An accuracy ratio of 10:1 is recommended for key, major and critical characteristics.
  - B7.2 Direct measurements are preferable to calculated measurements.
  - B7.3 Use radius gages for radii that are classified as minor only.
  - B7.4 A No-Go plug or pin should not be used for detecting over maximum conditions for characteristics generated by processes that may produce elongated holes.



## Appendix C: PREFERRED STATISTICAL METHODS

NOTE: Throughout this document, any reference to Cp and Cpk implies long-term capability. It should be noted that some statistical software programs (e.g. Minitab) or statistical publications might refer to Pp and Ppk as long-term capability and Cp and Cpk as short-term capability.

Use the flow diagram below to determine what statistical method is appropriate for the characteristic data sample.



C1. Normality Test – Using a minimum of 25 data points, create a histogram of the characteristic measured. If the histogram is bell (or lump) shaped and fairly symmetric, the sample is normally distributed and should have the Cpk calculated using methods described in section II. If the histogram is not bell shaped or is asymmetric, the sample is non-normal and should have the Cpk calculated using methods described in section III. If still unsure about the normality of the sample, run a statistical test for normality (Wilks-Shapiro, Chi-squared, etc...)

C2. Cpk Calculations for Normal Data – Sample standard deviation,  $s$ , is calculated using the following equation:

$$S = \sqrt{\frac{\sum_{i=1 \text{ to } n} (X_i - \bar{X})^2}{n-1}}$$

The Process Capability Ratio is calculated as follows:



$$C_p = \frac{USL - LSL}{6s}$$

$$C_{pkUpper} = \frac{USL - \bar{X}}{3s}$$

$$C_{pkLower} = \frac{\bar{X} - LSL}{3s}$$

Cpk is reported as the smaller value of Cpk Upper and Cpk Lower.

C3. Cpk Calculations for Non-Normal Data – You can treat your data as attribute data and use the method described in section C4 below. Contact the purchaser for assistance.

C4. Cpk Calculations for Attribute Data – Use one of the following methods depending on the criteria listed below.

Method 1 – Inspect each characteristic in your sample and identify as defective or non-defective. Then calculate  $p(\text{defective}) = (\text{number defective}) / (\text{number in sample})$ . Use a standard normal table to find Z and divide by 3 to find Cpk or use the abridged Z/Cpk table below to define the Cpk.

Method 2 – Used if no defects are observed in the sample for methods 1 above.

Calculate the estimated proportion defective,  $p(d) = 1/(n+2)$  where n is the number of characteristics inspected, convert this number to a Z score using the one-sided Z table and divide by 3 to obtain Cpk or use the abridged Z/Cpk table below.

Probability of defective = p(d)	Estimated Z	Cpk
Greater than 0.16 or > 16%	< 1	< 0.33
0.16 to 0.023 or 16% to 2.3%	1 to 2	< 0.67
0.023 to 0.00135	2 to 3	< 1.0
0.00135 to 0.000032	3 to 4	> 1.0 but < 1.33
Less than 0.000032	> 4.0	> 1.33



Method 3 - Used to estimate if  $Cpk > 1.0$  with small samples. Cannot provide  $Cpk > 1.33$  estimates. Given a very small sample (3 to 6 points) assessing process capability via direct calculation is not feasible. The approach outlined here assures that the process is well centered and has acceptable variation.

Variation test, calculate range of your sample of characteristics measurements

- Provide assurance that standard deviation of process is  $\leq 16.6\%$  of tolerance (that is,  $Z = 3$ )

Centering test, calculate mean of your sample

- Make sure that  $\bar{x}$  is at least one standard deviation away from either tolerance limit with 99% assurance.

If your data satisfies both the mean and the range test as detailed in table below, you can estimate  $Cpk$  as  $> 1.0$  (but not as high as 1.33).

# of Pieces	X Bar vs. Target	Range vs. Tolerance
2	+/- 3%	31%
3	+/- 9%	42%
4	+/- 12%	49%
5	+/- 14%	54%
6	+/- 16%	57%

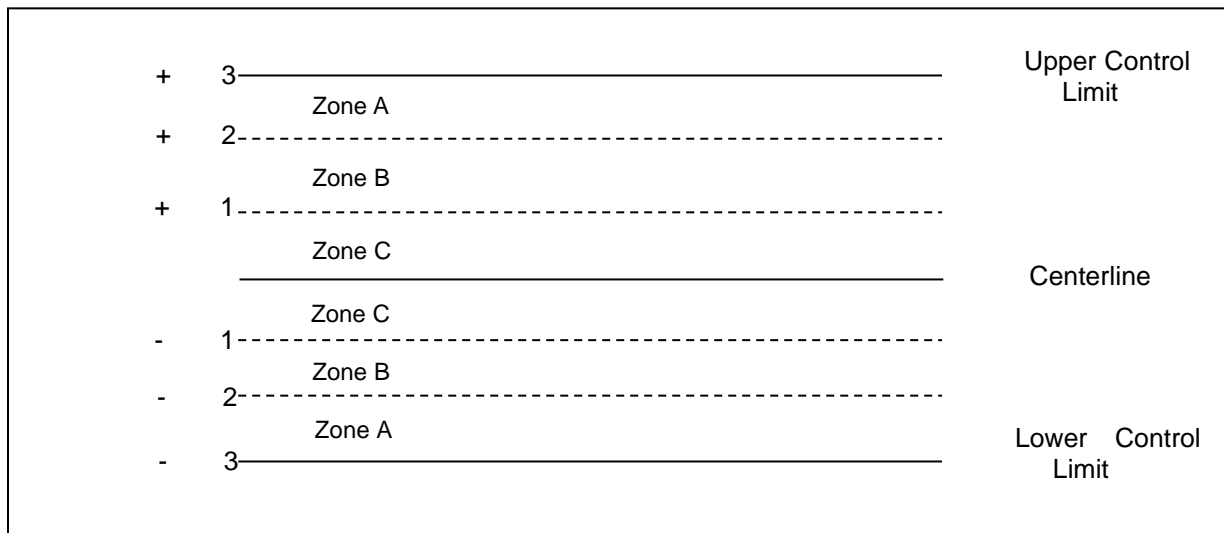
C5. Typical Variable Data Charting/SPC Signs of process drift or instability

