

APQP (Advanced Product Quality Planning)– A Journey to Flawless Products/Services

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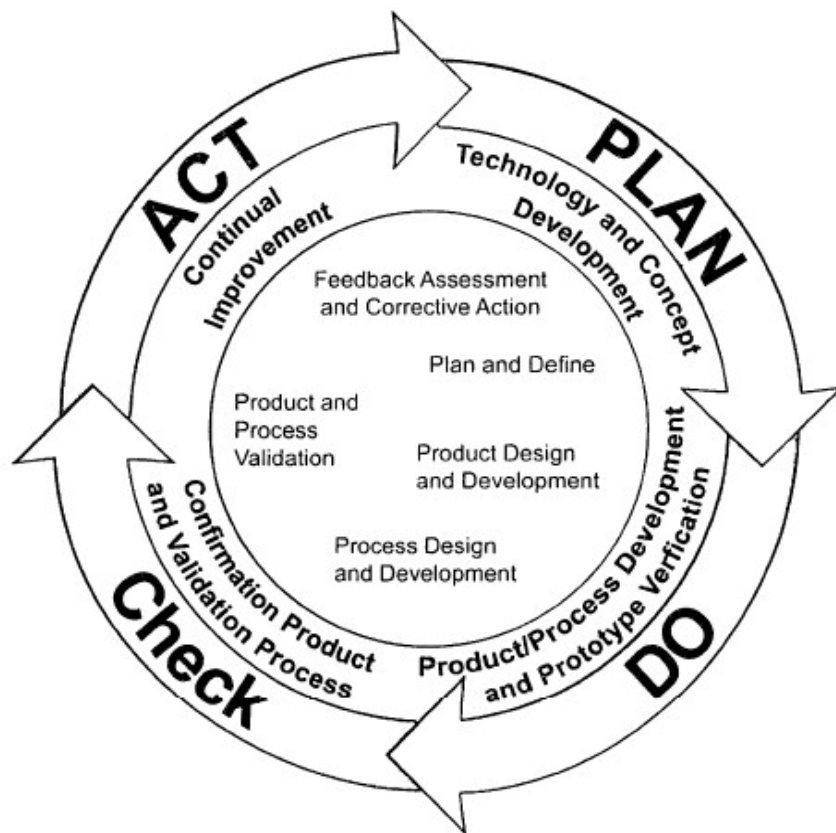
Introduction

- Review of the APQP Planning process and its applications to any industry/product/service.
- Define what APQP is and is not.
- Develop a Robust Process.

APQP Basics:

- What is Advanced Product Quality Planning?
 - It is a Journey, does not end.
 - It is a structured methodology based on fundamental requirements. Examples are defined in the APQP AIAG (Automotive Industry Action Group) or applicable gated project processes.
 - Addresses customer satisfaction by using a cross functional team approach. Team approach – SINGLE ACCOUNTABILITY.
 - Planning via a timing chart, process map or GANT chart; focuses on problem prevention.
- What is the output of the APQP process?
 - The out put is Continual Improvement of the Product/Service, Process and Societal (People) Realization. ALL STAKEHOLDERS.

APQP – Its commencement



- The APQP process addresses the following:
 - Organize a team. – Let's Organize
 - Define the scope, Purpose, Outcome.
 - Team to Team Transparency – Open communication.
 - Training requirements.
 - Customer, Company, Supplier, and Stakeholders involvement.
 - Engineering, Logistics, Purchasing, Human Resources, Information Systems, Quality Assurance.
 - Control Plans (Outcome from FMEA). Control your risks
 - Problem Resolutions.
 - Product Quality Timing Plan.
 - Plans relative to the Timing Requirements.

APQP – Outcomes

➤ What are the objectives of APQP?

