AESQ
STRATEGY GROUP™
A Program of SAE ITC

RM13145
Advanced Product Quality Planning (APQP) and Production Part Approval Process (PPAP) within Aerospace

An AESQ Reference Manual
Supporting SAE AS13100™ Standard

Issued March 15, 2021

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AESQRM145202103

1. The Aero Engine Supplier Quality Group (AESQ)

The origins of the AESQ can be traced back to 2012. The Aerospace Industry was, and still is, facing many challenges, including;

- Increasing demand for Aero Engines
- Customers expecting Zero Defects
- Increasing supplier / partner engine content
- Increasing global footprint

The Aero Engine manufacturers Rolls-Royce, Pratt & Whitney, GE Aviation and Snecma (now Safran Aircraft Engines) began a collaboration project with the aim of driving rapid change throughout the aerospace engine supply chain, improving supply chain performance to meet the challenges faced by the industry and the need to improve the Quality Performance of the supply chain.

Suppliers to these Engine Manufacturers wanted to see greater harmonisation of requirements between the companies. Each Engine Manufacturer had Supplier Requirements that were similar in intent but quite different in terms of language and detail.

This collaboration was formalized as the *SAE G-22 Aerospace Engine Supplier Quality (AESQ) Standards Committee* formed under SAE International in 2013 to develop, specify, maintain and promote quality standards specific to the aerospace engine supply chain. The Engine Manufacturers were joined by six major Aero Engine suppliers including GKN, Honeywell, Howmet Aerospace, IHI, MTU and PCC Structurals. This collaboration would harmonise the aerospace engine OEM supplier requirements while also raising the bar for quality performance.

Subsequently, the *Aerospace Engine Supplier Quality (AESQ) Strategy Group*, a program of the SAE Industry Technologies Consortia (ITC), was formed in 2015 to pursue activities beyond standards writing including training, deployment, supply chain communication and value-add programs, products and services impacting the aerospace engine supply chain.

AESQ Vision

To establish and maintain a common set of Quality Requirements
that enable the
Global Aero Engine Supply Chain
to be
truly competitive through lean, capable processes
and a
culture of Continuous Improvement.

The SAE G-22 AESQ Standards Committee published six standards between 2013 and 2019:

• AS13000 Problem Solving Requirements for Suppliers (8D) • AS13001 Delegated Product Release Verification Training Requirements (DPRV) • AS13002 Requirements for Developing and Qualifying Alternate Inspection Frequency Plans • AS13003 Measurement Systems Analysis Requirements for the Aero Engine Supply Chain • AS13004 Process Failure Mode & Effects Analysis and Control Plans • AS13006 Process Control

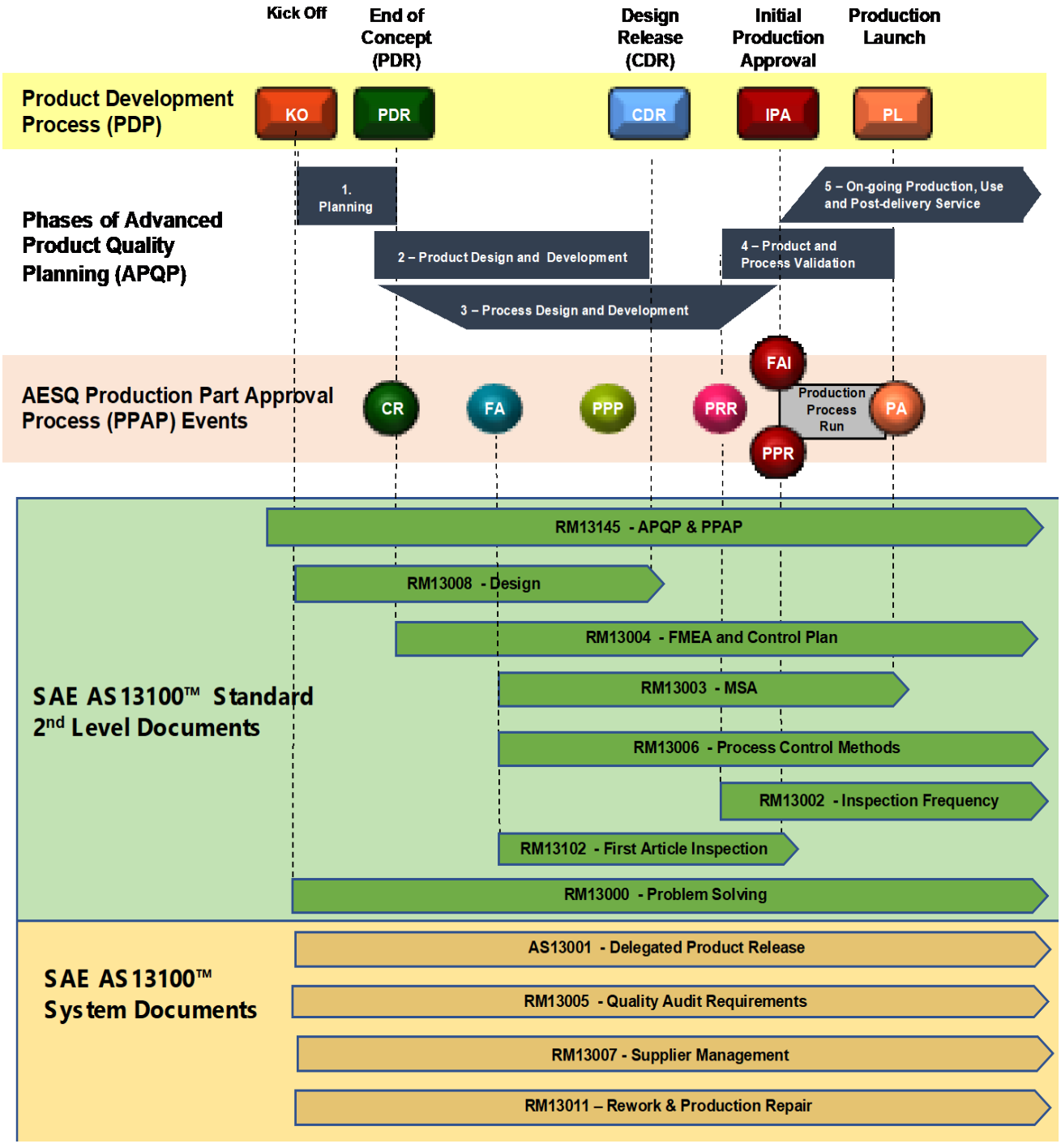
In 2021 the AESQ replaced these standards, except for AS13001, with a single standard, AS13100. The AESQ continue to look for further opportunities to improve quality and create standards that will add value throughout the supply chain. Suppliers to the Aero Engine Manufacturers can get involved through the regional supplier forums held each year or via the AESQ website http://aesq.saeitc.org/.

2. AESQ Reference Manuals and Acknowledgement

AESQ Reference Manuals: https://aesq.sae-itc.com/content/aesq-documents

AESQ published several associated documents in association with AS13100 which represents the consensus of the members of the AESQ. These documents are identified within the following table. Many contributions have enabled the development of these and within each document acknowledgement is given to the specific contributors (see respective Contributing Organization and Representative table). The relationship of these document to APQP and PPAP is:

Figure 1: Associated Reference Manuals



This is for teams and leaders of APQP and PPAP.

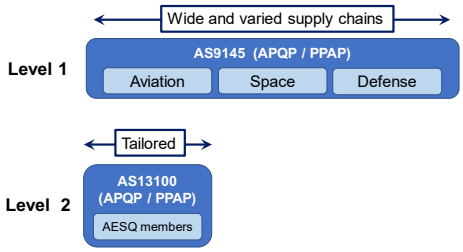
The scope includes:

- Application in different situations; New Product Design or Modifications, Transfer from one facility to another, New Process or Processing changes.
- APQP and PPAP Timing Chart providing a framework for the methodology.
- APQP and PPAP essentials for operating Projects.
- APQP-PPAP Flow Diagram for process management.
- Specifics about PPAP Specialist Roles and process management. E.g.: PPAP.

3. Forward

The intent of AS13100 regarding APQP and PPAP is to reduce the variation in customer specific requirements between AESQ Group members and promote best practice concerning the process management of APQP and PPAP. Chapter B of AS13100 is centred on APQP and PPAP. The development of this facilitates greater standardisation of requirements and process management practices.

Figure 2: AS9145 v AS13100 Comparison (APQP and PPAP)



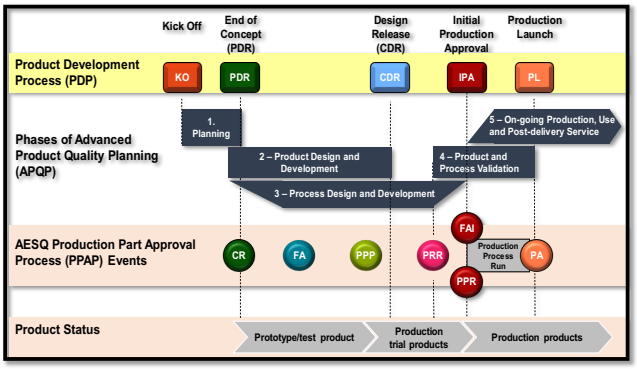
AS9145 was created to define the aviation, space, and defense process requirements for APQP and PPAP.

AS13100 Chapter B was created to complement AS9145 with tailored requirements and practices to the supply chains of AESQ Group members.

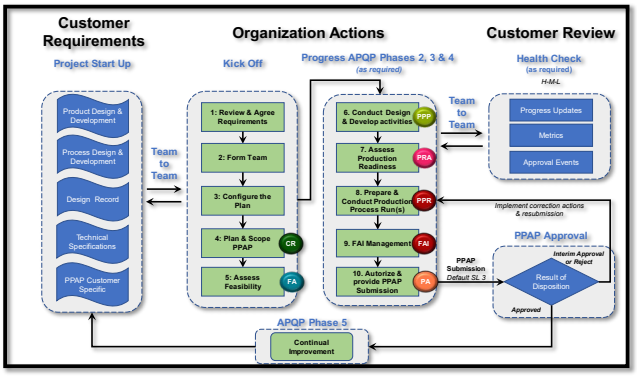
A successful APQP project will always start by understanding customer needs and wants. These are then translated into a plan aligned to customer/organisational requirements that are executed through a multi-disciplinary team approach. AS13100 Chapter B provides two lenses to enact this; A time-based framework (APQP and PPAP Timing Chart) and Customer/Supplier Management Process (APQP and PPAP Flow Diagram).

Figure 3: Illustrations used within AS13100 Chapter B

APQP and PPAP Timing Chart
(Time-based framework)



APQP and PPAP Flow Diagram
(Customer/Supplier Management Process)



APQP and PPAP Timing Chart: this is a development of the conceptional illustration found within AS9145. This provides a time-based framework for the APQP and PPAP methodology explained further within the APQP and PPAP Essentials section.

APQP and PPAP flow Diagram: this provides a process view of how an organization can manage APQP and PPAP during various situations; New Product design or change, transferring product from one facility, introducing new process or changing, etc. The flow describes this as a customer (blue)/supplier (green) management process to assist teams in assuring that timing meets or exceeds the customer plan, as well as meeting customer needs and expectation. The APQP and PPAP Flow Diagram section explains this.

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4. Terms used:

APQP and PPAP Events: These are planned events that clarify project timing and approval decisions associated to their meaning (APQP Assurance Framework). They provide synchronisation of APQP/PPAP activities for the team aligned to a product, as well as between the involved teams within a Project (Team to team).

APQP PPAP Elements: These are a characteristic part of the collective design, development and validation activities. They are the core APQP PPAP Elements actioned during APQP Phase 2, 3 and 4 up to Production Launch. An element has planned activities that need to be completed within the timeframe of the element and to satisfy associated requirements and/or standards. See appendix C.

APQP Packages: These are a division of a Project Work Breakdown Structure associated to the involved Bill of Material and Bill of Process (Process flow and configuration within the Supply Chain). Typically, this characterises the scope of work for a product, the involved organization(s) and their APQP and PPAP responsibilities.

Planning Deliverables: These are a characteristic part of the of APQP Phase 1 (Planning). The output may provide data and/or information for use in other phases. They have planned activities that need to be completed within the timeframe of the planning phase and to satisfy associated requirements and/or standards. See appendix D.

Voice of the Customer: This is about understanding needs and wants. The Voice of Customer (VoC) is a collective insight into customers the needs, wants, perceptions, and preferences. What is discovered should be translated into meaningful objectives that help in closing any gaps between the customers' expectations and the organization's offering. This could be gathered by; Surveys, Stakeholder interviews, Requirements cascade, Management comments and direction and Inputs from past projects.

Bench Marking: This is about finding the best practices. Benchmarking is the process of comparing one's processes and performance metrics to industry or other companies' best practices. Typically measured are quality, time and cost. Benchmark data can provide input to establish measurable performance targets, as well as ideas for product and process design. Product and process benchmarking could include identifying the best in class performance measures and determining how the performance was achieved. It provides valuable inputs for new designs and concepts, helping to improve existing products and the capabilities of the benchmark companies.

Assumptions: This is about what is critical to final success and assumed. Assumptions made during product and process design are critical to the final success and therefore, should be documented during the design process. Assumptions should always be subject to design verification and validation. The technical specifications, inputs for planning the quality program.

History and Lessons Learnt: This about understanding what we know already. History and Lessons Learnt relates to gathering knowledge, experience and information that has an association with the scope of the project. Information about past performance, quality issues and users' problems, when available, should be considered. A list of historical producers concerns/issues should be prepared to assess the potential for recurrence during the design, manufacture, installation and use of the product. These should be considered as an extension of the other design requirements and included in the analysis of organization needs.

Table 1: Contributing Organizations and Individuals

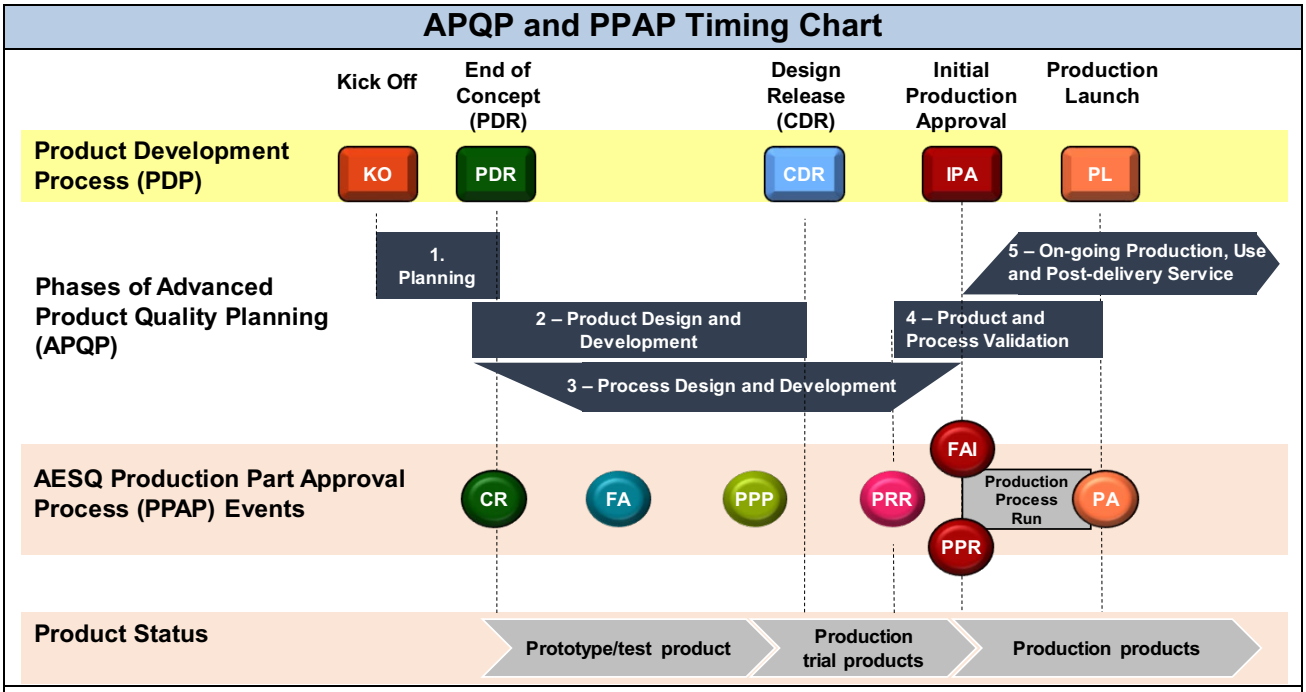
This document represents the consensus of the members of the AESQ. The Team members who developed this reference manual and whose name appears below, wish to acknowledge the many contributions made by individuals from their respective organizations.

Organization	Representative
Rolls-Royce	Karl D Evans – Team Leader
GE Aviation	Melanie Deroo
GE Aviation	Micheal Fuehner
MTU	Thomas Herter
GKN Aerospace	Ake Winkvist
GKN Aerospace	Inger Henstrom
Pratt & Whitney	Brian Murphy
Safran	Nathalie Noblet

5. Introduction to APQP and PPAP

The following APQP PPAP Timing Chart within AS13100 Chapter B is a development of the conceptional illustration found within AS9145 which outlines the APQP and PPAP methodology.

Figure 4: APQP and PPAP Timing Chart



The difference between the AS13100 and AS9145 conceptional illustration relates to extra PPAP Events and the use of Event Icons as visual aids to content and guidance. The purpose of each APQP and PPAP Event icon. E.g.: KO – Kick Off can be found within the APQP and PPAP Essentials section.

The benefits of this methodology are:

- Improved collaboration and communication
- Improved risk management
- Reduced costs
- Less rework and waste
- Meeting customer wants and needs

5.1 Application of APQP and PPAP:

APQP and PPAP benefits new product development efforts and products currently in production where changes are planned. This in practice covers various types of product and/or process change situations and, depending on which some or all the content of APQP and PPAP. The following Change Situations are used to categorise these various types of product/process changes. To assist teams and leaders operating APQP and PPAP several Application Matrices are provided as part of this reference manual (E.g.: the below Application Matrix for APQP Phases):

1. New Product Design,
2. Product Design Modification,
3. Transfer from one facility to another (no product mod.),
4. New Process (no Product mod or new product design),
5. Processing changes (no Product mod),
6. Specific to Process Tooling replace/refurb
7. Negligible Process Change.

These situations provide a defined criterion (AS9145: 4.1.2) for the application of APQP and PPAP, and the scope of products and/or processes for which it applies. Invoking this can be through customer flow down (customer initiation) or by the organization (Self-initiation). When APQP and PPAP is invoked, this continues to apply when previously approved products and processes undergo change (e.g. introduction of a new production process, change to existing production process, after the initial transfer of the product from one facility to another).

Table 2: Application Matrix for APQP Phases

This application matrix depicts the typical level of APQP Phase application (AS9145: 4.3.2.2) up to the Production Launch (APQP Event) against the change situations.

	Change Situations (as guidance, move left to right until relevant) Green refers to Non-Product Changes						
APQP Phase	New Product Design	Product Design Modification	Transfer from one facility to another (no product mod.)	New Process (no Product mod or new product design)	Processing changes (no Product mod)	Specific to Process Tooling replace/refurb	Negligible Process Change
1: Planning	**X**	**X**	**X**	**X**	**Limited**		
2: Product Design and Development	**X** [1]	**X** [1]					
3: Process Design and Development	**X**	**X**	**X**	**X**	**X**	**Limited**	
4: Product and Process Validation	**X**	**X**	**X**	**X**	**X**	**X**	**Limited**

Meaning (level of application):

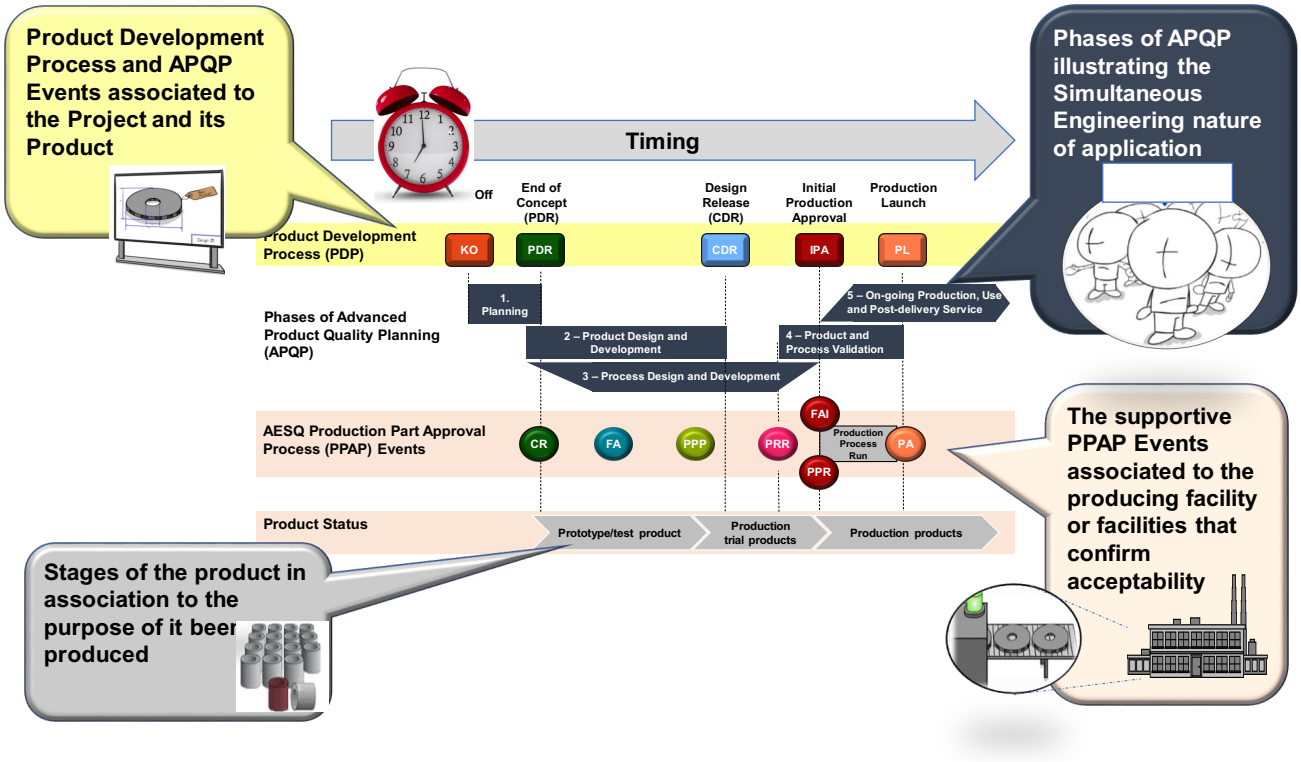
X – Application in accordance to requirements.

Limited – Application will be small scale.

Blank – Application is unlikely.

[1] - Application by the organization of this phase will depend on their design and/or manufacturing responsibility. E.g.: Organizations that do not have design responsibility have limited requirements to fulfil in APQP Phases 2.

Figure 5: Interpreting the APQP and PPAP Timing Chart



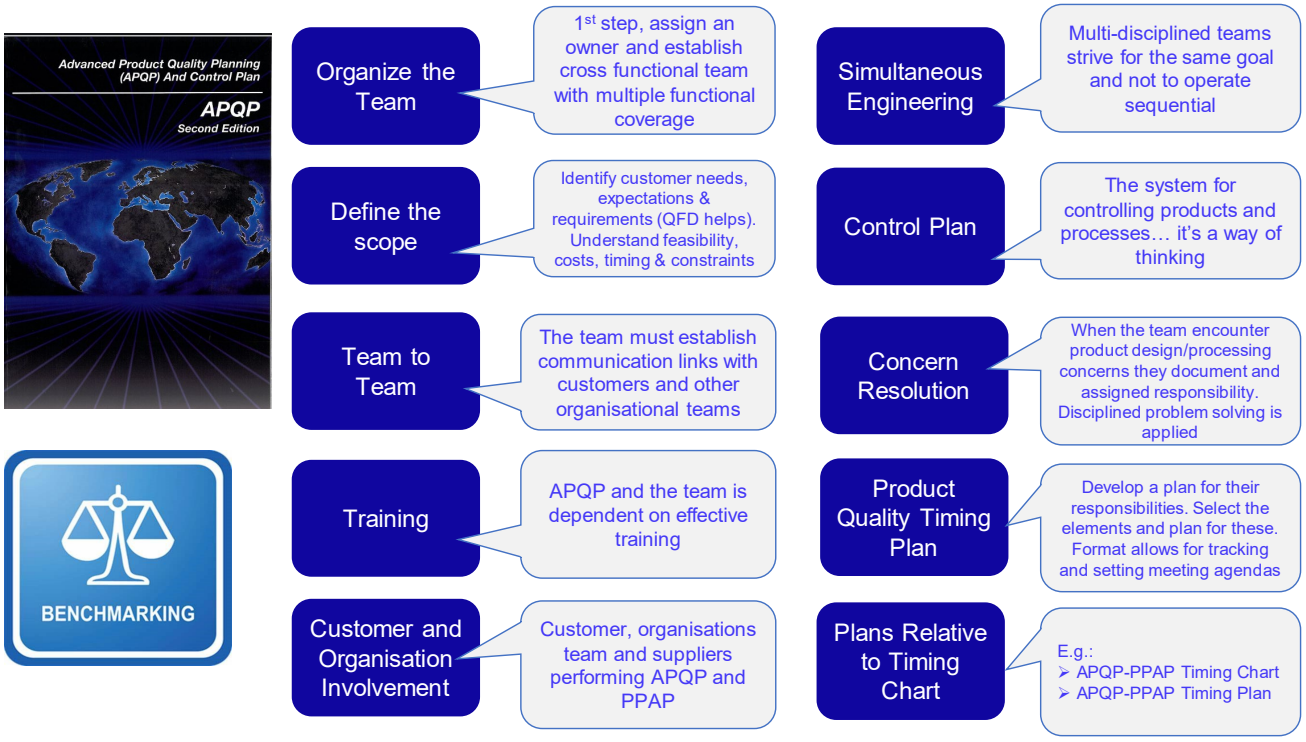
This chart provides vision of how the many aspects of APQP and PPAP come together. It reflects the importance of Timing and Simultaneous Engineering as;

- The success of any project must account for meeting customer needs and expectations in a timely manner at a cost that represents value.
- Problem prevention is driven by Simultaneous Engineering performed by product and manufacturing engineering activities working concurrently within teams and across the whole project.

Simultaneous Engineering is where multi-disciplined teams strive for a common goal. The purpose is not to operate sequential series of phases where results are conveyed to the next area for their activities and to expedite the introduction of products sooner. The organization's team is responsible for assuring that timing meets or exceeds the customer timing plan.

More information on the fundamentals that support APQP and PPAP can be found in AIAG Advance Product Quality Planning and Control Plan, which is summarised as:

Figure 6: AIAG APQP Fundamentals



6. APQP and PPAP Essentials

Outlined within this section are essentials to apply APQP and PPAP as a project regardless of scale and complexity. These are:

- **APQP Project Management**
- **Phase 1 (Planning) Kick-Off to PDR**
- **APQP Package Structure**
- **APQP and PPAP Events**
- **Project and teams Event Timeline (Flight Path)**
- **Phase 2, 3 and 4 (Product/Process Design, Development and Validation)**
- **Core 27 APQP PPAP Elements:**
- **APQP and PPAP Timing Plan**
- **Control Plan**
- **APQP Phase 5**
- **Supply Chain Risk Management Process (APQP Project Assurance)**

The APQP and PPAP Flow Diagram section helps to understand how these apply against a business process framework.

6.1 APQP Project Management:

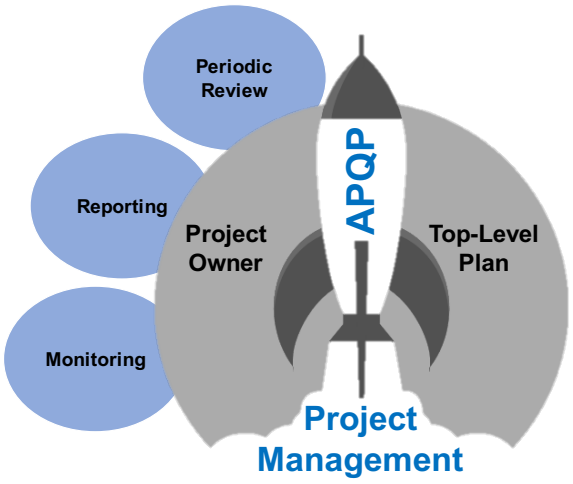
The goal of any Project operating APQP and PPAP is meeting customer needs while providing competitive value. Initiation of APQP Project Management (AS9145) is the starting point, along with establishing the following as a minimum and appropriately to the scale of the project and type of situation(s).

Table 3: APQP Project Management Themes

APQP Project Management Themes			
Project Owner	**Top-Level Plan and Schedule**	**Monitoring and Reporting**	**Periodic Reviews**
✓ A person accountable for accomplishing project objectives and ensuring appropriate resources ✓ Enabled through an organizational position, role and qualifications to carry out this role for the scale and situation.	✓ Clarity on the foundation for what is to take place. ✓ The route to achieving high-level technical, quality and cost targets	✓ Progress Updates ✓ Metrics ✓ Approval Events. ✓ Processes for effective reporting and communication	✓ Planned for the ideal frequency and to the right depth ✓ Who is involved and their role is defined

To ensure that customer needs and expectations are clearly understood the following inputs are gathered, the understanding of which develops through the planning phase of APQP:

- Requirements; Customer, Regulatory and internal
- Voice of the Customer,
- Bench Marking,
- Assumptions,
- History and Lessons Learnt

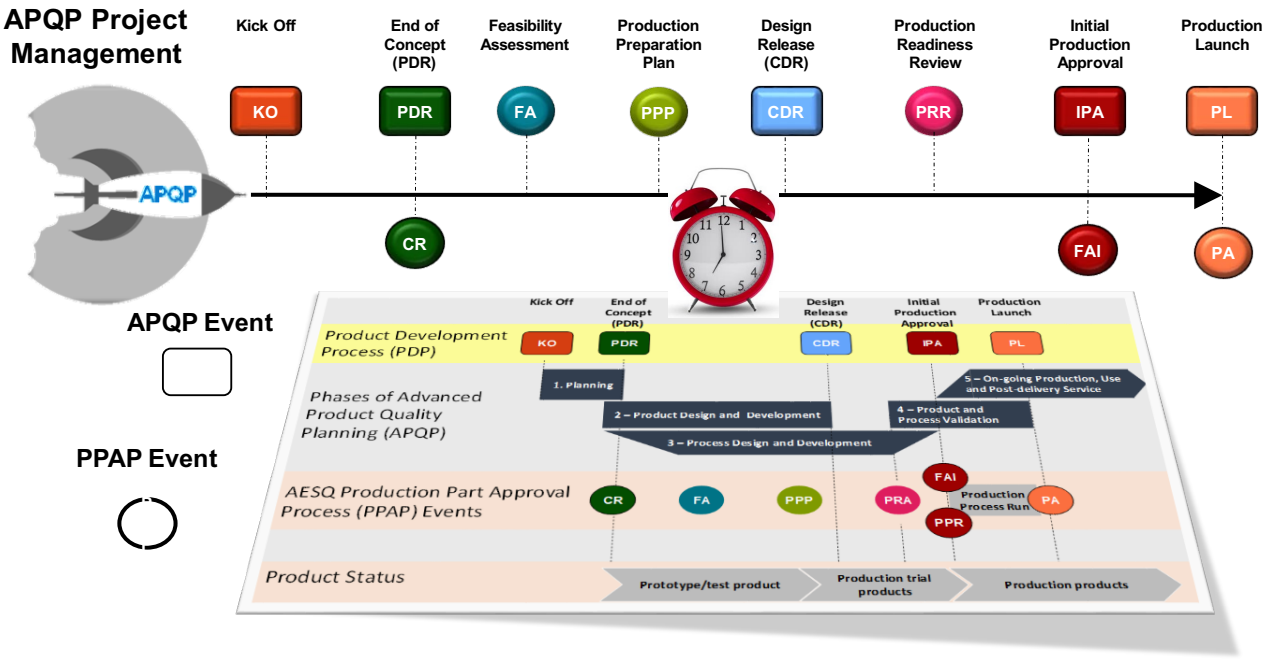


The initial goals for the APQP Project Management are expressed as a "pass criteria" for Kick-Off (Appendix B).