The following warning rules are commonly used in conjunction with the zones shown in Figure below:

- One Point falls beyond Zone A.
- Two out of three consecutive points on one side of the centerline fall in Zone A or beyond.
- Four out of five consecutive points on one side of the centerline fall in Zone B or beyond.
- Eight consecutive points fall anywhere on one side of the centerline.



- Six consecutive points steadily increasing or decreasing.
- Eight consecutive points on both sides of the centerline with none in Zone C.
- Fourteen (14) consecutive points alternating up and down.
- Fifteen (15) consecutive points on both sides of the centerline all in Zone C. This is a warning that the data may be too consistent. There could be a gage problem or some other event that has caused a shift in the output and should be investigated.





**Table 2: CHARACTERISTIC ACCEPTANCE PLAN MATRIX** (Ref. Appendix A, Table 1)

CHARACTERISTIC TYPE	PROCESS CONTROL CAPABILITY EVALUATION PLAN	MEASUREMENT DATA TYPE	PROCESS PERFORMANCE	PLANS ALLOWED
Supplier Defined KC: Key Characteristics OR GE-AJA DRAWING: - Critical - Major - Key Characteristic See ([4])	Process is IN CONTROL and CAPABLE for characteristic	Variable	Cpk $\geq$ 1.33	Variable Data: Table 1 - #1 thru #8
	"Control by Means other than 100% Characteristic Evaluation" permitted. Required to monitor by Control Chart	Attribute [1]	ZERO non-conformances for an adequate [2] process period	Attribute Data: Table 1 - All except #4
	Process is NOT IN CONTROL and/or NOT CAPABLE for characteristic	Variable	Cpk < 1.33	Variable Data: Table 1 - #1
	"Control by Means other than 100% Characteristic Evaluation" is NOT permitted	Attribute [1]	More than ZERO non-conformances for defined process [3]	Attribute Data: Table 1- #1
Non-Key Characteristics  Except characteristics described by [4] below	Process is IN CONTROL and CAPABLE for characteristic	Variable	Cpk $\geq$ 1.0	Variable Data: Table 1 - #1 thru #8
	"Control by Means other than 100% Characteristic Evaluation" permitted. Required to monitor by Control chart or Verification Plan	Attribute [1]	<1 nonconformance per 750 evaluations over an adequate [2] process period	Attribute Data: Table 1 - All except #4
	Process is NOT IN CONTROL and/or NOT CAPABLE for characteristic	Variable	Cpk < 1.0	Variable Data: Table 1 - #1
	"Control by Means other than 100% Characteristic Evaluation" is NOT permitted	Attribute [1]	>1 nonconformance per 750 evaluations [3]	Variable Data: Table 1 - #1
[4] Inaccessible or other characteristics controlled by a special plan	Requires GE-AJA approved Acceptance Plan; such plans must include process control provisions	Variable or Attribute	Generic process capability Study or other capability assessment	Requires special plan plus Table 1 - #2 thru #8

[\*] Supplier establishes/explains a notation (other than above Drawing notations) e.g., [KC]. This notation included in the CLASS column of form GT1007-3.

[1] Characteristics required by Drawing and evaluated by "Attribute" gages which accept/reject to specific limits. Does not include characteristics which are not generated intentionally (e.g. scratches, dents, tool marks). 100% characteristic evaluation must be performed for NDE (Nondestructive Evaluation), when required on the drawing or in a referenced specification.

[2] "Adequate" period considers all common causes for process variation. A written rationale is defined by supplier and accepted by GE-AJA Quality Representative.

[3] A process which produced nonconformances may be re-evaluated after introduction of corrective action.

[4] Certain characteristics (e.g. certain cast dimensions) may require or justify special GE-AJA approved Acceptance Plans.





## Appendix D: OPERATOR ACCEPTANCE PLAN

### D1. Purpose

To establish minimum requirements for an Operator Acceptance Plan, hereafter referred to as OAP. This plan will allow certified operators to verify characteristics at the point of generation. All elements of the plan are subject to purchaser disapproval.

### D2. Minimum Requirements

D2.1 The supplier's OAP shall identify provisions for training, certification, work station audits, disqualification, records and retention.

D2.2 Only certified operators or inspectors shall perform final verification of product characteristics.

D2.3 Characteristics generated by non-certified operators shall be verified by a certified operator or inspector.

D2.4 Traceability of measured characteristics to the inspector/certified operator shall be maintained to the part/lot.

D2.5 Recertification requirements shall be identified

### D3. Training

D3.1 The Supplier's OAP shall provide a process for training all operators on the procedures and work instructions that pertain to their immediate job function. Each operator shall be trained on the following, as applicable:

D3.1.1 Measurement and test equipment

D3.1.2 Engineering drawings

D3.1.3 Router/Op sheets/Work Instructions, usage and documentation

D3.1.4 Non-conforming hardware

D3.1.5 Safety and part handling

D3.1.6 Visual inspection techniques (e.g. tin soldier inspection)

D3.1.7 Geometric Tolerancing

D3.2 Consideration shall be given to the following when developing individual operator's training.

