Peer Reviewed Referred
and UGC Listed Journal
(Journal No. 40776)

ISSN 2277 - 5730

AN INTERNATIONAL MULTIDISCIPLINARY
QUARTERLY RESEARCH JOURNAL

AJANTA

Volume-VIII, Issue-I
January - March - 2019
Part - I

IMPACT FACTOR / INDEXING
2018 - 5.5
www.sjifactor.com

Ajanta Prakashan

ISSN 2277 - 5730

AN INTERNATIONAL MULTIDISCIPLINARY
QUARTERLY RESEARCH JOURNAL

AJANTA

Volume - VIII Issue - I Part - I January - March - 2019

Peer Reviewed Refereed
and UGC Listed Journal

Journal No. 40776

ज्ञान-विज्ञान विमुक्तये

IMPACT FACTOR / INDEXING
2018 - 5.5
www.sjifactor.com

❖ EDITOR ❖

Asst. Prof. Vinay Shankarrao Hatole
M.Sc (Maths), M.B.A. (Mktg.), M.B.A. (H.R.),
M.Drama (Acting), M.Drama (Prod. & Dir.), M.Ed.

❖ PUBLISHED BY ❖

Ajanta Prakashan
Aurangabad. (M.S.)

CONTENTS OF PART - I

2. Brought Out Part (BOP) Quality Manual in Automotive Industries

Prof. (Dr) Satish Ubale
Sumit Godalkar

Abstract :

Quality, Cost, Service. Technology and Delivery are the key expectations of automotive market. To keep long term survival and to make profitable growth requires supreme business efficiency and resourcefulness. To maintain organisation business strength require closely working with its supply base to make sure that requirements and expectations are clearly understood by supplier partner.

BOP Quality Manual is a part of the organisation "Quality Assurance Manual" and concluded between organisation and suppliers, and designed with a view to provide supplemental information in order for parts and supplier quality assurance activities to confirm to the respective provisions of the "General Agreement for Purchase of parts" and the "General Agreement for Quality Assurance". Suppliers are required to comply with each of the requirements specified in the "General Agreement for Quality Assurance" with BOP Quality Manual as guidance on practice of quality assurance.

BOP Quality Manual expect suppliers to be committed to a zero-defect approach and to demonstrate that commitment through on-time delivery of fully conforming products, rigorous adherence to defined processes and requirements, and also active participation in value improvement. It establishes a process of providing high quality that satisfies expectations of organisation product users. BOP Quality manual is applied to all parts ordered by organisation under the General Agreement for Purchase of Parts. The scope of BOP Quality Manual includes all quality assurance activities such as APQP, PPAP, MSA, SPC & FMEA performed by suppliers to ensure the appropriate quality of delivered parts.

This research paper explains the significance of BOP Quality Manual and essential terms which supplier needs to be complied by process improvement approach.

Keywords – APQP, FMEA, SPC, MSA, Control Plan, PPAP, Error Proofing, PFD.