After Kick-Off (KO) the project implements their monitoring, reporting and periodic review structure. These form a part of an APQP Assurance Framework described later in this section (AESQ Supply Chain Risk Management Process.

Part of the Top-Level Plan will be to establish a timeline for the project which includes the APQP and PPAP Events and their target completion dates (baseline dates). Additional expectations of customer and organization are added to this as Project Milestones. E.g.: Certification, if the situation relates to new product design or first parts delivery for a Transfer from one facility to another. These are all accounted for within the Project Targets.

Figure 7: APQP Project Timeline for Events

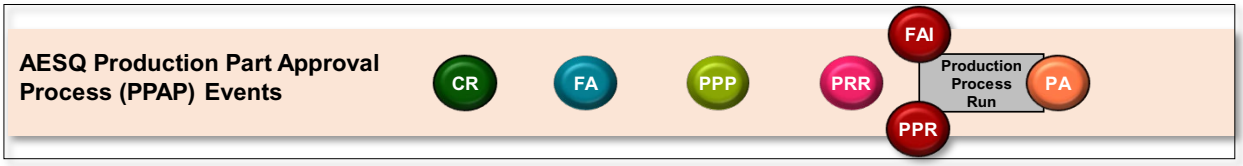


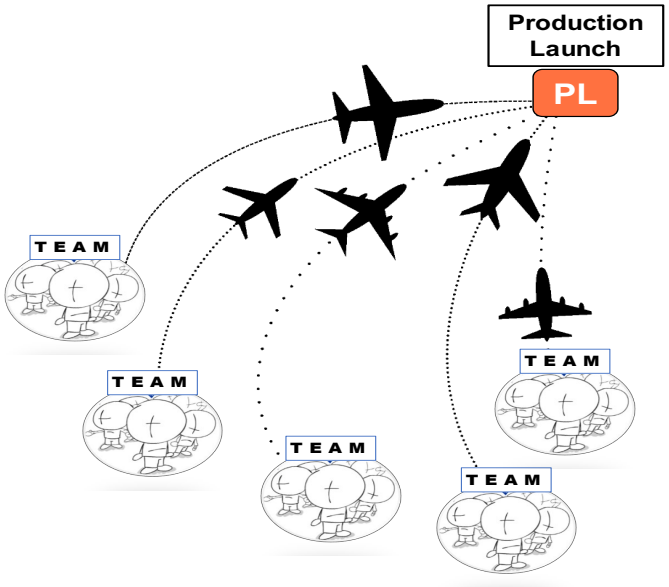
The Top-Level Plan accounts for activities, owners and timing that satisfies the purpose of these Events and Milestones and Pass Criteria (see APQP and PPAP Event Purpose table and Appendix B). At the top level and from Project Kick Off onwards a basic project timeline is communicated to all who are involved and stakeholders. This includes target dates that have been established through stakeholder review.

Events provide clarity on project timing, approval decisions (APQP Assurance Framework) and synchronisation of APQP/PPAP activities for the team aligned to a product, as well as between the involved teams within a Project (Team to team).

- **APQP Events**: These align to the project and reflect the customer, organizational and project needs. They are associated to the organizations Product Development Process, their management of APQP and organizational responsibilities. Successful completion of Production Launch (PL) identifies that the requirements defined during the Planning phase of APQP have been achieved. The addition of customer and/or organizational milestones may be appropriate for certain projects. E.g.: Certification (New or changes to product design) and first parts delivery (Transfer from one facility to another).

- **PPAP Events:** As the APQP Timing Chart guides, some of these events align to APQP Events as they have an interrelationship. All these PPAP Events are associated to the management of PPAP as a process and the resulting PPAP Submission/disposition. One or more PPAP Submissions can be linked to each APQP Package (see Plan and Scope PPAP) and each follows this sequence of these events. Approval of the PPAP Submission identifies acceptability of the product from the associated facility.



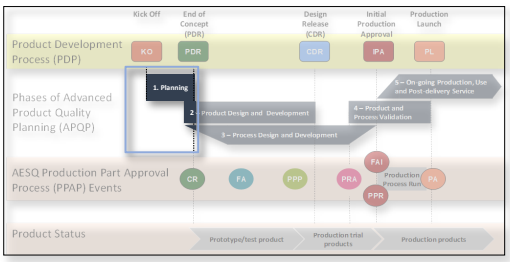


Within a project and team to team, events ensure that all are on a common flight path and synchronised regardless of the scale and complexity.

6.2 Phase 1 (Planning): Kick Off to PDR:

The goals of Kick Off to PDR stage are expressed by the "pass criteria" for PDR found within Appendix B: Event Pass Criteria. The summary is:

- ✓ Business Case accepted
- ✓ Preliminary Design Agreed
- ✓ Schedule Agreed
- ✓ Remaining APQP and PPAP Events Configured
- ✓ APQP Package Structure defined and APQP Assurance initiated for the Project
- ✓ Project requirements are defined in a way that can be verified



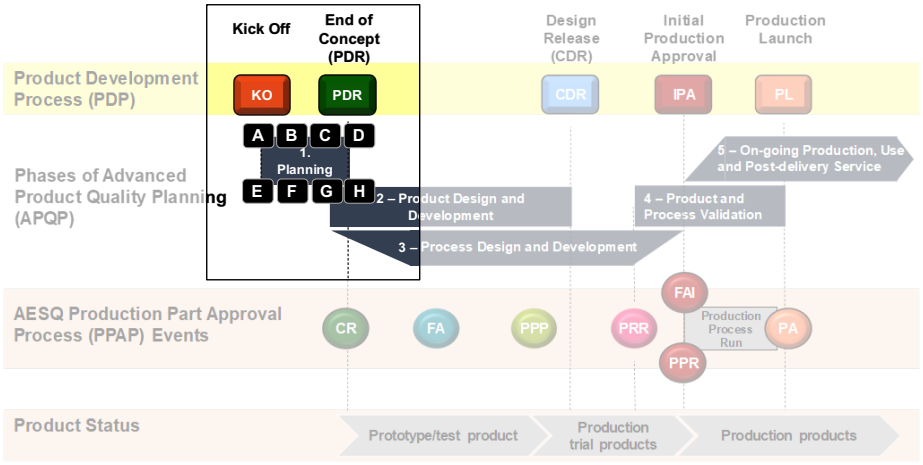
This stage of APQP fully covers the Planning Phase and the initiation of design and development (Product and/or Process) to support the goal of PDR. I.e.: Some of the APQP and PPAP Elements from APQP Phase 2 and 3 may start during this stage.

The Planning Phase progresses to complete specific deliverables (A to H) referenced in AS9145 Appendix A. The application of each will depend on the change situation (Planning Phase Deliverables Matrix). Each of these are described within Appendix D: Planning Phase Deliverables Bite Size Explanations.

Table 4: Planning Phase Deliverables

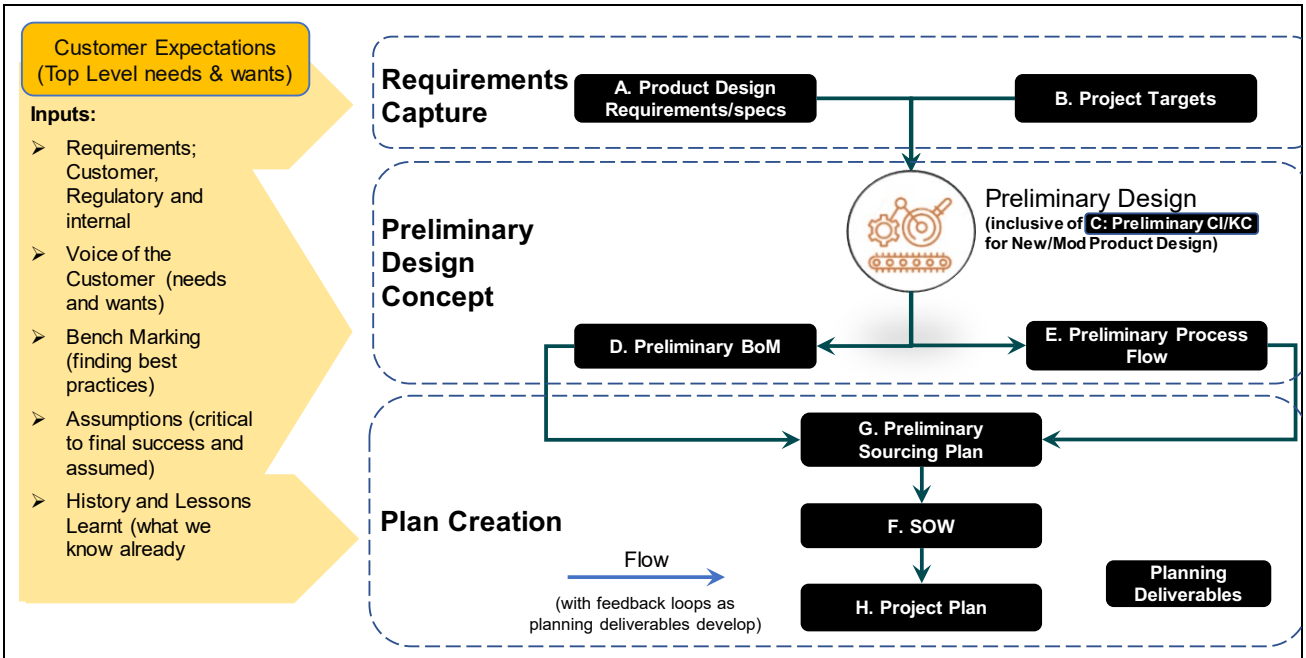
A. Product Design Requirements/specs	E. Preliminary process flow diagram
B. Project Targets	F. SOW review
C. Preliminary CI / KC's	G. Preliminary sourcing plan
D. Preliminary BOM	H. Project Plan

Planning Deliverables: Each is an activity that has been completed to meet a specified intent in support of the Planning Phase of APQP. The output can provide data and/or information for use in other phases.



The purpose of this stage is to truly understand the Customer Expectations, Requirements, Preliminary Design and Planning for realising these. The APQP Planning Phase Model captures the relationship with this and the Planning Phase Deliverable, and their flow / dependences.

Figure 8: Planning Phase Model / Flow



Simply speaking, customer needs and wants are understood early in this stage of APQP, after all a happy customer is fundamental. However, these are worthless if they cannot be realised by the involved organizations so Manufacturing, Assembly, Service, etc needs are fundamental as these deliverables develop. Robust feedback loops, communication and involvement through activities is essential. Once both customer and organizational needs are properly understood and captured, this pool of knowledge would have developed the Requirements. Techniques such as Quality Function Deployment (QFD) aid translating the needs into requirements.

As this understanding of the Requirements develops, the preliminary design concept develops to satisfy them as a solution. The associated **Product Design Requirements (A)** and the related identification of **Preliminary CI/KC's (C)** influence the preliminary design activities. **Project Targets (B)** inform this and as part of this the **Preliminary BOM (D)** and/or **Preliminary Process Flow (E)** develops, this aided by early feedback from use of APQP and PPAP Element such as Design for Manufacture, Assembly and Service, and Failure Mode Effects Analysis (FMEA), and preliminary capacity assessment.

Maturity of this preliminary design enables the **Preliminary sourcing plan (G)** to be developed, potential risks to be understood and mitigations determined. Product realisation is enabled through a Statement of Work (SOW) and by gathering information from teams and departments involved and essential when establishing a good Project Plan. **SOW (F),** a quality **Project Plan (H)** and timing develops the schedule that is aligned to **Project Targets (B).**

Table 5: Application matrix for Planning Phase Deliverables

The Planning Phase Deliverables Application matrix depicts as guidance the typical level of use against the standard situations.

	Change Situations (as guidance, move left to right until relevant) Green refers to Non-Product Changes						
Planning Phase Deliverables	New Product Design	Product Design Modification	Transfer from one facility to another (no product mod.)	New Process (no Product mod or new product design)	Processing changes (no Product mod)	Specific to Process Tooling replace/refurb	Negligible Process Change
Product Design Requirements/specs *	**X**	**X**					
Project Targets	**X**	**X**	**X**	**X**	**X**		
Preliminary CI / KC's*	**X [1]**	**X [1]**					
Preliminary BOM*	**X [1]**	**X [1]**					
Preliminary process flow diagram	**X [3]**	**X [3]**	**X**	**X [3]**			
SOW review	**X**	**X**	**X**	**X**	**X**		
Preliminary sourcing plan	**X**	**X [2]**	**X [2]**	**X [2]**	**X [2]**		
Project Plan	**X**	**X**	**X**	**X**	**X**		

Key:

* When no new product design or modification is taking place (green zone). These are represented by the established Design Record, Product Specifications and BoM.

X - Mandatory if Customer and/or Regulator and/or AS13100 require this, otherwise recommended. Either:

- Create new,
- Update the existing,
- Develop in part aligned to what has changed.

X [NOTE] – as above X and consider these Notes:

[1] - this would be design responsible organizations only (not Make to Print)
[2] - when supply chain has the potential to be impacted
[3] - appropriate to the process scope. I.e.: method and/or Supply Chain

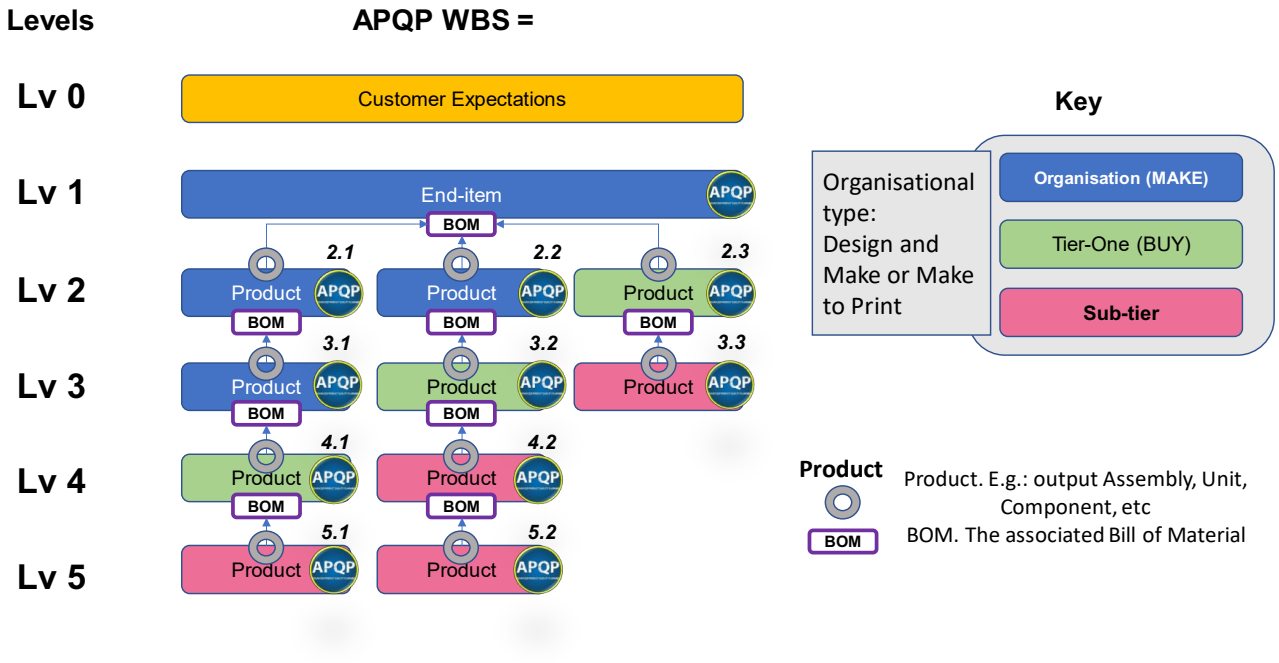
6.3 APQP Package Structure:

APQP Projects will be varying in scale and complexity and are best delivered through a Work Breakdown Structure (WBS). Structuring Projects using APQP Packages Structure in the following way aids managing scale and complexity:

	**Why is it important –** The WBS reduces complicated activities to a collection of tasks. This is important for the project management to oversee the tasks more effectively and for ownership to be with the right resources. Breaking the project into APQP Packages allows task and team ownership of APQP-PPAP Elements for the related product and/or process to be managed in coordinated way.

Figure 9: Structuring APQP Packages

Level 0 represents the pool of knowledge regarding the customer and expectations; Voice of the Customer, assumptions, bench marking, history, lessons learnt, etc.
Levels 1, 2, 3…. represent the planned or actual supply sequencing and its relationship with the Products BOM, these broken into APQP Packages.



An APQP Package is a combination of the product and processing configuration. The ideal resolution is the facility/organization and the product. These are influenced by the Planning Phase Deliverables (Table 4) Preliminary BOM (D), Preliminary Process Flow (E) and/or Preliminary sourcing plan (G):

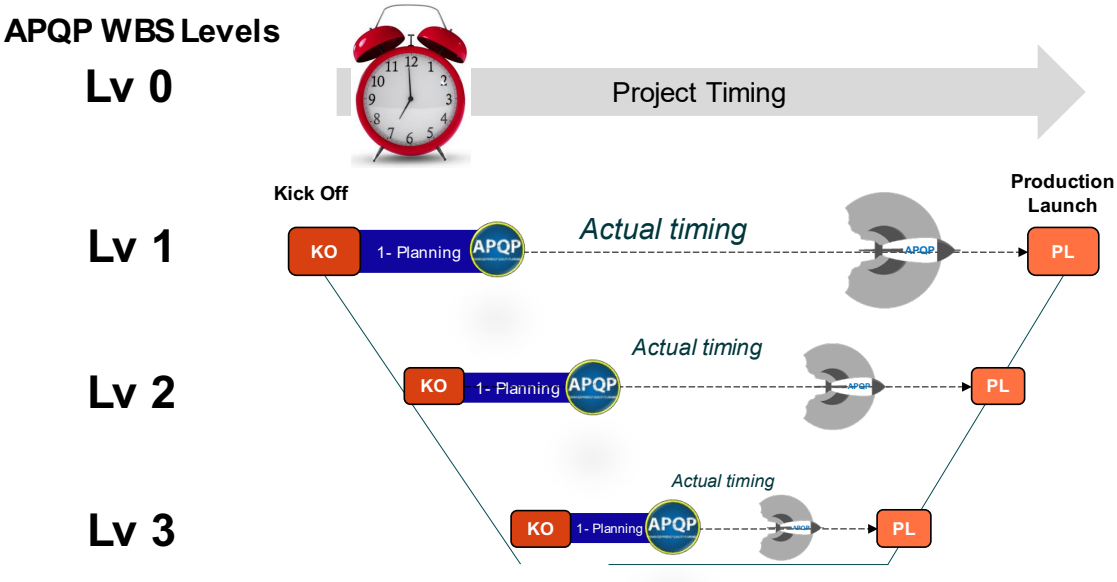
Figure 10: What defines an APQP Package

- **Product Configuration** would be the latest issue Bill of Material (BOM) for the product.
- **Process Configuration** would be the relevant Process Flow for the product. I.e.: facility to facility within a supply chain and / or Op to Op of the method.

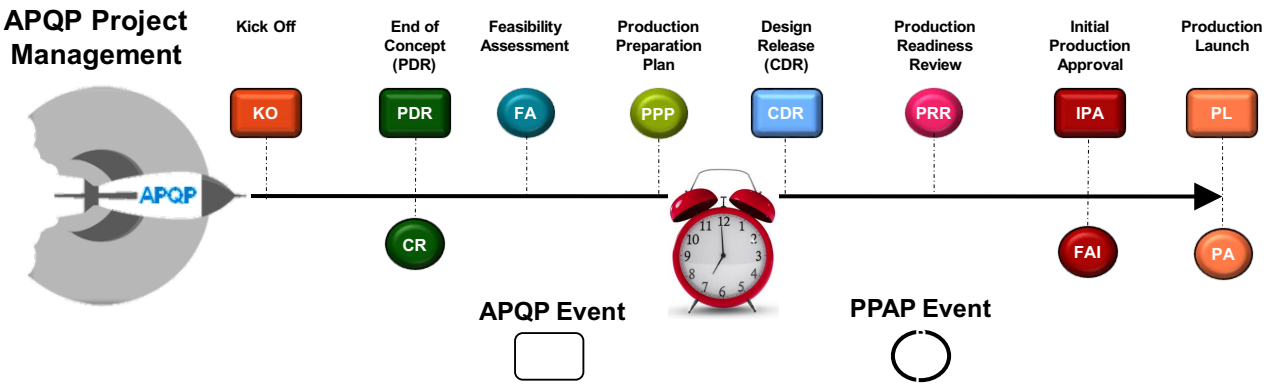
An understanding of how many APQP Packages, their relationships and scope is part of the planning phase (APQP Phase 1). A team may be accountable for one or more APQP Packages. The number of teams and this ownership will be based on a host of factors such as; accountability of activities (design v make), the supply chain (sourcing plan, preliminary process flow).

How the project timing translates into actual lead-times is a conversion of the needs (customer, organizational and project) against the APQP Packages (work breakdown structure) and their dependences on each other. This can be expressed as a V-diagram which helps to show against levels, how the timing translates against the overall project timing. The lower the level the more likely the related lead-time is compressed.

Figure 11: APQP V Diagram



6.4 APQP / PPAP Events:



The Project Timeline for Events provides a useful flight path for the team(s) involved in the project to follow. Between teams (Team to team) this helps synchronise plans and their activities when using common target dates. Connecting these with the APQP PPAP Timing Plan explained later will aid the individual teams in developing their plan. They also play a role in the APQP Assurance framework explained later (Supply Chain Risk Management Process).

The flight path could involve all these Events, or some as explained in Creating A Project / Team Flight Path. I.e.: The change situation is an influencer. The meaning of all PPAP Events can be found within AS13100 Chapter B.

Table 6: APQP and PPAP Event Purpose

Event Icon	Purpose
	**Kick Off:** The purpose of this event is to confirm definition of the program scope including high-level technical, quality and cost targets and a basic timeline.
	**End of Concept (PDR):** The purpose of this event is to demonstrate that the preliminary design meets all system requirements with acceptable risk and within the cost and schedule constraints and establishes the basis for proceeding with detailed design.
	**Feasibility Assessment:** The purpose of this event is to be confident at an early stage of the project in the potential to produce the product design during production. This confidence is established through the involved production supply organization(s) assessment of Feasibility. The scope of Feasibility Agreed in this context would be for a new engineering design, modification or an existing product that is new to the facility such as a transfer from one facility to another.
	**Production Preparation Planning** The purpose of this event is to be confident that the preparation planning is suitable for the level of complexity being managed and resources needed by the production supply organization.
	**Design Release (CDR):** The purpose of this event is to demonstrate that the maturity of the design is appropriate to support proceeding with full-scale fabrication, assembly, integration, and test.
	**Production Readiness Review:** The purpose of this event is to be confident that the production processes are appropriately defined, documented, and ready for production by the production supply organization.
	**Initial Production Approval:** The purpose of this event is to demonstrate that products produced in a series production environment meet the defined design intent.
	**Production launch:** The purpose of this event is to confirm that launch of production demonstrates a controlled and capable full-scale production.

6.5 Project and Team Event Timeline (Flight Path)

The type of situation that projects manage through APQP will vary; New Product design or modification, a transfer from one facility to another a new process, etc. Even the work breakdown structure within a project and associated APQP Packages can deal with different situations. Therefore, it is important to be able to configure events for the type of situation based on their meaning and value. E.g.: Design Release (CDR) intent relates to maturity of the product design and development activities and if it is suitable to proceed. Therefore, CDR is relevant to New Product Design, however, it's not for a Transfer of production from one facility to another (no product design change).

By treating the individual APQP and PPAP events as selective the most appropriate configuration can be made for the type of situation. "Y" indicates that this event is recommended for this situation. The table shows all APQP and PPAP Events:

Table 7: Application Matrix for Events

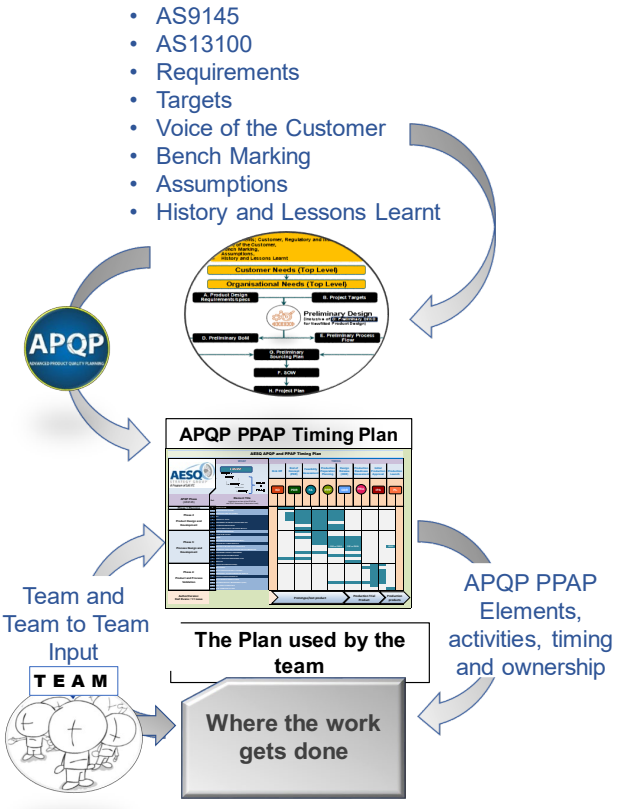
Events APQP (bold text) and PPAP Those with the same colour Event icon are aligned timing wise on the APQP and PPAP Timing Chart		Change Situations (as guidance, move left to right until relevant) Green refers to Non-Product Changes						
		New Product Design	Product Design Modification	Transfer from one facility to another (no product mod.)	New Process (no Product mod or new product design)	Processing changes (no Product mod)	Specific to Process Tooling replace/refurb	Negligible Process Change
Kick-Off	KO	Y	Y	Y	Y	Y	Y	
End of Concept (PDR)	PDR	Y	Y	Y	Y	Y		
Customer Specific Requirements	CR	Y	Y	Y	Y	Y	Y	Y
Feasibility Assessment	FA	Y	Y	Y	Y			
Production Preparation Plan	PPP	Y	Y	Y	Y	Y	Y	
Design Release (CDR)	CDR	Y	Y					
Production Readiness Review	PRR	Y	Y	Y	Y	Y		
Production Process Run start	PPR	Y	Y	Y	Y	Y	Y	
First Article Inspection	FAI	Y	Y	Y	Y	Y	Y	Y
Initial Production Approval	IPA	Y	Y	Y	Y	Y	Y	
PPAP Approval	PA	Y	Y	Y	Y	Y		
Production launch	PL	Y	Y	Y	Y	Y		

Meaning (level of application):
Y – this event is used
Blank – this event is unlikely to be used

6.6 Phase 2, 3 and 4 (Product/Process Design, Development and Validation)

As the involved team or teams progress APQP Phase 1 (Planning) they establish their plan and finalise this as an outcome of this phase (AS9145 – Project Plan).

The content of their plan details the activity or activities, along with the timing/owners necessary to meet requirements and the involved APQP-PPAP Elements (Core 27). The application of an Element is influenced by the responsibilities of the team (and their organization), the situation that is being managed and contractual obligations such as customer-specific requirements. The APQP PPAP Timing Plan serves as an aid to teams when conducting the planning activity.



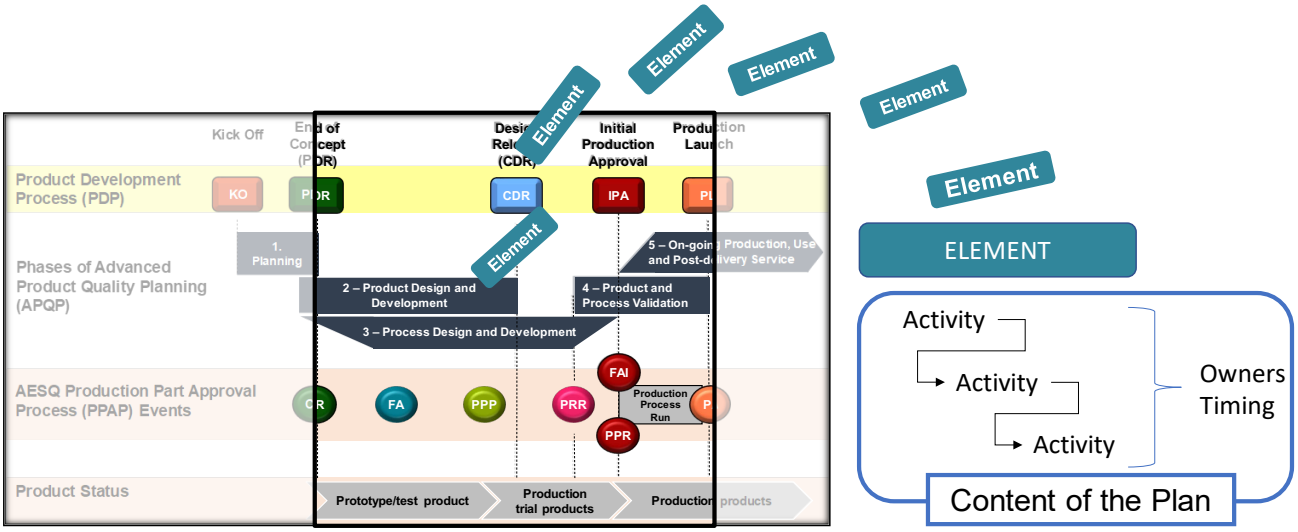
APQP-PPAP Elements have facilitate the delivery of phase 2, 3 and 4 (AS9145) the goal of which are:

- Phase 2 – Product Design and Development; The goal of this phase is to translate the technical, quality, and cost requirements into a controlled, verified, and validated product design. Design validation is achieved using prototype, development, or production parts in test environments that can represent the customer's installation and subject the product to extreme conditions required by contract or regulation.
- Phase 3 – Process Design and Development; The goal of this phase is to design and develop the production processes needed to produce product that consistently fulfil technical, quality, and cost requirements while operating at the customer demand rate.
- Phase 4 – Product and Process Validation: The goal of this phase is to validate that product fulfils the design requirements and the production processes have demonstrated the capability to consistently produce conforming product at the customer demand rate. Product validation is achieved using product produced from the defined production processes.

