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Applicability of Quality Principles for Valve Sourcing and Expediting – The Indian Valve Sourcing and Expediting Series

*Paul Gregory F**

ABSTRACT

Sourcing and expediting activities are technical twins and the activities require high level of discipline and technical excellence. Valve sourcing offices are blooming faster in India and they are either affiliated to a Parent Organization overseas or independent. Independent Valve Sourcing Offices work in collaboration with regional valve manufacturers and with Overseas Valve Manufacturers and bridge the Supply Chain gap between them.Quality Principles are necessary to maximize the performance of sourcing and expediting teams. ISO 9001 provides guidelines to practice quality management system and is also applicable to sourcing and expediting activities as well. Based on ISO 9001 and several other quality principles, this article provides guidelines to efficiently operate a sourcing and expediting office. Real time guidelines to operate principles such as KANBAN, 5S, 8D, FMEA, Statistical Quality Control have been presented in this research article and sufficient examples have been provided. This article will be an eye-opening manual to maximize the performance of Valve Sourcing and expediting teams

Keywords: *Sourcing; Expediting; KANBAN; Statistical Quality Control; FMEA.*

1.0 Introduction

Valve sourcing and expediting is a series of activities, wherein the team with procure the required valve components for their Parent Organization which is located overseas.

Hence the chief role of the sourcing and expediting team will be procuring the required component at the required quality and at the required time.

Hence certain quality management principles have to be applied in the office such that the performance of the sourcing teamsare maximized. It is suggested that the sourcing and expediting office adopts a PDCA cycle for their activities.

Stage 01: Plan the activities
Stage 02: Do / Develop the activities
Stage 03: Check the performance of the activity
Stage 04: Act for improvement of the activity

Consider the following example, A sourcing manager has assigned to his Chief Expeditor to expedite the progress of procurement of Swing Check Valve Mounting Plate of certain specification.

The Purchase Order (PO) has been provided to a local industry X that manufactures of the mounting plates. In such a case, the PDCA must be set into action.

1.1 Stage 01: Plan the activities

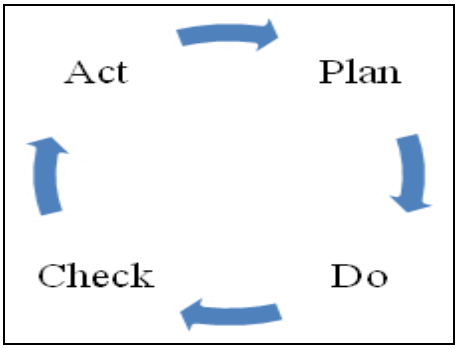
In the planning stage, the expeditor has to first verify the supporting documents. The various documents that have to be read by the expeditor are:

1. Supplier Appraisal Report (Prepared by Sourcing and expediting Office)
2. Call for Quotation / Call for Tender Document
3. Quotation by the supplier.
4. Purchase Order (PO) issued by the Parent Organization
5. Acceptance of Purchase Order Document provided from the supplier.
6. Proforma Invoice (If advance payment made)
7. Component Drawings.
8. Quality Requirement documents (For self-improvement)

The expeditor has to calculate the time provided for manufacture and supply of the Mounting Plates, quality required and the quantity.

**School of Energy, Department of Mechanical Engineering, PSG College of Technology, Coimbatore, India*
(E-mail: paulgregoryresearches@zioho.com)

Fig 1a: Simple Pdca Cycle



Based on the time provided in the PO, the expeditor must schedule the number of expediting visits required for the supplier. However there shall be a planned number of telephonic expediting follow-ups too.

It is preferred that the sourcing manager maintains a KANBAN Board in the office similar to production KANBAN Boards , such that there is regular monitoring of the tasks completed by each expeditor and inspector. KANBAN principles have been discussed in the upcoming sections.

The expeditor must also prepare a check sheet to collect data from the supplier during visit. The check sheet must contain details about the Mounting Plate and also about the detailed manufacturing process.

1.2 Stage 02: Do the activity

The expeditor then has to visit the supplier's manufacturing unit and must collect all details that has been planned to be collected.

The behavior of the expeditor with the supplier must be polite and must not be rude. Expeditor must not show any kind of dominant behavior at the supplier's unit and must handle any negotiations with a higher order of diplomacy.

1.3 Stage 03: Check the performance of the activity

The checking activity will not be of much importance in the first cycle of PDCA as the expeditor will not have much data to compare the previous data with. If it is a second expediting visit, then the expeditor will also have data from the first expediting visit.

