Documentation: definition and expectation

Design Record - Drawing with Measurement / Note Identifiers
When required, the supplier shall submit a copy of all design records (drawing, specification documents, CAD model) they hold for the relevant part / product being supplied. This is to ensure the supplier has the correct revision levels for all relevant Documents. This includes print notes, standard tolerance notes and specifications, and anything else that is relevant to the design of the part.

Process Flow Map
The Process Flow Map shows all the steps required in the manufacturing of the part. It should include all of the main steps in the processing of the part including incoming components, measuring, and inspection. The Process Flow Diagram should match the control plan and the Process Failure Mode and Effects Analysis (PFMEA) and includes the flow of non-conforming materials and parts. Suppliers are required to complete a process flow chart for each product (including all sub products).
The Process Flow Diagram must clearly identify each individual process step and include the following:
- A schematic layout of the complete process flow from receipt of raw material / subcontracted parts through to the dispatch of the part to GS
- Identification where an individual process step involves the manufacture or modification of either a Critical or Significant Characteristic
- All inspection and test points
- All on and off-line storage points

Process Failure Mode and Effects Analysis (PFMEA)
Process Failure Mode and Effects Analysis (PFMEA) is an analytical technique that ensures potential failures due to the processes involved in the manufacture of a product and the associated causes of those failures have been considered and addressed and will create a risk profile based on the manufacturing process of a product. A PFMEA could result in certain processes being identified as Critical or Significant.
A PFMEA must be structured so that each individual process step (from the Process Flow Diagram) has been considered.

Design Failure Modes and Effects Analysis ("DFMEA")
When required by the GS qualification team and when supplier is responsible for design, the supplier must provide DFMEA. A DFMEA is an analytical technique that ensures potential failures due to the design of a product and the associated causes of those failures have been considered and addressed, a DFEMA will create a risk profile based on the design of a product. A DFMEA could result in certain design features being identified as Critical or Significant. DFMEA identifies the Product CTQ necessary inputs into the following PFMEA activity.

Where the supplier has the design responsibility, they will share their DFMEA with GS. In either case the DFMEA shall, be made available electronically for review or be made available for desk review.

Quality Control Plan
The Quality Control Plan mirrors the PFMEA (Process Failure Mode and Effects Analysis) and provides more details on how potential issues are checked in the incoming inspection, assembly process, or during the inspection of the finished part.
Unless otherwise directed by the GS SQE, the control plan must, at a minimum, contain the following information:
- Clear identification of item, component, or system to which control plan is applicable
- Listing of all technical documents that govern the inspection or test activity (i.e. supplier documents, GE specifications, industry codes/standards)
- Identification of the test or inspection criteria in an itemized listing. Each line item must include:
  - What is to be inspected (to the characteristic level)

  - How it is to be inspected
  - What frequency it is to be inspected
  - When the inspection or test is to be performed (in manufacturing process)
  - Who is to perform the inspection (e.g., Operator, Inspector, etc.)
  - Acceptance criteria
  - Provision for sign off by the party performing the inspection
- Identification of project specific inspections and tests
- Sign-off documentation signifying completion of each inspection and test
- Clear definition of GS and GS involvement in the inspection and test activities (i.e., in–process inspections, GS witness and hold points, document reviews and GS and/or GS release inspections, etc.)
- Identification and verification of CTQs and inspection methods.

Detailed planning of packaging and preservation for shipment and storage

Measurement System Analysis Studies
A Measurement System Analysis is a statistical analysis process that is used to assess how effective the measurement system(s) used to relate to the Process Control of all Critical or Significant Characteristics. Typically, it includes the Gauge R&R (Gauge Repeatability and Reproducibility) for the critical characteristics and a confirmation that gauges used to measure these characteristics are calibrated.

Dimensional Results
The Dimensional Results report will identify the specified nominal size, the specified tolerance and the actual size achieved for each dimensional feature. Where a gauge is used to assess the conformity of the part, the supplier will identify the gauge number on the Dimensional Assessment and Results report and supply a copy of the gauge calibration certificate.
Where Critical and Significant Characteristics are identified on the drawing these must be indicated on the Dimensional Results report. Results are to be entered in all cases and where out of specification this must be clearly indicated. This list includes the product characteristic, specification, measurement results, and assessment showing if the dimension "passed" or "failed". Typically, a minimum of 5 pieces are reported per product.