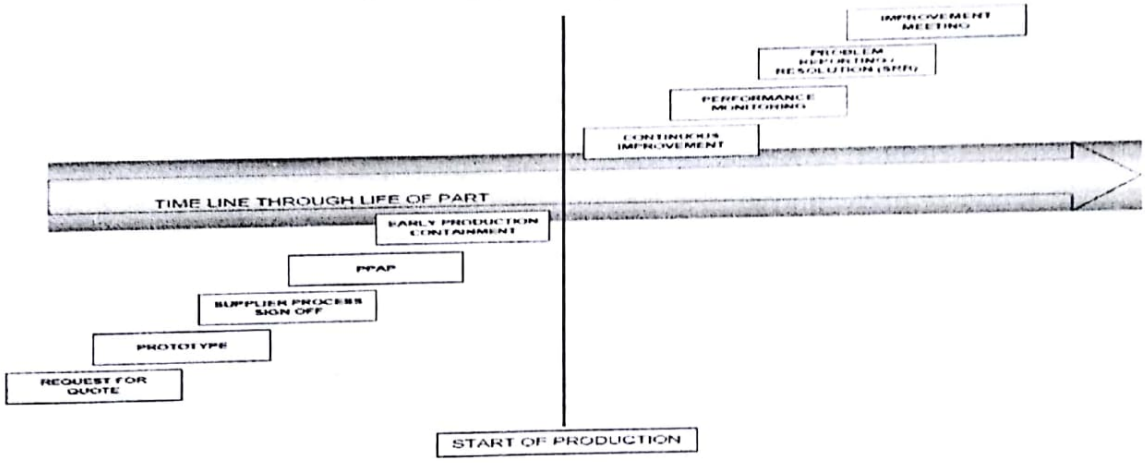
Introduction

BOP Quality Manual is bonding between Organisation and supplier relation. BOP Quality Manual requires the effective application of quality management systems, including effective Advanced Product Quality Planning (APQP) and corrective/preventive action processes. The Prime objectives of BOP Quality Manual implementations are to maintain a constant focus on continuous improvement at both manufacturer and each supplier.

BOP Quality manual will provide a roadmap through the quality requirements and procedures at each stage of product life. This manual starts each section with the "basics" and then offers relevant specifics for the topic to educate supply base can only improve our ability to work as a team and to achieve completely satisfaction by fulfilling the needs of our customers. Continuous improvement and a firm commitment are the keys of quality; through which we can meet our goals of "highly satisfied customer".

BOP Quality manual follow the Supplier Stages Timeline show below.

Fig. 1 – Supplier Stages timeline



Ref. Alex Product INC. – Supplier Quality Manual

This timeline provides a method for controlling supplied products and process from quote through the life of the part. The objective of this manual is to detail review of each step on the timeline.

The horizontal axis is representing life of the part (time). The vertical axis is representing the point in time relating to the Start of Mass Production. The steps area is broken into two phases by the vertical axis. The first phase is referred to as preproduction Stage and the second phase is Mass Production Stage.

The first steps are employed prior to the start of mass production to proactively work with the supplier, ensuring a quality product at the start of mass production. It is a Supplier Quality representative or Engineer responsibility to work with a supplier team and arrange to facilitate or implement the Advanced Product Quality Planning (APQP) Activities. The second steps are mass production stage, in which supplier team are motivated for strictly adherence of defined process and continuous improvement for increasing value of products.

Structure of BOP Quality Manual -:

Implementation of BOP Quality manual contains four important sections.

1. General.
2. Preproduction Stage.
3. Mass Production Stage.
4. Reference.

General -:

This section explains the policies and principles of organisation. Along with company past history roadmap, it focuses on basic requirement from supply base to achieve organisation predefined goal. Organisation defines standards for his supply base, which should be complying within defined time line.

a. Company Background – This paragraph explains, organisations past milestone achievement and future ambitions. Organisation success story not only motivate internal associates but also it creates model for supplier partner.

b. Quality Policy – A quality policy is a document developed by management to express the directive of the top management with respect to quality. Organisation Quality policy always guides in quality related decision making process. All necessary quality documents should be made as per Quality policy.

c. Control of the Quality system manual – Organisation has copyrighted of his BOP Quality Manual. Supplier has to agree to take care and preserve the confidentiality of each other confidential information and will not disclose any confidential information to any third party. BOP Quality Manual is always in custody of supplier quality representative, who has authorised by organisation.

d. Quality Management System – It is a set of policies, processes and procedures, which are focused on consistently meeting customer requirement and achieving highest level of

customer satisfaction. Quality Management System is essential to create superior quality of product and also meet all customer expectations in terms of Environmental, Governmental and Hazardous substance regulatory policies.

e. Management Responsibility – Supplier has to register its quality contacts to organisation in order to communication with organisation about quality to be effective. First quality representative should be from executive officer level.

f. Sub-supplier quality assurance – Supplier is whole responsible for his outsource processes. Supplier has to be established basic requirements for quality assurance of purchased parts and outsourced processes in order for quality of the parts to be properly controlled by his sub-supplier.

g. Control of quality records – Organisation shall identify quality records which suppliers may require for quality presentation or QC story.

Preproduction Stage -:

In supplier stage management activity, preproduction stage ensures the quality of process and on time delivery as per organisation part submission event. After receiving letter of Intent, supplier has to make detail manufacturing plan. From design approval process to Mass production part events, all macro level activities should be mentioned in manufacturing time line.

a. Design Record - Organisation shares the printed copy of drawing along with the purchase order (PO). If supplier is responsible for designing, then Each and every feature must be "ballooned" or "road mapped" to correspond with the inspection results.

b. Authorised Engineering changes – After reviewing design feasibility, supplier may request for specs or necessary changes in design. The documents which contain spec or design modification request are called "Engineering change notice".

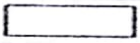
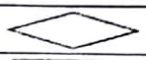
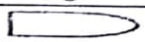
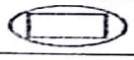
c. Customer Engineering Approval – This approval is usually done after engineering test or performance test carried out at customer end. Supplier requested by "Engineering change Notice", before PPAP submission. Modified Parts are getting received by temporary deviation request.

d. Design FMEA – Design Failure Mode Effect Analysis document is jointly reviewed by customer and supplier. DFMEA explains all critical and high impact product characteristics. *It* is a methodical and analytical approach used for identifying potential risks introduced in a new

or changed design of a product. The DFMEA initially identifies design functions, failure modes and their effects on the customer with corresponding severity ranking of the effect.

e. Process flow diagram - A process flow diagram is a diagram to indicate the steps and general flow of plant processes and equipment. Process flow diagram starts with raw material receipt and ends with finish good. Symbols are used to indicate flow of processes.

Table 1 – Process flow Symbols

Symbol Name	Symbol	Description
Process		Where shape and nature of input material are transformed
Inventory		Raw material, parts storage
Flow Line		Direction of Process Flow
Quantity Inspection		Where volume and quantity of raw material are measured and compare with standard
Quality Inspection		Where quality characteristics of raw material are measured and compare with standards
Delay		Where raw material, parts are behind schedule
Combined Symbol		Perform quantity inspection as well as quality inspection of parts
Combined Symbol		Where quantity inspection as well as processing are conducted
Combined Symbol		Flow Line crossing

Source: Primary

f. Process FMEA – Process FMEA is a 'Living Document", which should be continuously updated as per process improvement. PFMEA used to investigate potential failures and apply appropriate actions to prevent and contains these failures. PFMEA document develops by involving all affected areas representatives, such as design, manufacturing, inspection, quality etc and collect as much knowledge as possible.

Table 2 – Format for PFMEA

Process Input	Potential failure mode	Potential Failure Effect	Severity	Potential Causes	Occurrence	Current Control	Detection	RPN = (S * O * D)	Action Taken	Severity	Occurrence	Detection	Revised RPN

Source: Primary

g. Control Plans – Manufacturing Process design and Process FMEA are the basic input for preparing control plan. Control plan is the document, which monitor the functional element of quality control that are to be implemented in order to assure that quality standards of product.

The functional elements, which affect the performance, result of product such as leakage, abnormal noise etc. are also monitored in the control plan.

Control plan is designed in three phases:

1. Prototype
2. Pre-launch
3. Mass Production

Table 3 – Format for Control Plan.

Process Name	Failure Mode	Critical Item	Control Item	Specification	Person in Charge	Check Method	Frequency	Data Format

Source: Primary

h. MSA studies - A measurement systems analysis evaluates the test method, measuring instruments, and the entire process of obtaining measurements to ensure the integrity of data used for Quality analysis.

Calibration studies, components of variance, ANOVA gage R&R, gage R&R, attribute gage study, fixed effect ANOVA and destructive testing analysis are included in the measurement system analysis.

i. Dimensional Results - The *Dimensional Results* Report provides a record of the dimensional data taken from product produced during the production process run. It is section in which layout report of all outsource parts and report of all measurements specified by customer or the design drawing.

j. Material and performance test results – Supplier has to perform all parts and product materials chemical, mechanical and metallurgical tests, when specified on the drawing and control plan. The results of material test are directly affects the performance of the product so carrying of material test are beneficial, though it has not been mentioned on customer drawing.

k. Initial Process studies – Process FMEA guides to identify most critical characteristics in the process. This section shows all Statistical Process Control charts of critical characteristics. The purpose of SPC chart is to check, whether process has stable variability or not.

l. Qualified lab documents – In manufacturing process Testing of parts or product materials is one of important activity, as testing results define the reliability of product. Testing

in qualified labs means use of expert knowledge and advance technologies. This section explains the compilation of all necessary lab test reports.

m. Appearance Approval Report – It is Customer – Manufacturer joint approval activity. Those components are critical for appearance; customer should have to sign Appearance Approval Report with their acceptance criteria.

n. Master Sample – Supplier has to prepare Master samples, which should be approved / signed by Customer. Master sample concludes the acceptance criteria for visual or noise level standards.

Master samples are used to train the operators on subjective inspection such as visual or for noise. Control of master sample is supplier responsibility.

o. Control of Measuring and Monitoring equipment's – Supplier has to prepare check list of all routine or special measuring and monitoring equipment's. The traceability, accuracy, function and precision of all this equipment should be as per International or national standards.

p. Operation Standards / Work instructions – It is set of documents that describes procedures to be followed such as work sequence, illustrations of work, Jigs and Tools, quality characteristics and standards, operation key points, inspection methods, parts to be used, action to be taken when abnormality occurs and other cautions.

q. Packing standard approval report – Delivery packaging should be synchronised with customer production line and requirements. While defining packaging specifications following points are considered –

1. Past history.
2. Customer requirement.
3. Quality maintenance.
4. Limitation of shape, weight, carry-in method etc.
5. Theft proof, confidentiality protection.

r. Transition to mass production – Validity Testing – Supplier has to verify completion of Pre-production stage and issue mass production transition declaration. Organisation may visit with supplier to evaluate mass production readiness at supplier end. Following areas are evaluated in Transition activity –

1. Production :

- Permanent Tooling availability (Mold, Die).

- Permanent facilities (Testing devices, Jigs and Fixtures)
- Production Capacity (Cycle time)
- Packaging and transportation facilities.
- Manpower arrangement.

2. Quality –

- Past history.
- Countermeasure implementation.
- Precision of special checking fixtures.
- Process capabilities.
- Error proofing.
- Operation control documents.
- Employee training and education.
- Machine and Process validations.

Mass Production Stage -:

It is third stage of Supplier Quality Manual which explains transfer process from Development stage to Mass production stage. This stage contains are

a. Early mass Production Quality control - It is manufacturer and customer joint verification activity in which process capability and mass production readiness are verified. Process Cycle time and production yields are observed in minimum two hours' continuous production.

For Process capability should be met at least one of condition.

1. CPk > 1.33or P < 0.01 range is observed.
2. If 1< CPk < 1.33 or 0.01 < P < 0.3, 100% inspection or sampling inspection must be required.
3. If CPk < 1 or 0.3 < P, 100% inspection required.

b. Mass Production Quality control – Supplier has to maintain and do continuous improvement in the quality of process. Work procedure, control plan, PFMEA etc. should be continuously reviewed and control by doing standardizations. Production, inspection and testing equipment calibrations record should be maintained.

c. Identification and Traceability – Identification means Parts specification card, shall be required at the time of delivery. Company name, customer part number, customer part name, delivery date and quantity are necessary information in the Identification.

Traceability is essential term which provides the ability to find out suspected lot, track production record, quickly recall products and match replacement parts. Traceability identifies products to its point of origin.

d. Change point control – To improve product performance, avoid potential causes of errors & minimise severity of defects, it is essential to do changes in concern 4M condition such as change requires in the labour, material, methods and machining.

Along with planned changes, there are also some unexpected changes such as blackout, breakdown etc. The supplier shall maintain traceability of all changes and report to customer as per prescribed requirement. Supplier has to direct and control its sub-supplier change point.

e. Corrective Action Report - Supplier should ensure no nonconformity will flow. If any nonconformity detected, supplier has to submit detail analysis report & countermeasure.

Reference -:

Forth stage of Supplier Quality Manual, explain some important terms or core tools which strengthen the productivity and help to achieve supreme product quality with highest level of customer satisfactions. This stage contains are

a. Process Capability – The output of process has to meet customer design specifications, tolerances and requirements. Process capability Index judge the ability of process for meeting customer specifications.

Condition 1: Process Capability Index expressed as Cp –

When average of the distribution of the data same as median between upper and lower limit.

$$Cp = \frac{\text{Specification Range}}{6\,\delta}$$

i) If Cp > 1.00; Almost no nonconforming products will be produced. If Cp close to 1, then possibility to nonconforming product will occur.

ii) If Cp > 1.33; Process capability is considered adequate.

Condition 2: Process Capability Index expressed as Cpk –

When average of the distribution of the data is displaced from the median between upper and lower limit.

$$Cpk = \min (Cpl , Cpu)$$

Where

$$Cpl = \frac{Mean - LSL}{3\delta} \quad \& \quad Cpu = \frac{USL - Mean}{3\delta}$$

i) If 0.67 < Cpk < 1.00; Process Capability is insufficient, need to investigate displacement of median.

ii) If 1.00 < Cpk < 1.33; Process Capability is not sufficient, process improvement required until a Cpk of 1.33 is achieved.

iii) 1.33 < Cpk < 1.67; Process Capability is sufficient.

iv) 1.67 < Cpk; Process capability is more than sufficient.

b. Error Proofing – Error proofing means defect awareness, detection and prevention from occurrence.

Result of process FMEA gives the direction and define priority in the error proofing application. Such as

1. Possibility of error occurrences.
2. Severity of error mode.
3. Effectiveness of existing detection system.

c. Control Chart – To understand condition of processes, whether it is in the acceptable, marginal or critical, it is necessary to read trends in data points appeared on control charts. The purpose of control chart is to take proactive action when abnormality is observed in control.

Table 4 – Type of Control Chart.

Types of Data		Control Chart
Variable (Continuous Data)	Length, Weight, Time	X _ R Chart (X bar R Chart)
	Strength, Yield	X _ R Chart (X medin R Chart)
	Purity, Contents	X Chart
Discrete Value	Percent Defective	p Chart
	Number of Defects	np Chart
	Number of Problems	c Chart
	Number of problems per Unit	u Chart

Source: Primary.

d. 5 Principle for problem solving – This concept is used by suppliers to investigate the nonconformity and eliminates the root cause.

5 Principle Steps -:

1. Investigation of the facts.
2. Why Why analysis (5W 2H tool)

3. Appropriate measures.
4. Verification of the effects of measure.
5. Feedback and standardization.

e. Process FMEA – This core tool points out the potential causes of error in the development stage itself. Severity of defects, chances of occurrence and detection ability of process which defines the risk priority weightage. Counter action against high risk priority number will minimise the value of risk priority. The objective of countermeasure implementation is reduced risk priority number as we could.

Conclusion -

BOP Quality Manual is Quality assurance agreement between Supplier and OEM and creates awareness about OEM requirement and expectations from his supplier partner. It provides guideline for each stage of product life. It supports supplier for his products smooth transaction from development stage to Mass production stage. It motivates supplier to develop process oriented approach, problem solving technique and continuous improvement.

BOP Quality Manual guides supplier to take containment and preventative action at the time of non-conformity observed and reduces production cost.

Bibliography and References –

- Global Supplier Quality Manual.
  Allison Transmission, Inc (Allison) - First Edition February 2016. Date: 25/02/18; 10:35am.
- Supplier Quality Manual.
  https://www.polarissuppliers.com/files/polcy_procedure/Quality/SQAM%20.pdf. Date: 25/02/18; 10:53am.
- Global Supplier Quality Manual.
  http://www.kohler.com/corp/supplier/SQM_GPI_3009_Rev1_1_2008.pdf. Date: 26/10/18; 12:53pm.
- Advanced Product Quality Planning and Control Plans.
- Mark A. Morris, ASQ Automotive Division Webinar, February 8, 2012. Date: 28/10/18; 10:41am.
- ADVANCED PRODUCT QUALITY PLANNING (APQP) AND CONTROL PLAN.

- Chrysler Corporation, Ford Motor Company, and General Motors Corporation - Second Edition, July 2008 Copyright © 1994, © 1995, © 2008. Date: 20/03/18: 02:30pm.
- Supplier Quality Manual. Honda Motorcycle & Scooter India Pvt Ltd.
- Production Part Approval Process 4th Edition http://www.glaessner.de/homepage/Ppap_engl.pdf. Date: 10/06/18: 10:58am.
- POTENTIAL FAILURE MODE AND EFFECTS ANALYSIS (FMEA). DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation - Third Edition, July, 2001 Copyright © 1993, © 1995, © 2001. Date: 24/07/18: 05:12pm.
- Supplier Requirement Manual. http://www.faurecia.com/files/media/site_com_corporate/Suppliers/documents/fau-c-spg-4030_supplier_requirements_manual_2018.pdf. Date: 25/07/18: 10:58am.

CONTACT FOR SUBSCRIPTION

AJANTA ISO 9001: 2008 QMS/ISBN/ISSN

Vinay S. Hatole

Jaisingpura, Near University Gate, Aurangabad (M.S.) 431 004,

Cell : 9579260877, 9822620877 Ph: 0240 - 2[illegible]0877

E-mail : ajanta1977@gmail.com Website : www.ajantaprakashan.com