In this stage the expeditor is suggested to check the performance in two phases:

Phase I: External Performance of the supplier

Phase II: Internal Performance of the expeditor

In Phase I , the manufacturing status of the mounting plates has to be monitored. If satisfiable progress has been reported by the supplier during the first expediting visit and not in the second visit, then it a notable indication to be taken care of.

Care must be taken to note every parameter that would lead to a delay in the supply of the mounting plates as per PO.

In Phase II, the expeditor must make a self-analysis whether he has performed as per standards. The expeditor has to make a self-analysis for honesty, work efficiency and integrity.

A personalized KANBAN board shall be maintained by the expeditor to self-analyze the expeditor's task management skills.

1.4 Stage 04: Act for the improvement in the performance of the activity

This stage can also be divided into internal and external phases correspondingly. In case of Phase I, if there is a lag in the production schedule, then immediately the sourcing and expediting team must call for a discussion and remedial actions must be initiated.

Consider the case of mounting plates for swing check valves, if there is a lag reported in the production schedule, immediately there must be a sourcing team discussion and following which, there must be a discussion with the supplier to make sure that an alternate schedule is routed and the components are delivered in time.

In case of Phase II, there should be a self-improvement process and the expeditor must identify where he has went wrong and must ensure that the improvement really makes a positive change in the process.

Thus, it is suggested that the PDCA cycle shall be operated in each and every aspect of sourcing and expediting activity.

2.0 Documentation for sourcing and expediting

In any sourcing and expediting office, there needs to be proper documentation such that the work progresses at ease. Sourcing and expediting teams are very energetic and dynamic teams and hence proper guidelines to manage the documents are necessary. It is suggested to sort the documents as Inspection Documents and Process Control Documents.

2.1 Inspection documents

All technical documents that will analyze the quality of the component being supplied are termed inspection documents. Sourcing Inspectors are responsible for the analysis of Inspection Documents. Various documents that are suggested to be categorized under quality inspection documents are:

1. Approved valve drawings.
2. Purchase Order & Invoice (If any)
3. Approved data sheets for valves.
4. QC Plan and Sourcing Inspection Plan
5. Non-Destructive Evaluation Procedure Documents(NDE)
6. Welding Specification Procedures (WPS)
7. Heat Treatment Procedure Document.
8. Post-Weld Heat Treatment (PWHT) Document
9. Material Test Documents
10. Backseat Testing Procedure Document

It is suggested that right from PO to the Valve Shipping Documents, all documents corresponding to a single PO shall be filed in a separate Box File.

This will ensure easy accessibility in the future. It is also suggested that cloud storage to be also equipped and

11. Hydrostatic Shell Testing Procedure Document
12. Closure Testing Procedure Document
13. Test Equipment Calibration Document
14. Valve Packing and Shipping Document

all documents to be scanned and uploaded in a separate folder.

2.2 Process Control Documents

Documents that are required for the proper functioning of the sourcing office are termed as Process Control Documents.

In order to maintain the process control documents, the following concepts are suggested. Various documents that fall under this category are:

1. Employee Performance Documents
2. Scheduling Documents
3. Office Administrator Documents
4. Office General Maintenance Documents

2.3 KANBAN board

KANBAN is a lean manufacturing concept and it can be applied for a sourcing office management as well.

A simple KANBAN Board shall be maintained in sourcing offices by the Sourcing Offices.

Table 1: A Simple KANBAN Board

Waiting List	In Progress	Completed
1. Release Purchase Order to Sri Industries Private Limited. 2. Witness Inspection to Shanmuga Valves. 3. Expediting Visit to Keymer Steels Pvt Limited	1. Witness Inspection for ABC Valve Industry 2. NDT Level 02 Training for Inspectors Mr. Suresh, Mr. Krishnan 3. Facility Visit to XYZ Industries and to prepare industry appraisal	1. Shipping of Check Valves from HJK Industries

In India, Valve Sourcing offices are predominantly functioning with strength of 05-20 employees and hence a single board will be sufficient

to track the work flow.KANBAN is a work flow tracking system.

The KANBAN board shall be divided into three categories such as (01) Waiting List, (02) In Progress, (03) Completed.

A Typical KANBAN Board shall be of the following format:

2.4 S Methodology

This is another Lean Manufacturing Tool which can also be applied to Sourcing and Expediting offices as well. The 5'S' in the implementation are

1. **Seiri – Sort**

All unnecessary documents must be removed and only necessary documents must be kept.

1. **Seiton – Set in Order**

All necessary documents are to be kept organized in a systematic arrangement

2. **Seiso – Sweep**

The arranged documents must be well cleaned. Old file covers shall be replaced with new file covers.