D3.2.1 Previous related experience

D3.2.2 Performance reviews

D3.2.3 Job safety analysis results

D3.2.4 Non-conformance data

D3.2.5 Customer complaints/returns

D3.2.6 Internal workstation audit results

D3.2.7 Difficulty and criticality of the operation



## D4. Certification

Each candidate shall be evaluated to assure their understanding of the training material and their ability to perform and document the required measurements. See example in Exhibit A

## D5. OAP Workstation Audits

D5.1 Each certified operator shall be re-evaluated to an established audit plan. Audits shall be performed at least once per year, using a workstation audit form (see Exhibit B for an example)

D5.2 Satisfactory workstation audit completion shall result in continued certification. The records shall be updated, and the next audit date shall be established.

D5.3 If an operator fails the workstation audit, the Supplier will determine if re-training and/or increased audit frequency is necessary.

D5.4 Upon failed audit, the Supplier shall have a process to determine root cause, recommend a corrective action, and investigate whether non-conforming material was shipped to The Purchaser.

D6. Operator Disqualification - The Supplier shall develop a system for operator disqualification. Consideration shall be given to the following:

D6.1 Failure to follow documented work instructions

D6.2 Failure to pass an OAP workstation audit

D6.3 Inability to repeat/correlate measurements

D6.4 Change in job function or classification

## D7. Record Retention

D7.1 Records pertaining to the Operator Acceptance Planning shall include, but are not limited to:

D7.1.1 Evaluation and training (initial training and any re-training)

D7.1.2 Certification test results

D7.1.3 Audit results

D7.2 Certification records shall be maintained for the entire duration of the operator's employment, and audit results retained as an administrative quality record in accordance with [S-1005](#).



## OAP EVALUATION FORM

### Exhibit A

OPERATOR/INSPECTOR NAME:

BADGE:

CLASSIFICATION:

UNIT:

SHIFT:

### REQUIREMENTS

- Understands what and when to check and record, when required
- Understands how to properly correct errors
- Understands responsibility for all dimensions generated and checked
- Understands what gages and fixtures to use
- Understands that only gages/fixtures/instruments in cycle may be used
- Understands method of documenting accept/reject decisions
- Understands how to document a nonconformance
- Understands no substitute gages, fixtures or tooling are allowed without prior written authorization
- Understands what to do if a gage, fixture, instrument or tool is damaged, or has overdue calibration
- Understands responsibility of reviewing part paperwork, including special instructions and CTP (Continue to Process) dispositions prior to starting

### OPERATOR/INSPECTOR HAS BEEN FULLY INSTRUCTED ON

- Identifying/measuring machined features such as Radii, Surface Finish, tool marks, etc.
- Assuring that the previous operation is properly completed on the part paperwork and nonconformances are cleared for CTP (Continue to Process) disposition.
- How to properly identify and document non-conformances
- The need to follow work instructions as written, using the most current work instruction document
- Use of proper Personal Protective Equipment (safety glasses, gloves, etc.)
- How to use gauging/fixtures/instruments
- Use of approved markers for temporary part marking

### DURING THE COMPLETION OF THE OPERATION

- Does the employee follow Operation Sheets?
- Does the employee use proper shop practices, tools, fixtures, etc.?
- When required, does the employee make the proper checks and document properly?

### AFTER COMPLETION OF THE OPERATION

- Is the part paperwork correctly completed?

### DIMENSIONAL VERIFICATION (5 MEASUREMENTS MINIMUM)

PART NUMBER: \_\_\_\_\_ OPERATION NUMBER: \_\_\_\_\_

SERIAL NO.	OPERATOR VALUE	VERIFIED VALUE	DIFFERENCE	GAGE	Meets FAI gage requirements	Correlation?

Satisfactory completion of this form certifies the employee to perform all operations in their classification in this unit unless noted below:



OAP WORKSTATION AUDIT FORM

Exhibit B

OPERATOR/INSPECTOR NAME:

BADGE:

CLASSIFICATION:

Dept:

SHIFT:

Does part have matching router?

Does Router match the work instruction?

Is part marked with part no. and serial no?

Are work instructions being used?

Are gages at workstation within calibration cycle?

Are the correct gages being used?

When required, are all items from the planning recorded on the Log Sheet?

Are all nonconformances identified and documented?

Are approved markers/ink being used to mark on part?

DIMENSIONAL VERIFICATION (3 MEASUREMENTS MINIMUM)

PART NUMBER: \_\_\_\_\_ OPERATION NUMBER: \_\_\_\_\_

SERIAL NO.	OPERATOR VALUE	VERIFIED VALUE	DIFFERENCE	GAGE	Correlation?

AUDIT PERFORMED BY: \_\_\_\_\_

OPERATOR/INSPECTOR SIGNATURE: \_\_\_\_\_

CONTINUE OAP CERTIFICATION?

☐ YES

☐ NO

RETRAINING REQUIRED?

