Q1A
Advanced Product Quality Plan (APQP) & Production Part Approval Process (PPAP)

(Original Version)

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The terms “Item”, “PO”, “Buyer” and “Seller” used herein have the same meaning as “Work”, “Contract”, “Lockheed Martin” and “Seller”, respectively, as may be defined in another provision of the Purchase Order (PO) of which this Quality Clause Q1A is a part.

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I. PURPOSE

A. The purpose of the Advanced Product Quality Plan (APQP) process is for Seller to produce a product quality plan to support development of a product and ensure on-time/on-quality delivery with zero defects to Buyer.

B. An output of APQP is the Production Part Approval Process (PPAP). PPAP provides evidence that all Buyer engineering design record and specification requirements are properly understood by Seller, and that Seller's manufacturing process has the potential to produce product that consistently meets all requirements during an actual production run at the quoted production rate.

***Note**: This Quality Clause is modeled after AIAG's APQP/PPAP with distinctive requirements found in the Aerospace Industry (AS/SAE Requirements) and International Aerospace Quality Group (IAQG) Supply Chain Management Handbook (SCMH).*

II. SCOPE

A. The requirements of this Quality Clause are applicable in full to the PO and to all lower-level detail parts which comprise the part(s) on the PO. This includes parts/software/firmware manufactured, processed, assembled, tested, and/or inspected at sub-tier suppliers.

B. This Quality Clause shall apply to new product development efforts and to products currently in production where changes are planned.

C. This Quality Clause shall also continue to apply when previously approved products and processes undergo changes that affect Fit, Form and/or Function (e.g., introduction of a new production process, change to existing production process, change of production source, addition to the existing production sources, etc.).

D. The following items do not require APQP/PPAP, unless otherwise directed by Buyer:

1. Standard hardware and electronic piece parts (e.g., AN, MS & NAS standards; C, M & P standards; 2GNA00001 standard parts; etc.)

2. Commercial off-the-shelf (COTS) items

E. In the case of a conflict between other industry standards and this Quality Clause, this Quality Clause takes precedence.

F. For the interpretation of requirements and guidance in this document:

- The word "shall" indicates mandatory requirements.
- The word "should" indicates a recommendation.
- The words "example" and "for reference", and the word "should" appearing in Note sections, are for guidance only.
- The word "Note" is used for additional clarification.

III. RELEVANT DOCUMENTS

It is the responsibility of Seller to work to the latest version of the specifications referenced within this document and/or as indicated in the PO. It is the responsibility of Seller to obtain copies of the non-LM documents specified herein. These include but may not be limited to the following:

LM Aero Documents:

Appendix QX, Supplier Quality Requirements

External Documents:

It is the responsibility of Seller to obtain copies of the non-LM documents specified herein. These include but may not be limited to the following:

AS9100, Quality Management System

AS9102, Aerospace First Article Inspection Requirement

AS9103, Variation Management of Key Characteristics

ASTM 2782, Standard Guide for Measurement Systems Analysis (MSA)

SAE J1739 Potential Failure Mode and Effects Analysis (Design FMEA, Process FMEA)

AIAG APQP Manual

AIAG PPAP Manual

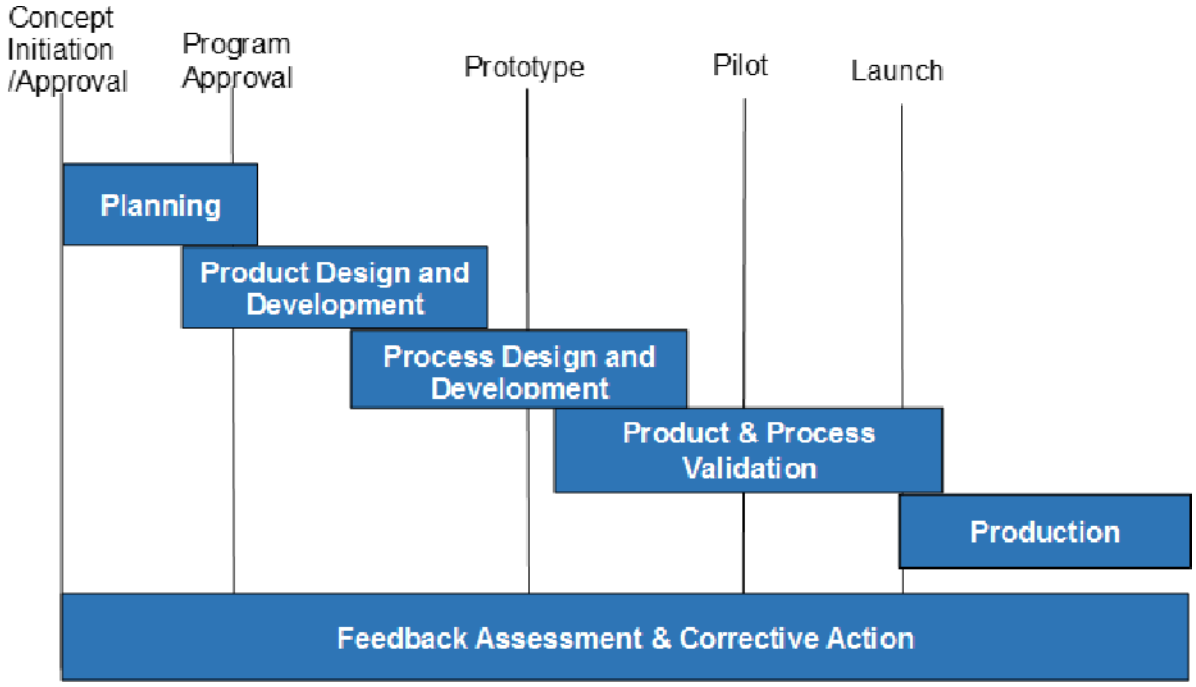
AIAG Measurement Systems Analysis (MSA) Manual