6.7 Core 27 APQP PPAP Elements:

These are a characteristic part of the collective design, development and validation activities. They are the core APQP PPAP Elements actioned during APQP Phase 2, 3 and 4 up to Production Launch. The content of the plan post PDR Event will contain activities that associated to all or some of these elements. I.e.: An element has planned activities that need to be completed within the timeframe of the element and to satisfy associated requirements and/or standards.

Figure 12: Core APQP and PPAP Elements



They are recognised within the APQP PPAP Timing Plan (Appendix A.) which provides their timing relationship.

1. DESIGN RECORD and BOM
2. DESIGN RISK ANALYSIS (DFMEA)
3. DESIGN FOR MANUFACTURE
4. PRODUCT CI and KC
5. PACKAGING SPECIFICATION
6. DESIGN VERIFICATION/VALIDATION RESULTS
7. PRELIMINARY SOURCING PLAN RISK ANALYSIS
8. PROCESS FLOW DIAGRAM
9. FLOOR PLAN LAYOUT
10. PACKAGING, LABELLING, ETC
11. TEST INSPECTION PLAN (Char. Matrix)
12. PFMEA
13. PROCESS KEY CHARACTERISTICS
14. CONTROL PLAN (Pre-Launch / Production)
15. PRELIMINARY CAPACITY ASSESSMENT
16. WORK STATION DOCUMENTATION
17. SUPPLY CHAIN RISK MANAGEMENT PLAN
18. MSA PLAN
19. PRODUCTION PROCESS RUN(S)
20. MSA STUDIES
21. INITIAL PROCESS CAPABILITY STUDIES
22. DIMENSIONAL and NON-DIMENSIONAL RESULTS
23. PRODUCT VALIDATION RESULTS
24. INITIAL MANUFACTURING PERFORMANCE STUDIES
25. CUSTOMER SPECIFIC REQUIREMENTS (PPAP)
26. FIRST ARTICLE INSPECTION
27. PPAP SUBMISSION (incl. Approval Form)

These element's relationship to the APQP Phase is illustrated and those that are light blue will be an item of the PPAP file and PPAP Submission (Submission Level). Actual applicability will be dependent on the type of situation being managed (New design, modification, transfer, new process, progressing change, etc) and the organizations responsibilities (design make v make to print v design only, service, etc). E.g.: Make to print has limited responsibility for Phase 2 element. AS13100 provides clarification on those related to PPAP – see Typical Use of Element table and requirements. For the remaining element's, this would be through requirements of the customer and associated standards. #25 refers to Customer Specific Requirement which may lead to additional elements or content depending on these requirements.

Figure 13: APQP and PPAP Element Mapped against APQP Phases

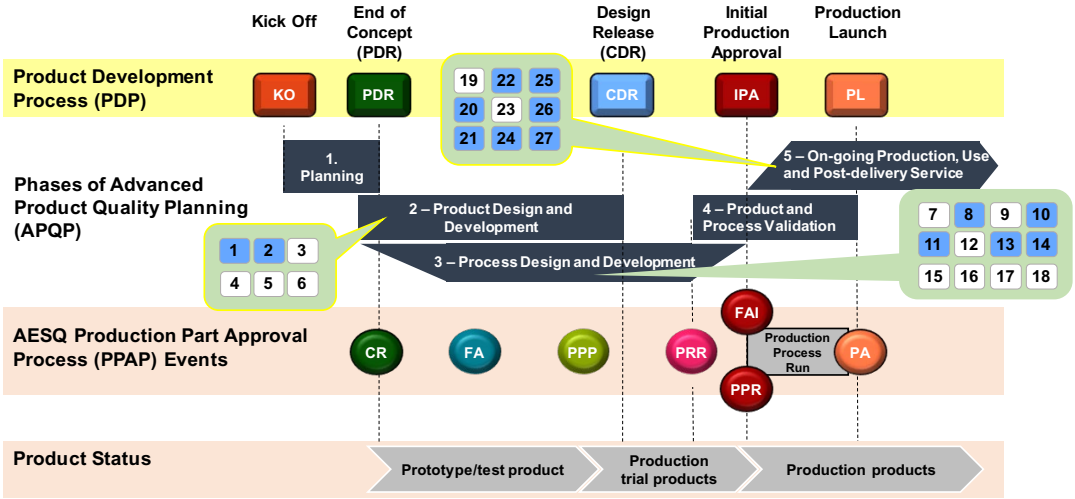


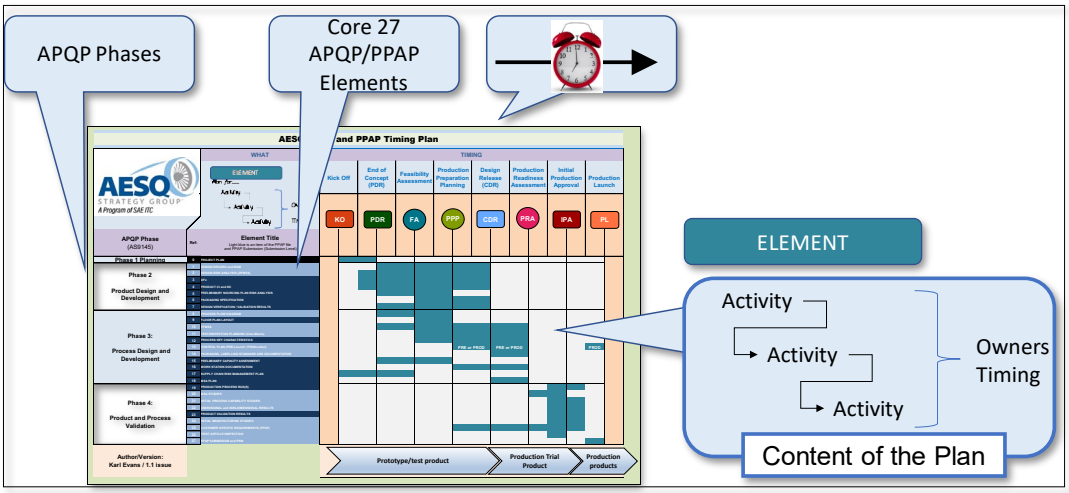
Table 8: APQP and PPAP Element Source Information

#	APQP and PPAP Element	Ref. Info.	#	APQP and PPAP Element	Ref. Info.
1	DESIGN RECORD and BOM	RM13008	15	PRELIMINARY CAPACITY ASSESSMENT	Appendix C
2	DESIGN RISK ANALYSIS (DFMEA)	RM13004	16	WORK STATION DOCUMENTATION	Appendix C
3	DESIGN FOR MANUFACTURE	RM13008	17	SUPPLY CHAIN RISK MANAGEMENT PLAN	Appendix C
4	PRODUCT CI and KC	RM13008	18	MSA PLAN	Appendix C
5	PACKAGING SPECIFICATION	RM13008	19	PRODUCTION PROCESS RUN(S)	APQP-PPAP Flow Diagram
6	DESIGN VERIFICATION/VALIDATION RESULTS	RM13008	20	MSA STUDIES	RM13003
7	PRELIMINARY SOURCING PLAN RISK ANALYSIS	Appendix C			
8	PROCESS FLOW DIAGRAM	RM13004	21	INITIAL PROCESS CAPABILITY STUDIES	RM13006
9	FLOOR PLAN LAYOUT	Appendix C	22	DIMENSIONAL and NON-DIMENSIONAL RESULTS	Appendix C
10	PACKAGING, LABELLING, ETC	Appendix C	23	PRODUCT VALIDATION RESULTS	Appendix C
11	TEST INSPECTION PLAN (Char. Matrix)	Appendix C	24	INITIAL MANUFACTURING PERFORMANCE STUDIES	Appendix C
12	PFMEA	RM13004	25	CUSTOMER SPECIFIC REQUIREMENTS (PPAP)	Appendix C
13	PROCESS KEY CHARACTERISTICS	Appendix C	26	FIRST ARTICLE INSPECTION	RM13102
14	CONTROL PLAN (Pre-Launch/Production)	RM13004	27	PPAP SUBMISSION (Inc. Approval Form)	Appendix C
5	PRELIMINARY SOURCING PLAN RISK ANALYSIS	Appendix C	Light blue is an item of the PPAP file and PPAP Submission (subject to Submission Level)		

6.8 APQP and PPAP Timing Plan

The APQP and PPAP Timing Plan is centred on the core APQP and PPAP Elements that are accounted for within the plan developed by the team. I.e.: Those actioned during APQP Phase 2, 3 and 4 up to Production Launch. It provides guidance on the timing of Elements and their relationship to; Events, Product Status and Simultaneous Engineering. Teams use this as a planning tool to determine the related activities, timing and ownership as part of the plan. Application of elements (which are switched on or off) is guided by the Application Matrix for APQP and PPAP Elements.

Figure 14: Illustration of APQP and PPAP Timing Plan Content



Good practice is for organizations to develop the APQP and PPAP Timing Plan specific to their operational and customer needs. An example is to confirm the involvement of departments or job role using R A C I (Responsible, Accountable, Consult or Informed) for each element.

Table 9: Example of Element RACI

Element	Departments				
	Manuf. Eng.	Quality	MRP	Manuf.	Design Eng.
PFMEA	R/A	I	C/I	C/I	C/I

As the team develops their plan, they establish the related activities for each Element along with the timing and owner(s). This results in a detailed planning and a plan as an outcome of APQP Phase 1: Planning. The step that are taken are:

1. Identify which *Elements are applicable (Application Matrix for APQP and PPAP Elements).
2. Use the timing plan template for approximate timing and relationships.
3. Plan the activities that will deliver each Element, consider the interdependencies (E.g.: inputs/outputs).
4. Establish who is the best owner (using RACI when these have been developed) and specific start and finish dates.
5. Record this within the organizations planning system.

*Not all Elements apply to every type of situation – see Core APQP PPAP Element

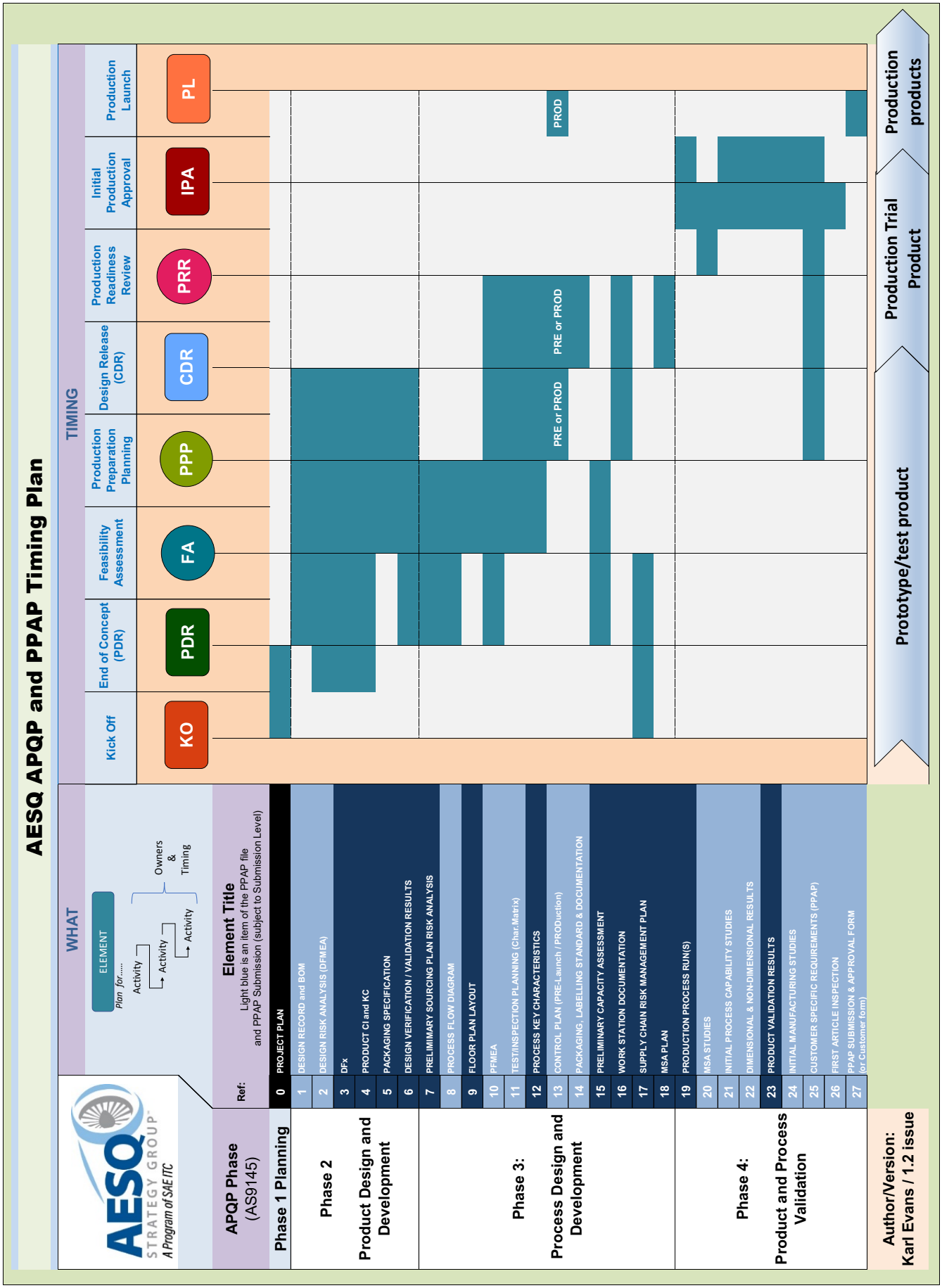

AESQ APQP and PPAP Timing Plan
AESQ STRATEGY GROUP
A Program of SAE ITC
WHAT
TIMING
APQP Phase (AS9145)
Ref:
Element Title
Light blue is an item of the PPAP file and PPAP Submission (subject to Submission Level)
ELEMENT
Plan for.....
Activity
Activity
Activity
Owners & Timing
Kick Off
End of Concept (PDR)
Feasibility Assessment
Production Preparation Planning
Design Release (CDR)
Production Readiness Review
Initial Production Approval
Production Launch
KO
PDR
FA
PPP
CDR
PRR
IPA
PL
Phase 1 Planning
0 PROJECT PLAN
Phase 2
Product Design and Development
1 DESIGN RECORD and BOM
2 DESIGN RISK ANALYSIS (DFMEA)
3 DFx
4 PRODUCT CI and KC
5 PACKAGING SPECIFICATION
6 DESIGN VERIFICATION / VALIDATION RESULTS
Phase 3:
Process Design and Development
7 PRELIMINARY SOURCING PLAN RISK ANALYSIS
8 PROCESS FLOW DIAGRAM
9 FLOOR PLAN LAYOUT
10 PFMEA
11 TEST/INSPECTION PLANNING (Char.Matrix)
12 PROCESS KEY CHARACTERISTICS
13 CONTROL PLAN (PRE-Launch / PRODuction)
14 PACKAGING, LABELLING STANDARD & DOCUMENTATION
15 PRELIMINARY CAPACITY ASSESSMENT
16 WORK STATION DOCUMENTATION
17 SUPPLY CHAIN RISK MANAGEMENT PLAN
18 MSA PLAN
19 PRODUCTION PROCESS RUN(S)
Phase 4:
Product and Process Validation
20 MSA STUDIES
21 INITIAL PROCESS CAPABILITY STUDIES
22 DIMENSIONAL & NON-DIMENSIONAL RESULTS
23 PRODUCT VALIDATION RESULTS
24 INITIAL MANUFACTURING STUDIES
25 CUSTOMER SPECIFIC REQUIREMENTS (PPAP)
26 FIRST ARTICLE INSPECTION
27 PPAP SUBMISSION & APPROVAL FORM (or Customer form)
PRE or PROD
PRE or PROD
PROD
Prototype/test product
Production Trial Product
Production products
Author/Version:
Karl Evans / 1.2 issue

Table 10: Application Matrix for APQP and PPAP Elements

APQP and PPAP Elements	Change Situations (as guidance, move left to right until relevant) Green refers to Non-Product Changes						
	New Product Design	Product Design Modification	Transfer from one facility to another (no product mod.)	New Process (no Product mod or new product design)	Processing changes (no Product mod)	Specific to Process Tooling replace/refurb	Negligible Process Change
DESIGN RECORD and BOM *	X [1]	X [1]					
DESIGN RISK ANALYSIS (DFMEA)	X [1]	X [1]					
DESIGN FOR MANUFACTURE	X [1]	X [1]					
PRODUCT CI and KC *	X [1]	X [1]					
PACKAGING SPECIFICATION	X [1]	X [1]					
DESIGN VERIFICATION/VALIDATION RESULTS	X [1]	X [1]					
PRELIMINARY SOURCING PLAN RISK ANALYSIS	X	X [4]	X	X [4]	X [4]		
PROCESS FLOW DIAGRAM	X	X	X	X	X		
FLOOR PLAN LAYOUT	X	X	X	X	X		
PACKAGING, LABELLING, ETC	X	X	X	X	X		
TEST INSPECTION PLAN (Char. Matrix)	X	X	X	X	X		
PFMEA	X	X	X	X	X		
PROCESS KEY CHARACTERISTICS	X	X	X	X	X		
CONTROL PLAN (Pre-Launch / Production)	X	X	X	X	X		
PRELIMINARY CAPACITY ASSESSMENT	X	X	X	X	X		
WORK STATION DOCUMENTATION	X	X	X	X	X		
SUPPLY CHAIN RISK MANAGEMENT PLAN	X	X [4]	X	X [4]	X [4]		
MSA PLAN	X	X	X	X	X	X	
PRODUCTION PROCESS RUN(S)	X	X	X	X	X	X	
MSA STUDIES	X [2]	X [2]	X [2]	X [2]	X [2]	X [2]	
INITIAL PROCESS CAPABILITY STUDIES	X [P]	X [P]	X [P]	X [P]	X [P]	X [P]	
DIMENSIONAL and NON-DIMENSIONAL RESULTS	X	X	X	X	X	X	
PRODUCT VALIDATION RESULTS	X [P]	X [P]	X [P]	X [P]	X [P]	X [P]	
INITIAL MANUFACTURING PERFORMANCE STUDIES	X	X	X	X	X		
CUSTOMER SPECIFIC REQUIREMENTS (PPAP)	X	X	X	X	X	X	
FIRST ARTICLE INSPECTION	X	X [3]	X [3]	X [3]	X [3]	X [3]	X [3]
PPAP SUBMISSION (Inc. Approval Form)	X	X	X	X	X	X	

Key:

* When no new product design or modification is taking place (green zone). These are represented by the established Design Record. Product Specifications and BoM.

X - Mandatory if Customer and/or Regulator and/or AS13100 require this, otherwise recommended. Either:

- Create new.
- Update the existing
- Develop in part aligned to what has changed.

X [NOTE] – as above X and consider these Notes:

[P] - apply in accordance to product specific requirements related to the Design Record and associated specification (E.g.: KC's)

[1] - for design responsible organizations only

[2] - When specified by the related MSA Plan (Phase 3 of APQP)

[3] - RM13102, consideration to LAI maybe likely

[4] - when supply chain has the potential to be impacted

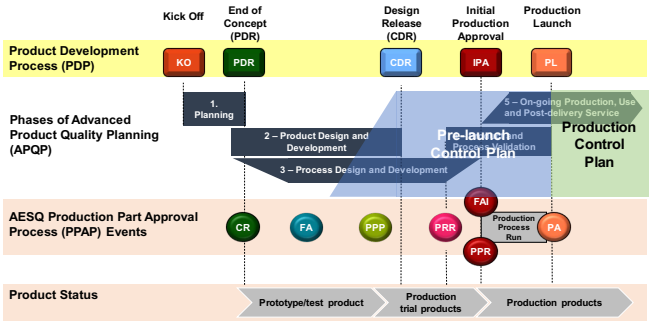
6.9 Control Plan

What is this?

Control Plan is a methodology that provides a structured approach to the definition of value-added process and product controls necessary to ensure conforming product (RM13004). As part of APQP this has two stages: Pre-launch and Production standard. The intent is that in advance of production launch the number of controls is generally much higher than after regular/ongoing production since the optimised standard may not have been identified.

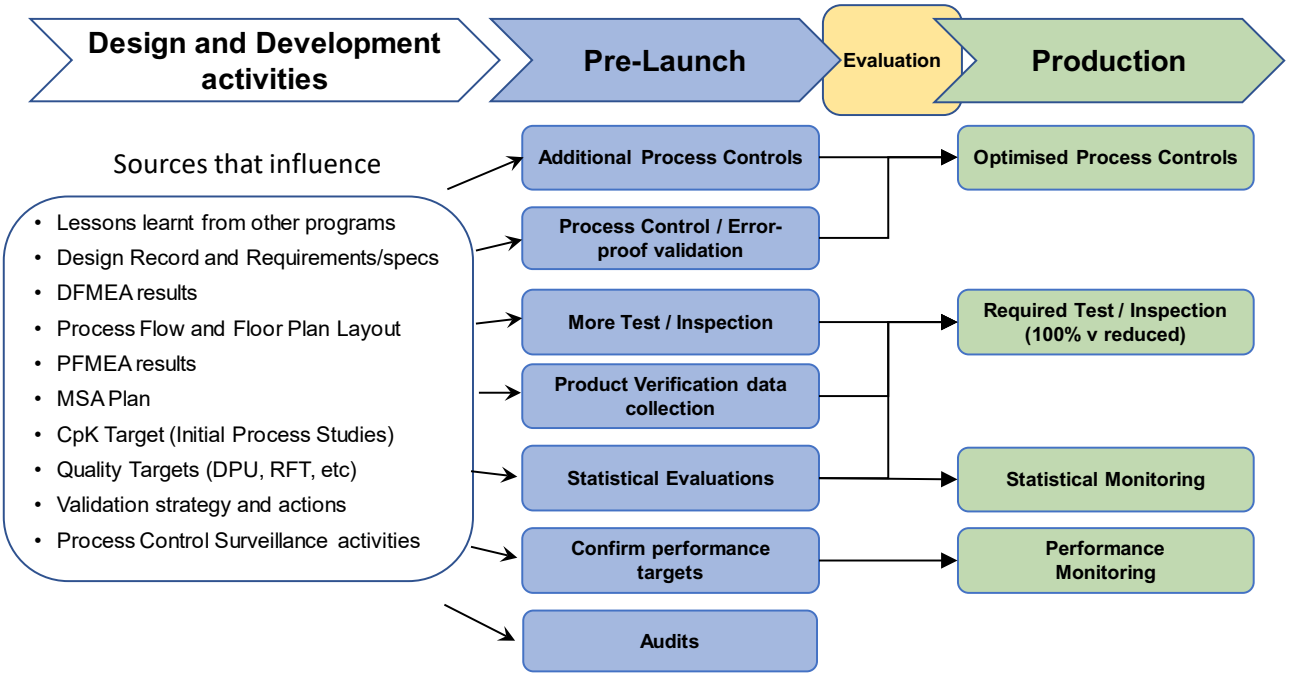
- Pre-Launch includes all dimensional and non-dimensional measurements that are required to occur. This should include enhancements that limit the potential of non-conformance and the validation of the production process.
- Production control plan is a comprehensive documentation of product/process characteristics, process controls, tests and measurement systems that will occur during postproduction Launch.

Timing of Implementation:



The time before the production launch event is ideal to take actions to learn about the behaviour of the process and product. Greater customer protection from non-conformance should be provided during this period of understanding. Enhancements enable learning and customer protection during the pre-launch stage. As illustrated, they can be in several forms and after capture / evaluation data these are translated into the Production standard.

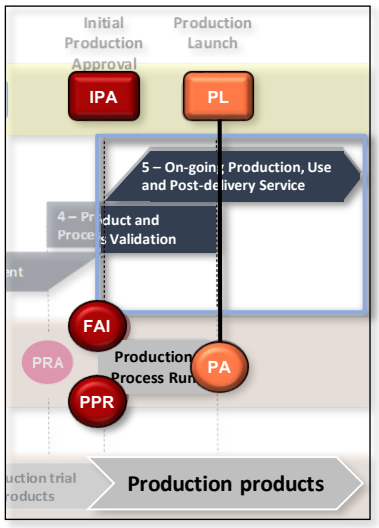
Figure 15: Pre-Launch and Production Control Plan



6.10 APQP Phase 5

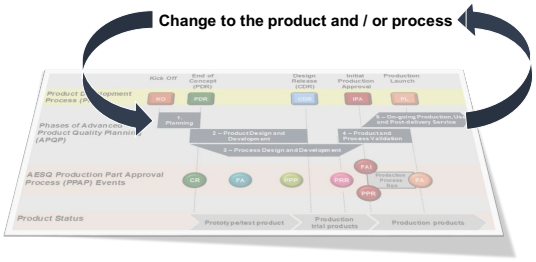
The goal is to ensure customer requirements are continually fulfilled using process control, lessons learned and continuous improvement. The product or service must perform in the customer environment and this usage provides learning by the organization and customer. Passing the Production Launch (PL) confirms that launch of production demonstrates a controlled and capable full-scale production (Appendix B, the pass criteria). Appropriate action is taken if they are not to deal with the risks.

Production Launch event judges the effectiveness of the APQP efforts. As a minimum this evaluates and determines if Project Requirements established in Phase 1 have been fulfilled.



These Project Requirements may need to evaluate performance within the customer environment by Production Launch. I.e.: Phase 5 actions between Initial Production Approval (IPA) and Production Launch (PL). E.g.: The customers product assembly and the products quality, cost and delivery performance impact on their operations. Additionally, or alternatively this maybe planned post Production launch. I.e.: Accounted for after Production launch (PL). E.g.: The customer's replacement parts and service operations such as Maintenance and Repair Organizations needing to meet requirements for quality, cost, and delivery.

APQP as an improvement cycle is repeated when management of change to the product and / or process is triggered.



Throughout Phase 5 the capture of lessons learnt takes place to improve customer satisfaction and the organizations ongoing application of APQP and PPAP.

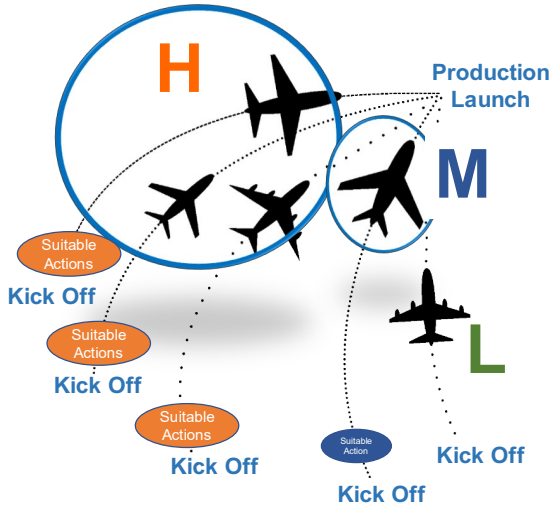
1. The organization capture lessons learned and best practices to improve the product realization process and future products. Input to Lessons Learned and Best Practices can be obtained through a variety of methods such as:

   - Warranty data (e.g., field failures).
   - Corrective action plans.
   - Customer quality data.
   - Early life monitoring.
   - Key Performance Indicators.
   - FMEAs or other risk analysis records act as a repository for documenting design and process lessons learned.
   - Read across with similar products and processes.

2. A product of lessons learnt is the identification of improvement opportunities that increase customer satisfaction (e.g., delivery, cost, efficiency, variation reduction) and appropriate actions are taken to implement these.

6.11 Supply Chain Risk Management Process (APQP Project Assurance)

The purpose of this is to prompt a common practice for APQP assurance up and down the supply chain, within Projects and Team to Team. From the start to the end of a project (Kick Off to Production Launch) this acts as the Project APQP Assurance and flight control for the project owner along with the involved teams. Using the project's work breakdown and related APQP Packages, each APQP Package is allocated into groups based on risk. I.e.: Assigned to H-M-L group. This then determines the APQP Assurance route to be taken during the project.



The APQP Assurance route involves applying risk reduction practices and health-check actions (progress updates, metric monitoring and levels of independent APQP PPAP Events approval). Essentially, more of this for high and less for low. The final part of the route is the PPAP Approval (PPAP Submission, disposition and result).

These risk reduction practices are centred on:

- Sourcing strategy and plan.
- Stocking policy.
- Supplier Development strategy.
- Special actions.

APQP Project Management (AS9145) calls for monitoring, reporting and periodic reviews which this provides through a standardised framework that considers 3 methods of *Health Check and the PPAP Approval:

- *Progress Updates.
- *Metrics.
- *Approval of Events.
- PPAP Submission.

APQP ASSURANCE ACTIONS				
Health Check Rating	Health Checks			PPAP Approval
	Progress Updates [1]	Metrics [1]	Approval of Event [1]	PPAP Submission [1]
H	Y (maximum customer frequency)	Y	Y (all)	Y (based on SL)
M	Y (minimum customer frequency)	Y	Y (configured)	Y (based on SL)
L		Y		Y (based on SL)

This framework provides greater attention by Project Owner, stakeholders and Team to Team based on risk and an independent assurance to the team managing the APQP Package.

This does not reduce their accountability for the quality and delivery of the work taking place.

The APQP-PPAP Flow diagram section (see Customer Review) demonstrates the application of this between organizations (Customer/supplier). The following describes the steps for evaluating and progressing each APQP Package.

Starting by deciding on risk (H-M-L) for each APQP Package the process steps formulate an APQP Assurance route. This involves deciding on the right risk reduction practices (sourcing strategies, stocking policies, supply development strategies, etc.) and then applying health checks as the project progresses. Typically, this starts in advance of PDR (APQP Event) by confirm H or M or L for the APQP Package.

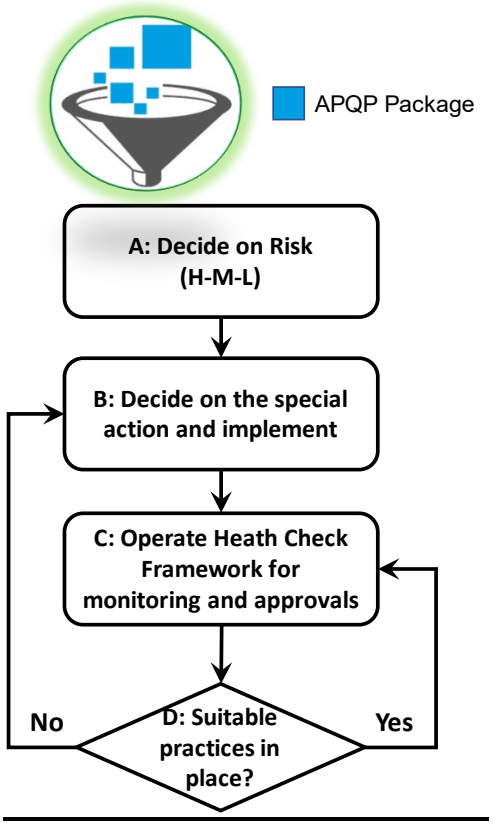


Figure 16: Supply Chain Risk Management Flow

Decide on Risk (H-M-L)

The Risk is determined by an evaluation of the APQP Package which typically considers the associated lessons learnt, involved product and organization factors. Lessons learnt is centred on what is already known and the following provide considerations for product and organization factors. Each organization should establish a practice to determine risk for H-M-L.

Product factors:

- New design.
- Manufacturing techniques are new to the industry.
- Special Processing capability shortfalls
- Similar products are subject to numerous design changes that threaten program timing.
- High product or process complexity
- Product is strategically important due to high visibility or functional performance.
- High warranty on existing product.

Organization factors:

- New supplier or new manufacturing location.
- REACH compliance concerns
- Product or manufacturing technology is new to the supplier manufacturing location.
- Supplier's historic launch performance is poor.
- Supplier resources are stretched due to significant amount of new business.
- Supplier location has low APQP and PPAP capability .

Decide on Risk reduction practices and implement

Evaluating the risk would also generate an understanding of known or potential risk(s) associated with the organization and/or product. Typical example of risk reduction practices is:

- Additional source of supply (sourcing strategy and plan),
- Short term pull-forward of supply schedule, holding buffer stock (stocking policy),
- Work with the company to improve their capabilities, improvement projects, training (Supplier Develop strategy)
- Use of 3rd party inspectors to check product at the facility before it is released (special actions).

Implementation of these would be through the Supply Chain Risk Management Plan (Appendix C)

Operate the Health Check Framework assurance actions

Operating the Health Check Frameworks would be part of the ongoing Project Management activities and involve the Project Owner, stakeholders and teams as monitoring, reporting and periodic reviews take place. This explained within the APQP and PPAP Process Flow section (Health Check – APQP Assurance).

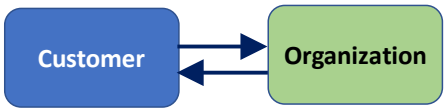
Are practices and actions effective?

Ongoing monitoring of the effective of the practices and actions are maintain. When the results are not positive, changes should be taken. E.g.: Add or alter the risk reduction practice, and/or change the Health Check applied risk (H-M-L).

7. APQP-PPAP Flow Diagram

7.1 Overview

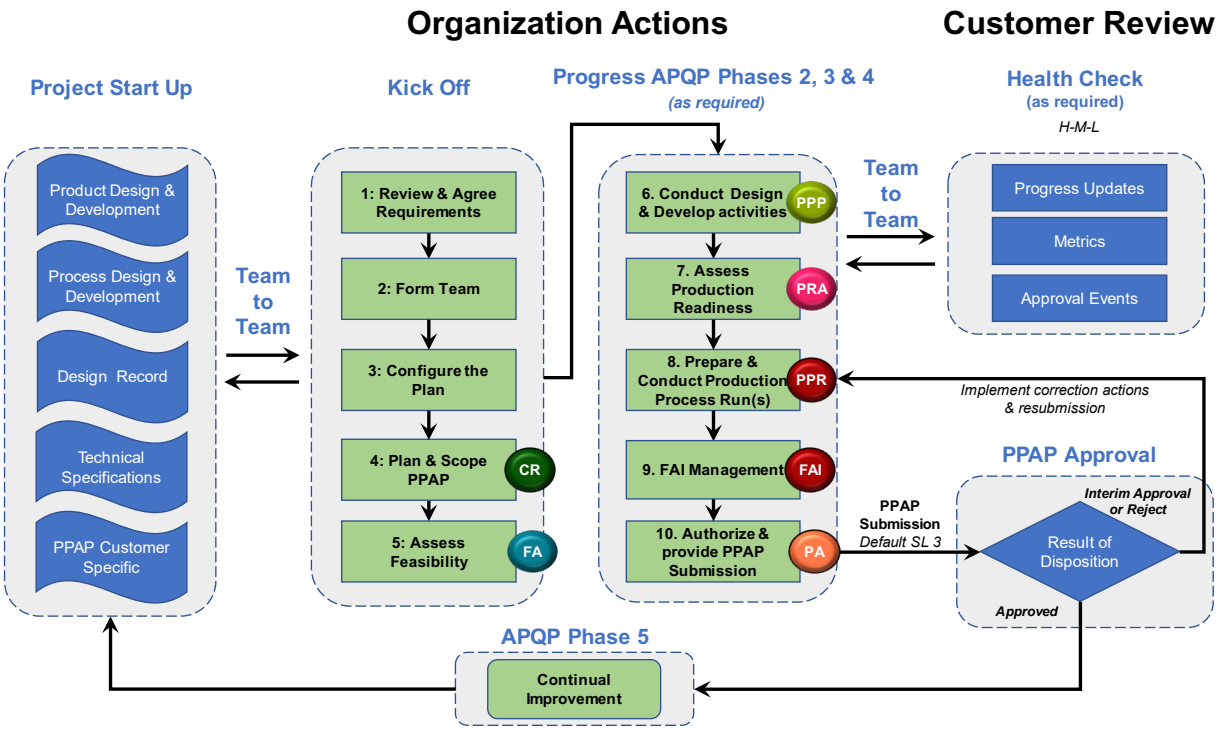
This section complements the APQP and PPAP Flow diagram found within AS13100 Chapter B by describing how this operates. The purpose of this diagram is to provide a process view of how an organization can manage APQP and PPAP as a standardised process during various situations; New Product design or change, transferring product from one facility, introducing new process or changing, etc. The flow presents this as a customer/supplier management process to assist teams in assuring that timing meets or exceeds the customer plan, as well as meeting customer needs and expectation.



The customer activities are represented by blue boxes and the organization as the supplier as green boxes.

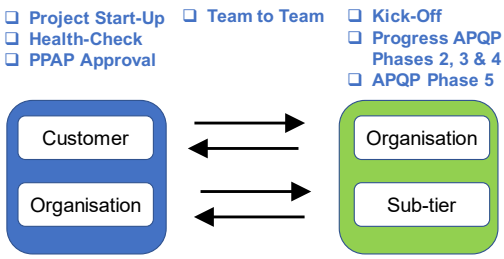
The coordination with AS9145 is through the APQP/PPAP Timing Chart, relationship with APQP Phases and linkage to the AESQ PPAP Events (Event icons).

Figure 17: APQP and PPAP Flow Diagram



Supply Chain Application

The APQP-PPAP Flow Diagram can be operated throughout the supply chain as a common customer/supplier management process by changing the ownership. I.e.: Ownership of blue/green transfers as it is applied within the supply chain levels (Customer of the product, organization and sub-tier providing product or service).



The Flow Step by Step

The APQP-PPAP Flow Diagram detail is explained within this chapter following the headline themes within the flow diagram of:

- **Project Start-Up.**
- **Team to Team.**
- **Kick-Off** (and associated steps 1 to 5).
- **Progress APQP Phases 2, 3 and 4** (and associated steps 6 to 10).
- **Health Check.**
- **PPAP Approval.**

For APQP Phase 5, see APQP and PPAP Essentials section.

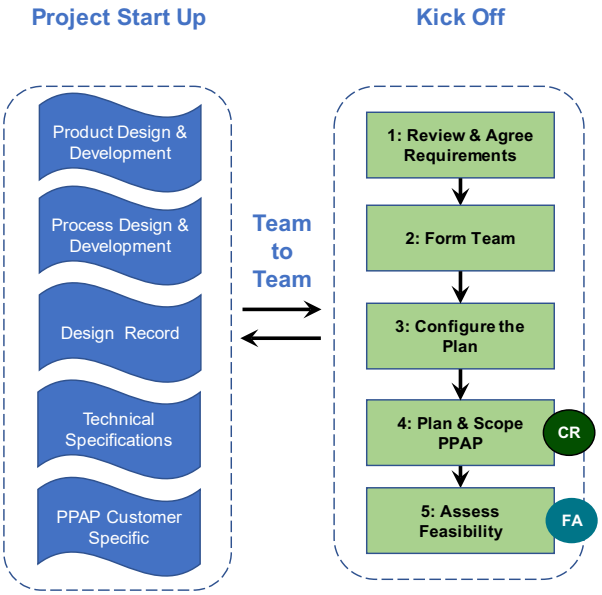
7.2 Project Start Up

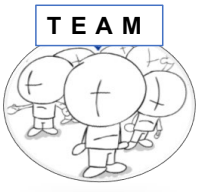
At the earliest point requirements are understood, captured and communicated to stakeholders.

The objective is to establish requirements that cover Product and/or Process design and development, design record and/or technical specifications and PPAP customer specifics.

The activities to establish these will depend on the change situation and responsibilities of the organizations involved. E.g.: For Product Design and Development during New Product Design or mod. (change situation) will be between organizations and their teams (Team and Team) using techniques such as Design for Manufacture/Assembly (RM13008). This aids the understanding of requirements, consideration of specific constraints and setting priorities in the Product Design Requirements.

Figure 18: Customer content of Project Start Up





The understanding and information flow between teams (Team to Team) is essential aspect of operating this APQP-PPAP flow which includes customer requirements.

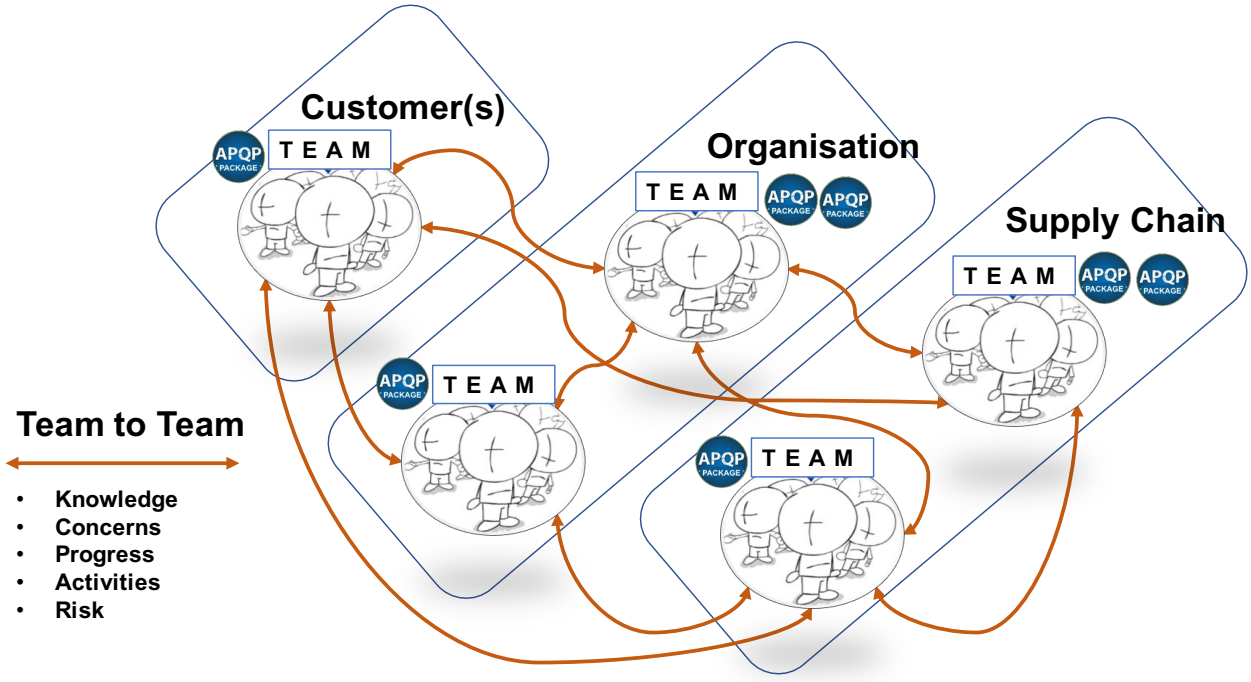
Types of APQP requirements are described within Appendix D: Planning Phase Deliverables Bite Size Explanation, and can be captured as Technical, Project Targets and Customer Specific Requirements for PPAP. The customers operation of the Supply Chain Risk Management Process will establish requirements associated with risk reduction actions, Heath-Checks (H-M-L) and PPAP Submission in accordance with required Submission Level (SL). See APQP and PPAP Essentials section and Supply Chain Risk Management Process (APQP Project Assurance).

7.3 Team to Team

Team to Team refers to the importance of establishing and maintaining good lines of communication with other teams across the associated project. The Team to Team links that are accounted for are:

- Knowledge gathering (Requirements understanding, Voice of Customer, Lessons Learnt, etc).
- Concern Management (as and when concerns occur real time corrective action).
- Progress Monitoring (how well is the plan going).
- Activities requiring input puts from/outputs to other teams (requirements flow, approvals, etc).
- AESQ Supply Chain Risk Management Process (APQP Project Assurance).

Figure 19: Team to team Connectivity



The landscape of a project will mean that multiple APQP Packages are managed across the involved teams. The independency between these is a fundamental aspect of Team to Team working and communication lines. Consider within your team and for the APQP Package(s) you own:

- Which other APQP Packages have important inputs/outputs?
- Which team(s) are accountable for these?
- How and when can your team most effectively communicate with these other teams?

7.4 Kick Off

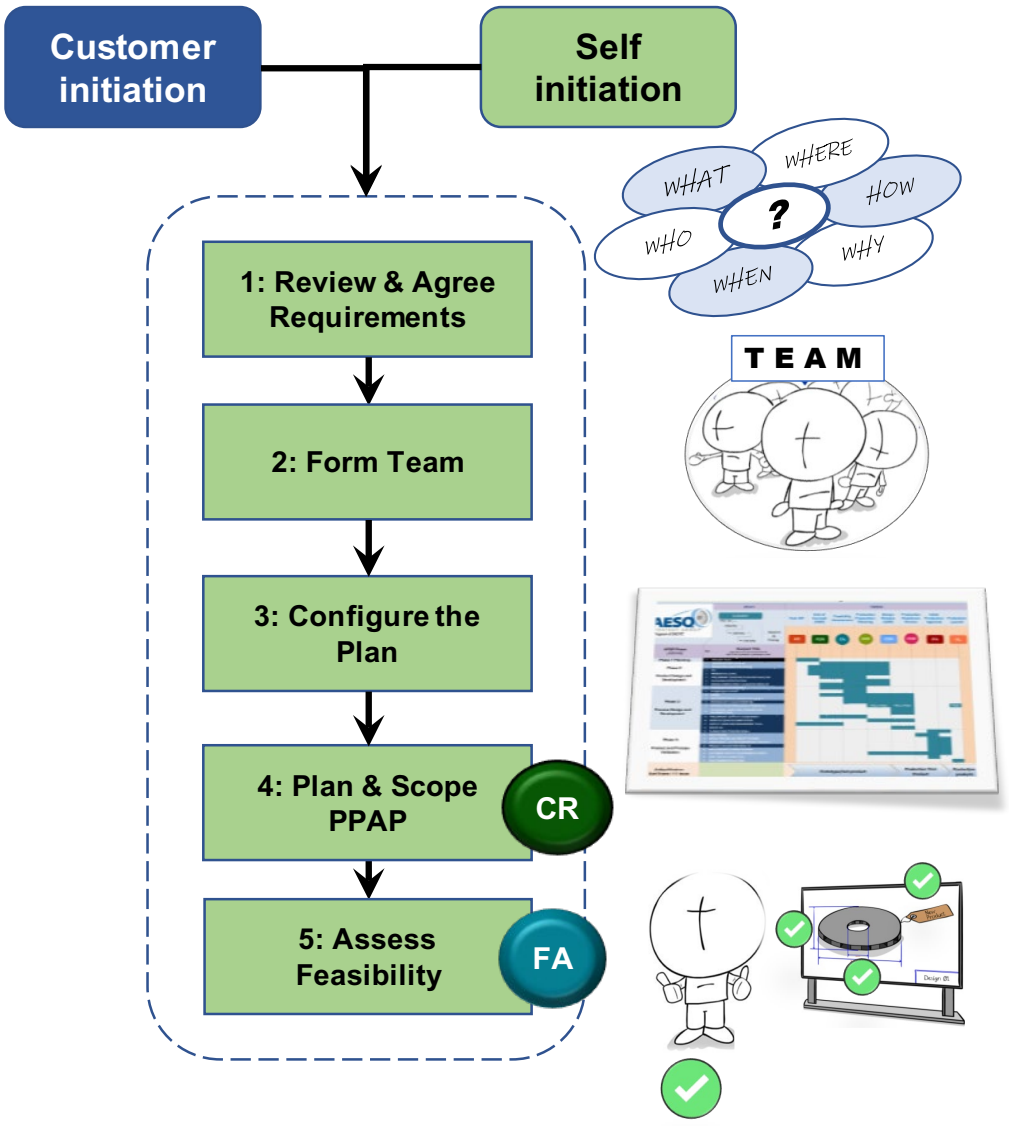
This aligns to the initiation of APQP Project Management (AS9145) by the organization and their application of APQP Phase 1: Planning found within the APQP Essentials section.

Customer initiation: this may start through a customer signal. E.g.: A new customer product, changes to the product by the customer engineering organization and changes to supply chain or processing requirements.

Self-initiation: the organization may also be a circumstance for this. E.g.: changes to supply chain by the organizations purchasing, process requirement changes by the organizations manufacturing, etc.

The identified Event icon circles (E.g. CR) help provide a timing relationship for these steps.

Figure 20: Steps of Kick Off

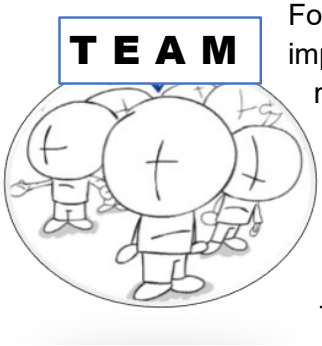


7.5 Review & Agree Requirements

The first step for the organization is to assign a project owner for the APQP project for their organization and initiate APQP Project Management (APQP and PPAP Essentials Section). It is important for the organizations in the earliest stage of the project to identify customer needs, expectations, and requirements. A multi-disciplinary team approach should be taken when completing this. Identifying and accounting for these is an important action which is an interaction with the Project Start Up aspect of the AESQ APQP PPAP Flow:

- Initate APQP Project Management; Project Owner, High-level Plan, Monitoring and Periodic Reviews.
- Define the roles and responsibilities of each area/department represented, consider application of APQP Phase (Application of APQP Phases table).
- Identify the customers, both internal and external.
- Determine the customer requirements; Translating the Customer wants and needs into Hows (Planning Phase Delievrables).
- Select the disciplines, individuals, and/or suppliers that must be involved with the team (Form Team).
- Understand customer expectations product. I.e., design.
- As APQP Packages become defined select a team leader accountable for the planning and progression of the plan.
- Assess the feasibility of the proposed design and/or requirements (Assess Feasilbilty).
- Identify costs, timing, and constraints that must be considered.
- Determine support required from the customer.

7.6 Form Team



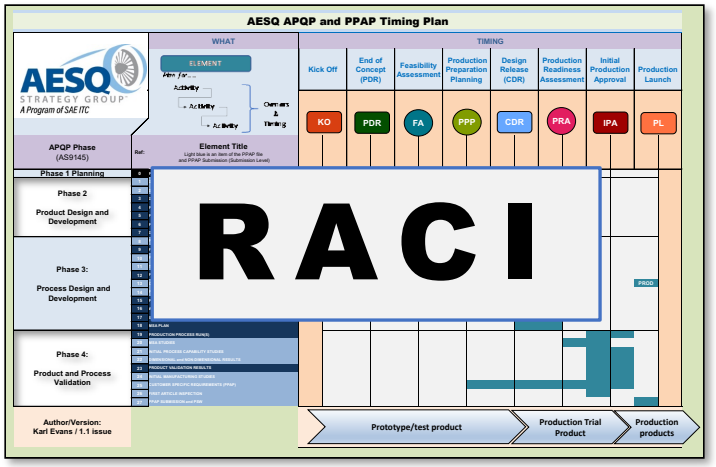
Forming and assigning responsibility to a multiple disciplinary team is an important aspect of APQP and PPAP Management. Effective operation requires involvement from all areas within the organization, customer and suppliers. A multi-disciplinary team includes representatives from engineering, manufacturing, material control, purchasing, quality, sales, field service, subcontractors, and customers as appropriate.

The size and mix of the team will vary depending on their scope of work and project timing. I.e. during the life of APQP Cycle team membership may change to accommodate for what is required during different periods. When resource planning a helpful technique is to consider what skills, knowledge and personal time commitment is needed for these stages;

	APQP Phase 1, KO* to PDR*	APQP Phases 2 and/or 3, PDR* to CDR/PRA*	APQP Phase 3 and 4, PRA* to PL*
What skills, knowledge and effort are needed	?	?	?

*referring to APQP and PPAP Events

It is important to account for this and conduct resource planning at the earliest point when forming the team. Progressing the planning activities as part of Configure the Plan will influence this along with the organization using aids such as APQP and PPAP Timing Plan.



Good practice is for organizations to have developed their version of the APQP PPAP Timing Plan to include a RACI for each of the Core APQP PPAP Elements. For each element the involvement of various roles are described as; Accountable, Responsible, Consulted and/or provide Input. These may vary for different situations.

To ensure the teams quality of work, APQP and PPAP competency needs should be accounted for with People Capability tools such as a Skill Matrix. For individuals wishing to find certified APQP and PPAP Training visit https://aesq.sae-itc.com/content/aesq-training

7.7 Configure the Plan

Each Plan is unique. The actual timing and sequence of execution is dependent on customer needs and expectations and/or other practical matters.

The Plan produced by the team contains a project objective and scope, which includes its relationship with one or more APQP Packages. It is most commonly represented in the form of a Gantt chart to make it easy to communicate to stakeholders and follow by the team members.

The APQP and PPAP Essentials section describes the role of the APQP-PPAP Timing Plan when planning for the Core 27 APQP. The plan produced by the team contains the activities, timing an ownership of activities associated to the APQP and PPAP Elements that are within scope.

Figure 21: Planning for APQP and PPAP

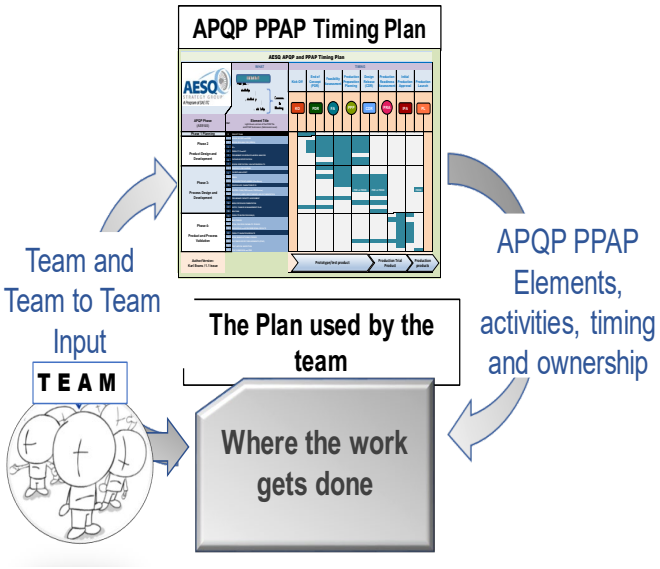
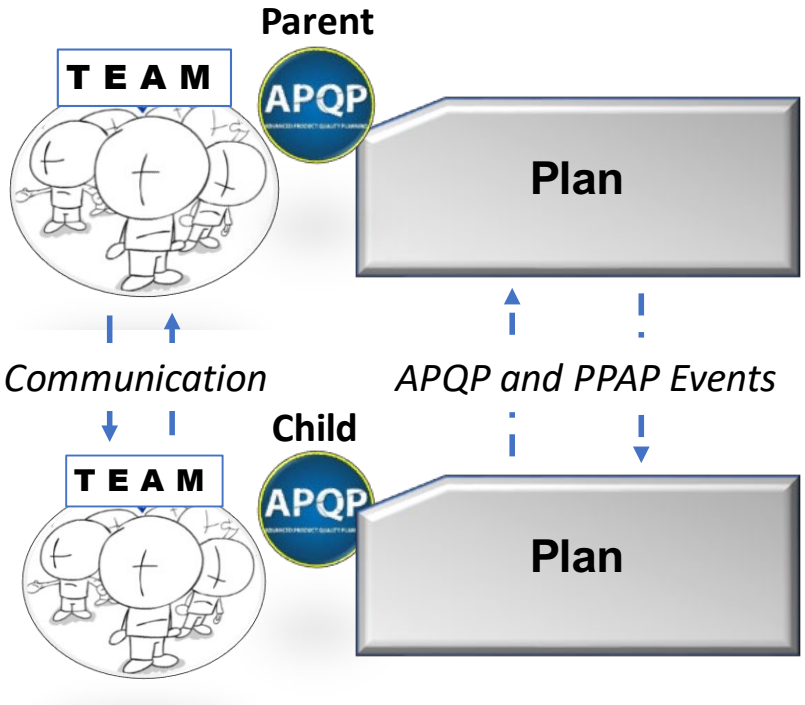


Figure 22: Connecting Team to Team Planning

The relationship with lower level APQP Packages (parent child relationship) and linkage to their plans is promoted through the Events and the planned project timing (baseline targets). Good practice is to represent these for associated APQP Packages as a timeline within the plan the team is using.



7.8 Plan and Scope PPAP

CR The activities and results from this step align with the Customer Specific Requirements Event. The Pass Criteria for this can be found in Appendix B.

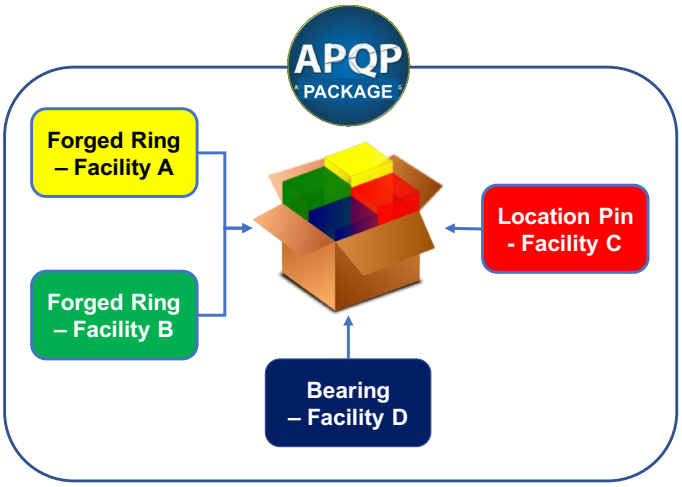
The planning activities specific to PPAP account for:

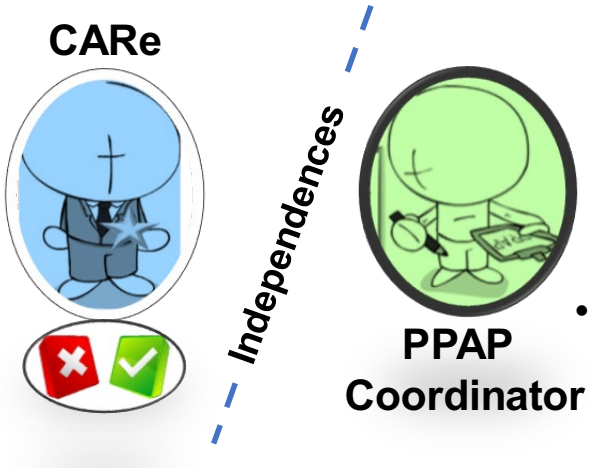
- The Production Process Run such as availability of product, availability of production resources and collection of data for related PPAP Elements (Step 8).
- First Article Inspection (FAI) is recognised as an element, RM131002 provides guidance on FAI and the planning of FAI which is an integrated part of this step.
- Providing the PPAP Submission (Step 10).

One or more PPAP Submissions can be linked to each APQP Package and this confirmed when planning. This is because a PPAP Submission relates to a product (casting, forging, component or assembly), the producing facility and the method used to produce this product (make, test, inspect, assemble, disassemble, processing, etc).

Figure 23: PPAP Submission v APQP Package

As an example, 4 PPAP Submissions are part of this one APQP Package. 3 products are involved and to be supplied using 4 facilities in total, as one product (forged ring) is dual sourced.





Two special roles support effective process management of PPAP, and an outcome of this step is to nominate who they are for each involved product. These roles are (see role profile);

- Customer Authorised Representative (CARe)
- PPAP Co-Ordinator

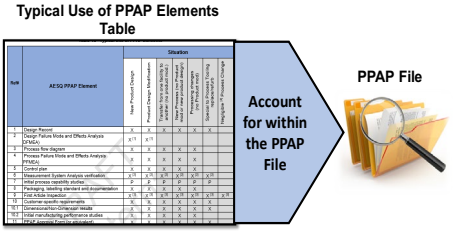
Table 11: Differences between PPAP File and PPAP Submission

The PPAP File should not be confused with the PPAP Submission. The difference is:

PPAP Submission	PPAP File
• Provides evidence of compliance to the CARe. • Content is based on the submission level.	• Acts as a source of real-time information and maintained as activities progress. • One source of information for the PPAP Submission. • The format maybe in many forms; paper, electronic, etc.

The PPAP File is useful in many ways because:

- ✓ It is a source of evidence for compliance audits
- ✓ It is a reference and standard for manufacturing to consult during the life of a product's manufacture.
- ✓ It is a source of information to support an investigation into a quality or delivery concern.
- ✓ It is a source of learning when planning the introduction of a product or process change or new product from an associated family.

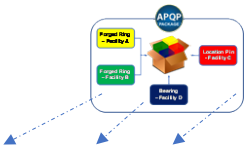


The content of the file will be influenced by the situation. E.g.: New Product v Transfer from one facility to another. This is mapped with AS13100 Chapter B and table 14: Typical Use of PPAP Elements.

For each planned PPAP Submission that relates to suppliers the submission level is determined (Section 9: Use of Submission Levels), the default being Submission Level 3. The customer will complete this as part of their Project Start-Up and the cascade of Customer-Specific Requirements.

Table 12: Mapping Content of PPAP Submission (Example Table)

When many products and PPAP Submissions are involved it can be useful to identify each within a matrix of what is required as illustrated:



Ref	Element title	Forging Ring - Facility A	Forging Ring - Facility B	Bearing - Facility D	Location Pin Facility C
1	Design Record				
2	Design Failure Mode and Effects Analysis (DFMEA)				
3	Process flow diagram				
4	Process Failure Mode and Effects Analysis (PFMEA)				
5	Control plan				
6	Measurement System Analysis Studies				
7	Initial process capability studies				
8	Packaging, labelling standard and documentation				
9	First Article Inspection				
10	Customer-specific requirements				
10.1	Dimensional/Non-Dimension results				
10.2	Initial manufacturing performance studies				
11	PPAP Approval Form (or equivalent)				

7.9 PPAP Co-Ordinator / Customer Authorized Representative (CARe)

See Appendix B for Training and Qualification for these roles.

Figure 24: PPAP Coordinator and CARe within the Supply Chain

Illustrated is the relationship between two key roles in connection with the table which are employers of their own organization:

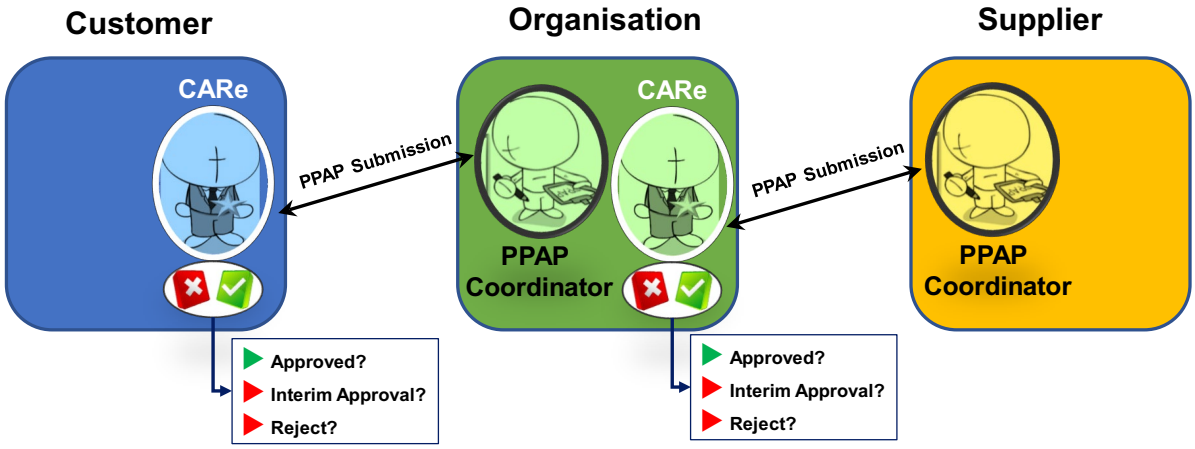


Table 13: PPAP Coordinator and CARe Role Profile

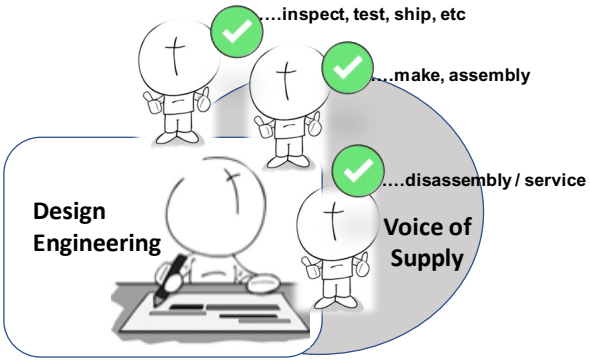
	PPAP Co-ordinator	Customer Authorized Representative (CARe)
What is this role?	They are the signatory of PPAP compliance for assigned product on behalf of the production supply organization. I.e. the facility producing the product. They co-ordinate the PPAP File, PPAP Submission and PPAP Management Process for assigned product.	They are the representative of the organization who receives the product from the production supply organization. I.e.: the customer within the supply chain. They are authorised on behalf of their organization to agree Customer Specific Requirements (PPAP) and conduct the disposition for assigned product.
	See APQP PPAP Flow diagram and associated reference information.	
What are they accountable for?	• PPAP File compliance • Verifying that the PPAP requirements are met on behalf of their organization. I.e. They check the PPAP submission before providing this to the customer. If any compliance gaps exist, they ensure corrective action plans accompany the PPAP Submission. • The signatory of PPAP compliance on behalf of their organization and for the product within scope. • Champion effective PPAP Process Management.	• Clarify and communicate requirements specific to PPAP and their products (PPAP Customer Specific Requirements). • Agree to adaptations of PPAP requirement where permissible. • Verify the result through the disposition process. I.e.: Approved or Interim Approval or Reject. • Promote active communication of learning and risk awareness among stakeholders.

7.10 Assess Feasibility

FA

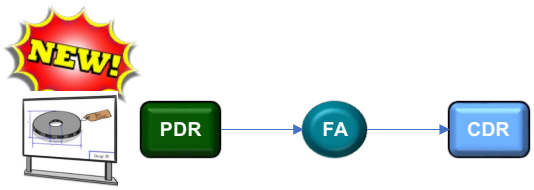
The activities and results from this step align with the Feasibility Assessment Event, the Pass Criteria can be found in Appendix B. The scope in this context would be for a new product design (or modifications) or non-product design changes such as a transfer from one facility to another.

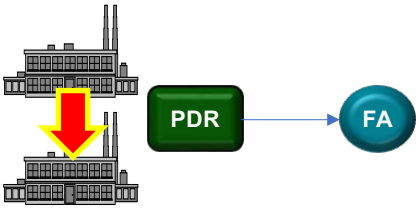
Does the design have the potential to be produced within requirements? The goal is to assess the product design and the potential for it to be produced through the involvement of production supply organization(s). I.e.: Confirm the issued design record (product specification or drawing) is feasible (likely, probable and possible to be produced). Produced in this context covers make, assembly, disassembly/service, inspect, test, ship, etc.



Early consideration of this and resulting action during the phases of APQP provide many benefits; Lower Production Cost, Higher Quality, Quicker Time to Market, Lower Capital Equipment Cost, Greater Automation Potential, Production up to Speed Sooner, Factory Availability, Fewer Engineering Changes

Feasibility Assessment provides a clear voice for the involved production supply organization(s) regarding the design's potential to be produced. This is different to PDR and CDR as they differ in purpose (see below) and usage during different situations (Event Application Matrix). E.g.: as illustrated, New Product Design v Transfer from one facility to another (no design change):





PDR

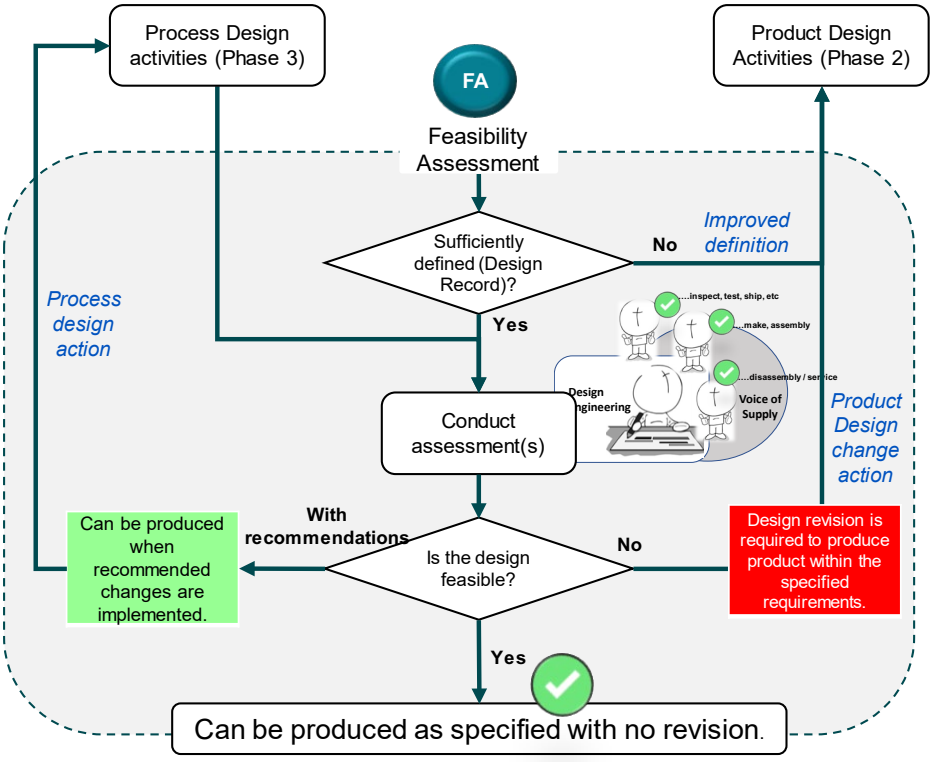
The purpose of this event is to demonstrate that the preliminary design meets all requirements with acceptable risk and within the cost and schedule constraints and decide whether to proceed with detailed design.

FA

The purpose of this event is to be confident at an early stage of the project in the potential to produce the product design during production. This confidence is established through the involved production supply organization(s) assessment of Feasibility.

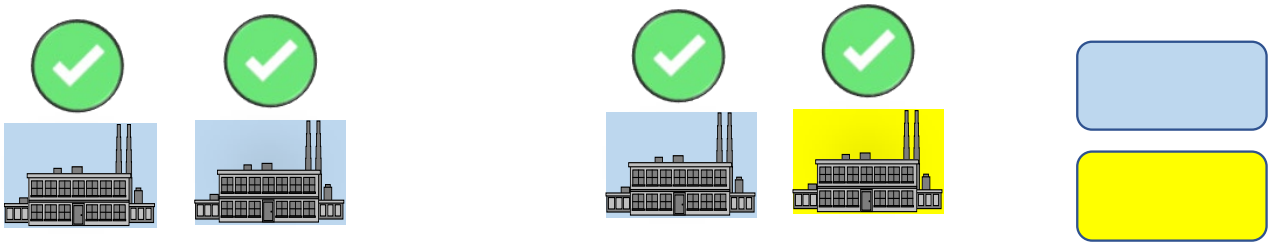
CDR

The purpose of this event is to demonstrate that the maturity of the design is appropriate to support proceeding with full-scale fabrication, assembly, integration, and test.

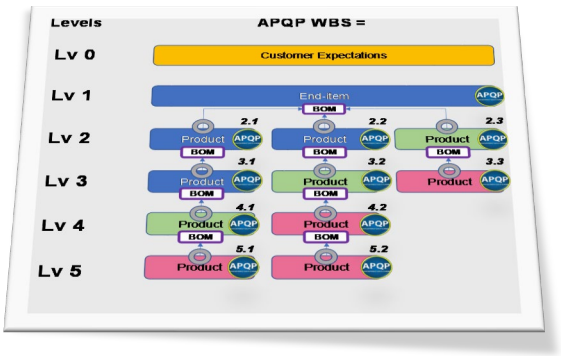


Typically, representation from production supply organization with experience and knowledge of the product and process options confirm the products feasibility. The product design is judged according to the pass criteria (Appendix B). Once ready, an assessment is carried out and actions taken if necessary. Those involved will be dependent on the organization's responsibilities.

I.e. To make, assembly, disassembly/service, inspect, test, ship, etc. This may mean more than one organization may need to make this judgement based on the supply responsibilities. E.g.: A manufacture (make) and a repair organization (service) for a product carryout manufacture and MRO activities during its life cycle or two manufacturers for a product subject to dual sourcing.



The APQP Work Breakdown Structure (WBS) aids determining which organizations need to be involved in this judgement. This may mean overall judgement is confirmed through everyone involved organization specific confirmation. I.e.: Everyone saying yes means a positive result.



The table below (which could be used as a form) captures several key considerations when determining feasibility. Good practice is for organizations to add their lessons learnt knowledge to these considerations. E.g.: Capture application of commodity standards or known capability data for evaluation.

Table 14: Feasibility Assessment (Example format)

Agree?		Considerations:
Yes	No	
		▪ Is the product adequately defined to enable feasibility evaluation?
		▪ Can the product be produced to design requirements (as written)?
		▪ Can the product be produced to design specifications / tolerances?
		▪ Can the product be produced with process capability to meet requirements?
		▪ Is there adequate capacity to produce product?
		▪ Does the design allow the use of efficient material handling/shipping techniques?
		▪ Can the product be produced within cost parameters?
		▪ Do capabilities exist to produce the product? Or can they be acquired?
		▪ Can the product be produced without incurring any unusual: ▪ Costs for capital equipment? ▪ Costs for tooling? ▪ Alternative methods? ▪ Compliance issues such as REACH?
		▪ Additional lessons learnt considerations: > > > > > > >

Feasibility Assessment Outcome:	
Feasible:	Can be produced as specified with no revision.
Feasible with recommendation:	Can be produced when recommended changes are implemented.
Not feasible:	Design revision is required to produce product within the specified requirements.

Notes associated with outcome:

7.11 Progressing APQP Phases 2, 3 and 4

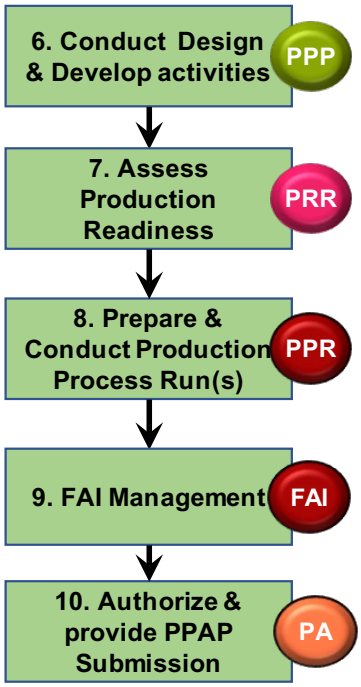
In reference to APQP PPAP Timing Chart, this aligns to APQP Phase 2: Product Design and Development, APQP Phase 3: Process Design and Development and APQP Phase 4: Product and Process Validation.

APQP Phase 2 is only fully operated when Product Design activities are taking place. I.e.: It's not relevant to changes such as –

- Transfer of production from one facility to another with no product modification
- New Process with no Product mods or new product design
- Processing changes with no Product mods
- Specific to Process Tooling replace/refurb

The identified Event icon circles (E.g. PPP) help provide a timing relationship for these steps.

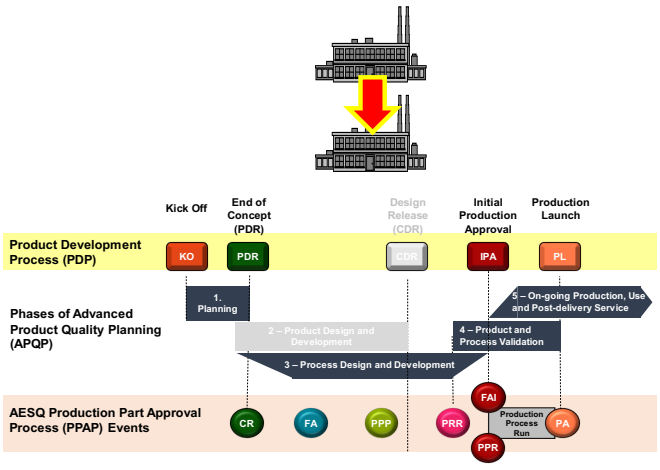
Figure 25: Steps of APQP Phase 2, 3 & 4

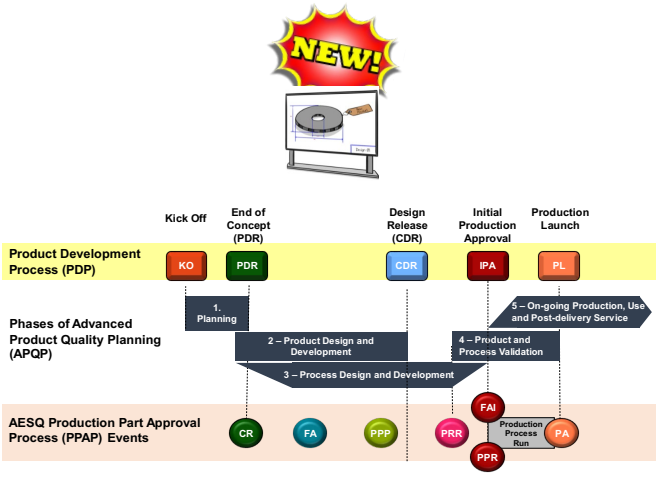


7.12 Conduct Design and Development activities

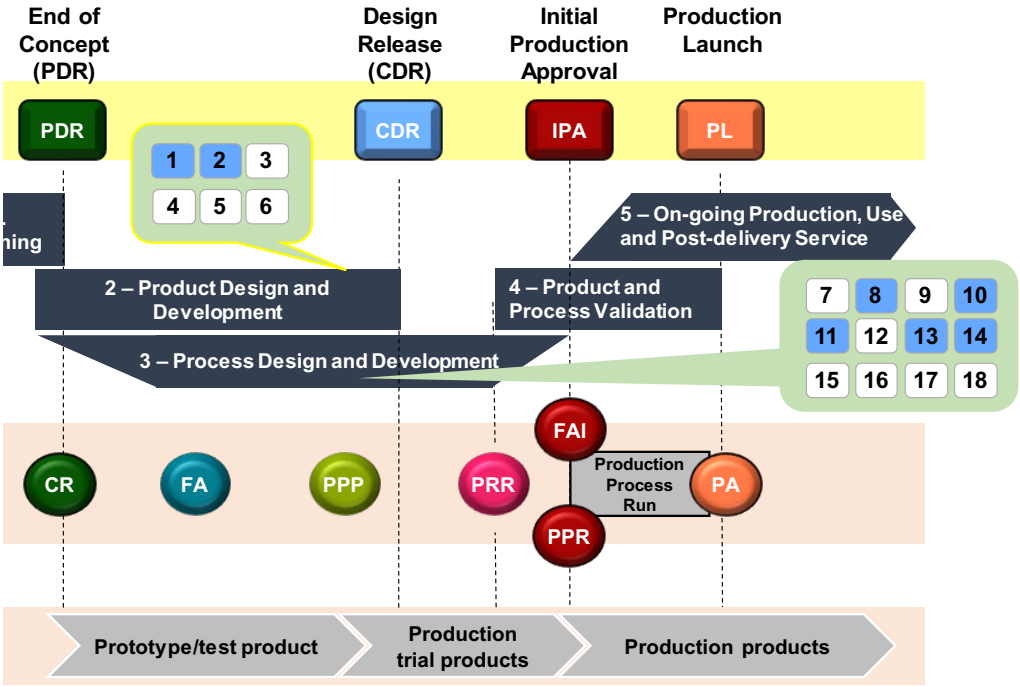
This refers to the execution of Phase 2 (Product Design and Development) and Phase 3 (Process Design and Development). Depending on the situation all or some of Phase 2, 3 and 4 applies (Table: Application of APQP Phases), along with the associated APQP-PPAP Elements. This concept is illustrated below by comparing Transfers (no product design change) and New Product Design and the greying out of Phase 2 and CDR.

Figure 26: Transfer v New Product Design application of Phase 2





The actual timing and sequence of APQP and PPAP Elements is dependent on the plan used by the team and other practical matters involving Team to Team interactions and needs. E.g.: Sequencing of activities to provide input information like availability of Design Record.



Illustrated are the APQP and PPAP Elements centred on Phases 2 and 3. The APQP and PPAP Essentials section explains these phases and the associated APQP and PPAP Elements, along with the creation of this plan.

Feedback activities are operated within the team and Team to Team on a suitable frequency so that learning and actions are managed in appropriate manner. Feedback is an important role within APQP and PPAP, the types involved are expressed within Team to Team section. I.e.:

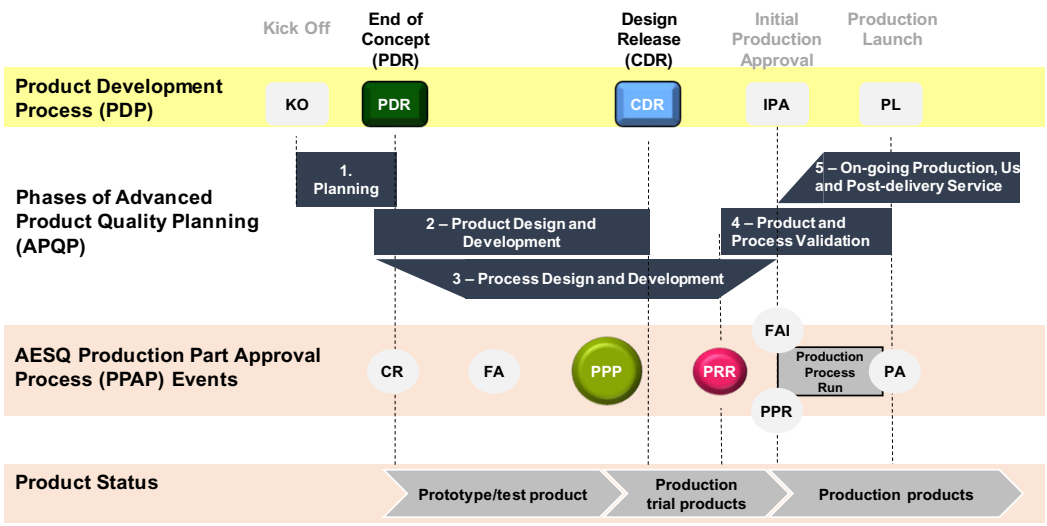
Feedback activities:

- Concern Management (as and when concerns occur real time corrective action).
- Progress Monitoring (how well is the plan going?).
- Activities requiring input puts from/outputs to other teams (requirements flow, approvals, etc).
- The AESQ Supply Chain Risk Management Process and APQP Project Assurance.

Functionally led practices are maintained such as reviews and the results from these are an integral part of the feedback taking place. The types of these will be dependent on situation for which APQP is being applied, along with the organizational responsibilities. E.g.: a new product design would involve Design Reviews.

Design reviews:

- These are regularly scheduled meetings led by the organization's design engineering activity and must include other affected areas. The design review is an effective method to prevent problems and misunderstandings. See RM13008.



Alignment to APQP and PPAP Events: This step shows alignment to Production Preparation Planning. This is to provide a simple datum point for timing for the process step. However, events such as PDR, CDR and PPR (next step) have relationship and should not be discounted when operating this step. CDR and PRR signal a delivery point for phase 2 and 3 respectively.

Production Preparation Plan Event:

This step aligns to the Production Preparation Plan event. The purpose is to ensure all the resources necessary for production are planned for. The Pass Criteria for the Production Preparation Plan Event can be found within Appendix B.

The planning needs to be though personnel with known and experience on the related activity themes (see below) and all of these will not always apply. This will be dependent on the needs of the production method (make, assemble, disassemble, inspect, test, location, automation, etc), customer schedule and demand rate.

The format and detailing of this plan would be based on the organizations planning tools and practices. The following provides an example of typical content and could be used as a basic plan template.

Table 15: Production Preparation Plan Content (Example format)

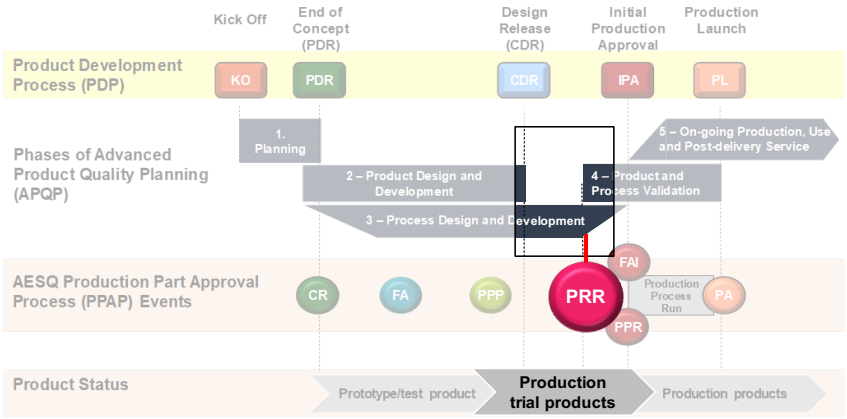
Activity Themes:	Action or Actions	Owner	Planned completion date	Status
Work station documentation	• . • .			
NC/CNC Programs	• . • .			
Material Handling and Packaging	• . • .			
Product Transportation	• . • .			
Workplace Visual Management	• . • .			
Maintenance planning	• . • .			
Tooling / Fixture	• . • .			
Operators: Recruitment, Training, etc	• . • .			
Equipment / Machines	• . • .			
Test / Inspection: Gauging, Fixtures, etc	• . • .			
New Equipment / Machine Commission	• . • .			
Material scheduling	• . • .			
Consumables	• . • .			
Material (casting, forgings, components, etc)	• . • .			

7.13 Assess Production Readiness

PRR

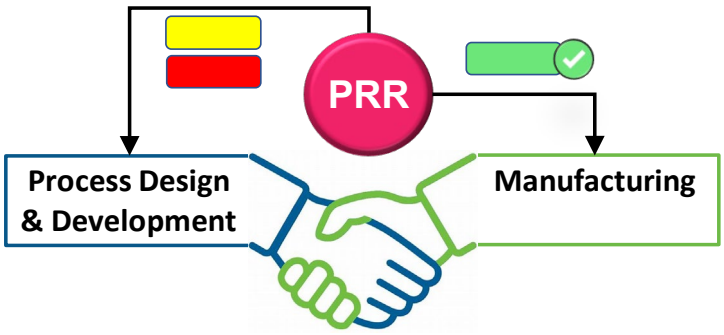
The activities and results from this step align with the Production Readiness Review Event and the Pass Criteria for this can be found in Appendix B.

The objective is that the manufacturing facility/area are confident that the production processes they will be using are appropriately defined, documented, and ready for production use. The attention is on the results from the Process Design and Development (APQP Phase 3) activities.



Typically, this is a review by a multi-disciplinary team of; operator training, manufacturing documentation, control plan, associated measurement tools, specification of equipment, tools and fixtures, maturity of developed processes and their evaluations (such as Manufacturing Readiness Level.)

They verify that the production processes are appropriately defined, documented, and ready for production use.



The focus for this should is the effects and quality of work taken place during the Process Design and Development activities. The following can be used as a check list when making the judgement of:

- Ready,
- Action Required or Not Ready:

Table 16: Production Readiness Review Judgements

Judgement	Criteria
Ready	Ready with no changes to the defined and documented process.
Action Required	Ready when recommended changes are implemented.
Not Ready	Revision required to defined and documented process to produce in production.

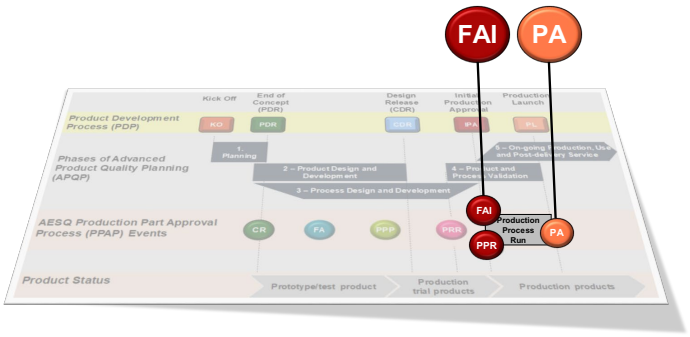
Table 17: Production Readiness Review Check List (Example format)

Consideration	Satisfactory?
Process Flow Diagram	Y / N / NA
Floor Plan Layout	Y / N / NA
Operator Training	Y / N / NA
Packaging, Labelling, transportation, etc	Y / N / NA
Test Inspection Planning (Char. Matrix)	Y / N / NA
Manufacturing Readiness Level	Y / N / NA
PFMEA	Y / N / NA
Process Key Characteristics	Y / N / NA
Control Plan (Pre-Launch / Production)	Y / N / NA
Preliminary Capacity Assessment Results	Y / N / NA
Work Station Documentation	Y / N / NA
Supply Chain Risk Management Plan	Y / N / NA
MSA Plan	Y / N / NA
Availability / schedule for production resources (Prod. Prep. Plan)	Y / N / NA

7.14 Prepare and conduct Production Process Run:

The Production Process Run or runs enables product to be produced using the intended production process for product and process validation. I.e.: Planned production standard and resources are used to make an agreed number of products, and the generated data is evaluated.

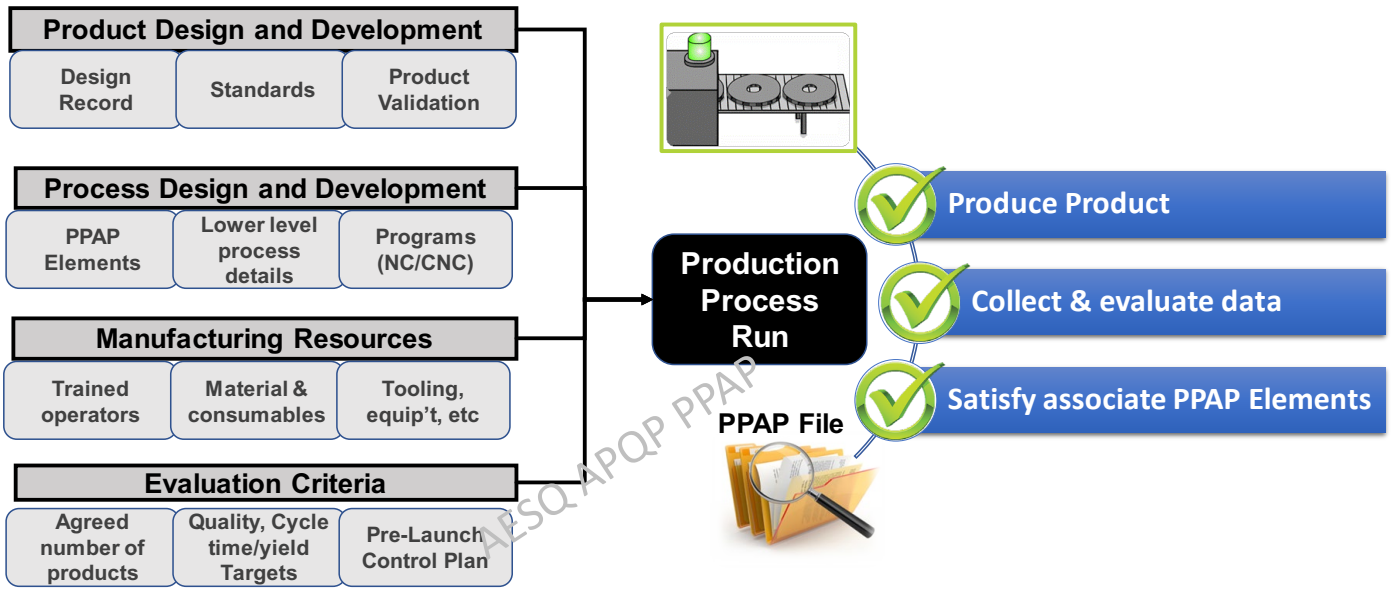
This can service FAI and PPAP requirements as they both equally use product produced using the production standard for data evaluation. The FAI Event is early and PA Event later in timing to the Production Process Run.



The Production Process Run(s) are carried out at the production facility. When submission level indicates a customer witness is required, involvement of the customer nominee takes place.

An effective Production Process Run depends on the right inputs. The goal is for product and data to provide objective evidence that PPAP Elements have been satisfied.

Figure 27: Attributes of the Production Process Run(s)



- **Produce Product, collect / evaluate data and satisfy the associated PPAP Elements:**

The results obtained from the production process run are used to satisfy the requirements of the AESQ PPAP elements (AS13100 Chapter B). The associated elements to the Production Process Run(s) are:

- **Measurement System Analysis Studies –** These taken place when called for by the MSA Plan. They provide an understanding of the capability of the specified test or inspection. Measurement System Analysis (MSA) can be established using several methods such as full gauge R&R, repeatability study, measurement uncertainty analysis, or attribute agreement analysis. A study of measurement system bias confirms the measurement results are valid. See RM13003.
- **Initial Process Studies -** This type of data refers to key characteristics and the confirmation that the process used is capable and stable. I.e.: Measure and evaluate against SPC targets (CpK). See RM13006.
- **Dimensional / Non-Dimensional results -** This type of data to demonstrate the achievement of targets for metrics such DPU (Defects Per Unit). They are also a source for reduced/sample inspection authorisation, and provide physical data on sample parts, and data to support verification activities. See Appendix C.
- **Initial Manufacturing Studies -** This type of data is collected during the production process run for an agreed number of products to determine rate potential of the manufacturing method. I.e.: Measured cycle times and yield rate and compare them to targets for the required rate. See Appendix C.

7.15 FAI Management

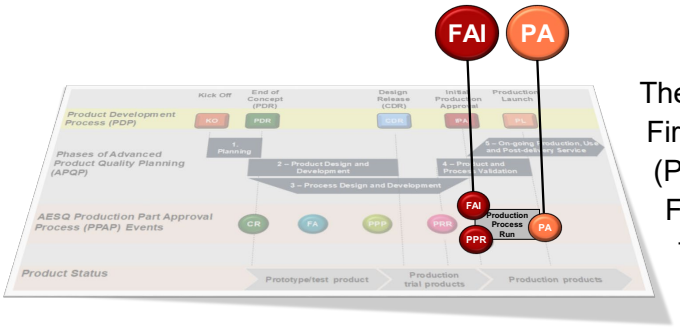
FAI	The activities and results from this step align with the First Article Inspection Event and the Pass Criteria for this can be found in Appendix B.

First Article Inspection (FAI) Management is conducted to determine Product Verification (AS9145) and RM13102 provides detailing on FAI Management. The planning activities during Step 4 (Plan and Scope PPAP) accounts for First Article Inspection Report (FAIR) for the product(s) in scope. Typically, when Customer Specific Requirements call for Customer Engineering Approvals (Appendix C), the timing of this would synchronise with this step of the process and satisfying the FAI Event.

Table 18: First Article Inspection v PPAP Submission

FAI	FAI approval is of the part regarding the product sample. FAI is part of PPAP but may be approved prior to the PPAP Submission.
PA	PPAP is approval of the process from a facility regarding the product.

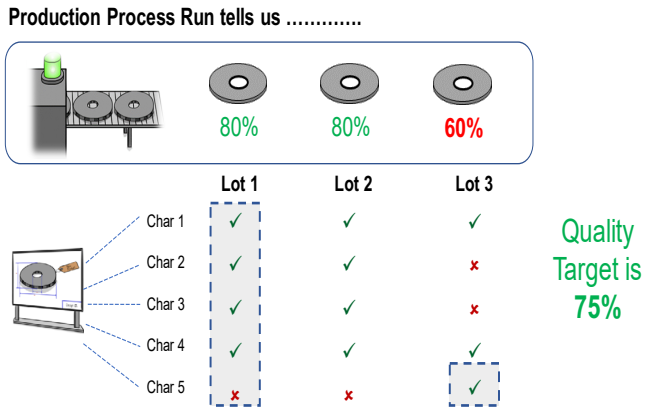
Figure 28: Timing of First Article Inspection and PPAP Submission



The timing is represented by the PPAP Events of First Article Inspection (FAI) and PPAP Approval (PA). The Production Process Run serves both FAI and PA, thus providing first production parts for FAIR requirements.

Figure 29: Differences between FAI and PPAP

When considering the following illustration and confirming Quality, the differences between FAIR and PPAP Approval would be:



- FAIR confirms the process can produce all characterises at least once. By lot 3 this has taken place.
- PPAP Approval confirms the performance of the process against quality target. By Lot 3 the performance is not achieving target of 75%, even when the FAIR is approved.
- Both utilise common data from making production part; however, they provide different validations regarding quality.

7.16 Authorize and provide PPAP Submission

PA The activities and results from this align with the PPAP Approval Event and the Pass Criteria for this can be found within Appendix B

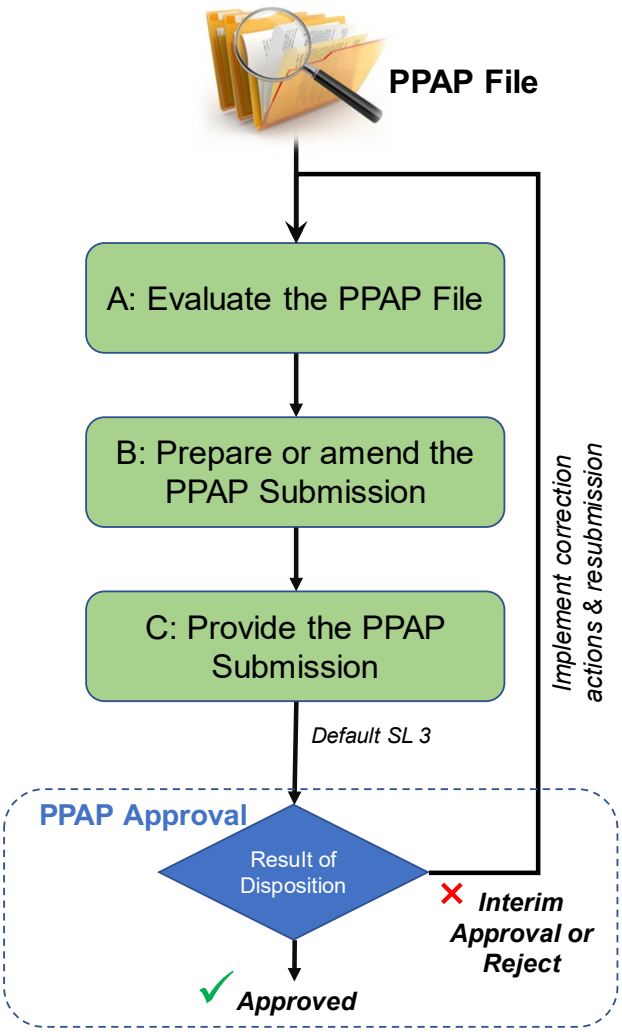
Refer to Step 4 (Plan and Scope PPAP) regarding these roles; PPAP Coordinator and Customer Authorised Representative (CARe).

The PPAP Coordinator who is responsible for the product is accountable for authorising and providing the PPAP submission on behalf of their Organization. The steps taken are illustrated in the following flow. This starts by evaluating the PPAP File and finishes when the Approval Form is “Approved” as an outcome of the disposition of the PPAP Submission.

> Interim Approval or Reject status means the process is not complete, compliance gap closure plans are implemented, and a re-submission takes place.

The following section explains each step.

Figure 30: Preparing and providing PPAP Submission flow diagram



A. Evaluate the PPAP File

The PPAP File is reviewed for completeness against AS13100 and customer specific requirements.

There is a distinction between the PPAP file held at the Production facility and the PPAP Submission. The Production facility hold of all the PPAP elements mandated by AS13100/AS9145 within the PPAP File. The format and structure of this is constructed to be useful to the facility and how it operates. Items could be within and/or link from this. It could be paper based or electronic.

The PPAP submission is based on the assigned Submission Level which may involve all or some of the PPAP Elements and provides evidence of compliance to the PPAP standard. The format and structure of this is constructed to be useful to the PPAP Co-Ordinator and Customer Authorized Representative (CARe). Take Submission Level 1 as an example, the contain of the PPAP File covers all the elements that apply and the PPAP Submission is solely the Approval form.

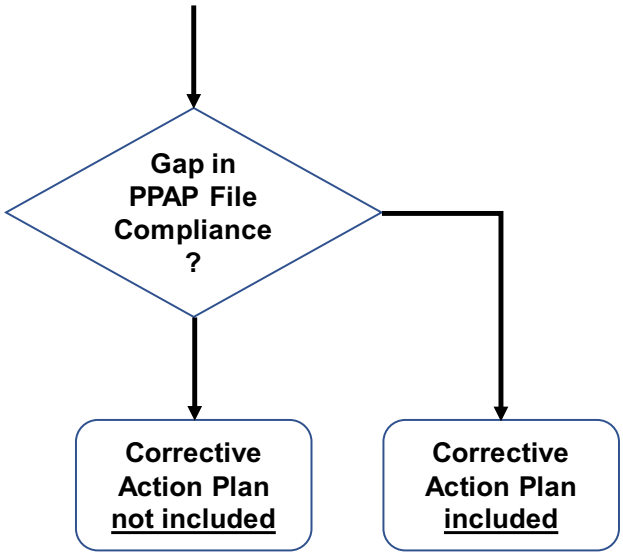
When evaluating the PPAP File the PPAP Coordinator has appropriate involvement of the team members and Subject Matter Experts (those with specialised knowledge on Elements). They support the evaluation of the PPAP File compliance and where gaps in compliance exist, corrective actions are planned and implemented.

B. Prepare or amend the PPAP Submission

The PPAP Coordinator creates a new PPAP Submission or amends a previously provided PPAP Submission when this has been judged as Interim Approval or Reject (resubmission).

When preparing the PPAP Submission (or resubmission) the PPAP Coordinator prepares the evidence in a suitable format that is understandable by the Customer Authorised Representative (CARe). This covers each PPAP Element required for submission (I.e.: what is called for by the Submission Level) and customer specific requirements.

Figure 31: Use of Corrective Action Plan



Corrective action plan(s) are included to resolve gaps in compliance identified by the PPAP Co-ordinator (or others who have been involved) during the PPAP File evaluation. The Corrective action plan includes commitment date for re-submission and information on any containment actions to ensure that only acceptable product is released to the customer. The following table captures the typical content of a corrective action plan.

Table 19: Corrective Action Plan for PPAP Submission (Example format)

Ref	Element title	Concern	Owner	Planned completion date	Action or related action document reference	Status
1	• Design Record					
2	• Design Failure Mode and Effects Analysis (DFMEA)					
3	• Process flow diagram					
4	• Process Failure Mode and Effects Analysis (PFMEA)					
5	• Control Plan					
6	• Measurement System Analysis Studies					
7	• Initial Process Capability Studies					
8	• Packaging, labelling standard and documentation					
9	• First Article Inspection					
10	• Customer-Specific Requirements					
10.1	• Dimensional/Non-Dimension results					
10.2	• Initial Manufacturing Performance Studies					
11	• PPAP Approval Form (or equivalent)					

C. Provide the PPAP Submission

When providing the PPAP Submission, the following takes place:

- The PPAP Coordinator issues the PPAP Submission (inclusive of PPAP Approval form or equivalent) to the Customer Authorised Representative (CARe). Example reasons for issue are captured in the below table.
- The PPAP Coordinator maintains suitable communication with the CARe during the disposition process which provides the result of either: Approved, Interim Approval or Reject.
- The PPAP Coordinator receives the response to the PPAP Submission from the CARe. They inform all key stakeholders of the result and ensure the PPAP File is updated. When the result is Interim Approval or Reject; they ensure any gaps or concerns raised have been understood and corrective action plans defined and implemented. The owners of any required action plans to address non-compliance (gaps) manage these and maintain communication with the PPAP Coordinator and Leader of the team, etc.
- Prior to a resubmission being provided repeat A and B.

Table 20: Example Reasons for PPAP Submission

Reason	Description (this signifies)
Initial Submission	The Approval Form is related to a first-time submission for this product and for the facility.
Correction of Discrepancy	The Approval Form is a repeat submission to correct a deviation or error on the prior submission.
Post Initial Submission	
Engineering Changes	The Approval Form is a result of engineering changes to this product.
Tooling	The Approval Form is a result of process change to tooling. Either the modification, transfer, replacement, refurbishment or additional tooling for production.
Sub-Contract/Sub-Tier or Material/Source Change	The Approval Form is a result of change of supply chain (source or material at a sub-contractor).
Change in Product Processing	The Approval Form is a result of a change to facilitates production process (make, assembly, disassembly, test, inspection, processing, etc).
Correction of Discrepancy	The Approval Form is a repeat submission to correct a deviation or error on the prior submission.

7.17 PPAP Approval

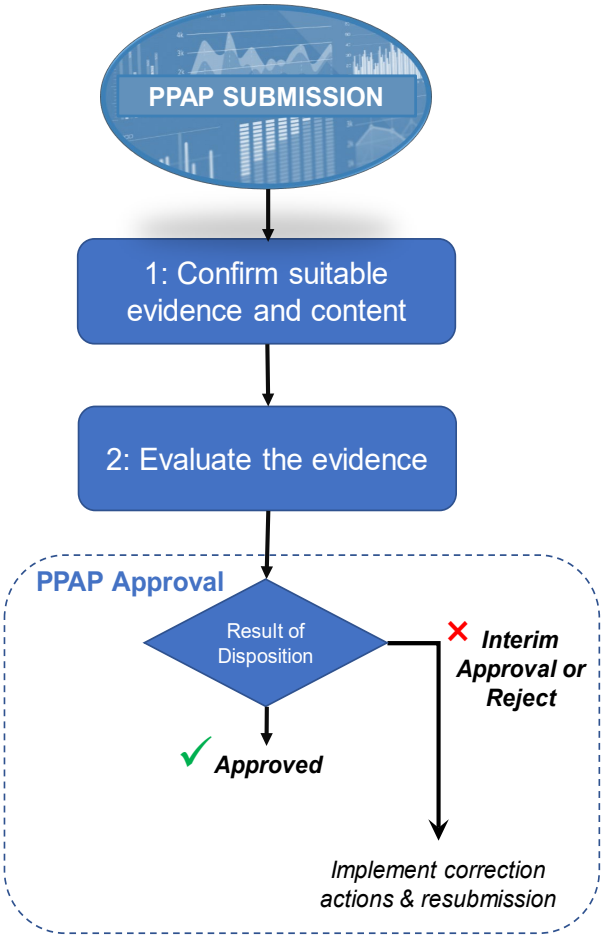
Disposition Process

Two roles specific to PPAP are referred to within this guidance; PPAP Coordinator and Customer Authorised Representative (CARe). The responsibility for the disposition process is with the CARe.

The CARe receives the submission and;

1. For each PPAP element required by the Submission Level (AS13100), confirms that suitable evidence and content has been provided, including necessary corrective action plan(s). The PPAP Coordinator is expected to have included a corrective action plan when they have identified compliance gaps.
2. Evaluate the evidence against AS13100 requirements, including customer specific requirements. Determine if each Element is acceptable to the requirements of AESQ APQP and PPAP, and associated standards (Accept) or not acceptable (Reject). See figure 32, the Disposition Element Summary (or equivalent) can provide a record of this per Element. When the evidence was not required this would be “N/A”. I.e. Submission Level did not call for “Submit” or the type of situation is not mark “X”, etc. (AS13100 Chapter B). The CARe would make a note of this and explain why the evidence content submitted is not acceptable as evaluation comments. A record of the disposition is made using the associated PPAP Approval Form or equivalent (e.g.: Customer specified form) and documentation.

Figure 32: PPAP Disposition Process Flow



The PPAP submission is dispositioned using the Approval Form as; Approved, Interim Approval or Reject:

- Approved would be when all PPAP Elements are accept (no reject) and the CARe is convinced that no concerns exist and all PPAP requirements have been fulfilled.

- Interim Approval or Reject require a resubmission, corrective action plan(s) and implementation of controls such as ship authorizations of the product under the conditions/restrictions.

Table 21: Disposition of PPAP Elements Summary (Example format)

Ref	Element title	Accept	Reject	N/A	Evaluation Comments
1	Design Record				
2	Design Failure Mode and Effects Analysis (DFMEA)				
3	Process flow diagram				
4	Process Failure Mode and Effects Analysis (PFMEA)				
5	Control plan				
6	Measurement System Analysis Studies				
7	Initial process capability studies				
8	Packaging, labelling standard and documentation				
9	First Article Inspection				
10	Customer-specific requirements				
10.1	Dimensional/Non-Dimension results				
10.2	Initial manufacturing performance studies				
11	PPAP Approval Form (or equivalent)				

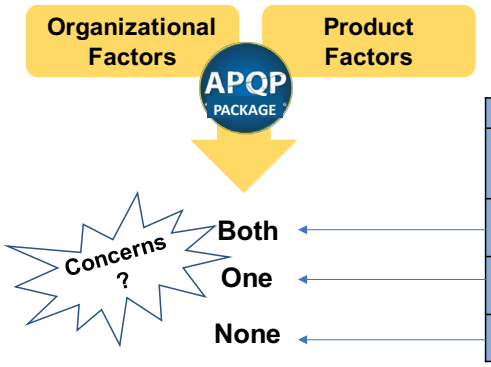
7.18 Health Check aspect of APQP Assurance Framework

The purpose of the framework is to prompt a common standard up and down the supply chain, within Projects and Team to Team. Within the APQP and PPAP Essentials section the Supply Chain Risk Management Process describe how this is applied.

Figure 33: APQP Assurance Framework and use of H-M-L

Each organization should establish a practice to determine risk. As the Supply Chain Risk Management Process explains the guidance is to base this on the involved organization (E.g.: producer) and product. When operating the framework (as guidance):

- Low means neither Organization or Product are of concern.
- Medium means one of these is of concern.
- High means both Organization or Product are of concern.



APQP Assurance Actions				
Health Check Rating	Health Checks			PPAP Approval
	Progress Updates [1]	Metrics [1]	Approval of Event [1]	PPAP Submission [1]
H	Y (maximum customer frequency)	Y	Y (all)	Y (based on SL)
M	Y (minimum customer frequency)	Y	Y (configured)	Y (based on SL)
L		Y		Y (based on SL)

Operating to this framework provides:

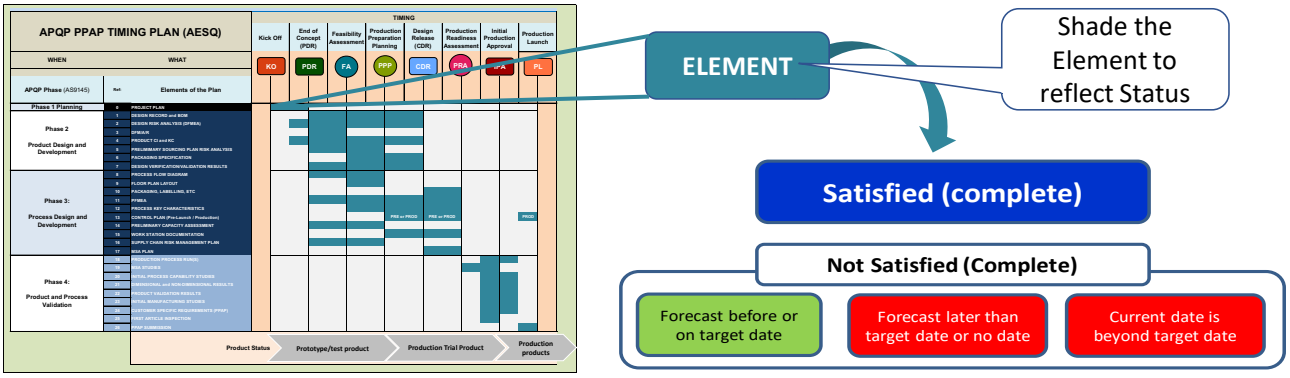
- **Progress Updates**

This refers to Periodic updates on progress relating to plans which at least should account for:

- Project Plan – Product Introduction activities
- Production preparation plan – implementing the resources for ongoing production.

The APQP PPAP Timing Plan provides a template for the project plan updates by colour coding the elements by status in relation to its associated APQP Package:

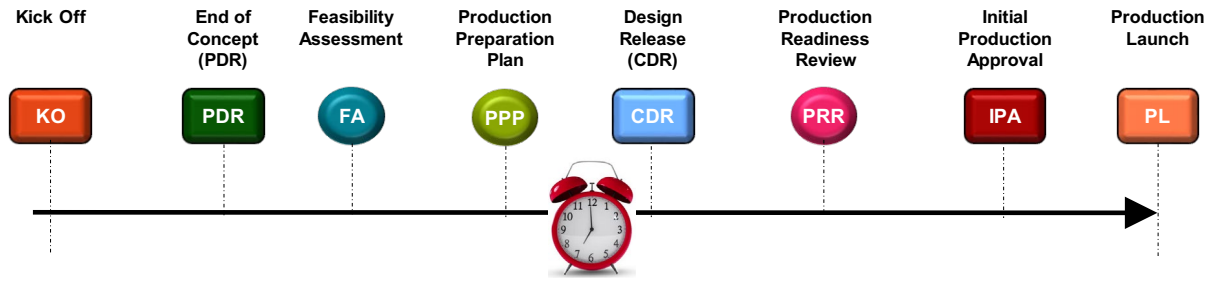
Figure 34: Progress Reporting of APQP Status



Metrics:

For APQP and PPAP the use of metric has a relationship with timing, where in the cycle the project is means that particular metrics are more relevent than others. The alignment of suggested metrics in the following table is to demenstrate what is revelent where:

Table 22: Example Metrics

KO* to PDR*	PDR* to CDR/PPR*	PRA* to PL*
1. APQP Package and Event adherence.		
2. APQP Packages with a resourced plan.	3. Products with contracted source (make or buy). 4. Products confirm as Feasible (FA). 5. Products released through CDR. 6. Processes released through PRR.	7. Products and PSO with Complete FAIR. 8. Products and PSO with Approved Approval Form.
*referring to these APQP and PPAP Events PSO refers to Production Supply Organization. I.e.: facility producing the product  		

- **Approval of Events:**

This refers to APQP and PPAP Events and an independent agreement/approval by an accountable person (a decider) for the final decision that the Event Pass Criteria has been satisfied. This principle works for various situation. E.g.: could be for product as it is undergoing the transfer from one facility to another, or when product design change is taking place. Which actual Events would be within scope varies by situation (Event Configuration Table).

The purpose is to develop confidence in APQP efforts as the project progresses and apply suitable independent experience / review of the quality of working. This will be between customer and organization and/or through identified roles within the organization.

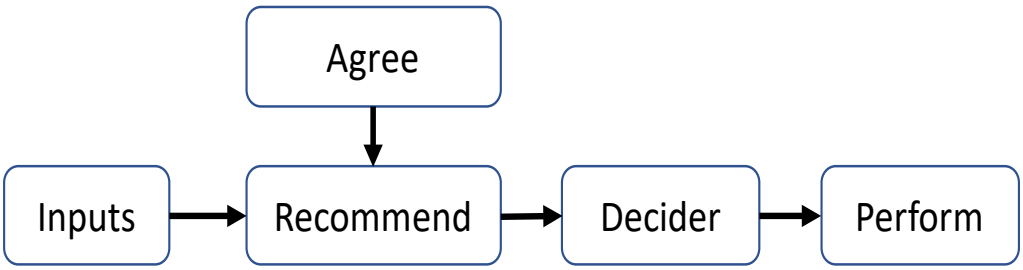
"Event Pass Criteria" can be found within Appendix B and adding to this with organizational learning, experience and know how is recommended. I.e.: Additional confirmations to those stated within the Pass Criteria.

Table 23: Configuring Events for Agreement/Approval

The framework identifies the application of this as:

High – Y (all)	This meaning that an independent agreement/approval takes place for all the events.
Med – Y (configured).	This meaning that an independent agreement/approval takes place for some of the events (typically PDR, CDR, IPA and PL when applied) and the team is responsible for the remaining.
Low – Blank	This meaning that no independent agreement/approval takes place for any events and the team is responsible for this.

Figure 35: APQP and PPAP Event RAPID

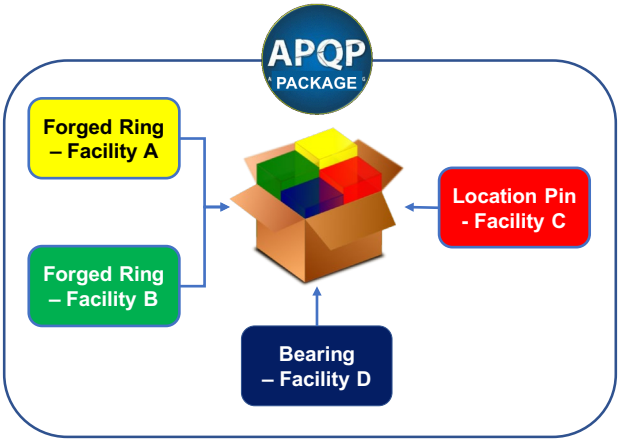


Good practice is for organizations to apply a clear decision structure such as RAPID (Recommend, Agree, Perform, Input and Decide). This clearly confirms the involvement of departments and/or job role and actions they carry out. How this works in practice follows this diagram.

- **PPAP Submission:**

This refers to the evidence provided as part of PPAP which is determined by the Submission Level used. Once this is provided the disposition takes place; See the disposition process to understand how this is carried out.

8. Use of Submission Levels



Submission levels are from SL1 to SL5, with the default level being set as SL3. They relate to the PPAP Submission oppose to the APQP Package. The example of this difference is covered earlier in the Plan and Scope PPAP step of the APQP and PPAP Flow Diagram. I.e.: the illustration shown.

8.1 Retention/Submission Table

The Retention/Submission table can be found in Chapter B of AS13100. For each of the elements any combination of the letters S, R, C, W are assigned for each of the 5 submission levels (example provided below). These letters are instructions on how each PPAP element, for a given submission level, should be managed. In all instances, supporting data for the PPAP elements is gathered regardless of the submission level set. The submission level relates to what is submitted, not what takes place during APQP. I.e.: the actual work that the organization is required to do for SL1 is the same as that for SL5.

Element Ref.	AESQ PPAP Element	Submission level				
		SL1	SL 2	SL 3	SL 4	SL 5
1	Design Record	S R	S R	S R	C R	S R W

Table 24: Meaning of Retention and Submission Table Key

S	**Submit;** this means that each element that has S in the table will require documentation, results, data, etc to be submitted.
R	**Retain;** this means that each element that has R in the table is retained as part of the PPAP file.
C	**Consult**; this means that each element that has C in the table can be either (S) and/or (W) and the specifics is agreed with the Customer Authorised Representative (CARe) as a customer specific requirement.
W	**Witness;** this means that each element that has W would be witness by the Customer Authorised Representative or nominated representative through a supporting data/information review at the manufacturing location.

8.2 Changing the Submission Level

To change from the default submission level (SL 3) the following is used as a decision aid.

Table 25: Criteria for Changing the default Submission Level

When both the scope and circumstance is valid then the change from SL 3 to the selected Submission Level should be taken.		
Submission Level	**Scope**	**Circumstance**
SL 1	Disposition of Approval form (confirming compliance or gaps and corrective action plan).	• The Production Supply Organization (I.e.: producing facility) demonstrates good quality / delivery performance and APQP and PPAP process management *and* • No foreseen concern with this product and Change Situation. I.e. New Product Design or Modifications, Transfer from one facility to another, New Process or Processing changes, etc
SL 2	Disposition of Approval form (confirming compliance or gaps and corrective action plan) and supporting SPC data	• The purpose is to evaluate quality performance of the process; Process capability of Key Characteristics and quality metrics such as Defects per units (DPU)
SL 3 **(Default)**	Disposition of Approval form (confirming compliance or gaps and corrective action plan) and all associated elements	• Default unless alternative submission level is specified
SL 4	Disposition of content to be agreed through submission and witness combinations	• When tailoring the combination of submission/witness is necessary
SL 5	As SL 3, disposition is supported by witness activities	• The Production Supply Organization (I.e.: producing facility) quality / delivery supply performance and management of their Product Development Process is unknown *or* • Level of risk for this product and/or type of processing is of concern for the situation (New Product Design or Modifications, Transfer from one facility to another, New Process or Processing changes)

Appendix A.: Training and Qualification

For individuals wishing to find certified APQP and PPAP Training visit https://aesq.sae-itc.com/content/aesq-training

The purpose of this section is to outline the syllabus for training providers to develop training content that will be recognised by the AESQ Strategy Group members and endorsed on https://aesq.sae-itc.com/content/aesq-training. Training provider must ensure that the course includes enough time on these mandated aspects, have completed the registration process with AESQ APQP/PPAP SME's and be an AESQ Recognized Training Provider.

APQP and PPAP Training:

This training is aimed at those employees that are directly involved in APQP and PPAP as team members who are working the process and/or leadership within businesses deploying AS13100 APQP PPAP.
.
Typically, they will be from the Design, Manufacturing Engineering, Quality, Operations and Maintenance functions.

The training should include an assessment to evaluate learning and award individuals with recognition of their personal learning.

Table 26: Syllabus for APQP and PPAP Working Together Training Standard

THEME	OUTCOMES	MINIMUM CONTENT
Applying APQP and PPAP within businesses and supply chains	• Appreciate the benefits of applying APQP and PPAP different situations. • Understand how APQP and PPAP can be applied to different situations.	• Understanding the role and benefits of APQP and PPAP when managing Product Introduction (New Product Design or Modifications, Transfers, New Process introduction, etc). • Outline how APQP and PPAP is applied within the different situations used within RM13145. • Provide examples of application. • Explain the relationship between RM13145 and associated RM13xxx documents.
APQP and PPAP Essentials	• Understand the content of the APQP and PPAP Timing Chart. • Understand key principles of APQP Project Management. • Understand the actions to initiate Projects. • Appreciate all 27 core APQP and PPAP Elements.	• Understand the content of the APQP and PPAP Timing Chart; 5 phases of APQP, APQP and PPAP Events, Product Status and their relationships. • Explain the actions to initiate Projects through Kick Off to PDR including Planning Deliverable. • Describe how to achieve Kick Off and PDR Pass Criteria. • Identify each Planning Deliverable; What this is, how it is conducted and application for different situations. • Explain how to establish APQP Packages and Work Breakdown Structures. • Understand the importance of multiple function teams and good management practices. • Identify for each of the core 27 APQP and PPAP Elements; What these are and how they are conducted • Explain the use of APQP and PPAP Timing Plan, providing examples of planning good practices • Explain the differences of types of Control Plans and examples, their application and benefits.
Applying Project APQP Assurance	• Understand the AESQ Supply Chain Risk Management Process and APQP Project Management Framework	• Explain methods of determining H-M-L Risk. • Identify types of risk reduction actions and examples. • Identify types Progress Review and Metrics, explaining their use during Projects. • Explain the Pass Criteria for APQP and PPAP Events, application in different situations and independent agreement/approval. • Understand the concept of RAPID decision thinking. • Explain how RAPID framework is configured for business and used in different situations.
Operating the APQP and PPAP Process Flow	• Navigate the Process Flow and understand how this applies within businesses and supply chains.	• Identify the relationship of the Process Flow to aspects of the themes; Applying APQP and PPAP within businesses and supply chains, APQP and PPAP Essentials, applying Project APQP Assurance. • Explain the steps of the Process Flow and examples of the types of activities that take place.

PPAP Coordinator and Customer Authorised Representative (CARe) Training Standard:

This training is aimed at those employees that are undertake the role of PPAP Coordinator and Customer Authorised Representative (CARe) within their business and as part deploying AS13100 APQP PPAP.

The training must include an AESQ APQP/PPAP Approved assessment to evaluate learning and award individuals with recognition of their personal learning.

The training provider must ensure that the course includes enough time on these mandated aspects, have completed the registration process with AESQ APQP/PPAP SME's and be an AESQ Recognized Training Provider https://aesq.sae-itc.com/content/aesq-training.

Table 27: Syllabus for PPAP Coordinator and CARe Training

THEME	OUTCOMES	MINIMUM CONTENT
Essentials of PPAP Process Management	• Understand the fundamentals of APQP and relationship between APQP and PPAP. • Appreciate the role of PPAP in various situations. • Navigate the APQP and PPAP Process Flow diagram and understand how this applies to PPAP. • Understand the how the PPAP Coordinator and CARe conduct their accountabilities.	• Explain the fundamentals of APQP • Understand the difference between an APQP Package, PPAP File and PPAP Submission. • Explain the steps of the Process Flow that manage PPAP and examples of the types of activities that take place. • Explain the purpose of PPAP Customer Specific Requirements, use and suitable decision-making practices.
Evaluating the PPAP File	• Understand what an acceptable standard for each Element of the PPAP File is.	• Explain the expected standard of each PPAP Element and association with AS13100 and associated Reference Manuals. • Provide examples of the expected standard of each PPAP Element. • Confirm the difference between the PPAP File and PPAP Submission.
Preparing and Evaluate PPAP Submission	• Appreciated the meaning and use of Submission Levels. • Understand how to prepare and provide a PPAP Submission. • Understand when / how corrective action plan is used and what is an acceptable standard.	• Explain the steps taken when preparing and Evaluating PPAP Submission. • Provide examples of the types of activities that take place when completing these steps. • Understand the accountability of PPAP Coordinator when this is carried out.
Disposition of the PPAP Submission and Approval Form	• Be capable of conducting a disposition of the PPAP Submission. • Judge a PPAP Submission as Approved, Interim Approval and Reject.	• Explain the steps taken when completing the disposition of the PPAP Submission and Approval form. • Explain the use of the Approval Form and AESQ member companies' differences in forms. • Understand the accountability of Customer Authorized Representative when this is carried out. • Provide examples of the types of activities that take place when completing these steps.

Appendix B: APQP and PPAP Event Pass Criteria

Recommended Pass Criteria for use when agreeing or approving each Event is provided in the following:

Table 28: Pass Criteria for APQP and PPAP Events

Events APQP (bold text) and PPAP		Pass Criteria The purpose is to develop confidence in APQP efforts as the project progresses and apply suitable independent experience / review to the quality of working
Kick-Off		▪ Project Owner appointed. I.e.: Person responsible for accomplishing project objectives and ensuring appropriate resources are available. ▪ High level Plan & expectations established. I.e.: customer expectations are understood, including APQP activities and PPAP/validation needs, and emerging requirements. Expectations include high-level technical, quality and cost targets and basic timeline of program and program configuration such as Teams, their scope (product / processes) and timing (Kick off, PDR, etc). ▪ Monitoring & reporting defined. I.e.: Implement a multidisciplinary approach to ensure effective communication, monitoring and reporting across the business (typically includes the design, manufacturing, quality, operations, and other stakeholders). This accounting for Customers and suppliers, as appropriate, and initiate of APQP Assurance. ▪ Periodic Reviews planned. I.e.: Schedule of Program Reviews established which accounts for the sub-level teams as they Kick-Off. ▪ Resource Commitment confirmed. I.e.: Estimates established, and budget/stake holder commitments confirmed. ▪ PDR Check Point configured. I.e.: Objectives and assumptions, deciders, suppliers and customer of PDR agreed.

End of Concept (PDR)		▪ **Business Case accepted.** I.e.: The effects on program objectives such as customer satisfaction, quality, profitability, cash flow and change in revenue are understood, along with the resources needed to realise the program. ▪ **Preliminary Design met requirements and acceptable (risk, cost & schedule constraints).** I.e.: The preliminary design (product/process) is defined to a suitable resolution to determine that requirements can be met, and constraints agreed to be acceptable. ▪ **Lower level planning outputs acceptable (risk, cost & schedule constraints).** I.e.: results of the various sub-level Team activities are understood, and constraints agreed to be acceptable. ▪ **Bill of Material (BoM) & Process (Bop) ready for release**. I.e.: Configurated Product BoM and/or Process BoP suitable to proceed with the detailed design development. ▪ **SMART Program Plan defined**. I.e.: The planned control and execution of the program post Program PDR is defined and approved. ▪ **APQP Package Structure defined and initiated**. I.e.: APQP WDS, APQP Levels and Program Management are determined to a suitable level. At least for Tier-One. ▪ **APQP Assurance programme defined.** I.e.: Activities to define H-M-L for products and sources, metric targets and periodic reviews structure are defined. Ideally applied to each APQP Package. ▪ **Events configured**. I.e.: Objectives and assumptions, deciders, suppliers and customer of each post PDR check point is agreed.
Customer Specific Requirements		▪ **All PPAP Requirements are sufficiently defined for the PPAP Coordinator to verify and agree.** I.e.: Quality and/or Customer Demand Rate targets, submission level (if different to SL3), quantity of parts to be produced (Production Process Run), additions to the standard PPAP Requirements, date for the PPAP Submission, etc. ▪ **Stakeholder communication taken place.** I.e.: Those who need to know the details understand what is to be expected.
Feasibility Assessment		▪ **All products confirmed as sufficiently defined for Feasibility Assessment by their Production Supply Organizations representative.** I.e.: Content of the Design Record is enough for the producing facility or facilities to make the assessment. ▪ **Each product has Feasibility confirmed by their Production Supply Organizations representative (see Feasibility Assessment form).** I.e. Example Feasibility Assessment form confirms all is "feasible", by the producing facility or facilities and evaluated against appropriate process flow diagram and sourcing plan.

Production Preparation Plan		▪ **All Production Supply Organizations have enough commercial commitments in place.** I.e.: Contracts are in place to enable them to commit a Production Preparation Plan. ▪ **All Production Supply Organizations and their facilities have satisfactory plans (see Production Preparation Plan Content Table).** I.e.: See example of Production Preparation Plan. The facility or facilities intended for producing the product have identified and planned all resources (e.g., production and test/inspection equipment, tooling, jigs, fixtures, computing processes, materials, packaging/transport solution, supply chain, trained work force, facilities) required to produce a product in enough quantity to satisfy the customer demand rate.
Design Release (CDR)		▪ **All products have completed Design Verification Plans and their results are satisfactory.** I.e. planned factors such as risk mitigation for DFMEA verified. ▪ **All products, their Design Record and BoM complete to production standard.** I.e.: fully defined in a finalised state incl. CI, KC, values/tolerances, export control rating, etc. for ongoing manufacturing. Ongoing change is conducted under formal change control. ▪ **All products as defined can meet their Cost Target.** I.e.: target(s) defined during planning.

Production Readiness Review		▪ **The definition of production methods is confirmed as enough to determine readiness by all Production Supply Organizations**. I.e.: Fully defined in the finalised state for ongoing production. ▪ **All Production Supply Organizations can confirm their production method definition is ready (Production Readiness Review form).** I.e. Example Production Readiness Review form confirms 'ready' as the facility or facilities intended for producing the product have assessed and are satisfied with the process design and development activities (e.g., equipment, operator training, manufacturing documentation, control plan, associated measurement tools).
Production Process Run start		▪ **The Production resources are available to be used when conduct Product Process Run or Runs.** I.e.: design and development activities are satisfactory, tooling/equipment are available. ▪ **Material is available and to the intended production standard.** I.e.: raw material, castings, forgings, components, etc that are to be used and/or consumed. ▪ **Actions and ownership for the collection of data**. I.e.: What is measured? When? How? By whom?

First Article Inspection		▪ **Content of FAI is confirmed as enough to judge the status.** I.e.: Content called on by RM13102 is accounted for. ▪ **FAI for the product is approved and complete.** I.e.: RM13102 is satisfied. ▪ **When Customer Engineering Approvals are required, they have been satisfied.** I.e.: Any Customer Specific Requirements calling for Customer Engineering Approvals.
Initial Production Approval		▪ **All products have a complete FAIR (RM13002**). I.e.: FAIR for the products comply to RM13102. ▪ **All products have validated prototype transportation and/or packaging and/or protection solutions.** I.e.: Transportation between facilities and movement within accounted for, including special requirements for materials and/or special processes.

PPAP Approval		▪ **Content of PPAP Submission and Approval Form is confirmed as enough to judge the status.** I.e.: All that needs to be within the PPAP Submission is present and in a format that is understandable by the Customer Authorized Representative (CARe). ▪ **PPAP Approval Form for the product is approved (not interim approval or reject) complete.** I.e.: The form and PPAP Co-ordinators actions for preparing an providing are satisfactory.
Production launch		▪ **The Project Requirements have been confirmed as met.** I.e.: Those defined during APQP Phase 1: Planning are all evaluated, and result met requirements ▪ **All facilities have an approved PSW for each product they are supplying.** I.e.: Each involved facility has an approved PSW form for the product they supply ▪ **All Production Supply Organizations Load and Capacity has been confirmed as acceptable.** I.e.: Order Book review / Planning Assessment completed for involved PSO's ▪ **Total Cost targets are met for the product, BOM and implementation of the solution.** I.e.: target(s) defined during planning

Appendix C: APQP and PPAP Element Bite Size Explanations

Only Elements with no specific AESQ Reference Manuals are discussed within this section. E.g.: PFMEA has RM13004 so this is not covered. All Reference Manuals can be found https://aesq.sae-itc.com/content/aesq-documents

Table 29: APQP and PPAP Element Reference Information

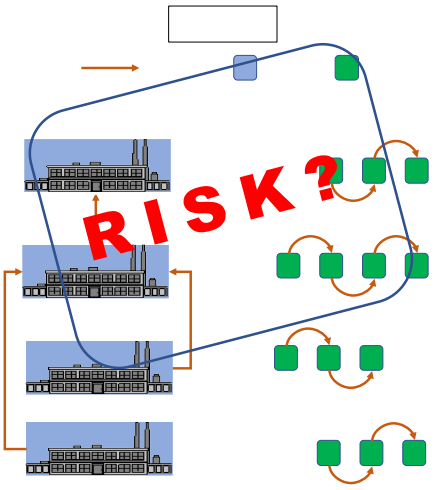
#	APQP and PPAP Element	Ref. Info.	#	APQP and PPAP Element	Ref. Info.
1	DESIGN RECORD and BOM	RM13008	**15**	PRELIMINARY CAPACITY ASSESSMENT	Appendix C
2	DESIGN RISK ANALYSIS (DFMEA)	RM13004	**16**	WORK STATION DOCUMENTATION	Appendix C
3	DESIGN FOR MANUFACTURE	RM13008	**17**	SUPPLY CHAIN RISK MANAGEMENT PLAN	Appendix C
4	PRODUCT CI and KC	RM13008	**18**	MSA PLAN	Appendix C
5	PACKAGING SPECIFICATION	RM13008	**19**	PRODUCTION PROCESS RUN(S)	APQP-PPAP Flow Diagram
6	DESIGN VERIFICATION/VALIDATION RESULTS	RM13008	**20**	MSA STUDIES	RM13003
7	PRELIMINARY SOURCING PLAN RISK ANALYSIS	Appendix C			
8	PROCESS FLOW DIAGRAM	RM13004	**21**	INITIAL PROCESS CAPABILITY STUDIES	RM13006
9	FLOOR PLAN LAYOUT	Appendix C	**22**	DIMENSIONAL and NON-DIMENSIONAL RESULTS	Appendix C
10	PACKAGING, LABELLING, ETC	Appendix C	**23**	PRODUCT VALIDATION RESULTS	Appendix C
11	TEST INSPECTION PLAN (Char. Matrix)	Appendix C	**24**	INITIAL MANUFACTURING PERFORMANCE STUDIES	Appendix C
12	PFMEA	RM13004	**25**	CUSTOMER SPECIFIC REQUIREMENTS (PPAP)	Appendix C
13	PROCESS KEY CHARACTERISTICS	Appendix C	**26**	FIRST ARTICLE INSPECTION	RM13102
14	CONTROL PLAN (Pre-Launch/Production)	RM13004	**27**	PPAP SUBMISSION (Inc. Approval Form)	Appendix C
5	PRELIMINARY SOURCING PLAN RISK ANALYSIS	Appendix C	Light blue is an item of the PPAP file and PPAP Submission (subject to Submission Level)		

7	• **PRELIMIMARY SOURCING PLAN RISK ANALYSIS:**

What is this?

An assessment that typically considers risk associated with the process in its preliminary design stage, the internal and external sources (Suppliers) involved and the product it produces.

The application would be in association with the Teams scope of their APQP Package(s); Supply Chain/facility, method or Operation



Why is it important –

- The earliest opportunity to consider potential risk and preventions
- Early influence of the Process design for Production (relationship, selecting best processes and sequences of process steps) and the Product design
- Sets the mindset for the future process design and development.

At a glance:

1. Scope the application; supply chain/facility, method or Operation,
2. Involve the right people; experiences and knowledge,
3. Gather information, data and lessons learnt,
4. Agree risk ranking method and the minimum risks to consider are;

- Complexity of product and/or intended production solution,
- Historical quality/delivery/cost issues,
- Uncertainties due to new technologies, processes, and suppliers,
- Lessons learnt – what you already know that should be considered.
- Level of dependency on the customers business – too much or too little dependency?

9	• **FLOOR PLAN LAYOUT**

What is this?

The floor plan layout aids developing an efficient production environment by providing a visual understanding of the machines, equipment, material flow, work stations, part delivery points, etc. Potential impact can be determined by;

- Quality,
- Flow,
- Rate,
- Cost
- Safety.

Why is it important –
Draws attention to;

- The need for important control items, such as inspection points, control chart location, applicability of visual aids, interim repair stations, and storage areas to contain non-conforming material.
- Constrains to achieving target cycle times and yield rates
- Physical movement, consideration to ergonomics and accessibility

At a glance:

The floor plan layout should be developed in such a manner to optimise the material travel, handling and value-added use of floor space and should facilitate the synchronous flow of materials through the process. When used in conjunction with the related Process Flow Chart and illustrates;

- Machines / work stations, key equipment, Necessary work instruction points and floor location for each operation.
- Material flow as it transforms.
- Stages of product configuration.
- Involvement of operators and movement (highlighting hazards and planned safety).
- Material Delivery and exit point.
- Work place Visual Controls.

Work place Visual Controls enable quick understanding of the status of the workplace to identify abnormalities which facilitates problem solving and continuous improvement during ongoing production. I.e..: General visual information, material control, production status, etc.

10	• **PACKAGING, LABELLING, ETC**

What is this?

The packaging, labelling standard and documentation. The customer will usually have packaging and labelling requirements to be incorporated into any specifications for the product. An aspect of this is the consideration to transportation within the production facility and between facilities. The team should ensure that individual product packaging is designed and developed.

Why is it important –

- The earliest opportunity to consider and prevent potential risks to the product through internal and external processes (I.e.: receipt of components, product movement / assembly, packaging, shipment, and customer receipt of product)

At a glance:

- Customer packaging and labelling standards or generic packaging requirements are reviewed and accounted for. The packaging design should ensure product integrity at point of use.
- The packaging design should assure that the product performance and characteristics will remain unchanged during packing, transit, and unpacking.
- Consider the packaging requirements for transporting product between each process step from receipt of initial goods through arrival at the customer. The packaging should have compatibility with all identified material handling equipment including robots.
- Consider customer and regulatory requirements where applicable.
- Points to consider during packaging design should include:
  - Damage prevention (impact, electrostatic damage, etc.)
  - FOD (Foreign Object Debris) from inappropriate packaging materials.
  - Weight and size of packaging/container.
  - Hazardous materials.
  - Labelling and marking requirements.
  - Lessons learned from other projects and from past quality issues.
  - Test shipment (where feasible) to validate as early as possible.

11	• **Test Inspection Plan (Char. Matrix)**

What is this?

This is the activities undertaken to plan tests and /or inspections applied during production and specific operations to verify conformance to Design Record. I.e.: A detailed description of inspection and test activities (e.g., tolerances, methods, gages) for features or attributes to be performed during specific manufacturing operations for production.

Why is it important –

- This provides confidence that all product characteristics have tests and/or inspections specified during production to verify conformance against requirements of the design record (dimensional, material and performance). This maybe 100%, sampling, reduced or alternative practices.
- This mapping provides a direct and efficient practice to confirm that each characteristic has an associated measurement relevant for the characteristic type and practice untaken or if not, confirmation that a verification can be achieved.
- Sampling or reduced or alternative practices (not 100%) allow operating costs to be reduced.

At a glance:

Characteristic matrix (RM13004) provides a method for mapping requirements of the design record to stages of the process where they are verified. I.e.: Plan the test/inspection criteria which is carried out. This will involve evaluating the available inspection options and down-selecting the most appropriate one. The objective is to ensure that the production inspection process is reliable, robust and can be completed in the most cost-effective manner.

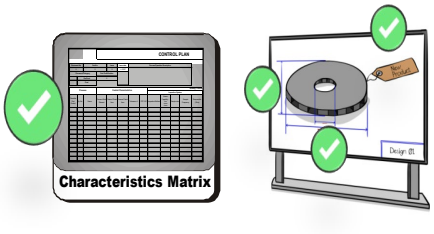
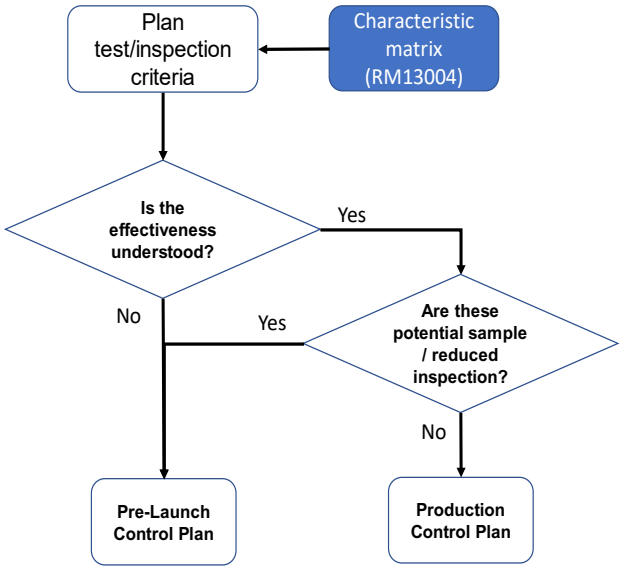


Figure 36: Planning Test / Inspection



Once the production method for the test and/or inspection has been established the effectiveness can be confirmed through the Pre-Launch Control Plan and use of “enhancements” (see Pre-launch Control Plan).

Planning for Sample/reduced inspection (not 100%) and the related data acquisition is also accounted for with the Pre-Launch Control Plan.

13	• PROCESS KEY CHARACTERISTICS

What is this?
These are key characteristics of the process (AS9103) that are known through lessons learnt, identified within standards, etc or have been identified through studies such as DOE, risk analysis such as FMEA. Consequently, their importance warrants attention and evaluation to consider the optimum control(s).

Error-proofing helps an operator avoid mistakes. Essentially it is the true prevention and ideal process control. This in contrast to measurement after and then reacting to the result.

Why is it important –

- Building Quality into the product and/or process is best achieved through prevention and error-proofing
- Greater control of inputs into a process operation will lead to consistent outputs and lessen the dependency on inspection / test.

At a glance:

Process KCs can be inputs to, or outputs from the manufacturing method that are important to process and/or product performance (normally identified by Product KC's through the design record):

- Key process inputs are the process parameters which, if measured and controlled within prescribed limits, will guarantee the capability of the production process.
- Key process outputs are the product or process attributes which, when measured and compared to prescribed limits, validate the capability of the process. In other words, these are the key parameters which when controlled, will minimize process variation that could impact product quality.

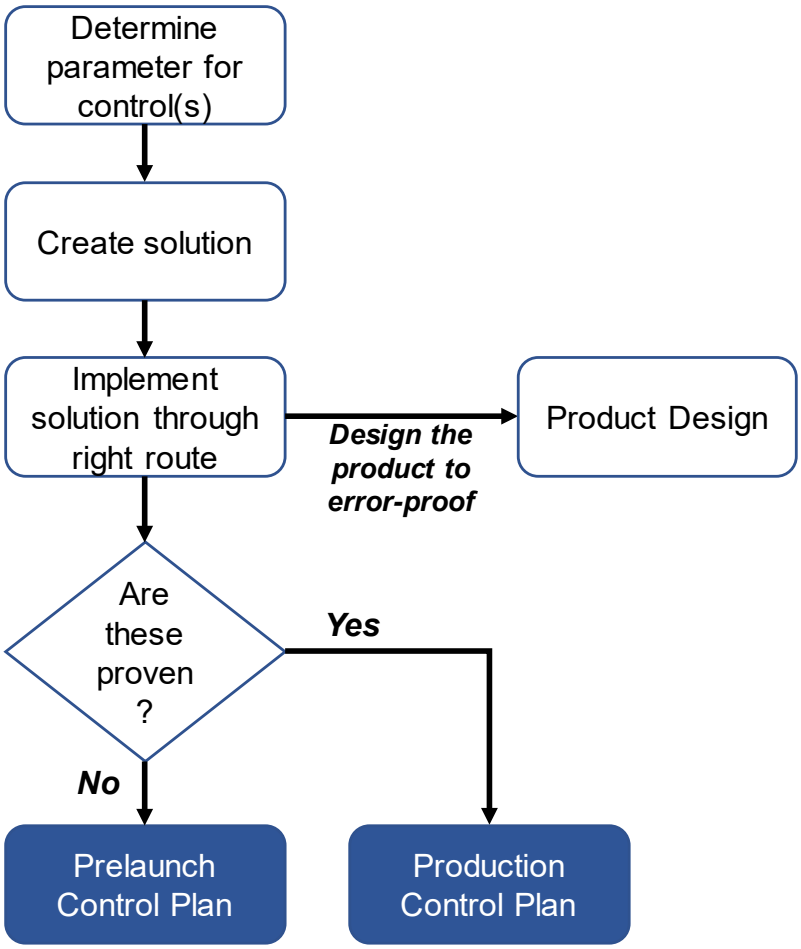
- **Determine Process parameter** for control from sources such as: Lessons Learnt, related standards, DOE, process risk analysis, common Production Control Plans.

- **Create Solution** with the following sequence of prioritisation;
  1. Design the product to error-proof
  2. Design the process to error-proof
  3. Apply control to process inputs
  4. Apply control to process outputs

- **Implement solution through the right route**. E.g. Product error-proof the design would be through Design Engineering v Process through Manufacturing Engineering

- **Are these proven?** Establish the best method to confirm the effectiveness of the solution and account for this within the Pre-Launch Control Plan. E.g. measurement, use of controlled non-conformance, etc. If this is already proved to be effective and no action necessary, this would only be accounted for in the Production Control Plan when applying process input or output controls.

Figure 37: Process KC Flow



15	• **PRELIMINARY CAPACITY ASSESSMENT**

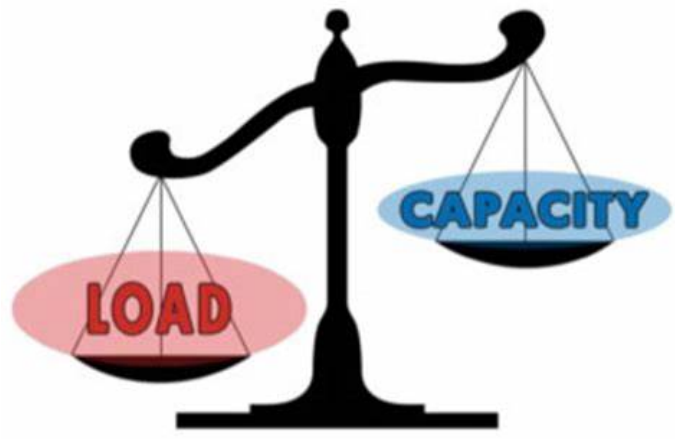
What is this?

Preliminary Capacity Assessment provides an early understanding of what resources (e.g., people, equipment, facilities) are necessary to produce product to customer needs (E.g. delivery schedule) and potential concerns to be managed when assessing and considering factors.

Later through the design and development activities of the process the production resources for the lower-level detailing (E.g.: Test/inspection equipment, tooling, jigs, fixtures, computing processes, trained work force, etc) are identified which support the Production Preparation Planning Event.

	**Why is it important –** • This enables an early understanding of the short, medium and long-term capacity needs to be accounted for when designing the production process and planning the introduction of this.

At a glance:



The types of factors to be assessed would be;

- Technology.
- Obsolescence.
- Manpower.
- Capability.
- Capacity Constraints.
- Surge/backup strategies.
- Logistics.
- Lead-time.
- Lessons Learnt.

•

16	• **WORK STATION DOCUMENTATION**

What is this?

These should be created for all employees having responsibilities for the operation of processes that impact on product quality and accessible for use at the work station (machine, equipment, tool). These instructions are derived from sources such as lessons learnt, the control plan and the process design and development activities. Media and the format would be suitable to the application (environment, users, etc) and describe the best operation method with which they can maintain quality, delivery, cost, and safety.

Why is it important –

- Establishes constancy in the process leading to quality, delivery, safety and cost target being met.
- Standardises the process for continual improvement to take place.

At a glance:

Each work instruction accounts for:

- Operation number.
- Operation description.
- Main steps required to complete the operation.
- Key points/ Care points and reasons for them.
- Inspection requirements, including reaction.
- Instructions.
- Identification of Special Characteristics and Key Features.
- Reference number, authorisation signature and date.

17	• SUPPLY CHAIN RISK MANAGEMENT PLAN

What is this?

This is the planned activities to reduce risks identified through AESQ Supply Chain Risk Management Process. The types of risk reductions this process outlines are;

- Additional source (sourcing strategy and plan).
- Short term pull-forward of supply (stocking policy).
- Work with the company to improve their capabilities (supplier develop strategy, development and approvals for special processing).
- Special Actions such as 3rd party inspectors check product before it is released, REACH Assessments.

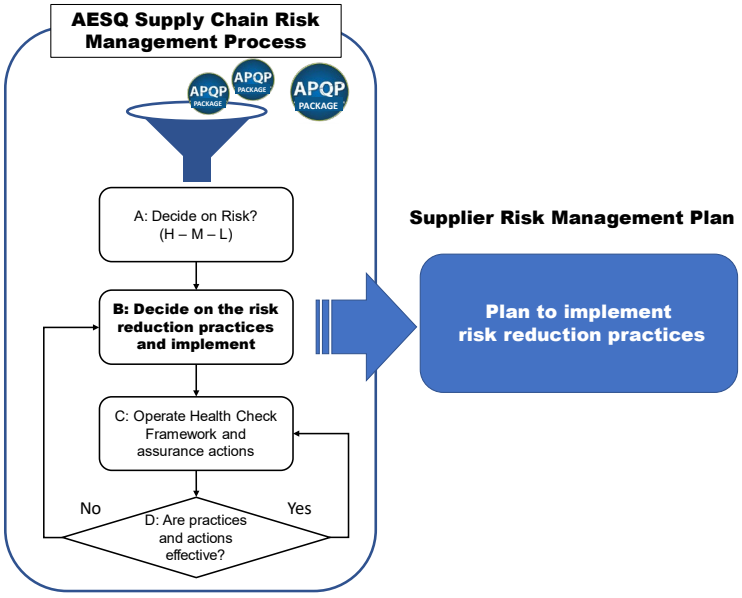
Why is it important –

- Confirms the actions, timing and ownership for reducing risk.
- Provide an understanding of how Health Checks are to be managed and enables the monitoring of this. .

At a glance:

- Decide on Risk Reduction practices (AESQ Supply Chain Risk Management Process).
- Plan Implement of practices.
- Implement and monitor effectiveness (AESQ Supply Chain Risk Management Process).

Figure 38: Supply Chain Risk Management Process V Plan



18	• **MSA PLAN**

What is this?

Planning MSA identifies which tests take place on which gages during the associated APQP PPAP Element 20: MSA Studies. I.e.: Which of the test / inspection methods intended for production use need to be qualified by MSA. The MSA planning should at least include expectations of RM13003 to include, gage linearity, accuracy, repeatability, reproducibility, and bias or correlation to a known standard.

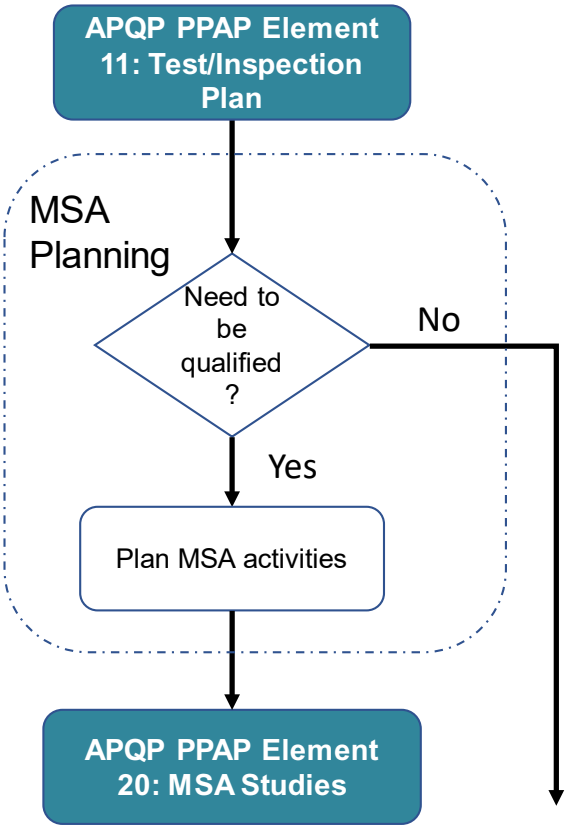
Why is it important –

- The effectiveness of test and inspection equipment will affect the accuracy of product during production.
- Inaccuracy would mean product could be considered correct when it is NOT OK or incorrect when it is OK. Resulting in wasted effort, unnecessary costs and/or product failure in service.

At a glance:

In relation to the Test / Inspection Criteria developed as part of APQP PPAP Element 11: Test / Inspection:

Figure 39: MSA Planning Steps



- Consider all identified measurement techniques, their associated characteristics and if they need to be qualified by MSA.

- When this is necessary plan suitable MSA activities (RM13003).

- The Plan used by the Team is updated to include planning of these MSA's as part of the MSA Studies Element or a specific plan for MSA Studies is linked to their Plan.

22	• DIMENSIONAL AND NONDIMENSIONAL RESULTS

What is this?

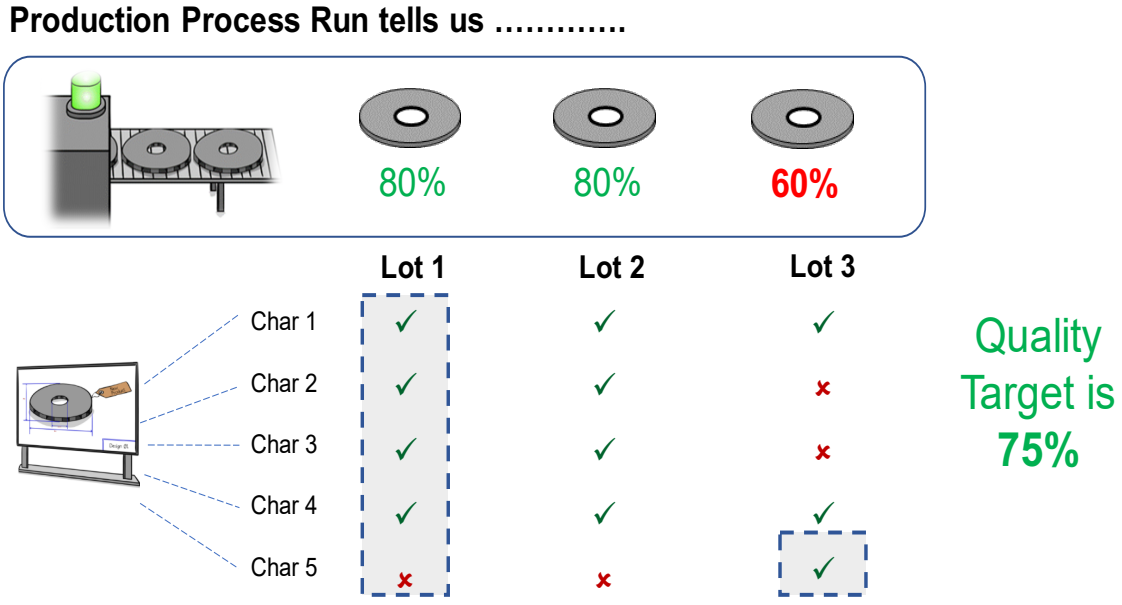
This data is used to demonstrate the achievement of quality targets for metrics such DPU (Defects Per Unit) and can provide supporting data for reduced/sample inspection requests / authorisation. When sample parts are produced these results provide reference values and data to support verification activities such assembly trails.

Why is it important –

- This enables quality requirements that will have been factored within the design and development phases (product and/or process) to be validated
- Quality targets are aligned to customer needs and an influence on operating costs, early confirmation ensure customer satisfaction and business profitability.

At a glance:

Refer to RM13002 reduced/sample inspection requests / authorisation and this data can be used as source information when enough data is collected.



- In reference to confirming quality targets;
  - The target would have been agreed with the customer or defined by the organization as part of the PPAP Event (Customer Specific Requirements).
  - An agreed number of products are used from the production process run(s). If this number is not the full quantity produced during the production process run(s), they would be randomly selected to represent the performance of the process.
  - Data collection will come from the tests/inspections intended for use in ongoing production and using these during the Production Process Run.
  - The collected data can be evaluated to determine the results. See illustration, in this case the quality target of 75% is not achieved.

  - Results are recorded (see example format) along with the evaluation against targets used. The specifics of this is important to have been confirmed as this could be against an average performance across the products used or no product below target value
  - Calculation of Defects per Unit (DPU) product by product would be (using the example format):

    Per Product = Number of Char lines "NOT OK"

  - Calculation of % of Right First-Time characteristics (RFT characteristics) product by product would be (using the example format and example shown in the above illustration):

$$\textbf{Per Product} = \frac{\textbf{Number of Char lines "NOT OK"}}{\textbf{Total Char lines}}$$

Table 30: Dimensional / Non-dimensional Report (Example format)

CHAR. No.	DIMENSION / NON-DIMENSION SPECIFICATION (state specification value and unit of measure)	TOL/ LIMIT (-)	TOL/ LIMIT (+)	RESULTS (Dimensional or Attribute)				
				Product 1	Product 2	Product 3	Product 4	Product 5

23	• PRODUCT VALIDATION RESULTS

What is this?

This is the validation testing (E.g.: material/functional performance) performed to assure that a product in the production configuration fulfils the needs of the customer and other identified stakeholders. The results are from production tooling and processes and when applied during PPAP, from product/material produced during Production Process Run(s).

At A Glance:

- Apply testing as required by design validation (design validation plan).
- Compile results into a test report (see example format).
- Supply results to design validation plan owner for evaluations (involving suitable knowledge owners, agreement from Engineering) to determine if all requirements have been achieved.
- Take corrective action where requirements are not achieved.

Table 31: Product Validation Report (Example format)

CHAR No./Ref	**SPECIFICATION** (state specification value and unit of measure)	**CRITERIA**		**PRODUCT RESULTS**					**EVALUATION** (tick)	
		Limit (-)	**Limit (+)**	**1**	**2**	**3**	**4**	**5**	**OK**	**NOT OK**
									☐	☐
									☐	☐

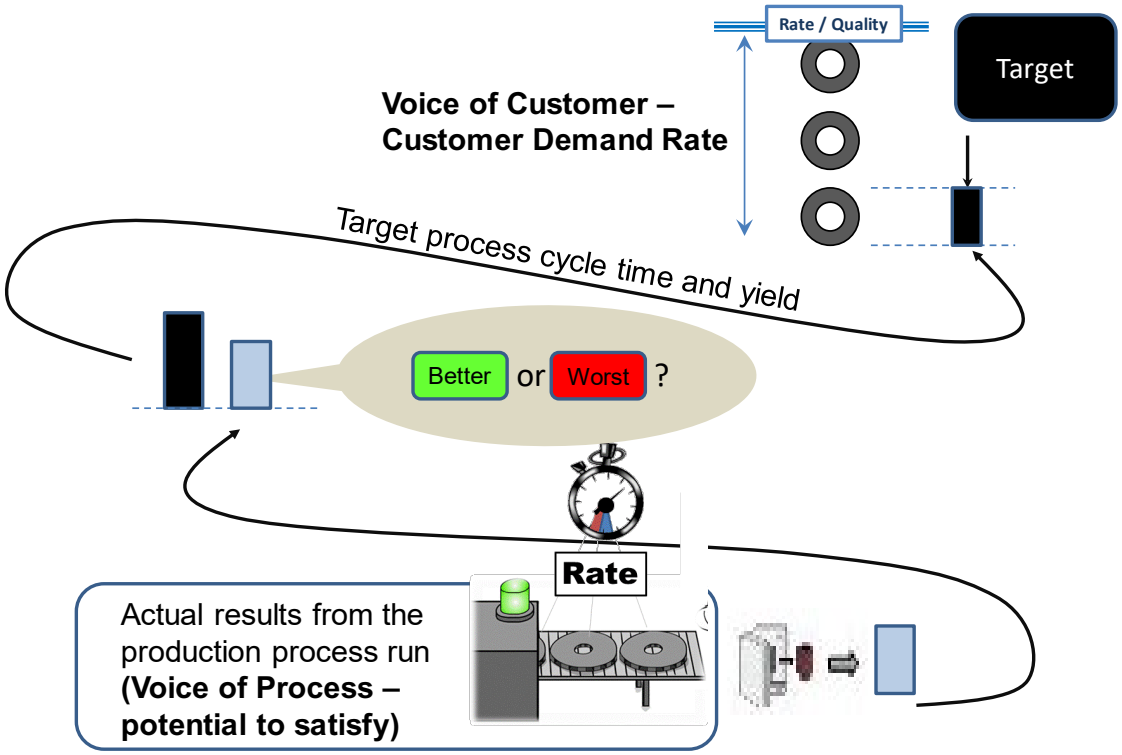
24	• INITIAL MANUFACTURING PERFORMANCE STUDIES

What is this?

This data demonstrates operation by operation the rate potential of the manufacturing method by comparing the actual process performance against predetermined targets. E.g.: Cycle time and yield targets.

As illustrated the principle is to measure the voice of the process. This is compared this with predetermined targets based on the Customer Demand Rate requirement (the voice of the customer). In this case 3 per day is the customer demand rate. The predetermined target value per piece would be the process operation time and yield rate.

Figure 40: Principles of the Initial Manufacturing Performance Studies

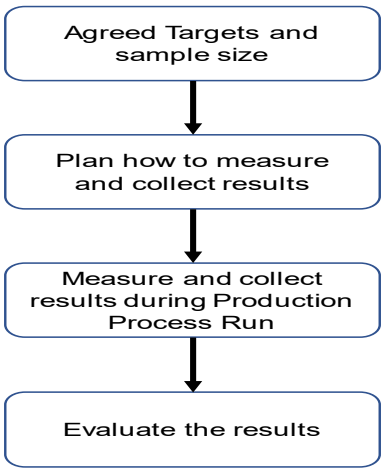


Why is it important –

- Rate requirements will have been a consideration of the design and development phases (product and/or process) and this activity validates the achievement of the specific targets
- Rate targets are aligned to customer needs and achieving these will influence operating costs, early confirmation to ensure customer satisfaction and business profitability.

At a glance:

Figure 41: Conducting the Initial Manufacturing Performance Studies



By following these steps this can be carried out and the detail for these in in the following. Section.

- Agreed Targets and sample size:

The Customer Demand Rate and target used would be agreed with the customer or defined by the organization as part of the Customer Specific Requirements Event. The target is based on the intended application during production. I.e.: Producing individual parts or a batch of parts due to the use of equipment. For example: Using an oven for Heat treatment would establish targets for cycle time and yield based on the maximum part count capacity of the oven. Or when forming parts using a die would establish targets for cycle time and yield based on the intented number of cavities.

An agreed sample size (number of products/process cycles) is confirmed for data collection during the production process run(s). If this number is not the full quantity produced during the production process run(s), they would be randomly selected to represent the performance of the process.

- Plan how to measure and collect the results:

The used measurement method for capturing data should be practical to apply when carrying out the Production Process Run(s). E.g.: operator recording results, using shop floor data system, video recording and play back, person observing and measuring the process, etc. The type of data collected is broken into the following fundamentals:

Table 32: Fundamentals of Total Run Time

Total Run Time				
Set Up time (A)	**Total Production Time (B)**			**Shutdown time (F)**
	Total Cycle Time (C)	Total Planned downtime (D)	Total Unplanned Downtime (E)	

Total refers to the total time measured during the Production Process Run for this result

- Measure and collect during the Production Process Run / Evaluate the results:

The planned measurements are carried out as part of the Production Process Run and account for the agreed number of products.

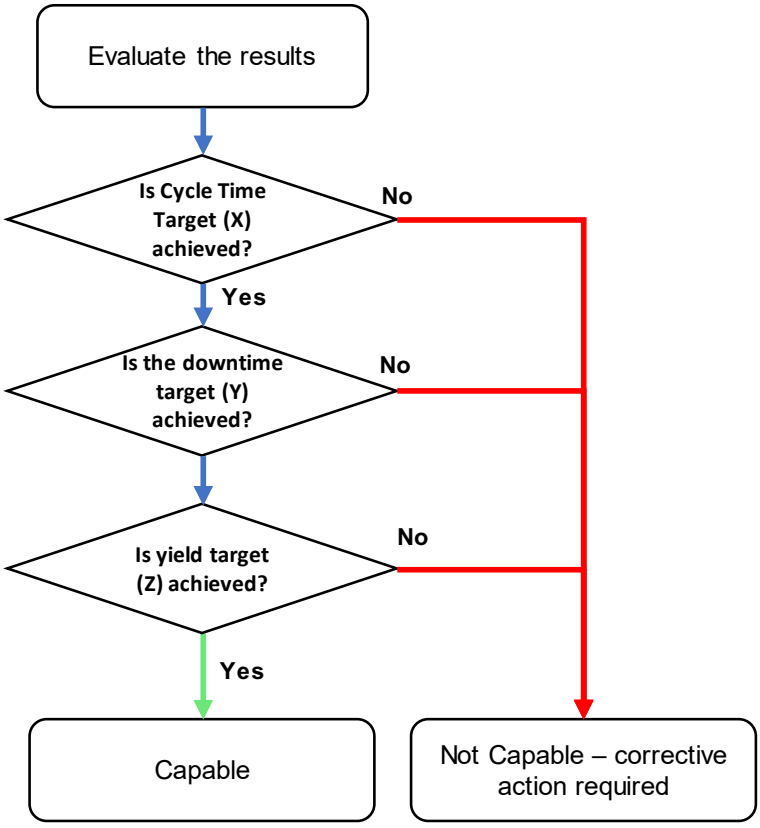


Table 33: Initial Manufacturing Performance Studies data and evaluation

As the flow diagram describes, the evaluation confirms rate capability of the process when the values for X, Y and Z (see table) achieved the specified target. I.e.: Achieving or bettering Targets for processing time, set up time and shut down time, along with yield. These are explained in the below table.

The following refers to information shown in the fundamentals of Total Run Time table.

Description	Part by part Calculation	Batch Calculation	Considerations
Actual Processing Time Performance (X)	X = B - D / # parts	X = B - D / #Batches	Total Unplanned Downtime (E) is included in target value for X. The target used would include an expected level of unplanned down time. I.e.: Target for X is based on cycle time assumptions + unplanned downtime allowances.
Actual Set Up / Shutdown (Y)	Y= A + F	Y= A + F	This allows for the influence of downtime on the X value to be considered.
Actual Yield (Z)	Z= G / # parts	Z= G / # parts	When the Z target is less than 100% yield. This requires additional processing time to make up the shortfall in scrap or reworking.
Number of Conforming Products	G	G	Parts that are reworked during the processing time (I.e. within X value) through planned rework operations and are conforming as a result of these. They are not be counted within the G value. I.e.: When the process intended application has effective rework loops built into it.

25	• **CUSTOMER SPECIFIC REQUIREMENTS (PPAP)**

What is this?

These are additional PPAP Requirements (or adaptations) which are specified by the customer and/or the organization.

Why is it important –

- They provide flexibility to add bespoke actions relevant to the product and / or process.
- The purpose is to benefit validation and verification activities associated to the product within scope

At a glance:

Examples are:

- Change to the default Submission Level.
- Specifying Quality, Rate targets and quantity of products used during Production Process Run.
- Specifying Date for PPAP Submission in advance of Production Launch.
- Specifying extra measurements such as weighing parts.
- Confirming application of additional PPAP Elements (see following referred to within AS13100 Chapter B).

They can be found within Customer Specific Requirements documents, Purchase Order and other forms of requirements flow down from customers. 10A, B and C are identified within AS13100 Chapter B and explained in the following:

10.A	**Customer Engineering Approvals**

What is this?

These are approval requirements of the customers engineering process. Typically linked to material and performance testing, the results and other attributes to be evaluated to assurance related engineering requirements have been met. The customer would define and communicate these.

At a glance:

Follow requirements specified by your customer.

10.B	**Process Control Surveillance**

What is this?

Process Control Surveillance identifies any potential concerns relating to the essential manufacturing controls rather than waiting to discovery them during ongoing production. It is conducted as part of the Process Validation and during the Production Process Run(s).

Why is it important –

The aim is to confirm that:

- The developed Low-Level Detail is implemented and fit for purpose.
- The manpower working on the product (production line, warehouse, handling, control) knows what to do on the product and when and how.
- The bough-out material, parts and components are under control.
- The production and control machines and equipment are validated and maintained.
- The documentation relative to the product is implemented.
- The people in charge are trained.
- The environment has no negative impact on the product.

At a glance:

Potential concerns can be evaluated from surveying the manufacturing process (all operations or through a sampling plan) when considering the following:

Table 34: Process Control Surveillance Content (Example)

Ref:	Question	Yes	No	N/A
	MANUFACTURING PROCESS			
1	Is the product being manufactured at the production facility and using the production tooling, gauging, process, materials, operators, environment, and process settings?	☐	☐	☐
2	Does the actual process flow agree with the process flow diagram, as documented in PPAP file?	☐	☐	☐
3	Are operator instructions / visual controls available and adhered to at each work station?	☐	☐	☐
4	Is all in-process documentation, such as process control charts, in place at the time of the Production Process Run?	☐	☐	☐
5	Is the documentation utilised to drive a defined reaction plan and corrective action process?	☐	☐	☐
6	When required, are production boundary samples available at required work stations?	☐	☐	☐
7	Are the boundary samples approved by Rolls-Royce?	☐	☐	☐
8	Are maintenance plans in place?	☐	☐	☐
9	Are repair and maintenance spares available?	☐	☐	☐
10	Is there planned downtime for preventative maintenance?	☐	☐	☐

	PRODUCT QUALITY					
11	Are all Production checking fixtures complete, with acceptable measurement system studies (i.e.Gauge R and R) performed, Operator instructions / visual aids available?	☐	☐	☐		
12	Are all in process gauging and controls complete, functional and in place?	☐	☐	☐		
13	Do the Control Plans agree with the actual process?	☐	☐	☐		
14	Do production product checks and statistical monitoring take place as outlined in the Control Plan?	☐	☐	☐		
15	Are the defined Test Inspection Criteria fully utilised within the process and adhered to?	☐	☐	☐		
16	Are the Test Inspection Criteria requirement adequate to meet the Design Definition / Specification and customer requirements? I.e. Control points, frequency of checks, method deployed?	☐	☐	☐		
17	Are potential failure modes, as identified in the PFMEA, addressed through error-proofing or the control plan?	☐	☐	☐		
18	Does the reaction plan (ref: Control Plan) ensure effective containment and correction?	☐	☐	☐		
19	Do the parts produced off production tooling during the production process run meet the Customer's requirements for on-going quality?	☐	☐	☐		
20	Does the manufacturing process have sufficient in-process controls?	☐	☐	☐		

	NON-CONFORMANCE					
21	Were all non-conformances detected by the methods detailed in the Control Plan?	☐	☐	☐		
22	Did the PFMEA identify the potential failure modes?	☐	☐	☐		
23	Do all the observed rework and repairs effectively correct the non-conformance(s)?	☐	☐	☐		
24	Are all open concerns closed, from the manufacture of product prior to this production run?	☐	☐	☐		
	SUB-CONTRACTOR / SUB-TIER					
25	Are the parts used in the Manufacturing process to the intended production standard?	☐	☐	☐		
26	Are adequate Test / Inspection methods in place for all Receiving area's?	☐	☐	☐		
27	Are Controls in place in the Receiving area's, to isolate incoming material until it has been approved? (Incl. Containment and correction)	☐	☐	☐		
	PACKAGING AND HANDLING					
28	Is the Packaging Data Card or Technical Instructions available and adhered to?	☐	☐	☐		
29	Are the Packaging and handling methods robust (In-process and final)? I.e.: Causes no non-conformance	☐	☐	☐		
30	Does the packaging method used (in-process and final) effectively eliminate the potential for process errors or mixed stock?	☐	☐	☐		

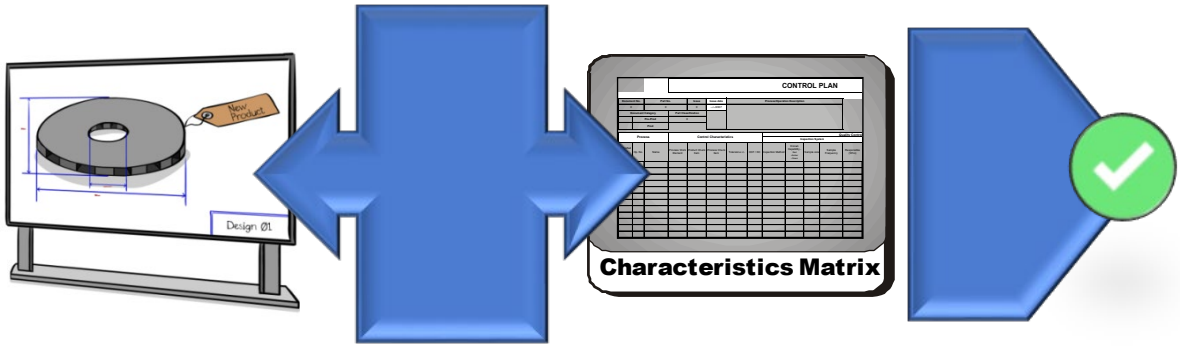
10.C	**Workstation test/inspection planning**

What is this?

This is evidence of the activities undertaken to plan tests and /or inspections described within Element 11 and provides confidence that all product characteristics have tests and/or inspections specified during production and that these are appropriately described. E.g., tolerances, methods, gages, etc.

At A Glance:

See Element 11, RM13004 and the use of Characteristic Matrix.



27	• **PPAP SUBMISSION (Inc. Approval Form)**

What is this?

This is the action of providing the PPAP Submission which includes the approval form required by the customer and, depending on the Submission Level, will involve varying evidence / content depending on the situation. Inclusion of Approval Form relates to the PPAP Approval Form which can be a customer specified template.

Why is it important –

- This establishes confidence that the PPAP Requirements have been satisfied.

At a glance:

- See APQP-PPAP Flow Diagram and associated process steps
- Customer Authorised Representative agrees or disagrees and provides instructions;

Approved	All PPAP requirements have been fulfilled. The Production Supply Origination is therefore authorised to ship product
Interim Approval	All PPAP requirements have not been fulfilled; however, the Production Supply Origination is authorised to ship product under the conditions/restrictions specified by the customer (typically the Customer Authorised Representative)
Reject	All PPAP requirements have not been fulfilled and the Production Supply Origination is not authorised to ship product.

Appendix D: Planning Phase Deliverables Bite Size Explanations

What is this?

This is an activity that has been completed to meet a specified intent in support of the Planning Phase of APQP. This section explains the intent. The output can provide data and/or information for use in other phases. A to H refers to Deliverables referenced within AS9145 Appendix A.

Table 35: Planning Phase Deliverables Reference Information

Phase Deliverable	Ref. Info	Phase Deliverable	Ref. Info
A. Product Design Requirements/specs	Appendix D	E. Preliminary process flow diagram	Appendix D
B. Project Targets	Appendix D	F. SOW review	Appendix D
C. Preliminary CI / KC's	Appendix D	G. Preliminary sourcing plan	Appendix D
D. Preliminary BOM	Appendix D	H. Project Plan	APQP PPAP Essentials section

A • Product Design Requirements/specs

What is this?

These are the customer wants and needs, and regulatory requirements, that are converted into defined design objectives.

Why is it important –

- This establishes confidence that customer wants, and needs have been understood

At a glance:

Design objectives that these can be converted into are:

- ✓ Functional performance,
- ✓ Architecture constraints (e.g. space, interfaces, external envelop, etc.),
- ✓ Type of material,
- ✓ Special processing constraints,
- ✓ Weight,
- ✓ Specific acceptance criteria based on attribute information (appearance, colour, door, noise, etc.),
- ✓ Regulatory requirements (safety environment and trade compliance, etc.),
- ✓ In-house best practices & lessons learned,
- ✓ Reliability

B • Project Targets

What is this?

These are Customer expectations, regulatory requirements, and project specific objectives.

Why is it important –

- This establishes objectives for the project to achieve

At a glance:

These can be:

- ✓ Safety
- ✓ Warranty, field problems
- ✓ Quality (Defects Per Unit) in-process and as received
- ✓ Manufacturability (Rate, lead-time, processing yields, set-up, downtime)
- ✓ Service life,
- ✓ Reliability,
- ✓ Durability,
- ✓ Maintainability,
- ✓ Schedule
- ✓ Customer and/or organizational project milestones
- ✓ Cost
- ✓ Change Incorporation points

C • Preliminary CI / KC's

What is this?

These are characteristics of importance. Critical Items (CI) are the items with a significant impact on product realization and its use. Key characteristics (KC) are features or attributes whose variation has a significant impact on the CI and/or product. Impacts such as safety, performance, fit, form, function, manufacturability, service life, etc. Knowledge of the product and the manufacturing processes will help determine the preliminary product and process CIs and KCs.

Why is it important –

- These require specific actions to ensure they are adequately managed through the design and manufacturing processes.

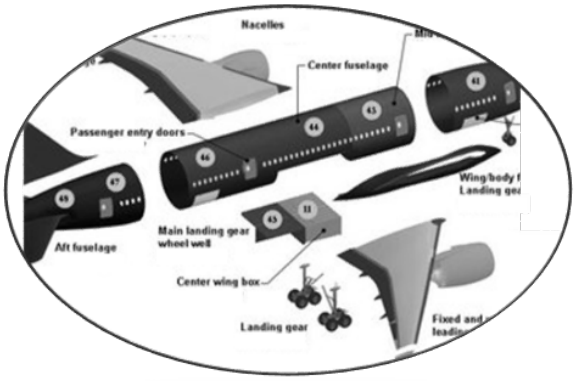
At a Glance:

- Involve a multi-disciplinary team including Design and Manufacturing Engineering or Supplier Manufacturing Engineering
- Scope the best techniques to determine these (Quality Function Deployment (QFD) and previous DFMEA/PFMEA on similar product/processes)
- Identify and categorise the CIs/KCs
- Record CI / KC as part of the technical requirements.

D • Preliminary BOM

What is this?

This is the configuration of the conceptional design. E.g.: Initial Engineering Bill of Material.



This is intended to visualise the product and its configuration enough so that the involved team members and stakeholders can understand, contribute to and/or evaluate the proposal.

Why is it important –

- The Product Design and Development activities for complex products are best managed by breaking the saleable product into sub-systems / product breakdown allowing; ownerships and responsibilities to clear, early make and buy decisions, development of the Preliminary Process Flow.

At a Glance:

- Product design is broken down into its configuration. E.g.: Visual illustration or Product to BOM configuration diagram.
- Early Team based review takes place. E.g.: Design for Manufacture/Assembly.
- Based on inputs, the configuration is updated and the preliminary BOM is developed.

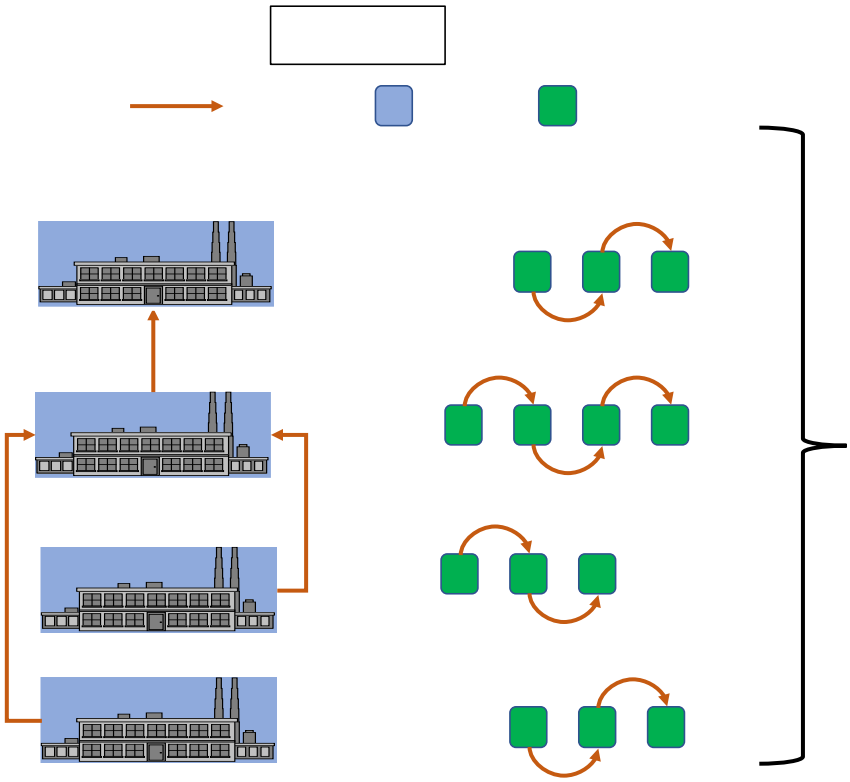
E • Preliminary process flow diagram

What is this?

The Preliminary Process Flow describes the anticipated process for the product. The process design could be a totally new production strategy or proposal based on an existing production solution or a combination of these. This is intended to visualise the proposed production process / system enough so that the involved team members and stakeholders can understand, contribute to and/or evaluate the proposal.

A visualisation of the proposed production process / system is used to demonstrate how the product and its Bill of Material (BoM) will be produced. This would be the macro view (high-level) and in a suitable format to identify the content of the Bill of Process. I.e.: the right combination of supply chain (facility to facility) and method (operations). This captures processes (proven methods or innovative technologies), when and where they are applied (high-level sequencing, flow of product), etc.

Figure 42: Concept of Prelim. Process Flow



Why is it important –

- Joining the Preliminary BoM and Process Flow provide and understanding of what the potential supply chain and process looks like, and their relationships. This allows options to be explored and risks uncovered through activities like Design for Manufacture.

At a glance:
The term preliminary is used to highlight that this could change and mature during the design and development activities (Phase 2 and/or 3). Typically, this would consider:

- Design concept to support the project design targets
- Preliminary sketches, drawings/ CAD data of the product
- Presentation of simulations
- Preliminary identification of product Key Characteristics (Preliminary CI / KC).
- Preliminary Bill of Materials (BoM)
- Preliminary Sourcing Plan
- Explanation of proposed new technologies and differences from the current design
- Proposed manufacturing facility
- Product Design and Process Validation Planning
- Regulated material rules apply to banned substances and recycling requirements.

F • SOW review

What is this?

Statement of Work (SOW) clarifies the enablers to the whole project; resources, scheduling project against live / other scheduled projects, etc.

Why is it important –

- The important meaning of this doc is to share what the project entails with people who are working on it, whether they are collaborating or are contracted to work on the project.

At a glance:

Items to consider are;

- Deliverables and due dates.
- Activities that lead to the deliverables, and who these tasks are assigned to.
- Resources needed for the project including facilities and equipment.
- Specifications and procedures.
- Governance process for the project. E.g.: APQP Project Management.

Good practice is to develop a compliance matrix which summarises how these will be met and that identifies exceptions between Customer and Organization, along with resolutions.

G • Preliminary sourcing plan

What is this?

This provides an early intention of the sources responsible for the necessary delivery the project plan and related products/services. The combination of preliminary BOM and process flow enables the organization to make initial make/buy decisions. I.e. what are produced in-house and those that will be outsourced.

Why is it important –

- Early understanding of which organizations are to be involved enables communication channels to be established, engagement in the upfront design decisions and knowledge gathering (lessons learnt, best practice, etc) to be benefited from.

- A multiple disciplined team performs an analysis for make/buy decisions.
- Purchase function;
    - Advises on external sourcing and provides necessary information regarding product and quality requirement that will be flowed down to suppliers.
    - Determines supplier's capability based on risk analysis, performance history and knowledge on previously provided products and/or services.
    - Establishes information (project timing, preliminary BOM/process flow) and develops a sourcing plan based on the above.
- The multiple disciplined team (or through the Sourcing Decision Process) agrees to the sourcing plan and risks reduction action (Supply Chain Risk Management Process/Plan)
- Purchase function and /or multiple disciplined team implements and monitors the plans (Sourcing and Supply Chain Risk Management)

H • Project Plan

What is this?

This is the plan used by team associated to the APQP Package(s) they are managing.

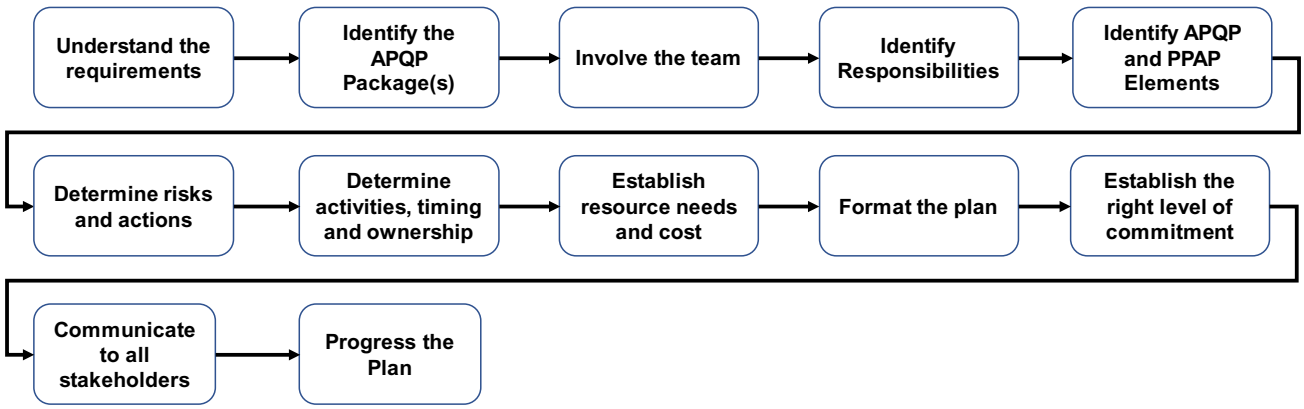
Why is it important –

- Provides a shared vision for what the project will accomplish, gives clarity on the responsibilities of team members and other organizations, organises the work of the project and can be used to prevent unnecessary work from herding legitimate project activities.

At a glance:

See APQP PPAP Essentials section:

Table 36: Steps used to create Project Plan for APQP and PPAP



Change History

Revision	Date	Description of Change
	MARCH 2021	Initial Release

For more information or to provide feedback:

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