☐ YES

☐ NO

QUALITY SIGNATURE

DATE

\* SUPERVISOR SIGNATURE

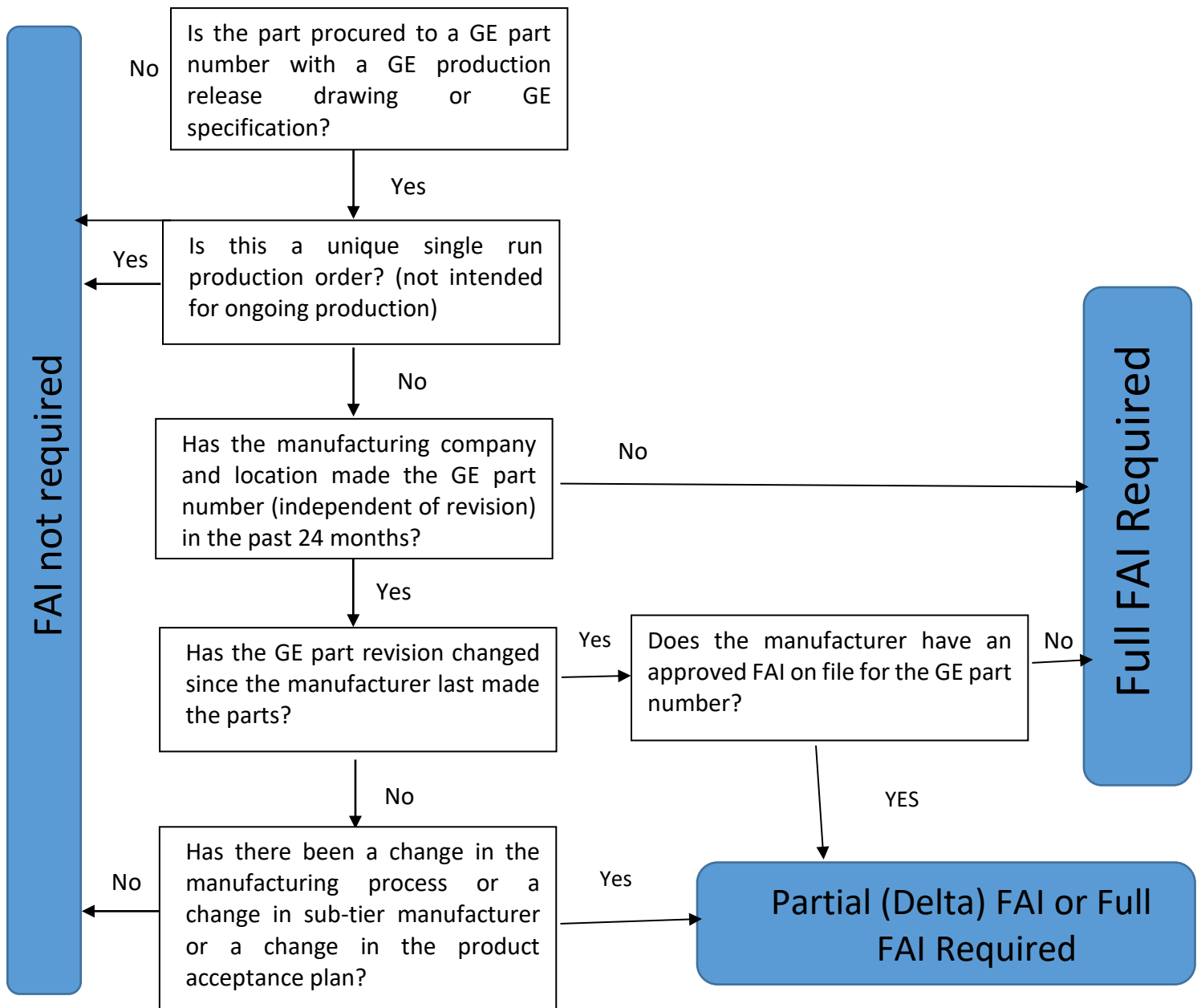
DATE

NEXT AUDIT DATE



## Appendix E

# FAI Applicability Guidance





## **GE-AVIATION JOINT AFFILIATES SUPPLIER REQUIREMENTS FOR CHARACTERISTIC ACCOUNTABILITY, VERIFICATION AND QUALITY PLANNING**

**Specification Number: S-SPEC-5**

**aeDMS #: S-1007**

**Issue Date: Sep 21, 2023**

*This specification is in addition to and in no way limiting, superseding, or abrogating any contractual obligation as required by the applicable procurement document.*

### **CHAPTER B – INTRODUCTION**

This document is constructed to incorporate the AS13100 part qualification requirements for product used to manufacture and produce Aerospace Engines.

The Production Part Approval Process (PPAP) is a key deliverable of Advanced Product Quality Planning (APQP) which allows the organization to manage supplier product related risk. Responsibilities and activities related to qualification of production parts and services are defined within this procedure.

When the AS13100 requirement is flowed down via purchase order, the supplier shall perform APQP and supply phase deliverables to the applicable condition(s) listed in the AS13100 standard and this specification.



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A.	PRODUCTION PART APPROVAL PROCESS (PPAP) APPROVAL FORM
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## 11. GENERAL

The supplier shall perform APQP and PPAP on new product representative of the first production run to verify that the production processes, documentation, and tooling have the capability to produce products that meet established requirements. The PPAP shall be approved by a GEAS SQE prior to shipment of the product.

GEAS reserves the right to witness the supplier's inspections and/or tests to determine the degree of conformance.

All forms shall be completed either electronically or in permanent ink and shall be completed in the English language. Native/non-English language may be included. In the event of any inconsistency between the supplier's native language and translations to or from English, the English language translation will take precedence.

Data shall be recorded in the Units of Measure specified on the drawing.