Material Certification
A summary of all tests that have been performed on the part. The summary should document any pass or fail inspection results. It should be signed off by GS and the supplier to show that all required tests have been done and any additional data for tests have been submitted.

Supplier Part / Assembly / Functional Test Results
A summary of all tests that have been performed on the part. The summary should document any pass or fail inspection results. It should be signed off by GS and the supplier to show that all required tests have been done and any additional data for tests have been submitted.

Process Capability Studies
Generally, this includes SPC (Statistical Process Control) charts for critical characteristics. These studies demonstrate that the critical processes are stable and are ready to begin the process validation builds.

The symbol to be used to identify a Critical or Significant Characteristic will be an inverted delta (∇) unless otherwise agreed with the GS Supplier Quality Engineer.
The inverted delta (∇) symbol must be over stamped on all documentation relating to the component (including those raised internally by the supplier). This includes Advanced Part Quality Planning documents, work instructions, labels etc.

CTQ: Critical to Quality, defined as measurable product or process feature/Characteristics that impacts the compliance to requirements or performance if the products deviate from them. Need to express them in a

measurable specification to control them and cascade them in manufacturing or operations. CTQ can be further classified as “Critical CTQ” and “Significant CTQ” based on impact

Product CTQ: CTQ which are measurable feature/Characteristics on the product that impacts the compliance to requirements or performance if the products deviate from them. Product CTQ’s should be specified on the lowest possible level (i.e. Component, Sub assembly)

Process CTQ: CTQ which are measurable feature/Characteristics on the process that impacts the Product CTQ performance if the process deviates from them. Process CTQ’s should be specified on the lowest possible level (i.e. individual process steps within Component manufacture)

Where a CTQ or Significant Characteristic relates to a dimension or specification, evidence of statistical capability is required, the required capability indices are:

- Pre-production study Pp/PpK = 1.67
- Machine study of 50 consecutive parts Cm/Cmk = 1.67
- During volume production Cp/Cpk = 1.33
- Gage R&R

Any CTQ or Significant Characteristic, which fails to achieve the required capability indices must be subject to 100% inspection as part of the manufacturing process. This 100% inspection must be shown on both the Process Flow Diagram and the Quality Control Plan.

No changes in the methods of manufacture and control of a CTQ or Significant Characteristic are permitted without obtaining written approval from GS.

Qualified Laboratory Documentation
Includes all the industry certifications for any lab that was involved in completing validation testing. If the supplier subcontracts the Dimensional Assessment and / or the Material / Performance Test Assessment, then they must use a laboratory complying with the requirements of ISO 17025.
If the supplier completes the Dimensional Assessment and / or the Material / Performance Test Assessment in-house, then they must supply a copy of the relevant calibration certificates for all equipment used.

Appearance Standard
The Appearance Standard verifies that the GS has inspected the final product and it meets all the required appearance specifications for the design. The report includes color, textures, fit (gaps between parts), etc.

Part Samples
A picture or physical sample of the production parts is included in the PPAP documentation along with the location where the parts are stored. A sample part that is signed off by the GS and supplier. A master part is normally used to train operators on subjective inspections such as visual or for noise.

Checking Aids
Checking aids are used by production and are a detailed list of all the tools used to inspect test or measure parts during the assembly process. This aid will list the part, describe the tool, and have the calibration schedule for the tool.

Packaging Plan
A picture or physical sample of the packing to be used to ship production part to the GE site. Document material and requirement for shipping to GE site.

Packaging Label
A picture or physical sample of the packaging external label for receiving to GE Site.

Agency Approval
A written document issued by the council authorizing a business entity or an institution to mark product as such.