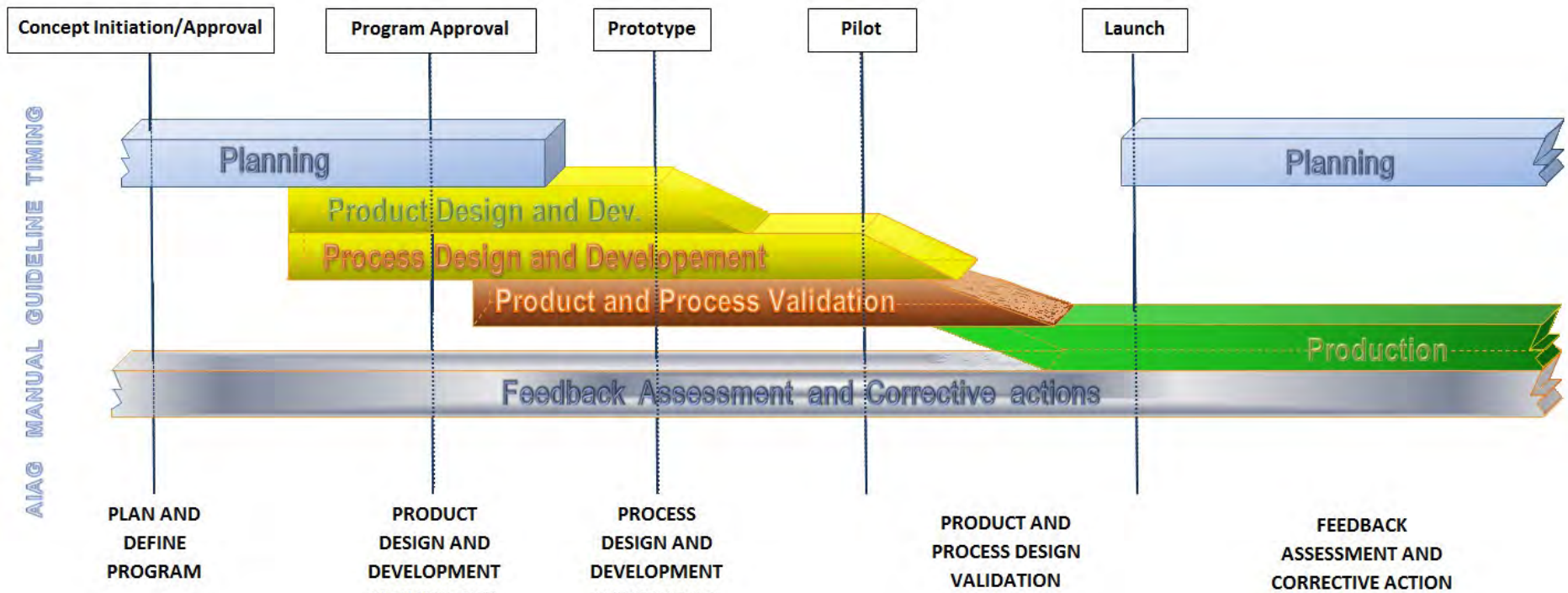
- Minimize Product, Process, People Risk. GOAL : NO launch quality risks. Execution is key
- Defect free products/services.
- On time delivery. Achieve Launch Milestones. Feasibility, Pre-Production, Production, and Follow-up.
- Effective communication.
- Meet Cost and Budget Targets.
- Drive a culture of Continual improvement.
- Improves the 3 P's. Product, Process, People.
- Successful and Increased Business Awards.
- Drives Innovation. Improves Competitive Advantage. Become NIMBLE.

APQP – Achieving the Purpose

➤ A robust APQP Process SHALL:

- Bring forward a quality plan that shall contribute to the development of a product/process or service and achieve customer approval for release. Agreement to Ship, Supply, Design, develop, Manufacture. The approval changes dependent of industry. Automotive: PPAP (Pre Production Approval Process); Aerospace (First Article). OEM Product FEU (Field Evaluation Units).
- Improve the safety, quality, productivity, reliability and safety of the products/processes/services offerings.
- Reduces development, procurement, equipment, re-development timing and cost. Meet Budget.
- Reduces risk, through comprehensive action list.
- Helps define your process, which will lead to an effective control plans.
- Keeps Teams focused on the tasks at hand, focus on risk reduction through actionable items.
- Ultimate Goal: customer satisfaction.

APQP – PHASES



APQP – Putting it in Motion – 1) PLAN AND DEFINE P1/G1

➤ Start the APQP process?

- Assign a program manager or Champion. Define the cross functional team. One Team; One accountability.
- Program Manager/Champion Scope and Target Outcome. Develops the timing Plan through team commitment.
- Follow the phases of the APQP. Note: This is in most part can be defined in any manner dependent upon Organization. This includes: Define the Requirements, Design Process, Process Design, Product Validation, Product Approval and Customer Follow-up.
 - ALL STAGES FOR ANY STAGE OF APQP NEEDS TO BE CUSTOMER FOCUSED.
- Populate Timing Plan with Key Milestones.
- Define any forthcoming or outstanding actions.
- For each stage Team Approval is recommended. Execute, Execute, Execute.

APQP – Phases Plan and Define P1/G1

- **DEFINE REQUIREMENTS – VOC (Voice of the Customer).** Remember VOC is all encompassing. Look at all areas of stakeholders that are affected by the Product/Service
 - ❑ **Capture the Requirements**
 - **Voice of the customer** – Customer, End User, Society and Stakeholders needs, requirements and expectations.
 - Market research (Previous Product/Services, Branding, Risks, Benefits).
 - Historical Information (Sales, Warranty, Quality, Recalls, Failures, Regulatory/Legal/Environmental, Risk Mitigation, Specifications, Lessons learned).
 - Surveys, Polls, Customer Feedback, Reviews, Market Tests
 - Team experience (Ask your core Team).
 - The above will define your requirements and set-in-order communication avenues with your stakeholders.

APQP – PLAN (Inputs) and Define P1/G1

- ✓ **Business Plan Marketing Strategy – Set the frame work for the quality planning.**
 - Identify constraints (cost, timing, investment, R&D, VA/VE suggestions, Safe launch costs).
 - INCO terms (understand the global market place).
 - Assess early risk & feasibility.
- **Product/Process Benchmark data – Provide input data to meet Customer and all Interested Parties requirements.**
 - Gap analysis and understanding the reason for the gap.
 - Sample parts from customer.
 - Preliminary listing of Special Product Characteristics.
 - Design Target/\Intent – FEASIBILITY REVIEW.APPROVAL

APQP – PLAN (Inputs) and Define P1/G1

- **Inputs** (continuing)
- **Product/Process assumptions**– All the assumptions about product features, design and process concepts are inputs to next phase.
 - Product Reliability Studies.
 - Customer inputs.
 - Design Goals.
 - Reliability and Quality targets and goals.
 - Preliminary Bill of Material.
 - Preliminary Process Flow Chart.
 - Cost Estimation Worksheet.

APQP – PLAN (Inputs) and Define P1/G1

- **Inputs** (continuing)
- **Product Assurance Plan**– translates design goals into design requirements. (Inclusive Process Design Goals)
 - Outlining program requirements (PPAP date, R@R, SOP other requirements).
 - Identification of reliability, durability requirements and goals.
 - Assessment of new technology, materials, application environment, packaging and manufacturing requirements that may place program at risk.
 - Use of FMEA and Lessons Learned Data Base.
 - Development of preliminary Engineering requirements.
 - Identify if facility changes are required (permits, infrastructure, etc.).

APQP – PLAN (Inputs) and Define P1/G1

- **Inputs** (continuing)
- **Management Support** – Management should be updated at the conclusion of every APQP phase.
 - Schedule Phase review approval meeting before APQP process transits to the next phase.
 - Conduct RISK ASSESSMENT.
 - Management involvement and commitment is vital to ensure success of APQP process.
 - Phase Approval

APQP – Product Design and Development (Plan/Do) P2/G2

- All the outputs of phase-I are now inputs to phase-II (Transitioning Plan.....Do).
- **Design** – Ensure that design goals were met and it is released for prototype.
 - Initial DFMEA is created (Many cases at Customer Level)
 - All functionality and reliability targets are assessed and met.
 - All environmental targets are assessed and met.
 - Design for manufacturability and machinability targets assessed and met. Verify drawings and specification changes.
 - Review Material and Engineering specifications.
 - Update BOM
 - Create DVP&R.

APQP – Product Design and Development (Plan/Do)

P2/G2

- All the outputs of phase-I are now inputs to phase-II.
- **Initiate Manufacturing Deliverables** – Ensure that all outputs are created for the next phase.
 - Visit Customer site, ensure all customer requirements are understood and captured.
 - Identify special process, inspections requirements.
 - Create special characteristics and ensure tracking through all related documentation.
 - Initiate process documentation including initial PFMEA, CP, process sheets, quality plans.
 - Initiate Safe launch plan (Audit Process) and consider costs related.
 - Set up APQP meeting schedule with customer.
 - Obtain marrying/equipment/service part if possible; understand complete functionality of the manufactured component.

APQP – Product Design and Development (Plan/Do)

P2/G2

- All the outputs of phase-I are now inputs to phase-II.
- **Environmental, Health & Safety** – Ensure that all aspects are reviewed and captured through this phase.
 - Identify environmental aspects and impacts.
 - Identify environmental air and water permit requirements.
 - Perform waste stream determinations.
 - Determine necessary H&S Operational controls.
- **Supplier Management**
 - Initial assessment of Tier2 and Tier3 Suppliers
- **System Requirements**
 - Update BOM, Action List/Program Chart/Gant, Conduct Risk Assessment.

APQP – Product Design and Development (Plan/Do)

P2/G2

- All the outputs of phase-I are now inputs to phase-II.
- **Management Support –**
 - Complete Assessment Obtain Management Buy-Off/Approval.
 - Lessons learned.....
 - Ensure all action items prior to proceeding forward.

APQP – Process Design/Deve/Prototype (Do) P3/G3

□ **Prototype realization.**

- All the outputs of phase-II are now inputs to phase-III.
- **Design** – Ensure that design meets the requirements and is released for prototype.
 - Proof of concept Design Validation complete.
 - DFMEA / Design Analysis and BOM is updated (Design Responsible)
 - Functional performance testing.
 - Product validation.
- **Prototype Build** – Develop comprehensive and effective manufacturing system through prototypes.
 - Create/revise all documentation for prototype (Process flow, PFMEA/Process Analysis, CP, Process Specifications, Operator and Gauging instructions).
 - ID/Lot traceability and packaging instructions

APQP – Process Design/Deve/Prototype (Do) P3/G3

- All the outputs of phase-II are now inputs to phase-III.

Prototype Realization (continue)

- **Prototype Equipment, Fixtures & Tooling** – Develop a strong foundation here
 - Identify & Source equipment, fixtures and tooling and issue P.O.'s.
 - Design and source work holding devices and approve concepts.
- **Prototype Material Supply and Subcontracted Processes**– Identify supplier for each component and subcontracted process for prototypes.
 - Source suppliers and identify requirements towards supplied material or subcontracted process for prototypes (Include all value added)
 - Approve design/concepts for prototypes.
 - Ensure all supplied material inspection including.
 - use of external laboratories (for required product design validation).

APQP – Process Design/Deve/Prototype (Do) P3/G3

- Outputs of phase-II are now inputs to phase-III.

Prototype Realization (continue)

- **Prototype Gauges**– Develop gauging concept for prototypes and ensure proper dimensional verification of parts.
 - Identify & Source measuring equipment.qualification equipment for prototypes and issue P.O.'s.
 - Manufacturing and delivery of equipment for prototype parts.
 - Perform MSA study for measuring equipment before use.
 - Create gauge instruction and add gauges to calibration program.
- **Prototype Parts Submission** – Ensure prototypes are delivered on time and conform to requirements.
 - Identify customer requirements related to prototype submission.
 - Produce and inspect prototype parts as required.
 - Prepare documentation and ship prototype parts/services/product.
 - Review Lessons Learned with Customer and
- establish improvement directions and goals.

APQP – Process Design/Deve/Prototype (Do) P3/G3

Outputs of phase-II are now inputs to phase-III

- **PROCESS DESIGN**
- **Production Equipment, Fixtures & Tooling** – Develop comprehensive and effective manufacturing system through APQP.
 - Identify & Source measuring/qualification equipment and tooling and issue P.O.'s. This includes production intent equipment as required..
 - Create floor plan layout. Ensure Product, Information and Communication Flow is included.
- **Production Material Supply and Subcontracted Processes**– Identify supplier for each component and subcontracted process.
 - Source suppliers and identify APQP requirements towards supplied material or subcontracted process for production purposes.
 - Approve design/concepts for production.
 - Establish sample sizes, pre-production requirements.
 - Ensure all supplied material inspection including
- use of external laboratories (Testing as required, customer specific requirements).

APQP – Process Design/Deve/Prototype (Do) P3/G3

- **Outputs of phase-II are now inputs to phase-III**
- **SYSTEM REQUIREMENTS**
 - Action/Program action tracker updated.
 - |Review Cost Baseline vs Budget (Tooling, Equipment, Resources)
 - Update BOM (Bill of Materials) create part in ERP/MRP
 - PFMEA/Process Analysis is updated and ensure that:
 - Severity is lined up with DFMEA.
 - Error proofing concept is developed.
 - RPN (Risk Priority Number, Weighted Variables) are conform AIAG recommendations (or customer requirements) Continuous Improvement Vital.
 - Address process sheets, engineering specifications.
 - Tool lists and set up customer owned tooling.
 - Facility and permit requirements.

APQP – Process Design/Deve/Prototype (Do) P3/G3

- **PROCESS DESIGN.**
- All the outputs of phase-II are now inputs to phase-III
- **SYSTEM REQUIREMENTS**
 - Ensure all action items are closed.
 - Complete self assessment 'Where are we at'
 - Risk Assessment Completion.
 - Obtain Management Support (Next Phase)

APQP – Production Planning/Design/Process Optimize(Do) P4/G4

- **All the outputs of phase-III are now inputs to phase-IV.**
- **Design** – Ensure that design meets the requirements and is released for production.
 - Design finalized, Frozen and Released to Production.
 - BOM is frozen and ERP.MRP Updated.

Production Equipment, Fixtures & Tooling Requirements–

- Review plant layout.
- Manufacture Service and assemble (Plant Layout).
- Machine Run off on Supplier site.
- Verify machine delivery in on time and to the schedule.

APQP – Production Planning/Design/Process Optimize(Do) P4/G4

All the outputs of phase-III are now inputs to phase-IV.

- **Production Equipment, Fixtures & Tooling Requirements–**
 - **Standard Production equipment.**
 - Faculty plan layout (Where is everything)
 - Manufacture and deliver work fixturing/Equipment.
 - Verify machine and work devices delivery to the schedule.
 - Manufacture and Deliver tooling.
 - **Production Material Supply and Subcontracted Processes–** Suppliers for each component and subcontracted process (very key for long term relationship).
 - Agreements/Releases/POs.

APQP – Production Planning/Design Optimize(Do) P4/G4

- All the outputs of phase-III are now inputs to phase-IV.
- **Production Material Supply and Subcontracted Processes– AT ALL DIRECT MATERIAL SUPPIERS**
- PPAP requirements for each supplier, or First Article.
 - Order and receive PPAP material.
 - Supplier's PFMEA (Process Failure Mode Effects Analysis) and CP (Control Plan).
 - Supplied material inspection when received including
 - Bring forward DFMEA information for supplier's PFMEA (If applicable).
 - Ensure all special characteristics are documented and reviewed.

APQP – Production Planning/Design Optimize(Do) P4/G4

- All the outputs of phase-III are now inputs to phase-IV.
- **Short Term Production Measurements**– Measuring.Qualification Equipment for production intent equipment parts and ensure proper dimensional verification of parts.
 - Manufacturing and delivery of gauges.
 - MSA study before use.
 - Gauge instruction and add gauges to calibration program.
- **Production Measurements**– Ensure final Measuring.Qualification Equipment for production intent and effective measurement system.
 - Manufacturing and delivery of gauges.
 - MSA study before use.
 - Measurement Instruction and add them to calibration (verification) program.
 - Equipment/Device fixtures.
 - Dedicated gauge stations.
 - 100% Gauge Station Inspection. Regardless of Statistical Data one defect is all it takes. HIGH RISK AT OEM LEVELS.

APQP – Production Planning/Design Optimize(Do) P4/G4

- **All the outputs of phase-III are now inputs to phase-IV.**
- **Dunnage and Packaging** – Ensure that proper dunnage and packaging instructions are available both for inbound and outbound material for production/value add purposes.
 - **Incoming (Supplier) Dunnage.**
 - Establish packaging requirements for each incoming component or material taking in account the floor layout and storage space.
 - Establish labeling requirements.
 - Approve dunnage concepts and designs.
 - Get Customer review/input. Reduce Risk.
 - Source incoming dunnage.
 - Establish required quantity and issue P.O.'s.

APQP – Production Planning/Design Optimize(Do) P4/G4

- All the outputs of phase-III are now inputs to phase-IV.
- **Dunnage and Packaging –**
- **Outgoing Dunnage.**
 - Packaging requirements for parts/product based on customer requirements.
 - Address labeling.
 - Approve dunnage concepts and designs.
 - GET Customer approval.
 - Source outgoing dunnage.
 - Quantity and issue P.O.'s.
 - Dunnage Maintenance.

APQP – Production Planning/Design Optimize(Do) P4/G4

- **All the outputs of phase-III are now inputs to phase-IV.**
- **Material/Service Handling Systems–** Ensure proper holding and transfer of parts.
 - Design and approve for each system.
 - Source Requirement and Issue PO.
 - Ensure action Items are tracked.
- **Human Resource Planning– IDENTIFY RESOURCES NEEDED.**
 - Establish requirements. (Recommendations, data, studies, cycle time, burst requirements)
 - Hire or transfer personnel.
 - Establish training plan based on training procedures, specific requirements and necessary and existent skills (Manager v Supervisor v Skilled).

APQP – Production Planning/Design Optimize(Do) P4/G4

- All the outputs of phase-III are now inputs to phase-IV.
- **Environmental, Health & Safety –**
 - Identify any hazardous material intended to be used.
 - Obtain and review MSDS (Material Safety Data Sheet) SDS (WHMIS 2015) for each hazardous material.
 - Integrate effective countermeasure
 - **System Management –**
 - Complete Risk Assessment.
 - Facility preparations and regulatory requirements.
 - Finalize Material, Traceability, System, Product Production.

APQP – Production Planning/Design Optimize(Check) P4/G4

- All the outputs of phase-III are now inputs to phase-IV.
 - **System Management –**
 - Update action tracker.
 - Cost analysis to Budget.
 - BOM and ERP/MRP Verification
 - PFMEA/Process Analysis update or RISK ASSESSMENT TOOL:
 - Address all high risk factors based on Product design Intent and Process Analysis.
 - Policies and Procedures Enhancements.

APQP – Production Planning/Design Optimize(Check) P4/G4

- All the outputs of phase-III are now inputs to phase-IV.
 - **System Management –**
 - Initial Work instructions and Visual Aids.
 - Complete Control Plan.
 - Containment Plan or Verification Plan (mock trial for services) Safe Launch inspection plan, FEP (Field Evaluation Plan), Quality Planning according to customer requirements (GP12 or CS1 Automotive).
 - Update Action Tracker
 - MANAGEMENT APPROVAL OF PHASE/GATE

APQP – Product/Launch Validation(Check) P5/G5

- All the outputs of phase-IV are now inputs to phase-V.
- **Production Equipment, Measuring Devices, Service Process IT, Fixtures & Tooling Requirements–**
 - Machines in place and complete PHSR (Pre Start Health Safety review) after commissioning.
 - Equipment Off at user plant / PM schedule.
 - Identify customer owned fixtures and tools.
 - Implement error/mistake proofing (all processes).
 - Complete PPAP (Part Production Approval Process), same for Subcontractors.
 - Validate all equipment capacity across the applicable process / supply chain.
 - Material Supply Verification

APQP – Product/Launch Validation(Check) P5/G5

- All the outputs of phase-IV are now inputs to phase-V.
- **Production Gauges/Measuring Device –**
 - Perform MSA (Measurement System Analysis) Studies. IF ON CONTROL PLAN OR QUALITY PLAN HAVE A MSA.
 - Perform Correlation with Customer gauges/measuring device/measurement device. IMPORTANT REFEREE IS NEEDED.
- **Dunnage and Packaging –**
 - Ensure all dunnage for incoming and outgoing is ready for production release.
- **Material Handling Systems –**
 - Ensure Handling Systems are functional, with PM (Preventative Maintenance defined)
 - System is PHSR.

APQP – Product/Launch Validation(Check) P5/G5

- All the outputs of phase-IV are now inputs to phase-V.
- **Human Resource Planning–**
 - Validate/Address job specific training.
 - Update training matrix.
- **Environmental, Health & Safety –**
 - Define lock out procedures and placards.
 - Assess all confined spaces.
 - Assess Physical Demand.
 - H&S Risk Analysis and Assessments.

APQP – Product/Launch Validation(Check) P5/G5

- All the outputs of phase-IV are now inputs to phase-V.
- **Run @ Rate – CAN YOU DO IT.....**
- Perform and evaluate trial Run @ Rate must meet customer requirements.
 - Collect data and analyze manufacturing process initial capability
- **System Requirements–**
- Final Work Instructions.
 - Safe Launch area and inspection criteria.
 - Update action tracker.

APQP – Production Feedback CA's (ACT) P6/G6

- All the outputs of phase-V are now inputs to phase-VI.
- **Production Equipment, Fixtures & Tooling Requirements–**
 - Determine tool usage, tooling/equipment update based on usage
 - Create tool change schedule.
 - Acquire adequate supply for all tooling/equipment.
 - Establish Critical & Spare Parts List.
- **PPAP Submission –**
 - Prepare PPAP documentation.
 - Review documentation with customer.
 - PPAP parts are shipped and obtain approval.
 - REMEMBER PPAP WARRANT IS AN EXTENSION OF CONTRACT. IN SOME CASES MONIES ARE RELEASED (Tooling, Program, R&D)

APQP – Production Feedback CA's (ACT) P6/G6

- All the outputs of phase-V are now inputs to phase-VI.
- **Ramp Up/Steady State** –
 - Customer requirements established, communicated, and met. Track Performance.
 - **Start of Production [SOP]** – Final Key milestone in the APQP process which marks the official production/product/service process start.
 - Quality Planning Sign off. Team approach

APQP – Production Feedback CA's (ACT) P6/G6

- All the outputs of phase-V are now inputs to phase-VI.
- **System requirements**
 - Management Support and Sign-off
 - Reduce Variation through Process Analysis and improvement
 - Improve on Capacity and Capability
 - Continuous Customer Centric approach. Engage your customer always
 - Use Lesson Learned from the Project to address similar processes, continuously improve and reduce variation, improve efficiencies and Improve Customer Satisfaction.
- APQP IS A CONTINUOUS JOURNEY.