## 12. APPLICATION

This specification applies to new product, processes, and work locations as well as previously approved product and processes when changes (as defined by [S-1005](#)) occur or a lapse in manufacturing of 24 months or more since the part was last produced. In accordance with S-1005, the supplier has the responsibility to inform their GEAS SQE and Sourcing 90 days prior to implementing any changes.

This requirement is not applicable to legacy product where the current revision has a documented approval with GEAS, unmodified Commercial off the Shelf (COTS) items, nor prototype/development parts which will not be saleable or used in production.

The supplier is responsible for flow down of the requirements of this document and associated standards, as appropriate, to their sub-tiers who design and/or manufacture GEAS product.

## 13. SCOPE AND PURPOSE

This specification establishes the part qualification requirements for suppliers to establish capability in production of conforming product in accordance with engineering drawings, technical specifications, applicable aerospace standards and purchase order requirements.

The requirements specified in this standard are complementary (not alternative) to contractual and applicable statutory and regulatory requirements. Should there be a conflict between the requirements of this standard and applicable statutory or regulatory requirements, the latter shall take precedence.





## 14. REFERENCES

AS9100	Quality Management Systems - Requirements for Aviation, Space, and Defense Organizations
AS9102	Aerospace First Article Inspection Requirements
AS9145	Requirements for Advanced Product Quality Planning and Production Part Approval Process
AS9146	Foreign Object Damage (FOD) Prevention Program - Requirements for Aviation, Space, and Defense Organizations
AS13100	AESQ Quality Management System Requirements for Aero Engine Design and Production Organizations
GT FORM-285	Production Part Approval Process Forms
GT1005-1	Unusual Visual Appearance
GT1005-2	Source Problem Report
GT1005-3	Supplier Nonconformance Material Report
<a href="#">S-1005</a>	GEAS Supplier Quality System Requirements
SCMH	IAQG Supply Chain Management Handbook
RM13000	Problem Solving Methods including 8D
RM13002	Alternate Inspection Frequency Plans
RM13003	Measurement Systems Analysis (MSA)
RM13004	Defect Prevention Quality Tools to support Advanced Product Quality Planning (APQP) and Production Part Approval Process (PPAP)
RM13006	Process Control Methods
RM13008	Design Work
RM13102	First Article Inspection Requirements (FAIR)
RM13145	Advanced Product Quality Planning (APQP) and Production Part Approval Process (PPAP)

## 15. APQP & PPAP TERMS AND DEFINITIONS

APQP – Abbreviation for Advanced Product Quality Planning.

COMMERCIAL OFF THE SHELF (COTS) - Commercially available items intended by design to be procured and utilized without modification.

CRITICAL ITEMS (CIs) AND KEY CHARACTERISTICS (KCs) – Dimensions and/or features that are imperative to the functionality. Nonconformances in these dimensions and/or features show a high probability for complete failure of the component functionality.

DIGITAL THREAD – a system which allows for the electronic submission of proprietary information in a secure method that protects the information and limits its use to authorized users. Digital Thread link: <https://digitalthread.geaviation.com/dd/createpackage/>.



DPD – Abbreviation for Digital Product Definition; Requirements of any digital data files that disclose, directly or by reference, the physical or functional requirements, including data files that disclose the design or acceptance criteria of a product.

FAI – Abbreviation for First Article Inspection; A planned, complete, independent, and documented inspection and verification process to ensure that prescribed production processes have produced an item conforming to engineering drawings, DPD, planning, purchase order, engineering specifications, and/or other applicable design documents.

GEAS – Abbreviation for GE Aerospace Systems which includes GE Aerospace Systems LLC, GE Aerospace Systems Ltd, Unison Engine Components Inc., Unison Engine Components Ltd, and Unison Industries, LLC.

MTE – Abbreviation for Measurement and Test Equipment.

PO – Abbreviation for Purchase Order.

PPAP – Abbreviation for Production Part Approval Process.

RPN – Abbreviation for Risk Priority Number which is a quantitative number to represent the amount of risk associated with a design and/or process.

SPECIAL PROCESSES - Any processes for production and service provision where the resulting output cannot be verified by subsequent monitoring or measurement and, consequently, deficiencies become apparent only after the product is in use or the service has been delivered.

SQE – Abbreviation for Supplier Quality Engineer and refers to the GEAS supplier quality engineer responsible for providing guidance through the product realization process.

STANDARD CATALOG ITEM – A part or material that conforms to an established industry or national authority published specification, having all characteristics identified by text description or industry/national/military standard drawing.

SUB-TIER – refers to a suppliers' supplier of material, parts, components, or services.

## 16. ADVANCED PRODUCT QUALITY PLANNING (APQP) REQUIREMENTS

### 16.1 General Requirements

The supplier's processes for product realization shall fulfill the requirements of this document for the products within the supplier's design and/or manufacturing responsibility.

The supplier shall define during the APQP planning phase the portions of the APQP phases that apply new product as well as product and process changes. Design phase deliverables are only applicable when there is supplier-designed product. The supplier shall include supply chain management planning to support the



project, identify supplier related risks, and define mitigation actions (as appropriate) including the flow down of this standard's requirements.

The supplier shall define the roles and responsibilities for managing and accomplishing APQP and PPAP elements and allocating resources appropriately.

Where AS13100 is invoked in a PO, the supplier shall establish a documented procedure to comply with the APQP and PPAP requirements in the AS13100 standard.

The supplier shall document PPAP package deliverables on GT FORM-285 "Production Part Approval Process Forms". This workbook utilizes the SCMh templates for deliverables. Alternatives to these industry standard templates are acceptable if the content is equivalent and approved by the GEAS SQE in advance of PPAP submission.