3. **Seiketzu – Standardize**

Place all the documents at convenience such that it is easy to access and as well as looks good.

4. **Shitsuke – Sustain**

Care must be taken that all documents are regularly kept at the same place, filed appropriately and the workplace is cleaned periodically.

3.0 Quality Principles for On-site Valve Inspection

Sourcing valves in India generally involves on-site quality inspection at the supplier's facility. Sourcing Inspectors follow a series of guidelines from various API, ASME, ISO and many more standards and perform witness inspections to assess the quality of the supplied components. In addition to the Valve Standards, there shall be other quality principles followed during inspection.

This will enhance the behavioral performance of the Sourcing Inspector and will improve his ability as a better professional.

In general, three types of inspection is carried out:

1. **First Party Inspection** – Inspection activities /Quality Assurance carried out by the supplier.
2. **Second Party Inspection** – Inspection activities carried out by the buyer
3. **Third Party Inspection** – Inspection services carried out by agencies hired by the buyer to perform inspection activities. ISO/IEC 17020 defines various requirements to carry out third party inspection services.

If the Parent Organization has its own sourcing and expediting office in India, then it will fall under Second Party Inspection and if the Parent Organization has deputed an agency on behalf of it, then it will fall under Third Party Inspection.

It is suggested that the following sequence of activities is carried out during quality inspection for valves.

Stage I: Pre- Inspection discussion and formulation of Test Plan

Stage II: Inspection activities at the start of machining

Stage III: Inspection activities during machining

Stage IV: Inspection activities with the product

3.1 Pre- inspection discussion and formulation of test plan

This is the first stage of any inspection process at the sourcing office. A well-defined Inspection Test Plan (ITP) will aid the effectiveness of the inspection activity. For a valve on –site inspection, a well-defined ITP will have the following components:

1. Sequence of operations in the manufacturing process.
2. Stages at which inspection shall be conducted. (Hold Points – H Points)
3. Tests to be conducted on the valve components and Test Reports that have to be reviewed.
4. Inspector allocation plan.

There are basic abbreviations in any ITP that has be carefully coded and deciphered from the data. Any ITP will generally have the following abbreviations:

H – Hold Point: The stagewhere the manufacturing has to be stopped and has to proceed only after approval from the inspector.

W (or) FW – Witness Point: It is a condition wherein the supplier/vendor has to perform the inspection and has to be witnessed by the Sourcing Inspector. This is a point wherein the Sourcing inspector has to decide whether he will witness or not and if the Sourcing Inspector decides not to witness, then the vendor can proceed with the manufacturing process after inspection and the Supplier organization shall be notified.

R – Review Pont: It is the condition wherein the Sourcing Inspector will review all required quality documents.

S (or) SW – Spot Witness Point: It is a random inspection point wherein, initially the inspection will be witnessed by the inspector and after which the inspector at his discretion schedules inspection and shall review the test reports of the previous test as well.

This is an overview of the inspection process that will be conducted for valves. It is suggested that Failure Mode Effect Analysis (FMEA) shall be incorporated into the quality process. The sourcing inspector should have knowledge about FMEA analysis for the particular type of valve and this will allow him to be judgmental in performing inspection activities. FMEA is an analytical tool that will identify all possible ways the product would fail in regards to the design, manufacturing process, assembly of the components. Hence knowledge of FMEA of the type of valve will allow the Sourcing Inspector to decide where he should concentrate more during the on-site inspection activities.

For example, Muhammed et al [1] has performed an FMEA analysis for butterfly valves for oil and gas industries. Muhammed et al has performed an FMEA analysis on a double eccentric butterfly valve of Jamesbury series and has identified five critical failure components and has computed Risk Priority Number (RPN) for the components.

RPN is a measure of the failure mode and it is function of Severity (S), Occurrence (O) and Detection (D).

- **Severity – S:** Severity in RPN is a measure of how severe the effect will be to the buyer. It is quantified in a scale of 1-10.
- **Occurrence – O:**Occurrence quantifies the probability of the failure on a scale of 1- 10.
- **Detection – D:** Detection quantifies how well control measures can be employed to prevent the failure on a scale of 1-10

$RPN = S \times O \times D$

The RPN for the critical components identified by Muhammed [1] are as shown in Table 2. Out of various components, seat has the highest RPN of 144 and hence the sourcing inspector has to concentrate more on the inspection of seats. To gain this knowledge, Sourcing Inspectors must be voracious readers of technical articles on Valves.

Table 2: RPN for Critical Components [1]

Component	RPN
1. Seat	144
2. Packing	98
3. Stem	80
4. Disc	24
5. Body	54

Thus, in this stage an ITP has to be formulated and the Sourcing Manager has to organize a meeting with the supplier and must discuss on the activities to be performed. A general ITP for Valve Inspection will have the following features before the start of manufacturing:

3.2 Inspection and Expediting Activities after the commencement of machining

After the machining has commenced, it is necessary that the planned systematic inspection activities are carried out. There are standards that have to be adhered appropriately.

Paul et al [2] has listed various standards applicable. Some key tests that will be conducted during valve inspection are:

1. Valve Body Shell Test,
2. Valve Backseat Test,
3. Low Pressure Closure Test,
4. High Pressure Closure Test,
5. Functional Test.

Table 3: ITP for Activites before Manufacturing

	Procedure	**Complying Standard**	**Document for verification**
Step 01:	ITP Meeting	Component Drawing, Purchase Order, Supplier Appraisal Documents, API6D, 598, 608, 600,602,603,609, 594,599, ASME B16.34	Minutes of Meeting
Step 02:	Welding Procedure Specification (WPS), Procedure Qualification Record (PQR) & Welder Qualification Certificate Verifications	ASME IX	Welding Record Book and Certificates
Step 03:	NDE Personnel Certificate and NDT Procedure Verification	ASME V	Procedure Sheets
Step 04:	Shell Test Procedure, Back seat Test Procedure, Low Pressure Closure Test and High Pressure Closure Test Procedure Verification	API 598	Procedure Sheets
Step 05:	Post Weld Heat Treatment (PWHT) Document Verification	API6D, 598, 608,600,602,603,609, 594,599, ASME B16.34	Procedure Sheets
Step 06:	Painting Procedure Verification	Society for Protective Coating (SSPC) Standards	Procedure Sheets

API 598 and ASME B16.34 provide guidelines to perform Valve Body Shell Test. The valve is subjected to hydrostatic pressure 1.5 times the rated pressure but less than 4 times the rated pressure and the valve is certified a pass only if no leak is found during the test. The duration of the test depends upon the valve size.

Table 4: Duration of Valve Body Shell Test

Valve Size	**Duration of Test**
Below 2 inches	15 seconds
2 ½ to 6 inches	60 seconds
8 to 12 inches	120 seconds
Above 14 inches	300 seconds

Valve Backseat Test is also guide lined by API 598. The valve is mounted on the test bench and is subjected to a hydrostatic pressure with loose packing gland and is observed for leaks.

The back seat test pressure shall be to a maximum of 1.1 times the allowable pressure. The duration of the test depends on the valve size.

Table 5:Duration of Valve Backseat Test

Valve Size	**Duration of Test**
Below 2 inches	15 seconds
Above 2 inches	60 seconds

Closure Tests are Valve Leak tests wherein the inlet of the valve is subjected to a hydrostatic pressure, the other side being closed. The leakage occurring on the closed side is observed. The test pressure shall not be 1.1 times the maximum allowable rated pressure. The duration of the test depends on the valve size. This is governed by the same API 598 and B16.34 standards.

Table 6: Duration of Valve Backseat Test

Component	RPN
1. Seat	144
2. Packing	98
3. Stem	80
4. Disc	24
5. Body	54

Hence a series of tests have to be conducted or has to be monitored by the sourcing inspector. During such monitoring certain quality principles can be followed. In case any of the tests provide unsatisfactory results, then an 8D problem solving methodology can be implemented. 8D is a problem solving methodology that could be adopted for valve sourcing and expediting activities as well. The procedure adopted in 8D is as foll
ows:

Stage I: Forming a working Team
Stage II: Defining the problem
Stage III: Provide a temporary solution to the problem
Stage IV: Problem Root Cause Analysis
Stage V: Develop a permanent solution to the problem
Stage VI: Implement the permanent solution to the problem
Stage VII: Prevent the problem from reoccurring
Stage VIII: Celebrate the team success

Thus if any problem arises during the valve manufacturing process, the inspection and the expediting team shall adopt this 8 stage problem solving methodology for better effectiveness (8D). This will develop a bonding between the inspection and expediting team members as well. In general the valve inspection procedure after the start of manufacturing will consists of the following activities as listed in Table 7

Table 7: ITP after commencement of valve manufacturing

	Procedure	Complying Standard	Document for verification
Step 01:	After casting- Visual inspection of Body, Cap, Bonnet	MSS SP -55	Inspection Report
Step 02:	Dimensional inspection of Body, Cap, Bonnet	DWG	Inspection Report
Step 03:	Chemical Composition inspection of Body, Cap and Bonnet	ASME II & ASTM Standards	Inspection Report
Step 04:	Trim Chemical Composition, Visual Inspection and Dimensional Inspection	DWG, ASME II, ASTM , MSS SP -55	Inspection Report
Step 05:	Inspection of welding for casting defects	WPS	Inspection Report
Step 06:	PWHT Inspection	Procedure Sheet	Inspection Report
Step 07:	NDE Inspection	Procedure Sheet	Inspection Report
Step 08:	Welding Inspection	WPS	Inspection Report
Step 09:	Inspection of Assembly components (Gaskets, Nuts,etc) inspection	ASTM	Inspection Report
Step 10:	Valve Assembly Inspection	DWG	Inspection

			Report
Step 11:	Valve Shell Test, Backseat Test, Closure Test and Valve Functional Test Inspection	DWG, API 598	Inspection Report
Step 12:	Painting Inspection	SSPC	Inspection Report
Step 13:	Final Review Inspection (Dimensions)	DWG	Inspection Report

Sourcing inspectors and sourcing expeditors must have a profound knowledge on Statistical Quality Control. Statistical Quality Control (SQC) refers to the set of activities that are statistically performed that maintain the quality of the product being manufactured. SQC can be categorized into:

1. Descriptive Statistics
2. Statistical Process Control (SPC)
3. Acceptance Sampling

Descriptive Statistics is a computational methodology wherein the data is organized well for better interpretation. Descriptive Statistics can be further categorized into Measure of Central Tendency and Measure of Variability. Acceptance Sampling is a statistical sampling technique that provides a methodology to accept or reject a lot. Statistical Process Control (SPC) is an important category in SQC. SPC is a statistical technique which is used to maintain quality inside considerable limits. Control limits are set up and data which fall inside the control limits are qualifiable SPC uses many tools to monitor the control limits. Some of the widely used tools are:

1. Control Charts
2. Cause and Effect Diagram
3. Pareto Chart
4. Histogram
5. Scatter Diagram
6. Flow Charts
7.

Sourcing expeditors and inspectors must have knowledge about this to observe the SPC at the supplier end. If the products are not found to comply to the control limits, then this situation may be taken into consideration for supplier appraisal for the next Purchase Order.

3.3 Inspection and Expediting activities after machining

Table 8: ITP after machining

	Procedure	**Complying Standard**	**Document for verification**
Step 01:	Name Plate Check	DWG	Final Report
Step 02:	Verification of Inspection Reports and Non-Conformance Report (NCR)	DWG, Inspection Report	Final Report
Step 03:	Packing, Marking and Loading Inspection Verifications	DWG, Purchase Order	Final Report
Step 04:	Shipping Document	Packing List / BOL	Final Report

Table 8 shows the inspection and expediting activities that will take place after the machining process. Sourcing expeditors are responsible for documentation.

4.0 Time Consciousness for Sourcing Expeditors

Time is an important dimension for the sourcing office. Sourcing office is responsible for the timely delivery of the product to the Parent Organization. Sourcing expeditors must be great time managers as well. In such a scenario, sourcing expeditors must be aware of the Takt time of the product. Takt time is an important parameter which relates the customer demand to the production time available.

$$\text{Takt Time} = \frac{\text{Production Time Available}}{\text{Customer Demand}}$$

Physically, Takt time refers the time that ensures the successful manufacturing of the products within the stipulated time that would ensure to meet the customer demand as well. This can be understood with an example. Consider there is a requirement for a brand of Swing Check Valve of 10 units per day.

Total Working Hours in a day = 8 hours = 480 minutes

Total Break during Working Hours = 60 minutes

Useful Work Hours = Production Time Available = 480-60 = 420 min

Therefore Takt Time = 420 / 10 = 42 minutes

The physical meaning of this value is that for every 42 minutes one Swing Check Valve has to be produced in order to meet the customer demand. Sourcing expeditors must have consciousness about Takt time to ensure timely delivery of the product.

5.0 Conclusions

Quality Principles are not only intended for lean manufacturing concepts, but can be applied to sourcing and expediting activities as well. Quality Principles, when implemented into day to day activities in valve sourcing and expediting will definitely accelerate the progress and the sourcing team will gain immense confidence. Sourcing inspectors and sourcing expeditors are great travelers as they travel very long distances for on-site inspection and implementing such quality principles will make them work smart.

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[3] API 598 Standards

[4] API, ISO, SSPC, ISME, ASTM Standards.