Productivity Improvement by using APQP & PPAP Tools for Development of Machining Process for Shell Finished SK-1815

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Abstract— Advance Product Quality Planning (APQP) & "Production Part Approval Process" commonly known as 'PPAP'. APQP &PPAP is an important part of the Process of product development allowing producers to evaluate the components and sub system which they from suppliers and establishing confidence in the suppliers' management systems. Although individual manufacturers have their own particular requirements. In this research Paper we have Prepare the Documentation process and time study for the changing process flow of machining for Rivon Industry, MIDC, Kolhapur .and also submitted APQP and PPAP to the Customer.

Keywords: Advance Product Quality Planning (APQP), "Production Part Approval Process (PPAP)

I. Introduction to Advance Product Quality Planning (APQP)

APQP is a systematic approach to production of the products and processes. This structure is a structured collection of quality specifications that enable manufacturers to produce a customer-satisfying product. The main aim of product quality preparation is to promote cooperation among technical practices and coordination. A Cross Functional Team (CFT) is used in the APQP process, including marketing, product design, sourcing, production, and delivery. APQP provides a consistent interpretation of the Customer Voice (VOC), converted into standards, technological criteria and unique characteristics. The advantages of the substance or the procedure are formulated by mitigation.

APQP encourages deliberate as well as accidental early recognition of the transition. Such improvements will lead to innovative new technologies that help consumer delights. We turn into disappointment and consumer frustration when not done properly. APQP emphasizes on the use of techniques and approaches to reduce the uncertainties involved with a transition in the existing product or procedure

II. When To Apply Advanced Product Quality Planning (APQP)

APQP promotes collaboration between supply chain and client / company. Standards which turn into even more precise requirements are explained as the cycle proceeds and decayed to more detail. Using APQP in two ways:

A. New Product Introduction (NPI) Support:

APQP improves the methods of product production by adding a emphasis on vulnerability as a workaround to loss. It helps the team to take action on the issue, rather than wait in the customer's lap for disappointment to appear in testing or worse. APQP uses risk-based techniques to concentrate on all aspects of product and process design, operation, quality management of procedures, labeling, and continuous improvement. Each APQP application could be special to an earlier application due to the percentage of new content, changes to current off-the-shelf technology or past history of failure.

B. Product or Process Change (Post Release):

APQP tracks a product or process transition other than Product Development, which guarantees that the possibility of transition is efficiently handled by avoiding the change caused issues.

III. Introduction to Production Part Approval Process (PPAP)

The manufacturing element clearance process PPAP is used in the automobiles distribution chain to create trust in the manufacturers of parts or their development cycle by means of a demon list that:

"Both consumer technical documentation and design specifications are fully recognized by the manufacturer so therefore the operation has the ability to deliver a product therefore reliably meets these criteria during the actual manufacturing cycle at the specified production cost."PPAP is an essential part of the equation of product development that enables manufacturers to analyze the parts and sub - system from distributors and also to gain trust in the vendor management solutions. While production is required have their very own unique specifications. PPAP was the result of collaborative attempts by Chrsler, Ford and GM, operating underneath the pretense of the automotive sector Action Group (AIAG) and the United States Quality Assurance Society (ASQC), to create industry-wide requirements that will extend to all of their multiple suppliers. The first PPAP Multiple Requirement Manual was published in 1993. PPAP is part of the Automobile Industry's overall Advanced Product Quality Assurance program, a step-by - step mechanism intended to ensure the development of an end-product that can please customers.

IV. When PPAP Submission Required

Report also isn't required; however, the management company retains the right to submit all of these records. In general, a PPAP is needed if a new component or a modification to an established portion or system is expected. It is at the discretion of each division of industries to decide when and why PPAP submissions would be needed. As a manufacturer, you will have the sort of compliance program that incorporates all the specifications of the PPAP application, irrespective of if you have been required to submit a request at any point during the life of the product. Submission of the PPAP needed for:

A. New component, process or supplier

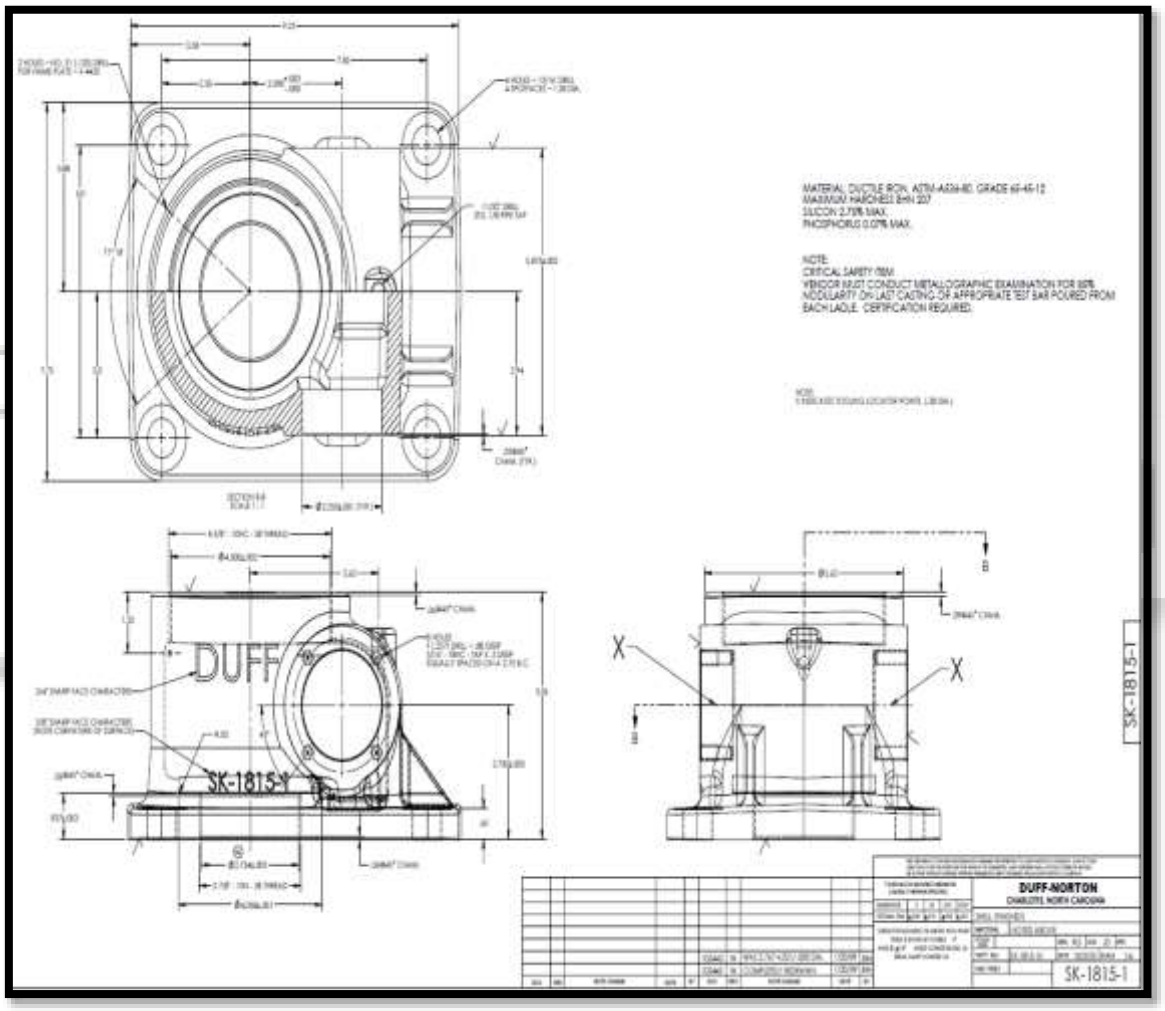
- Fresh component or new product
- New Manufacturers
- Latest process or modern tech

B. Updates to a current model

- Design, content or part shift.
- Old, modified or updated resources.
- Update or re-arrange existing tools.
- Tooling, production or facilities moved to various locations.
- Shift of manufacturer or non-equivalent material / services.
- Changes to the system or process part of the product.
- The tooling company has been inactive for 12 months.
- Shift in check or inspection process.
- High volume material: new supply of raw materials.
- Change the attractiveness attributes of the product.
- Changing of output cycle or system.
- Transfer of sub-supplier or source of content.

V. PROBLEM DEFINITION

Rivon Industry has a two years ago Developed the New part name of shell finished number SK-1815. when the part is developed company set the process for the VMC based but recently company purchased the new 4th axis for VMC so company decided the process of HMC shifted for the VMC. But Customer Required submitted new process APQP and PPAP submission also company need understand the Productivity improvement for shifting HMC to VMC



VI. ANALYSIS OF CURRENT PROCESS AND MODIFYING PROCESS

A. Current Process Flow Chart

PART NAME :- SHELL FINISHED					CUSTOMER NAME :- INDIMATE INDIA	
PART NUMBER:SK-1815					PROCESS RESOPNSIBILITY :- PRAMOD NALAWADE	
REV NO :00					CORE TEAM :- Mr. Vinod Revankar , Yogesh Mali , Vishnu Chavan , Pramod Nalwade, Sallauddin Makandar	
ISUUE DATE :-18/11/2019						
Process No	OP/BREIF DESCRIPTION	SPECIAL CHAR CLASS	INCOMING SOURCES OF VARIATION	PROCESS FLOW DIAGRAM	PRODUCT CHARACTERISTICS	PROCESS CHARACTERISTICS
10	RAW MATERIAL		Chemical composition	100	As Per Receiving Control Plan	
20	CASTING MFG. & INSPECTION		CORE , COLD SHUT , BLOW HOLE ,etc	200	As Per Control Plan	Temperature , Pattern
30	INCOMING INSPECTION & STORAGE		Casting Defects	300	As per Receiving CP	As Per Sampling Plan
40	Semi Finishing 1st lathe Operation		ID , OD , Depth , Radius , Chamfer	400	As Per Control Plan	Depth Of Cut , Speed ,Fixture, Tool Parameter
50	All Part Finishing 1st HMC Operation		Hole Drill,Bore Dia , Depth , Surface Finish , OD	500	As Per Control Plan	Depth Of Cut , Speed ,Fixture, Tool Parameter
60	VMC 1st Operation		Bore Dia , Depth , Surface Finish , OD	600	As Per Control Plan	Depth Of Cut , Speed ,Fixture, Tool Parameter
70	Packing		Box Size , Packing Method	700	As Per customer Requirement	Packing Work Instruction
80	DISPATCH (Customer)			800		On Time Delivery
90	STORAGE		Operation and Inspection		Transport	OPERATION

B. Current Process Time Study

1ST OPERATION: - ON LATHE MACHINE

						TIME	
Sr.No	Name of Tool	Operation	Machine	Speed	Feed	MINT	SEC
1	Rough Finish	100	LATHE	0.3	250	3	20
2	Smooth Finish	100	LATHE	0.1	500	2	20
3	Clamping & Declamping					1	30
4	indexing					1	30
				Total		7	100
				Total Time		8 Min 40 Sec	

2ND OPERATION: - ON HMC MACHINE

						TIME	
Sr. No	Name of Tool	Operation	Machine	Speed	Feed	MINT	SEC
1	Ø113.8 Boring Bar R.	200	HMC	80	450	1	26
2	Ø69.5 Boring Bar R.	200	HMC	50	500	1	30
3	Ø73 Boring Bar R.	200	HMC	50	500	1	15
4	Ø102.5 Boring Bar R.	200	HMC	20	400	1	15
5	Ø56.6 Boring Bar R.	200	HMC	50	450	1	12
6	Ø114.3 Boring Bar	200	HMC	25	450	1	18
7	Ø103.078oring Bar F.	200	HMC	27	419	0	21
8	Ø69.95 Boring Bar F.	200	HMC	41	494	0	14
9	Ø57.15 Boring Bar F.	200	HMC	50	683	0	12
10	Ø114.3 Boring Bar F.	200	HMC	500	831	0	17
11	Ø25 End Mill	200	HMC	500	1800	1	20
12	Ø6.5 Drill Chamfer	200	HMC	366	1200	1	16
13	Ø20.3 Drill	200	HMC	117	1950	2	15
14	Ø8.73 Drill	200	HMC	382	117	1	10
15	Ø20.63 Ream	200	HMC	231	382	0	14
16	5/16 Tap	200	HMC	1.41	231	1	10
17	1/8 Tap	200	HMC	0.94	1.41	1	15
18	Spot Face	200	HMC	400	0.94	1	10
19	Clamping &Declamping					3	10
20	Indexing					3	30
				Total		20	330
				Total Time		25	30

3RD OPERATION: - ON VMC MACHINE

						TIME	
Sr.No	Name of Tool	Operation	Machine	Speed	Feed	MINT	SEC
1	Ø3 Drill	300	VMC	25	200	0	45
2	Clamping &Dclamping					1	10
3	Indexing					0	15
				Total		1	70
				Total Time		2	10

C. New Process Flow Diagram

New Process Diagram is Prepared from HMC to VMC operation

PART NAME: - SHELL FINISHED					CUSTOMER NAME:- INDIMATE INDIA	
PART NUMBER:SK-1815					PROCESS RESOPNSIBILITY: - PRAMOD NALAWADE	
REV NO: 00					CORE TEAM: - Mr. Vinod Revankar , Yogesh Mali , Vishnu Chavan , Pramod Nalwade, Sallauddin Makandar	
ISUUE DATE:-18/11/2019						
Process No	OP/BREIF DESCRIPTION	SPECIAL CHAR CLASS	INCOMING SOURCES OF VARIATION	PROCESS FLOW DIAGRAM	PRODUCT CHARACTERISTICS	PROCESS CHARACTERISTICS
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40	Semi Finishing 1st lathe Operation		ID , OD , Depth , Radius, Chamfer	400	As Per Control Plan	Depth Of Cut , Speed ,Fixture, Tool Parameter
50	All Part Finishing 1st VMC Operation		Hole Drill,Bore Dia , Depth , Surface Finish , OD	500	As Per Control Plan	Depth Of Cut , Speed ,Fixture, Tool Parameter
60	VMC 1st Operation		Bore Dia , Depth , Surface Finish , OD	600	As Per Control Plan	Depth Of Cut , Speed ,Fixture, Tool Parameter
70	Packing		Box Size , Packing Method	700	As Per customer Requirement	Packing Work Instruction
80	DISPATCH (Customer)			800		On Time Delivery
90	STORAGE		Operation and Inspection		Transport	OPERATION

D. New Process Time Study

1ST OPERATION: - ON LATHE MACHINE

						TIME	
Sr.No	Name of Tool	Operation	Machine	Speed	Feed	MINT	SEC
1	Rough Finish	100	LATHE	0.3	250	3	20
2	Smooth Finish	100	LATHE	0.1	500	2	20
3	Clamping & Declamping					1	30
4	indexing					1	30
				Total		7	100
				Total Time		8 Min 40 Sec	

2ND OPERATION: - ON VMC MACHINE

						TIME	
Sr.No	Name of Tool	Operation	Machine	Speed	Feed	MINT	SEC
1	Ø113.8 Boring Bar R.	200	VMC	80	450	2	10
2	Ø69.5 Boring Bar R.	200	VMC	50	500	2	15
3	Ø73 Boring Bar R.	200	VMC	50	500	2	7
4	Ø102.5 Boring Bar R.	200	VMC	20	400	2	20
5	Ø56.6 Boring Bar R.	200	VMC	50	450	2	30
6	Ø114.3 Boring Bar	200	VMC	25	450	2	30
7	Ø103.07Boring Bar F.	200	VMC	27	419	1	10
8	Ø69.95 Boring Bar F.	200	VMC	41	464	1	15
9	Ø57.15 Boring Bar F.	200	VMC	50	683	1	10
10	Ø114.3 Boring Bar F.	200	VMC	500	831	1	30
11	Ø25 End Mill	200	VMC	500	1800	2	10
12	Ø6.5 Drill Chamfer	200	VMC	366	1200	2	10
13	Ø20.3 Drill	200	VMC	117	1950	3	10
14	Ø8.73 Drill	200	VMC	382	117	2	10
15	Ø20.63 Ream	200	VMC	231	382	2	10
16	5/16 Tap	200	VMC	1.41	231	2	20
17	1/8 Tap	200	VMC	0.94	1.41	2	15
18	Spot Face	200	VMC	400	0.94	2	10
19	Clamping &Dclamping					3	10
20	Indexing					3	30
				Total		39	312
				Total Time		44	20

3RD OPERATION: - ON VMC MACHINE

Sr.No	Name of Tool	Operation	Machine	Speed	Feed	MINT	SEC
1	Ø3 Drill	300	VMC	25	200	0	45
2	Clamping &Dclamping					1	10
3	Indexing					0	15
				Total		1	70
				Total Time		2	10

E. Total Estimated Time

SR. NO.	PROCESS STEP	MEASURING TIME
1	1ST OPERTAION	8 Min 40 Sec
2	2ND OPERATION	44 Min 20 Sec
3	3RD OPERATION	2 Min 10 Sec
	Total estimated time for Single part	55Min 10 Sec

VII. APQP DOCUMENT PREPARATION

A. APQP Time Chart

In this Document Total Development Chart Is displaced with the four different Categories such as

- Plan & Define Program
- Product Development
- Manufacturing Process Design & Development
- Product & process Validation
- Customer feedback assessments & corrective action

In this Categories all responsibilities and target time is set for each and every activity

B. Team Feasibility Commitment

In this Document Supplier Dedication by the quality control Planning Team that the layout can be produced, manufactured, evaluated, processed and transported in adequate volume at an affordable outcome and on timetable.

C. Product or Process Quality Check sheet

In this Document the process required to maintain the Quality of the product making a check sheet as well as responsibilities for those particular activities is appointed.

D. Process Flow Chart

The purpose of the Process Flow Chart is to document and clarify all the steps required for the production of a part. The main flow process Chart The purpose of the Process Flow Chart is to document and clarify all the steps required for the production of a part. Primary steps must be consistent with both the Control Plan and the PFMEA. Process flows must cover the entire manufacturing process (receiving through shipping). All key steps in the process and all offline activities (such as metric, evaluation and managing) must also be included in the Process Flow Chart. Process steps must be consistent with both the Control Plan and the PFMEA. Process flows must include the entire production process. The Process Flow Chart must also include all key steps in the process and all offline activities (such as measurement, inspection, and handling). The flow on conforming material such as scrap parts, non-conforming parts, and rework parts should also be included. The Process Flow can be provided in any format used within an organization.

E. Characteristic Matrix

In this Document the all the dimension and their respective processing operation and inspection method are displays. As well as the dimension is used for location and clamping for the next operation is also indicating in this matrix so easily understand the Process and Dimension of the machining part

F. Painting Specification

After Machining and Inspection, the Part it required the paint as per the customer requirement so if customer specifies some paint otherwise supplier suggests the paint with the specification for that particular paint so all actives is written in this Document.

G. Packing Specification

After Completing Painting all part is required to packing and shipment to the customer. Customer is required packing specification other than supplier suggests the Packing method with the specification for that particular Packing Materials all actives is written in this Document.

H. Sample Processing Observation

During the Machining process each operation required some Cycle time. So each cycle time is noted and calculates the production time for Each Part.

I. Sign-Off Report

Sign-off Report is total summery of all the document and each process

VIII. PPAP DOCUMENT WITH SUBMISSION LEVELS

The submission standard determines which elements are required to be submitted. Levels are used for a number of purposes and implementations. The level to be submitted is decided by every industry and, unless otherwise specified, it often corresponds to Level 3, which would be a complete PPAP submission. There are five rates of submission listed below, and each is usually applicable to the different areas listed.

Sr. No.	Requirement	Level 1	Level 2	Level 3	Level 4	Level 5
1	Part Submission Warrant	✓	✓	✓	✓	✓
2	Design Records & Ballooned Drawings		✓	✓		
3	Approved Engineering Change Documents		✓	✓		
4	Customer Engineering Approval			✓		
5	Design Failure mode Effect Analysis (DFMEA)			✓		
6	Process Flow Diagram			✓		
7	Process Failure Effect Analysis (PFME)			✓		
8	Control Plan			✓		
9	Measurement System Analysis (MSA)			✓		
10	Dimensional Result		✓	✓		
11	Material, Performance Test Results		✓	✓		
12	Initial Process study			✓		
13	Qualified Laboratory Documentation		✓	✓		
14	Appearance Approval Report (AAR)	✓	✓	✓		
15	Sample Product Parts		✓	✓		
16	Master Sample(s)				✓	✓
17	Checking Aids				✓	
18	Bulk Material checklist	✓	✓	✓	✓	

IX. PRODUCTIVITY IMPROVEMENT ANALYSIS

A. Production Capacity Analysis

1) HMC Based Production Capacity of Sk-1815

a) Time Study

SR. NO.	PROCESS STEP	MEASURING TIME
1	1ST OPERTAION	8 Min 40 Sec
2	2ND OPERATION	25 Min 30 Sec
3	3RD OPERATION	2 Min 10 Sec
	Total estimated time for Single part	36 Min

b) Production Capacity

Standard Time for the Working Hrs. in a single shift = 435 Min

Production per shift=435/36=12 Nos

Production per Day = 12x3=36 Nos

Production per Month = 36x26=936Nos

2) VMC Based Production Capacity of Sk-1815

a) Time Study

SR. NO.	PROCESS STEP	MEASURING TIME
1	1ST OPERTAION	8 Min 40 Sec
2	2ND OPERATION	44 Min 20 Sec
3	3RD OPERATION	2 Min 10 Sec
	Total estimated time for Double part	55Min 10 Sec

b) Production Capacity

Standard Time for the Working Hrs. in a single shift = 435 Min

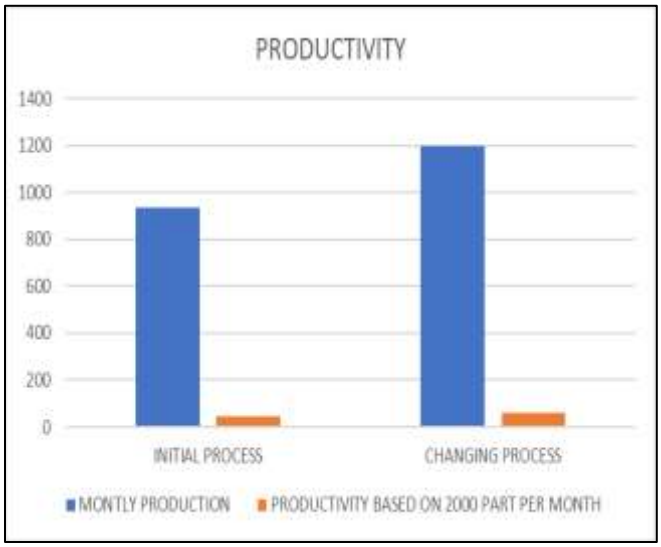
Production per shift=435/36=8X2 =16Nos

Production per Day = 16x3=48Nos

Production per Month = 48x26=1200Nos

B. Productivity Improvement

	MONTLY PRODUCTION	PRODUCTIVITY BASED ON 2000 PART PER MONTH
INITIAL PROCESS	936	46.8
CHANGING PROCESS	1200	60



C. Cost of Implementation and Payback Period

1) The Cost of Implementation If Only for the Fixture Modification

expected fixture modification cost =1,20,000Rupees

2) Profit per Month

OLD METHOD

TOTAL TIME REQUIRE	QTY OF FINISH PRODUCT	MONTLY PRODUCTION	CUSTOMER RATES FOR FINISHING	PROFIT PER PIECE ON HMC	PROFIT PER MONTH
36	1	936	950	470	439920

NEW METHOD

TOTAL TIME REQUIRE	QTY OF FINISH PRODUCT	MONTLY PRODUCTION	CUSTOMER RATES FOR FINISHING	PROFIT PER PIECE	PROFIT PER MONTH
55	2	1200	950	610	732000

3) Payback Period

OLD PROFIT	NEW PROFIT	INCREMENT	COST OF NEW FIXTURE	PAYBACK COST IS 10% OF PROFIT	PAYBACK PERIOD IN MONTH
439920	732000	292080	120000	29208	4.108463435

X. CONCLUSION

During the Process change in Manufacturing Process. Customer need all the document related to the change of process such as PPAP and APQP. This is needed because of customer need to build confidence between the suppliers

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