## 16.2 Advanced Product Quality Planning

The supplier shall account for the Supply Chain Risk Management Process when developing and managing the APQP and PPAP plan.

The supplier shall develop metrics to track process and completion of APQP and PPAP activities throughout product realization.

## 16.3 Phase 1 Requirements – Planning

The supplier shall complete planning and product concept phase and the associated deliverables in accordance with AS9145 section 4.3.

## 16.4 Phase 2 Requirements – Product Design and Development

The supplier shall complete the product design and development phase and the associated deliverables in accordance with AS9145 section 4.4.

KCs and CIs identified through the risk analysis shall be included into the design records. Critical Items and Key Characteristics identified through the design risk analysis shall be communicated to the manufacturer for consideration in the PFMEA.

***Section 16.4 is not applicable to suppliers without product design responsibility.***

## 16.5 Phase 3 Requirements – Process Design and Development

The supplier shall complete the process design and development phase and the associated deliverables in accordance with AS9145 section 4.5.

The supplier should share with GEAS SQE the preliminary process flow, PFMEA, control plan and identification of process CIs and KCs. These documents may be approved prior to submission of the PPAP; however, these documents shall only be approved once the document is in its final draft.



The process flow diagrams, PFMEAs, and control plans for groups or families of product or processes are acceptable if the manufacturing techniques and tooling of the product are consistent for varying product configurations. The supplier must have the approval of the GEAS SQE for product and process families.

High RPNs in the PFMEA which indicate significant risk of nonconformances in the process should be addressed with mitigation actions and is subject to the discretion of the GEAS SQE. Supplier shall take action on high RPNs as directed by GEAS SQE.

Control plans shall be completed in accordance with RM13004. Operations with high RPNs identified in the DFMEA and PFMEA document should have an inspection point listed in the Control Plan. Critical Items and Key Characteristics shall be identified on the control plan and in accordance with RM13006. When there are no design or process CIs or KCs, this requirement is not applicable.

The supplier shall comply and incorporate the supplemental requirements in accordance with AS13100 section 16.5.10 and AESQ Reference Manuals.

#### 16.6 Phase 4 Requirements – Product and Process Validation

The supplier shall complete the product and process validation phase and the associated deliverables in accordance with AS9145 section 4.6, RM13002, RM13003, and RM13004. The key deliverable is the successful completion and approval of the PPAP, inclusive of all required PPAP elements.

The production process run must be performed at the production site and under production conditions (i.e., tooling, gauges, material, personnel, environment).

MSA and Capability Studies shall be performed minimally on CIs and KCs. Corrective action shall be implemented for MSA results that fail to meet the internal or customer requirements. Corrective action shall be implemented for capability studies that fail to meet the threshold capability established by the customer and/or AS13100.

The supplier shall perform the FAI and record the results in accordance with AS9102. The supplier shall be responsible for all accountable characteristics, including those generated by their sub-tier suppliers.

When design requirements are in a DPD format and drawing information is not available or provided on the GEAS drawing for all applicable design requirements, the supplier shall establish a process to extract, verify and include the applicable accountable characteristics and DPD accountable characteristics in the FAI package. Additionally, the supplier shall ensure the production, inspection, and operations requiring verification have been completed as planned to achieve DPD design characteristics.



The supplier shall use the FAI form templates located in GT FORM-285 “Production Part Approval Process Forms”. Any alternate templates or forms must be approved by the GEAS SQE prior to PPAP submission. The FAI shall be submitted as part of the PPAP package. When alternative forms are approved, the form shall document all “Required” and “Conditionally Required” information.

If sub-tier suppliers do not account for their characteristics, the prime supplier is responsible for initiating a separate FAI package or including these characteristics in their FAI package.

The supplier shall ensure that all accountable characteristics are verified in their final condition. Where a characteristic cannot be verified in the final product condition, the supplier shall verify the characteristics once the final dimension or condition is achieved. The supplier shall ensure that further processing will not affect the conformance of the hidden feature.

## 16.7 Phase 5 Requirements – On-Going Production, Use and Post-Delivery Services

The supplier shall complete the on-going production, use and post-delivery services phase and the associated deliverables in accordance with AS9145 section 4.7.

## 17. PRODUCTION PART APPROVAL PROCESS REQUIREMENTS

### 17.1 Process Requirements for Production Part Approval Process

The supplier shall ensure the required PPAP elements are identified and maintained in a PPAP file in accordance with AS13100 Tables 11-14. The supplier shall provide the PPAP submission in accordance with submission level 3 as defined in AS13100 Table 11 unless other specified on the PO. All documentation required for PPAP submission must be made available for review to GEAS upon request.

PPAP documentation shall be considered a quality record and the supplier shall maintain records in accordance with the AS13100 record retention requirements in [S-1005](#). The supplier shall have a documented record continuity plan to maintain and transfer all PPAP records as well as associated manufacturing documentation to GEAS for any event that changes ownership of the supplier location, changes that lead to the transfer of the product to another location, or closure of the supplier location and/or business. The supplier must notify in writing the applicable GEAS site(s) and receive GEAS SQE approval prior to the destruction of any part qualification records within the required record retention period. Part qualification records include but are not limited to the PPAP package, previously approved FAI packages, manufacturing records such as travelers, operator qualification records, and material certifications.



The supplier is responsible to submit to the GEAS SQE the PPAP Approval Form (contained in GT FORM-285 "Production Part Approval Process Forms") for any product or process changes. The GEAS SQE shall evaluate the changes and provide documented feedback on the PPAP requirements.