Commodity Specification
Commodity specification is any process where the resulting output cannot be verified by subsequent monitoring and measurement and deficiencies become apparent only after the product is in use or the service has been delivered. Suppliers must have specific, documented, and controlled procedures for each special process performed. The supplier shall establish and monitor process CTPs/CTQs. Only qualified/certified personnel shall be assigned to perform a special process. The supplier must develop a specific training plan and check the performance of the individual associate on a regular basis.GS reserves the right to request, review, and approve all special process procedures, training documents, and certification records.
All quality records relating to a CTQ or Significant Characteristic must be archived in a suitable environment with ease of retrieval for a minimum of the duration of the contract, in line with the record retention policy.
Note: this includes maintenance and breakdown records.

Special processes include, but are not limited to:

- Alloy Composition Check Method
- Babbitting of Bearings
- Balancing
- Brazing
- Composite Processes
- Coatings
- Die casting
- Non-Destructive Testing/Examination ("**NDT**"/ "**NDE**")
- Electroplating/Plating
- Forging and hot forming
- Heat treatment
- High-alloy cold forming
- Laser Cutting and Marking
- Non-conventional machining – e.g. grinding, STEM drilling, ECM (Electro-Chemical Machining)
- EDM (Electro-discharge machining)
- Macro etching
- Steel Processing (includes bottom pour process / Continuous cast process)
  Pickling, Etching, Chemical Cleaning
- Painting and surface preparation
- Passivation Process
- Sand casting
- Shot blasting/peening
- Soldering
- Stamping (metal forming)
- Thermal cutting of Quench / Temper steels
- Welding

Focus on Welding
Suppliers and sub tier suppliers performing welding as a primary value-added process can be certified by an approved third party to include but not limited to:

- AWS (American Welding Society) Certified Fabricator
- ASME (American Society of Mechanical Engineers) boiler and pressure Vessel Fabrication Stamp Holder
- CWB Certification
- Major proof of qualification (Class E) in accordance with EN 1090 part 2 "Steel structures, execution and manufacturer qualification"
- PED (Pressure Equipment Directive) Certification
- AISC (American Institute of Steel Construction) Certification
- Other suitable certifying bodies as determined by industry and regional standards
- **Certified to ISO 3834 part 2 (PC1) or part 1 (PC2)**

Focus on PCBA
All contract manufacturers producing PCBAs for GS must meet minimum requirements as outlined in Electronic Supplier Quality Requirements. Additional requirements can be defined by each GS site or business in the form of GS Engineering technical specifications or as notes on drawings.
Product and process quality standards must meet all requirements specified in Electronic Supplier Quality Requirements for product performance per IPC610 Class 2, unless other specific by site or drawing.

Sub-tier identification
a member of Supplier's direct or indirect sub-tier supply base (including, without limitation, subcontractors and vendors of Supplier, and of Supplier's subcontractors and vendors) that provides goods and/or services in connection with Part.

GS Owned Tooling / Equipment Information
Information identifying GE owned tooling / equipment installed at Supplier Site.

GE Tooling and Equipment Asset Tag Picture
A picture of asset tag of equipment owned by GE at Supplier site.

Tooling PM Plan
Preventative maintenance schedule for GE tooling and equipment own that is regularly and routinely performed on physical assets to reduce the chances of equipment failure and unplanned machine downtime.

Sub-Tier First Piece Data and quality documentation
Qualification record from contract manufacturer of sub-tier first article.

Bill of Material and Approved Vendor List (BOM/AVL)
A list of the items needed to create a product as well as the instructions on how to assemble that product. A list of manufacturers currently approved by GS to provide the Materials specified in the bill of materials for the Product.

GS Specific Requirements
This section of the PPAP requirements is where each GS lists their own specific requirements for the PPAP process.

Part Certification or Part Submission Warrant (PSW)
The Part Submission Warrant is a summary of the entire PPAP submission and specifies:

- The drawing numbers and revisions
- Part information
- Test results
- Material declarations numbers
- Any deviations from earlier elements

Authorized Engineering Change
In some cases, the part / product being supplied will incorporate authorized engineering changes that are not currently shown in the drawing, specification documents or the CAD model, for example the part / product being supplied may have a concession issued. Where this is the case, the supplier shall submit a copy of these Authorized Engineering Change documents. This is to ensure both the supplier and GS have a record that the part / product being supplied will differ from the latest revision level of the design record.