IAQG Supply Chain Management Handbook (SCMH)

IAQG Aerospace APQP Manual

IV. ADVANCED PRODUCT QUALITY PLANNING REQUIREMENTS

The critical path in APQP consists of five phases along with ongoing feedback assessment and corrective action as depicted pictorially in the Figure below. Seller is responsible to execute the APQP and appropriately report the status to Buyer at the established frequency. It is Seller's responsibility to obtain industry standard documents such as the AIAG AQPQ Manual and SCMH Section 7.2 for additional guidance.



A. Phase 1-Planning Requirements

1. The goal of Phase 1 is to establish the framework of the project and product. The activities in this Phase should capture the building of the technical, quality, and manufacturing requirements, the identification of the parts to be outsourced, the building of the sourcing plan, and finally the building of the APQP timeline plan which describes all APQP activities and the schedule aligned with the project needs.

2. Seller shall identify and capture all technical and non-technical inputs applicable to the product.

3. Seller shall identify and capture all requirements from Buyer, regulatory requirements, benchmark data, lessons learned, company knowns and strategy.

4. Seller shall include in the plan a timeline of the APQP and PPAP deliverable elements required by this Quality Clause, PO, and those identified by Seller.

B. Phase 2-Product Design and Development Verification Requirements

1. The goal of Phase 2 is to translate the product requirements, as determined in Phase I, into the product design. In this Phase the intended production processes, potential suppliers and production sources used to realize the product and to design key characteristics are identified.

2. Seller shall ensure that a design risk analysis related to performance (i.e., fit, form, and function), durability, service life, reliability, manufacturability, maintainability, and cost is performed, and that appropriate risk mitigation activities are identified, prioritized, and completed.

3. Design Failure Modes and Effects Analysis (DFMEA)
   DFMEA assists in the identification of key design characteristics, helps prioritize action plans for mitigating risk, and serves as a repository for lessons learned.

   Seller shall produce a DFMEA when Seller is product design-responsible (reference SAE J1739).

   Note: DFMEA is a living document and should be updated accordingly, and reviewed periodically. A single design FMEA can be applied to a family of parts.

4. Product Critical items (CI) and Key Characteristic (KC)
   KCs and CIs identified through the risk analysis shall be incorporated into the design records (reference AS 9103).

C. Phase 3-Process Design and Development Verification Requirements

1. In Phase 3 the process which will be used to manufacture the product is designed and developed. The manufacturing process shall be designed and developed to ensure that Buyer's requirements, the design requirements, and the manufacturing organization's requirements can be met consistently both within Seller's internal manufacturing operations and by Seller's suppliers.

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2. Process Flow Diagram
   Seller shall have a process flow diagram that includes all operations in sequential order from receipt of materials through storage and shipment of finished product. This encompasses alternate process flows and movement of product to and from external operations.

   Note 1: Within the process flow diagram, there shall be sufficient detail of the production process steps and sequence.

   Note 2: Process flow diagrams for families of similar parts are acceptable if the new parts have been reviewed for commonality by Seller.

3. Process Failure Mode & Effect Analysis (PFMEA)
   The PFMEA assists in the identification of key process characteristics, helps prioritize action plans for mitigating risk, and serves as a repository for lessons learned.
   Seller shall develop a Process FMEA (reference SAE J1739).

   Note: A single process FMEA may be developed for a family of similar parts or materials, provided a formal review of risk priority numbers is performed for Buyer parts to ensure product will meet intended specification(s).

   Note: FMEA is a living document and should be updated accordingly, and reviewed periodically (periodic review at least annually).

4. Process Control Plan
   Seller shall develop a Process Control Plan that defines all methods used for process control and shall include a comprehensive reaction plan (reference AS9103).

   Note: Process Control Plan is a living document and should be updated accordingly, and reviewed periodically (periodic review at least annually).

5. Process Key Characteristics (KC)
   Process KCs are attributes or features whose variation has a significant influence on product fit, performance, service life, or producibility; and that require specific action for the purpose of controlling variation (reference AS9103).

   Where there are no Buyer identified process KCs, then Seller shall identify process KCs using PFMEA or other sufficient methods in order to establish variation control of product KCs and CIs.

   Key product/process characteristics shall be traceable from their originating document through the process flow, PFMEA, and control plan.

   Seller shall establish the frequency of process KC review for elimination and/or KC addition.

6. Measurement Systems Analysis (MSA) Plan
   Seller shall develop a Measurement Systems Analysis (MSA) Plan. The plan shall establish the analytical methods and acceptance criteria for gages, checking aids, and inspection equipment that require the MSA and the frequency of the MSA to be performed.

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7. Manufacturing Process Documentation
   Seller shall have controlled documented manufacturing work instructions and visual aids available for each process and at point of use.

D. Phase 4-Product and Process Validation Requirements

1. The goal of Phase 4 is for Seller to demonstrate that the manufacturing and assembly processes can produce conforming product at the required rate.

2. Measurement Systems Analysis MSA
   At a minimum, Seller shall perform an MSA on the measurement methods for KCs (product and process) identified in the Control Plan (reference ASTM E2782). Action plans are required when MSA results are not satisfied.

   NOTE 1: Applicable MSA studies can be established using various methods (e.g., bias studies, Gage Repeatability and Reproducibility (Gage R&R), repeatability
   study, measurement uncertainty analysis, and attribute agreement analysis).

   NOTE 2: Seller shall demonstrate that all measurement methods and checking aids included in the Control Plan are suitable and capable.

3. Preliminary Process Capability
   Seller shall perform initial process capability studies using industry recognized statistical methods. These studies shall be completed for product and process KCs
   identified within the design record and Seller Control Plan (reference AS9103).

   Note: Where no KCs have been identified by Buyer, Seller shall identify KCs and demonstrate initial process capability.

4. First Article Inspection (FAI)
   Seller shall perform FAI (reference AS9102) to validate that product realization processes are capable of producing parts and assemblies that meet engineering and design requirements. The FAI shall provide objective evidence that Seller's processes can produce compliant product and that Seller has understood and incorporated associated requirements.

   Seller shall perform FAI per Buyer's Appendix QX.

E. Phase 5- On Going Production

1. Phase 5 extends throughout the lifecycle of the product and consists of activities that are performed post product qualification. These activities should include but not be limited to defect reduction, improved cycle time, product improvements, and cost reductions. As these issues/opportunities arise, the process and controls established and validated in Phases 2-4 shall be reviewed and updated as necessary by Seller to address them.

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2. Variation Reduction (Preventive Action)
   Seller shall establish a variation management system to monitor processes, with special attention given to Buyer and Seller identified KCs (reference AS9103).

3. Product Quality Assurance (Corrective Action)
   Seller shall ensure that products continuously conform to all requirements. Seller shall establish a means for monitoring the product performance, and shall take action to determine root cause and implement corrective/preventative actions when the product is not performing to Buyer's desired levels (reference Appendix QX).

4. Product Improvement
   Seller shall investigate, evaluate, and incorporate product improvements to quality, cost, and delivery (including lead time reductions), as well as opportunities to enhance product performance and overall Buyer satisfaction, during the product's service life.

V. PRODUCTION PART APPROVAL PROCESS REQUIREMENT

A. PPAP is the output from the APQP as described in the Phases above. PPAP provides evidence that all Buyer engineering design records and specification requirements are properly understood by the organization to demonstrate that the manufacturing process has the potential to produce product that consistently meets all requirements.

B. PPAP is required with any significant change to product or process.

C. Product shall be taken from a production run, which shall be conducted at the production site, using the production tooling, gaging, process, materials, and operators representing the quoted or committed production rate.

D. The specific production quantity shall be determined using information from industry standards.

VI. PPAP FILE

A. Seller shall develop a PPAP file which consists of all the APQP elements.

B. The PPAP file shall:
   1. Be part number specific.
   2. Be retained by Seller at the manufacturing location.
   3. Be retained and maintained with all applicable items up to date and represent the current production process.

VII. APQP/PPAP EXIT CRITERIA

A. The APQP/PPAP will be considered complete when the following are met:
   1. Completion of all the APQP/PPAP requirements contained in this Quality Clause, including the completion of the PPAP file containing all the supporting objective evidence.

2. Completion and validation of all sub-tier supplier APQP/PPAP on sub-components, sub-assemblies, and processing, as applicable. This includes documented objective evidence of compliance to PPAP elements as applicable.
3. Successful manufacture, process, test, and inspection of the FAI item, with no defects or nonconformances to Buyer's requirements.

VIII. RECORDS

A. Seller shall maintain complete records of all the APQP and PPAP documents for the life of the product or for longer periods if specified elsewhere in the PO.
B. Seller shall make such records available for review upon Buyer's request, and forward records to Buyer at no additional cost, price, or fee to Buyer.

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