## 17.2 Production Part Approval Process File and Submission

All PPAP deliverables will be completed in accordance with AS13100 (as applicable) and any reference documents contain in that standard.

When PPAP deliverables are required to be submitted for GEAS approval, the PPAP package shall be submitted as a PDF document through [Digital Thread](#) or method as defined by the GEAS SQE. The supplier is responsible to ensure technical information remains confidential. Email shall not be used for submission method. *Digital Thread link:* <https://digitalthread.geaviation.com/dd/createpackage/>.

When the PPAP element is applicable but not required for submission to GEAS, the PPAP element shall be retained in the PPAP file at the supplier location and available for review upon request.

An incomplete PPAP or a PPAP containing nonconformances shall be marked as "Partial Submission" and annotated as incomplete on the PPAP approval form as well as provide a plan for resubmission to establish full approval. All nonconformances identified during the PPAP package generation shall be documented on the final PPAP submission and in accordance with AS9102, AS13100, and [S-1005](#). The supplier shall take corrective action on all nonconformances identified in the PPAP submission. Upon successful implementation of the corrective action, the supplier shall resubmit the PPAP package. Any nonconforming characteristics shall be 100% inspected on all parts from the production lot until the product is produced in a conforming condition.

The supplier shall identify authorized PPAP approvers including customer delegates and/or receiving internal PPAP submissions. The supplier shall ensure that the PPAP is reviewed and approved by authorized personnel prior to submission.

## 17.3 Production Part Approval Process Disposition

The PPAP submission shall be dispositioned as one of the following dispositions:

- Approval – Also known as Full Approval and indicates that all PPAP requirements have been fulfilled. An approved PPAP must be documented prior to shipment of product unless otherwise agreed to in writing by the GEAS SQE.



- Interim Approval – Also known as Partial or Conditional Approval and indicates that all PPAP requirements have not been completely fulfilled. The supplier may proceed with the PPAP submission, as directed by the GEAS SQE. In such cases, the supplier shall indicate an incomplete submission and provide the plan for resubmission to establish full approval.
- Reject status – Indicates that the PPAP requirements have not been fulfilled. The supplier must develop a plan to resubmit the PPAP and product is prohibited from shipping from the supplier location.

The disposition shall be recorded on the PPAP Approval Form. The supplier shall ensure that there is a documented PPAP Approval Form prior to shipping product intended for GEAS production.

#### 17.4 Production Part Approval Process Resubmission

Resubmission of the PPAP is required when the product does not receive an “Approval” PPAP disposition. The discrepancies identified in the previous submission must be corrected prior to resubmission for “Approval” disposition.

### 18. AESQ SUPPLY CHAIN RISK MANAGEMENT PROCESS – SUPPLEMENTAL REQUIREMENTS

The supplier shall prepare and execute a Supply Chain Management Plan in accordance with RM13145.

### 19. CONTROL PLAN – SUPPLEMENTAL REQUIREMENTS

The supplier shall prepare a control plan to address two distinct phases of the control plan: prelaunch and production. The supplier shall have a process for reviewing and updating the control plan throughout product realization process when changes occur.

#### 19.1 Pre-Launch Control Plan – Supplemental Requirements

The supplier shall prepare a prelaunch control plan in accordance with AS13100 section 19.1.

### 20. OVERVIEW – SUPPLEMENTAL REQUIREMENTS

#### 20.1 Key Quality Planning tools to support the APQP and PPAP processes – Supplemental Requirements

The supplier shall apply quality planning tools at the part number level unless otherwise directed by the GEAS SQE.

The supplier shall document lessons learned and link documents to allow easy read across when changes occur in the product or process.





## **21. KEY REQUIREMENTS FOR THE DEPLOYMENT OF QUALITY PLANNING TOOLS – SUPPLEMENTAL REQUIREMENTS**

### **21.1 Design FMEA - Supplemental Requirements**

Where there is supplier designed product, the supplier shall conduct design risk analysis using the DFMEA in accordance with RM13004 and AS13100 section 21.1.

The supplier shall create a DFMEA when there are new designs, changes to an existing design, or use of an existing design for a new application, location, or environment. The supplier shall establish responsibility for the DFMEA; however, the supplier shall ensure that the DFMEA is developed by a cross functional team. The DFMEA shall be started during the planning phase and is finalized in Phase 2 as a deliverable.

High RPNs which indicate significant risk to the design should be addressed with mitigation actions and is subject to the discretion of the GEAS SQE. Supplier shall take action on high RPNs as directed by GEAS SQE.

### **21.2 Product Key Characteristics (KC) - Supplemental Requirements**

For supplier designed product, the supplier shall comply with GEAS requirements and/or flowed down GEAS customer requirements on the identification of CIs and KCs.

### **21.3 Process Flow Diagrams (PFDs) - Supplemental Requirements**

The supplier shall develop a process flow diagram in accordance with RM13004. The supplier shall use the template defined in GT FORM-285 "Production Part Approval Process Forms". If an alternate template is used, the substitution must be approved by the GEAS SQE prior to PPAP submission.

### **21.4 Process FMEA - Supplemental Requirements**

The supplier shall develop a PFMEA in accordance with RM13004. The supplier shall use the template and rating criteria defined in GT FORM-285 "Production Part Approval Process Forms". If an alternate template is used, the substitution must be approved by the GEAS SQE prior to PPAP submission. CIs and KCs shall be clearly identified on the PFMEA.

High RPNs which indicate significant risk to the process should be addressed with mitigation actions and is subject to the discretion of the GEAS SQE. Supplier shall take action on high RPNs as directed by GEAS SQE. Mitigating actions shall have an owner and target dates recorded on the PFMEA document.





## 21.5 Process Key Characteristics (KC) - Supplemental Requirements

The supplier shall use the PFMEA to identify product and process CIs and KCs through evaluation of the RPNs as required by this specification. RPNs shall be recalculated after implementation of mitigating actions.

High RPNs in the DFMEA as well as design CIs and KCs shall be documented within the PFMEA.

## 21.6 Production Control Plan - Supplemental Requirements

Control plans shall be completed in accordance with RM13004 and shall be developed and implemented as early in the process as possible. The supplier shall use the template defined in GT FORM-285 "Production Part Approval Process Forms". If an alternate template is used, the substitution must be approved by the GEAS SQE prior to PPAP submission.

The control plan shall list product and process characteristics that will be monitored during the manufacturing process as well as the control methods.

## 21.7 Measurement Systems Analysis (MSA) - Supplemental Requirements

MSA(s) shall be completed in accordance with AS13100 section 7.1.5 and RM13003.

## 21.8 Initial Process Capability Studies - Supplemental Requirements

Initial Process Capabilities shall be completed in accordance with AS13100 section 17.1.1 Tables 11 & 12 as well as RM13006.



## APPENDIX A. Production Part Approval Process (PPAP) Approval Form

PPAP APPROVAL						
1. Part Number:		6. Additional Changes:				
2. Part Name:						
3. Part Revision Level:						
4. Drawing Number:		7. Customer Purchasing Representative:				
5. Drawing Revision Level:		8. Purchase Order Number:				
SUPPLIER INFORMATION						
9. Organization Name:				10. Supplier/Vendor Code:		
11. Address (Street, City, State, Country, Postal Code):				Country:		
12. Submission						
<input type="checkbox"/> Full Submission <input type="checkbox"/> Initial Submission						
<input type="checkbox"/> Partial Submission <input type="checkbox"/> Resubmission Reason: _____						
13a. PPAP ELEMENTS PROVIDED				13b. CUSTOMER PPAP ELEMENT ACCEPTANCE (Customer use only)		
Yes	No	N/A	ELEMENT DESCRIPTION	Yes	No	CUSTOMER COMMENTS
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1. Design Records	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2. Design Risk Analysis (e.g., DFMEA)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3. Process Flow Diagram	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4. Process FMEA	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5. Control Plan	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6. Measurement System Analysis	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7. Initial Process Studies	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8. Packaging, Preservation, and Labelling Approvals	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9. First Article Inspection Report	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10. Customer Specific PPAP Requirements	<input type="checkbox"/>	<input type="checkbox"/>	
Note: "No" selections in Section 13a require an Action Plan item documented in Section 14 below						
14. Action Plan				Element #	Target Date	
15. Declaration						
I, the supplier, submit this PPAP Approval form as declaration of having met all applicable requirements of the 9145 standard, except as noted above, including having implemented the requirements at the sub-tier level where applicable. I further certify that our production process meets all defined product delivery, engineering and quality requirements. I understand that the approval of this form by the customer does not release me from responsibility or liability for any non-conformances.						
Clearly Print Name and Sign		Title		Email Address		Date
16. Customer Use Only						
<input type="checkbox"/> Approved <input type="checkbox"/> Interim Approval <input type="checkbox"/> Rejected						
Comments						
Customer Authorization: Clearly Print Name and Sign		Title		Email Address		Date



## APPENDIX B. Submission/Retention Levels

PPAP ELEMENT NUMBER	AESQ PPAP ELEMENT	SUBMISSION LEVEL				
		SL 1	SL 2	SL 3	SL 4	SL 5
1	Design Record	S R	S R	S R	C R	S R W
2	Design FMEA	R <sup>[1]</sup>	R <sup>[1]</sup>	S R <sup>[1]</sup>	C R <sup>[1]</sup>	S R W <sup>[1]</sup>
3	Process flow diagram	R	R	S R	C R	S R W
4	Process FMEA	R	R	S R	C R	S R W
5	Control plan	R	S R	S R	C R	S R W
6	Measurement System Analysis verification	R <sup>[2]</sup>	R <sup>[2]</sup>	S R <sup>[2]</sup>	C R <sup>[2]</sup>	S R W <sup>[2]</sup>
7	Initial process capability studies	R	S R	S R	C R	S R W
8	Packaging, labelling standard, and documentation	R	R	S R	C R	S R W
9	First Article Inspection	R <sup>[3]</sup>	S R <sup>[3]</sup>	S R <sup>[3]</sup>	C R <sup>[3]</sup>	S R W <sup>[3]</sup>
10	Customer-specific requirements	R	S R	S R	C R	S R W
10.1	Dimensional/Nondimensional results	R	S R	S R	C R	S R W
10.2	Initial manufacturing performance studies	R	R	S R	C R	S R W
11	PPAP Approval Form (or equivalent)	S R	S R	S R	C R	S R
<sup>[1]</sup> Design and Manufacture organization only. <sup>[2]</sup> When specified by the related MSA Plan (Phase 3 of APQP). <sup>[3]</sup> In accordance with 9102.						
Key/Legend						
S	Submit to customer (or nominated representative).					
R	Retain a record as part of the PPAP file and make available to the customer upon request.					
C	Consult customer - submission (S) and/or witness (W) may be required.					
W	Witness by customer (or nominated representative) through a supporting data/information review at manufacturing location.					



**GE Aerospace**

Sourcing Quality Specification

Specification Number: S-SPEC-5

aeDMS #: S-1007

Issue Date: