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ANALYSIS OF REJECTION OF SQUARE PISTON AND ITS REMEDIES

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Abstract: *In current trends improving and increasing the productivity of the product is very essential to survive in the markets in case of any successful company. The understanding of the quality system must be done in a better methodology. The product variation and the process operational cost can be reduced by improving the method of optimization in terms of the quality method. In order to reduce the rejection rate as well as to give suggestions for improvement of the product we intend to apply quality control tools in the stages of the production process. In terms of any manufacturing company the company faces crisis in terms of having the part rejected after the process of manufacturing which both directly and indirectly affects the cost of the company. Companies may suffer deliberately from problems especially from high rejection as well as rework in the production processing lines. The various process parameters such as the machining operations, grinding, workpiece material etc. influence the product to be controlled and have high aspects in term of the quality of the product as well as give a brief improvement over the process. The common goal in any industry is to reduce the rejection. The process of rejection analysis helps in the identification of the problems that occur with quality as well as the production of the components in an industry which serves as an important key point in terms of the manufacturing processes.*

Keywords: Rejection, Quality, Production, Manufacturing.

INTRODUCTION

The seven tools of quality can be used where they can provide the significant cause as well as to identify the various methods, steps, process as well as the introduction of new solution for the probable cause. These tools are enlisted and is used highly in terms of quality as well as maintaining standards of the company as well as the product.

The seven QC tools are:

1. Stratification (Divide and Conquer)
2. Histogram
3. Check Sheet (Tally Sheet)
4. Cause-and-effect diagram ("fishbone" or Ishikawa diagram)
5. Pareto chart (80/20 Rule)
6. Scatter diagram (Shewhart Chart)
7. Control chart

PISTON FOR HYDRAULIC PUMPS

SQUARE PISTON

Figure 1 SQUARE PISTON AFTER ASSEMBLY

Finishing	-	Polished
Use	-	For Tractor
Product Type	-	Piston
Material	-	Cast Iron
Part Type	-	Pump Part
Surface Treatment	-	Coated
Weight	-	50-150 Grams (g)

Figure 2 PISTON AFTER CASTING

Figure 3 PISTON AFTER MACHINING PROCESSES

FLOW CHART

Flow Chart is one of the primary tools of the New Quality Tools Where the various process as well as the method are identified using a flow model for clear understanding. The flow chart is used to identify the various stages as well as the process nature and its timeline.

Figure 4 Piston After Manufacturing

FLOW CHART IN PRODUCT MANUFACTURING

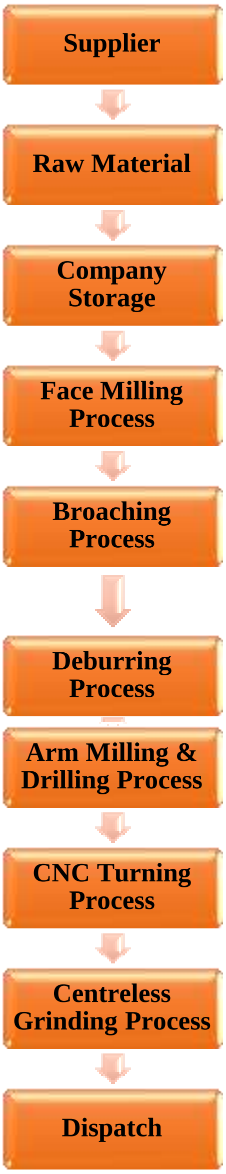


Figure 5 FLOW CHART OF MANUFACTURING

FLOW CHART IN MILLING PROCESS

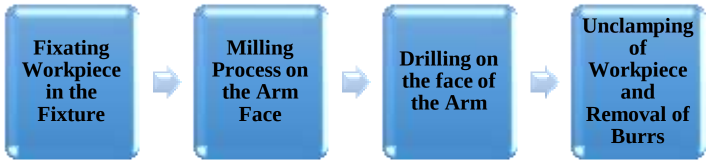


Figure 6 FLOW CHART OF MILLING MACHINE

Figure 7 COMPONENT AFTER MACHINING PROCESS

FLOW CHART IN BROACHING PROCESS

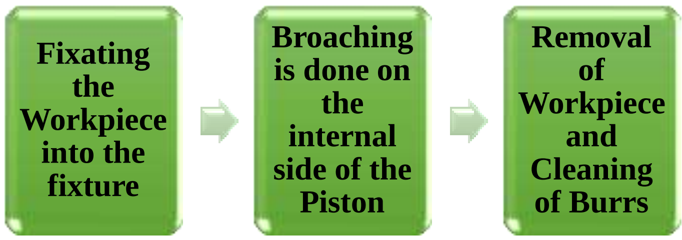


Figure 8 FLOW CHART OF BROACHING PROCESS

FIGURE 23 COMPONENT AFTER BROACHING PROCESS

FLOW CHART IN DEBURRING PROCESS

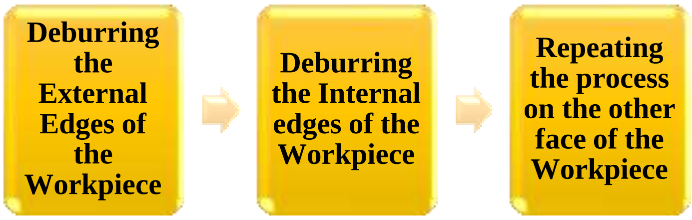


Figure 9 FLOW CHART OF DEBURRING PROCESS

Figure 10 COMPONENT AFTER DEBURRING PROCESS

FLOW CHART IN TURNING PROCESS

Figure 11 FLOW CHART OF TURNING PROCESS

Figure 12 COMPONENT AFTER TURNING PROCESS

FLOW CHART IN GRINDING PROCESS

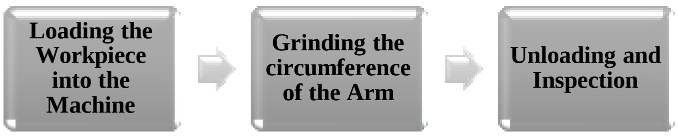


Figure 13 FLOW CHART OF GRINDING PROCESS

The Hydraulic Pump used in tractors is one of the major components that is manufactured in Cross Manufacturing Company. The Data Collected in the months of May, July And September shows that the most rejected part is the Piston Hydraulic Pump, Hence We use the Pareto Diagram to determine the various Rejection of Components that has been done in the piston machining line.

Pareto Analysis is a statistical technique in decision-making used for the selection of a limited number of tasks that produce significant overall effect. It uses the Pareto Principle (also known as the 80/20 rule) the idea that by doing 20% of the work you can generate 80% of the benefit of doing the entire job. Take quality improvement, for example, a vast majority of problems (80%) are produced by a few key causes (20%). This technique is also called the vital few and the trivial many.

REJECTION OF COMPONENTS

In order to reject the various defective components produced by the company the company uses the paretto analysis ,paretto analysis is done on the defects produced by the each machine used for production in the last 3 months

A comprehensive study was done on the number of rejected components by each and every machine used for production and the number of components staggered in one particular product which became the focus of this rejection analysis project

The piston was the front runner of the most defective components with 58 components being rejected in the last three months ,with cup gear shift being a close second with 24 components.

The differential cross produced 15 rejected components ,the center column ,shaft differential cross each producing 13 rejected components each ,couple rear drive creating 11 defects in its production and shaft lower link having the least number of component being rejected having only 6 in its tally.

Type of component	Number of defects
Hydraulic piston	58
Cup gear shift	24
Differential cross	15
Center column	13
Shaft differential cross	13

Couple rear Drive	11
Shaft lower link	6

Table 1 Types of Components

Upon The various components that have been manufactured the manufacturing of the piston is made with the greater number of rejections hence we select that particular component to reduce its rejection by analyzing the various causes of Rejection and to come up with a solution to reduce the rejection rate thereby providing Zero Defect as well as reducing the cost that has been used in production of the defective part.

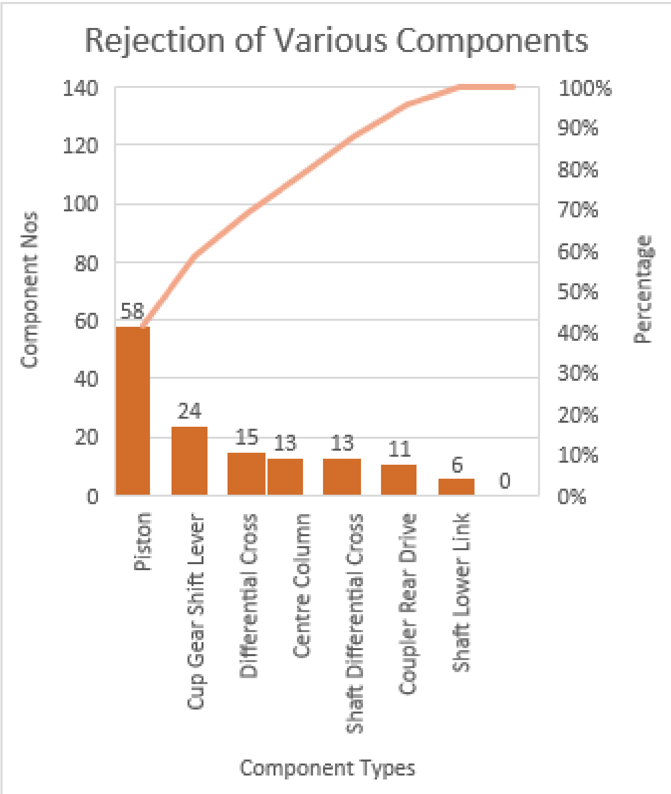


Figure 14 Pareto in types of components

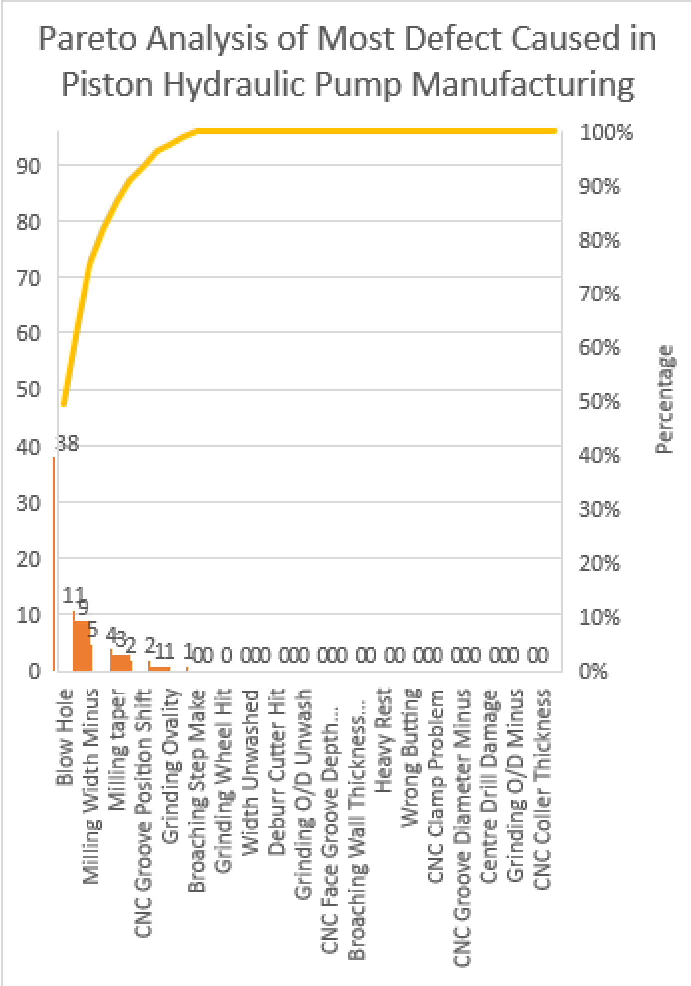


Figure 15 Pareto in Various defects

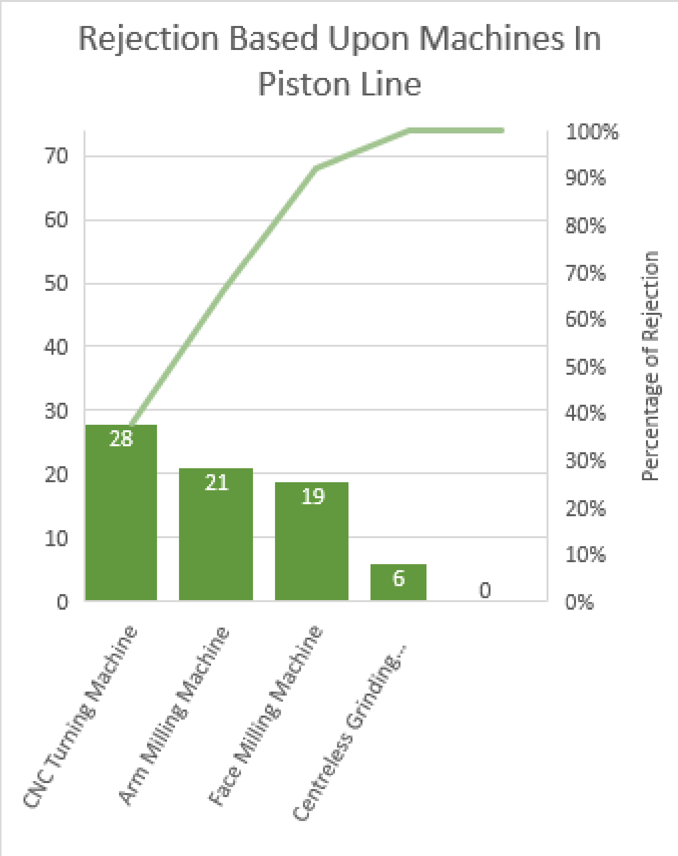


Figure 16 Pareto in various machines

Based Upon the Data Collected From the month of May, July & September the pareto Diagram has been constructed to determine the various Defects Produced in the various Machining Machines.

Type of machines	No of components
Cnc turning machine	28
Arm milling machine	21
Face milling machine	19
Centerless grinding macjine	6

Table 2 Types of machines

It is observed that the cnc turning machine saw the most number of rejection adding to 38 percent of all the rejection of components ,the second machine which witnessed the most rejection was arm milling machine ,it can be inferred that some of the defects can be carried over to cnc turning machine from this machine adding up to 21 components rejected but also 32 percent of the total rejected components,the third machine which has the most rejections is face milling machine with 19 components being rejected during the three months this record was taken with total percentage of components rejected from this machine amassing around 19 percent of the total component rejected, the centerless grinding machine has the least rejection with only 6 components adding up the final 9 percent of the total

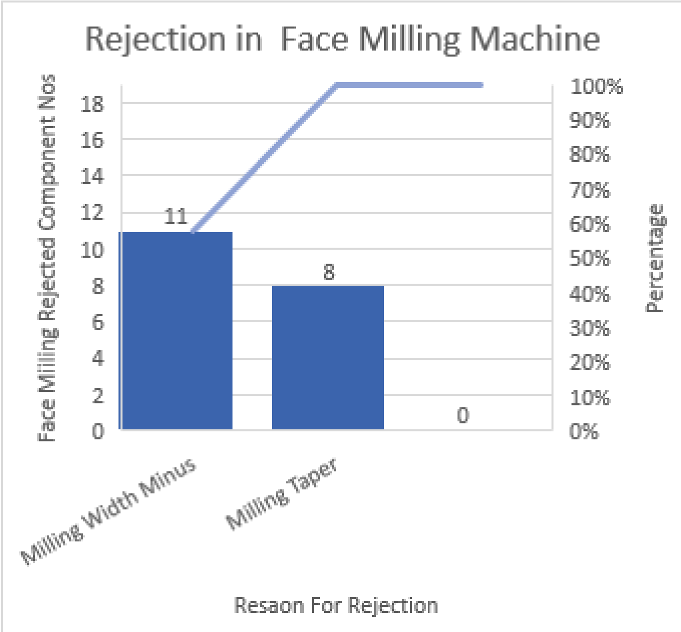


Figure 17 Pareto in Face milling

Upon Further Analyzing the statistics ,The Rejection in the Face Milling Operation is reasoned by two factors namely milling width minus and Milling Taper

Type of defects	No of components
Milling width minus	11
Milling taper	8

Table 3 Defects in milling process

During the three months face milling machine saw a total rejection of 18 components with a whooping lion share of defects coming from milling width minus defect rejecting a total of 11 components adding up to 55 perecent of the total percentage of components rejected, and the second type of defect namely milling taper rejecting its share of 8 components to its tally and contributing a total of 45 percent of total number of percentage of rejected components.

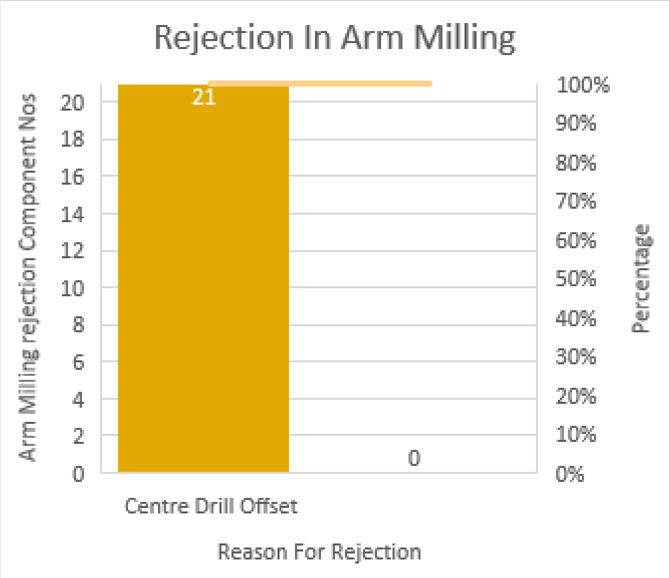


Figure 18 Pareto in arm milling

The Rejection In Arm Milling is reasoned by Only one factor which is Centre drill offset where whooping 21 Components have been rejected in the statistical analysis

All the 100 percent of rejection in arm milling came from centre drill offset defect.

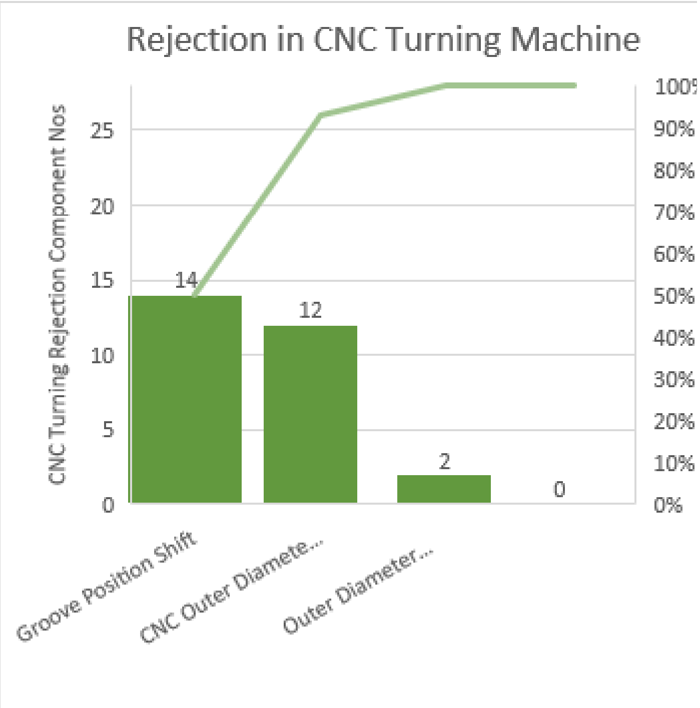


Figure 19 Pareto in turning machine

The Rejected Piston Components saw the highest percentage of rejection in CNC Turning Machine and the reason for rejection stems from three factors namely Groove position shift, CNC Outer Diameter Minus and Outer Diameter Lobbing.

Type of defect	No of component rejected
Groove position shift	14
Cnc outer diameter minus	12
Outer diameter lobbing	2

Table 4 Defect in Turning machine

Three type of defects dominate the cnc turning machine ,with the groove position shift defect rejected around 14 components during the three month period and contributing to a 50 percent of total percentage of total number of rejection percentage and the second close competitor of this defect being rejecting only 2 component less than the former being cnc outer diameter minus having rejected 12 components and adding a total rejection percentage of 42 and that gives us to the introduction of the third defect in the cnc turning machine being outer diameter lobbing rejecting a total pf only 2 components and adding to the final 8 percent of the total rejection percentage

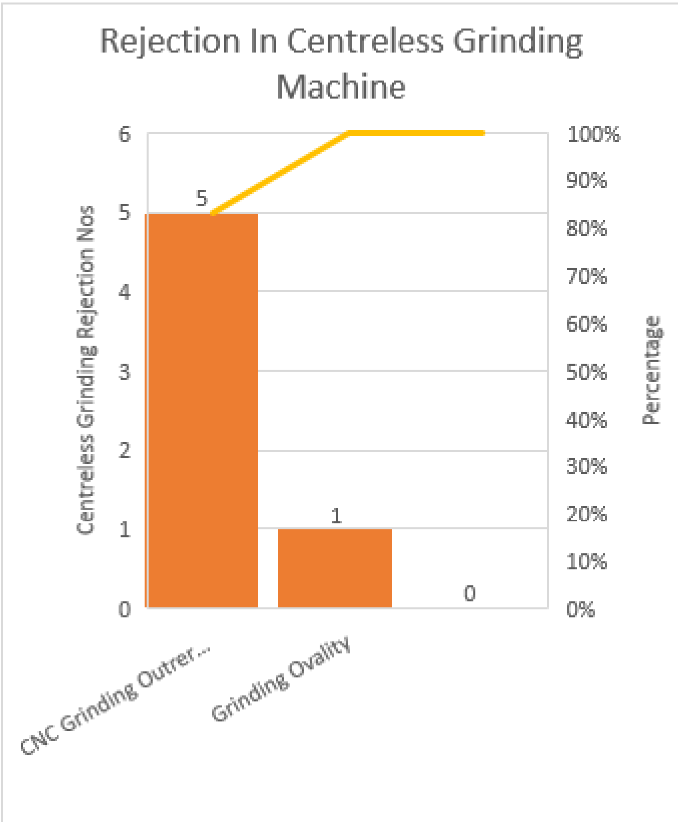


Figure 20 Pareto in Grinding machine

The Rejected Piston Components saw the least percentage of rejection in Centerless grinding Machine with grinding ovality and CNC Grinding Outer Diameter Minus rejected one and five components respectively.

Type of defects	No of components
Cnc grinding outer diameter minus	5
Grinding ovality	1

Table 5 Defect in grinding machine

Even the machine with least rejection , has given rise to two different type of defects them being cnc grinding outer diameter minus and grinding ovality, with the former rejecting up to 5 components being the total 80 percent of the rejected components and the latter rejecting only a single component adding up to 20 percent of the total components rejected

ISHIKAWA

The fishbone diagram or Ishikawa diagram is a cause-and-effect diagram that helps managers to track down the reasons for imperfections, variations, defects, or failures. The diagram looks just like a fish's skeleton with the problem at its head and the causes for the problem feeding into the spine. Once all the causes that underlie the problem have been identified, managers can start looking for solutions to ensure that the problem doesn't become a recurring one. Finally, the fishbone diagram is also a great way to look for and prevent quality problems before they ever arise. Use it to troubleshoot before there is trouble, and you can overcome all or most of your teething troubles when introducing something new.

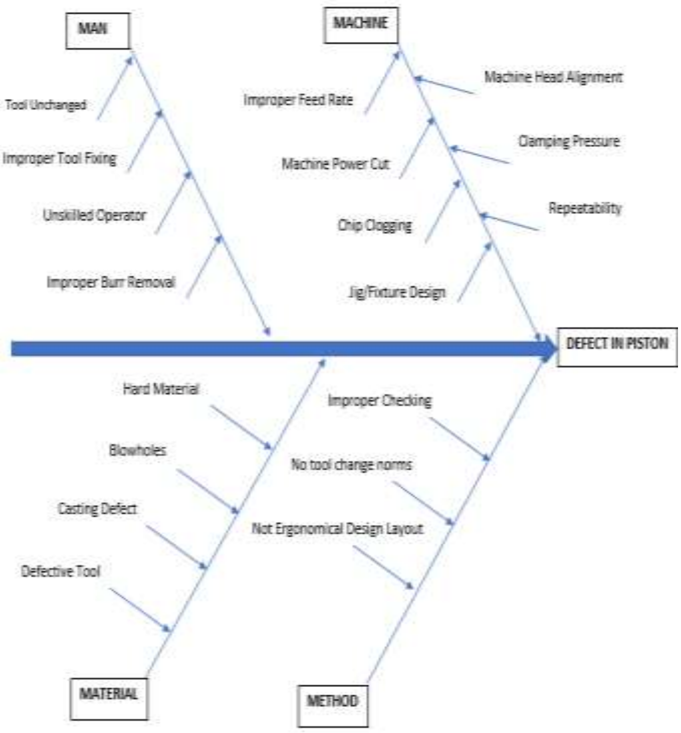


Figure 21 Ishikawa in Piston Defects

CONTROL CHART

The control chart is a graph used to study how a process changes over time. Data are plotted in time order. A control chart always has a central line for the average, an upper line for the upper control limit, and a lower line for the lower control limit. These lines are determined from historical data. By comparing current data to these lines, you can draw conclusions about whether the process variation is consistent (in control) or is unpredictable (out of control, affected by special causes of variation). This versatile data collection and analysis tool can be used by a variety of industries and is considered one of the seven basic quality tools.

Control charts for variable data are used in pairs. The top chart monitors the average, or the centering of the distribution of data from the process. The bottom chart monitors the range, or the width of the distribution. If your data were shots in target practice, the average is where the shots are clustering, and the range is how tightly they are clustered. Control charts for attribute data are used singly.

CONTROL CHART FOR HOLE DIAMETER FOR DRILLING

Date	Sample measures	Mean	UCL(3σ)	LCL(3σ)
2/12/2019	15.059	15.050	15.100	15.000
3/12/2019	15.059	15.050	15.100	15.000
4/12/2019	15.069	15.050	15.100	15.000
5/12/2019	15.047	15.050	15.100	15.000
6/12/2019	15.033	15.050	15.100	15.000
9/12/2019	15.045	15.050	15.100	15.000
10/12/2019	15.055	15.050	15.100	15.000
11/12/2019	15.053	15.050	15.100	15.000
12/12/2019	15.049	15.050	15.100	15.000
13/12/2019	15.063	15.050	15.100	15.000
14/12/2019	15.059	15.050	15.100	15.000
16/12/2019	15.043	15.050	15.100	15.000
17/12/2019	15.05	15.050	15.100	15.000
18/12/2019	15.039	15.050	15.100	15.000
19/12/2019	15.049	15.050	15.100	15.000
20/12/2019	15.058	15.050	15.100	15.000
21/12/2019	15.052	15.050	15.100	15.000
23/12/2019	15.051	15.050	15.100	15.000
24/12/2019	15.06	15.050	15.100	15.000
26/12/2019	15.047	15.050	15.100	15.000
27/12/2019	15.049	15.050	15.100	15.000
28/12/2019	15.05	15.050	15.100	15.000
29/12/2019	15.049	15.050	15.100	15.000
30/12/2019	15.058	15.050	15.100	15.000
31/12/2019	15.05	15.050	15.100	15.000

MEAN	15.052
STANDARD DEVIATION	0.007803204

Table 6 Control Chart for hole diameter

The above control chart is an example of the diameter of the hole to be drileed at the face of the arms of the piston. The x-axis denotes the day of the month for the particular observations while the y-axis deals with the quality characteristics i.e. the dimensions of the part. The average of the above samples is 15.050 which means measures an average 15.050 each day. The control limits are then calculated. The UCL is 15.100mm. The LCL is 15.000mm. This is the minimum allowable

measurement acceptable when only common causes are present. There is one point beyond the UCL. This is the first pattern that signifies an out of control point a special cause of variation. Special causes of variation are detected on control charts by noticing certain types of patterns that appear on the control chart. controlits is one such pattern.

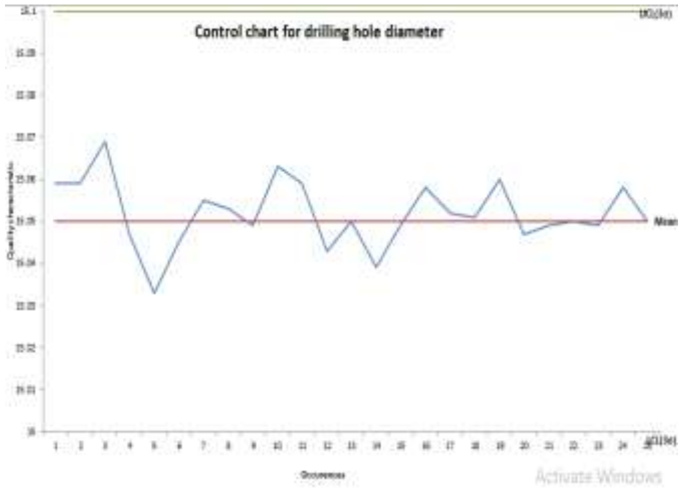


Figure 22 Control chart for hole diameter

CONTROL CHART FOR CENETERLESS GRINDING FINISH

Date	Sample measures	Mean	UCL(3σ)	LCL(3σ)
12-02-2019	25.047	25.051	25.057	25.045
12-03-2019	25.049	25.051	25.057	25.045
12-04-2019	25.056	25.051	25.057	25.045
12-05-2019	25.05	25.051	25.057	25.045
12-06-2019	25.049	25.051	25.057	25.045
12-09-2019	25.049	25.051	25.057	25.045
12-10-2019	25.053	25.051	25.057	25.045
12-11-2019	25.053	25.051	25.057	25.045
12-12-2019	25.051	25.051	25.057	25.045
13/12/2019	25.055	25.051	25.057	25.045
14/12/2019	25.053	25.051	25.057	25.045
16/12/2019	25.047	25.051	25.057	25.045
17/12/2019	25.049	25.051	25.057	25.045
18/12/2019	25.052	25.051	25.057	25.045
19/12/2019	25.051	25.051	25.057	25.045
20/12/2019	25.05	25.051	25.057	25.045
21/12/2019	25.049	25.051	25.057	25.045

23/12/2019	25.056	25.051	25.057	25.045
24/12/2019	25.047	25.051	25.057	25.045
26/12/2019	25.047	25.051	25.057	25.045
27/12/2019	25.051	25.051	25.057	25.045
28/12/2019	25.053	25.051	25.057	25.045
29/12/2019	25.055	25.051	25.057	25.045
30/12/2019	25.051	25.051	25.057	25.045
31/12/2019	25.055	25.051	25.057	25.045

MEAN	25.051
STANDARD DEVIATION	0.002891366

Table 7 Control chart for Grinding

The above control chart is an example of the finishing dimensions in the final process piston manufacturing which is centerless grinding.

The x-axis denotes the day of the month for the particular observations while the y-axis deals with the quality characteristics i.e. the dimensions of the part. The average of the above samples is 25.051 which means measures an average 25.051 each day. The control limits are then calculated. The UCL is 25.057mm. The LCL is 25.045 mm. This is the minimum allowable measurement acceptable when only common causes are present. There is one point beyond the UCL.

This is the first pattern that signifies an out of control point a special cause of variation. Special causes of variation are detected on control charts by noticing certain types of patterns that appear on the control chart. The point be-yond the control limits

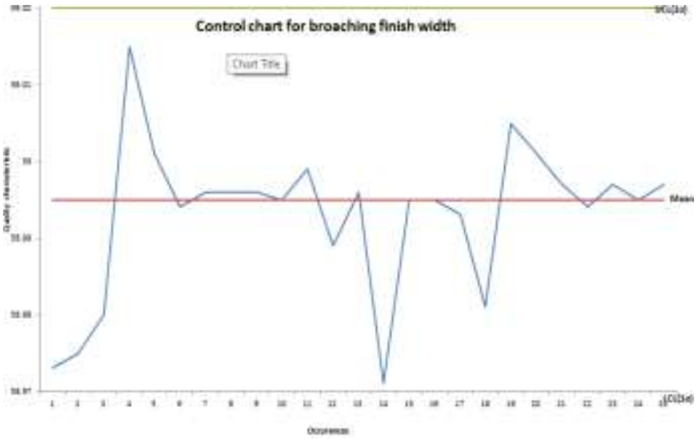


Figure 23 Control Chart for finish

CONTROL CHART FOR GROOVE LENGTH

Date	Sample measures	Mean	UCL(3σ)	LCL(3σ)
2/12/2019	28.12	28.015	28.140	27.890
3/12/2019	27.93	28.015	28.140	27.890
4/12/2019	27.92	28.015	28.140	27.890
5/12/2019	28.05	28.015	28.140	27.890
6/12/2019	28.012	28.015	28.140	27.890
9/12/2019	27.93	28.015	28.140	27.890
10/12/2019	27.99	28.015	28.140	27.890
11/12/2019	28.04	28.015	28.140	27.890
12/12/2019	28.12	28.015	28.140	27.890
13/12/2019	27.97	28.015	28.140	27.890
14/12/2019	28	28.015	28.140	27.890
16/12/2019	27.93	28.015	28.140	27.890
17/12/2019	27.9	28.015	28.140	27.890
18/12/2019	27.99	28.015	28.140	27.890
19/12/2019	28.1	28.015	28.140	27.890
20/12/2019	28.13	28.015	28.140	27.890
21/12/2019	28.13	28.015	28.140	27.890
23/12/2019	28.1	28.015	28.140	27.890
24/12/2019	27.85	28.015	28.140	27.890
26/12/2019	27.92	28.015	28.140	27.890
27/12/2019	28.02	28.015	28.140	27.890
28/12/2019	28	28.015	28.140	27.890
29/12/2019	27.99	28.015	28.140	27.890
30/12/2019	27.99	28.015	28.140	27.890
31/12/2019	28.12	28.015	28.140	27.890

MEAN	28.015
STANDARD DEVIATION	0.081752635

Table 8 Control chart for groove length

The above control chart is an example of the groove length tolerance that should be maintained in the turning operation.

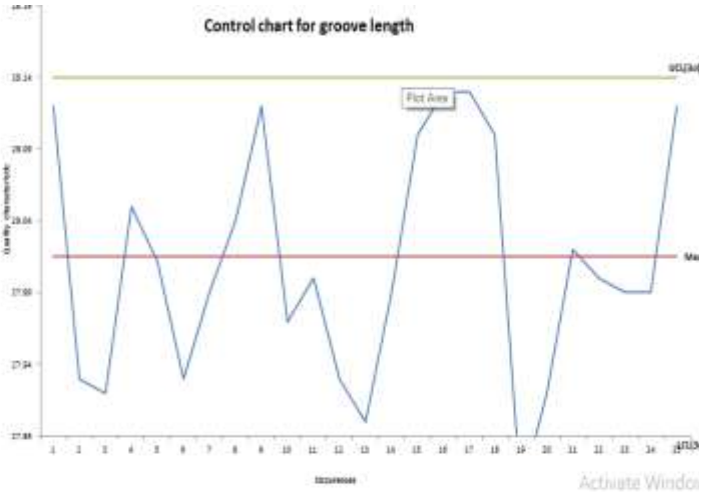


Figure 24 Control Chart for groove length

The x-axis denotes the day of the month for the particular observations while the y-axis deals with the quality characteristics i.e. the dimensions of the part. The average of the above samples is 28.015which means measures an average 28.015 each day. The control limits are then calculated. The UCL is 28.140mm. The LCL is 27.890mm. This is the minimum allowable measurement acceptable when only common causes are present. There is one point beyond the UCL. This is the first pattern that signifies an out of control point a special cause of variation. Special causes of variation are detected on control charts by noticing certain types of patterns that appear on the control chart. The point be-yond the control limits of such pattern.

CONTROL CHART FOR BROACHING FINISH WIDTH

Date	Sample measures	Mean	UCL(3σ)	LCL(3σ)
2/12/2019	58.973	58.995	59.020	58.970
3/12/2019	58.975	58.995	59.020	58.970
4/12/2019	58.98	58.995	59.020	58.970
5/12/2019	59.015	58.995	59.020	58.970
6/12/2019	59.001	58.995	59.020	58.970
9/12/2019	58.994	58.995	59.020	58.970
10/12/2019	58.996	58.995	59.020	58.970
11/12/2019	58.996	58.995	59.020	58.970
12/12/2019	58.996	58.995	59.020	58.970
13/12/2019	58.995	58.995	59.020	58.970
14/12/2019	58.999	58.995	59.020	58.970
16/12/2019	58.989	58.995	59.020	58.970
17/12/2019	58.996	58.995	59.020	58.970
18/12/2019	58.971	58.995	59.020	58.970
19/12/2019	58.995	58.995	59.020	58.970
20/12/2019	58.995	58.995	59.020	58.970
21/12/2019	58.993	58.995	59.020	58.970
23/12/2019	58.981	58.995	59.020	58.970
24/12/2019	59.005	58.995	59.020	58.970
26/12/2019	59.001	58.995	59.020	58.970
27/12/2019	58.997	58.995	59.020	58.970
28/12/2019	58.994	58.995	59.020	58.970
29/12/2019	58.997	58.995	59.020	58.970
30/12/2019	58.995	58.995	59.020	58.970
31/12/2019	58.997	58.995	59.020	58.970

MEAN	58.993
STANDARD DEVIATION	0.01006429 3

Tabel 9 Control chart for broaching

The above control chart is an example of the finishing dimensions in the width of the broaching machine in the broaching machine. The x-axis denotes the day of the month for the particular

observations while the y-axis deals with the quality characteristics i.e. the dimensions of the part. The average of the above samples is 25.051 which means measures an average 25.051 each day. The control limits are then calculated. The UCL is 25.057mm. The LCL is 25.045 mm. This is the minimum allowable measurement acceptable when only common causes are present. There is one point beyond the UCL. This is the first pattern that signifies an out of control point a special cause of variation. Special causes of variation are detected on control charts by noticing certain types of patterns that appear on the control chart. The point be-yond the control limits

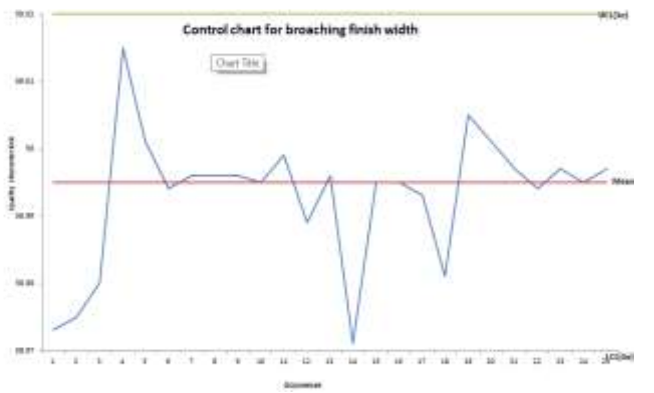


Figure 25 Control chart for broaching

ROOT CAUSE ANALYSIS

Eventually all manufacturing processes will experience problems with non-conforming parts, equipment failure resulting in lost productivity or rework expenses and possible increased scrap. Even with the best quality systems, training and Statistical Process Control (SPC), problems can happen. What must be prevented are the repeat problems. The problems you thought were resolved only to reoccur. Repeat problems can be experienced in everyday life. If you compare a manufacturing process to a garden, the process problems would be the weeds in the garden. If you pull up a dandelion and don't get the entire root it will just keep popping back up. It is much the same with manufacturing problems – if you don't get to the root cause of the problem, it is eventually (if not frequently) going to re-occur. The goal of a Root Cause Analysis (RCA) is to get down to the true cause of the problem, the root cause.

Root Cause Analysis for Centre Drill Offset Defect

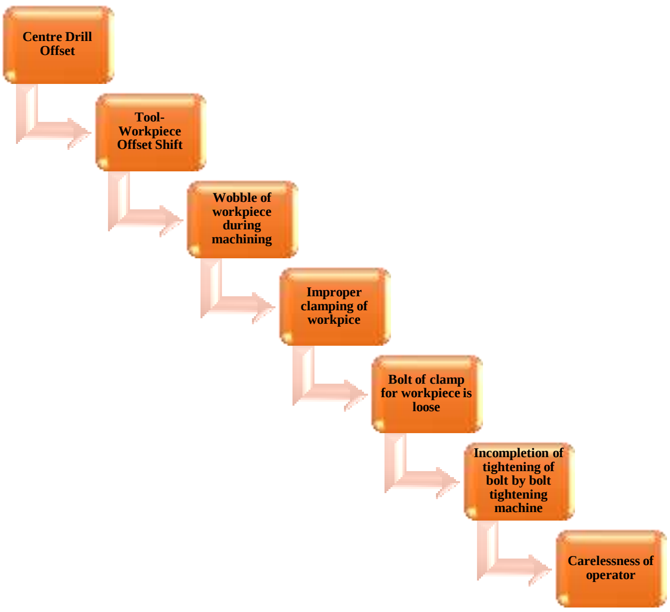
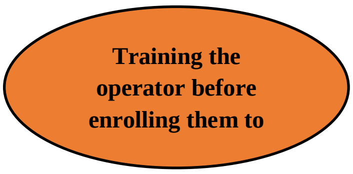


Figure 26 Root cause for Drill Offset

Root Cause Analysis of Milling Width Minus



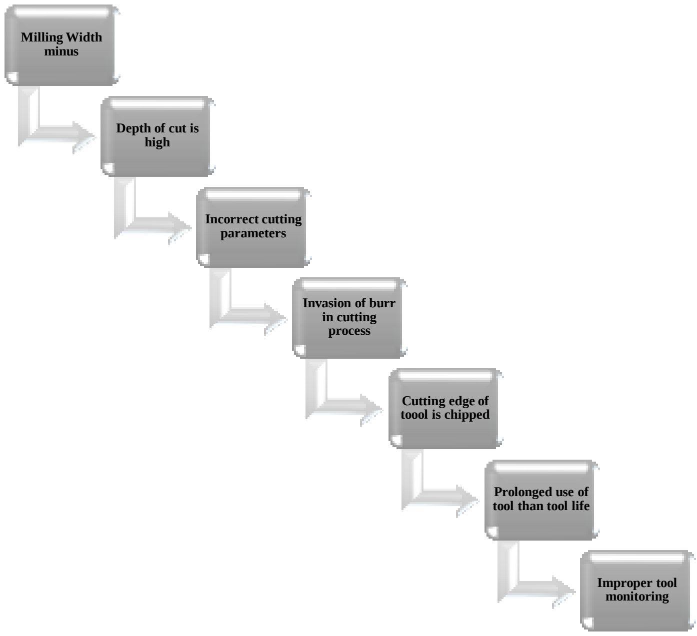


Figure 27 Root Cause for Milling Width

Root Cause Analysis of Centerless grinding Outer Diameter Minus

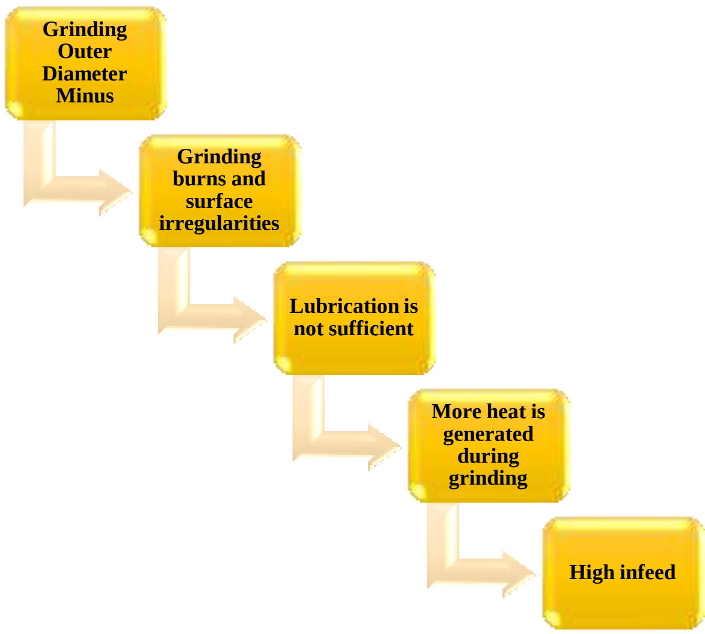


Figure 28 Root Cause for grinding Diameter

Root Cause Analysis of Milling Taper

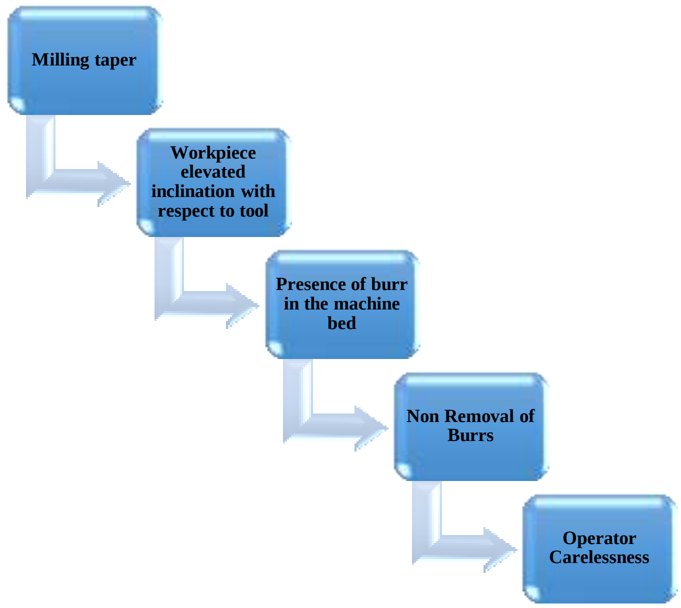


Figure 29 Root Cause for milling Taper

RESULTS

CAUSE TYPE	CAUSES	MEASURES
Operator skill (man)	Due to absence of skill chances of accidents at operation station is more	Operator should provide with sufficient training
Operator awareness (man)	Operator is not locating the part properly on gauge. Specified tolerance limit may vary due to Negligence	Operator should be trained regarding slight changes in part specification may affect quality
Material properties (material)	Poor material properties leads to Crack and damages	Material should be ductile enough to absorb pressure at peaks and not shatters
Metal Chips present on the chucks and tool (method)	Metal Chips present on the chucks and tool (method)	Make sure that chips are removed properly
Grinding outer diameter minus (method)	High infeed of the cutting tool	Infeed rate should be mitigated and should be paralel to the coolant supply
Milling width minus (method)	Incorrect cutting tool parameters fed in to the cnc machine	Tool parameters and its tool life must be monitored periodically by tool monitoring system or manual inspection
Centre drill offset defect (man)	Improper clamping of work piece	Training the operator on the job as well as testing the components
Milling taper defect(man)	Work piece elevated inclination with respect to tool	Positioning and fixing of the fixture And removing the burs using air gun
Tool indexing(method)	Wrong position of tool will damage the piston	Tool has to be accurately set
Speed (machine)	Improper machining on	Operator should follow

	the surface of piston	the SOP strictly
Tool grinding (method)	leads to deep cut or improper surface finishing	Tool has to be grind or changed whenever its necessary
Blow holes	Due to excessive gas content in the metal bar and rejection of dissolved gases during solidification,it includes hydrogen and nitrogen	detect before machining, requiring harmonic, ultrasonic, magnetic or x-ray analysis.

Table 10 Findings and Results

From the above table it can be seen that the several problems associated with the hydraulic piston are studied and the feasible solutions are also derived by our knowledge. After studying all problems related to each research papers individual solutions are provided. Based on solution on that problem effect on production is changed as increase in productivity or reduction of rejection rates.

CONCLUSION

In the earlier days traditional Quality Control techniques such as hit and trial or thumb rule are not guided by scientific principle or rules but follow an unsystematic approach leading to wastage of time, improper utilization of resources and ineffective solutions. These techniques do not provide optimum solutions but only provide a shortcut whose effectiveness is not guaranteed. Quality Problem Solving Analysis using various quality tools such as why why analysis, Frequency Sheets, control chart, Pareto Chart and Cause and Effect Diagram, it can be concluded that these scientific problem solving techniques are far better and efficient as well as provide systematic approach towards problem solving as compared to traditional quality control techniques used in Indian Industries leading to overall improvement in productivity.-Minimization of defect and rework is an important factor ensuring the quality of product. The importance of manufacturing industry in the economy is high. So manufacturing the quality product is essential to sustain in the global market. Customer satisfaction depends on quality of product. Good quality results in good establishment of brand name, good providers and builds reputation in market. We should know that 1 % defect leads to 100% defective for customer to buy product.

RECOMMENDATIONS

- Make Use of Poke Yoke Method, where without the application of the first the second stage does not undergo which minimizes the overall method rejection without need of analysis.
- Go and No-Go Gauges must be embedded with PLC Circuits such that before loading of the components the workpiece must be measured whether it has the required parameters of design. This prevents the defective material to be manufactured and reduces the total power and resources required.
- A separate division must be made such that the rejected and rework materials so that those are to be made as functioning workpiece so that material reductions can be achieved.
- Every Machine must have a Check, Lubricate and Inspect Chart (CLI) and before the start of the machine must be thoroughly checked with the chart such that maintenance can be done accordingly and helps in increasing the efficiency and the life of the machines.
- Machine Calibration must be labeled and maintained both on the machine and on a separate module such that efficient functioning can be maintained.
- The machine line must have a supply quality stage to check the casting material as well as a Final Quality stage to check whether the components can be supplied to the desired customers. The final Quality Stage must determine that the component has been manufactured with both dimensional as well as surface tolerances.
- Each machine must be embedded with the PLC and a Central server such that a component can be only moved in case if the same component was successfully finished the earlier stages.
- Weekly as well as monthly audit must be correspondingly done to check the quality as well as the ways to prevent defects and achieve zero defects.

- Quality of the product must be focused more than the Quantity of the product that has been manufactured.
- A respective span must be given for the use of coolants as well as tooling oils and they must be changed at equal intervals of time.
- The workstation mut be cleaned thoroughly for after a definitive number of components manufactured such that they are free from the burs that might affect the tools.
- The tool Calibration as well as the sharpness must be maintained and checked periodically.
- In case of safety the machines must be equipped with a sensor such that if they bring the hands while the machine is in operation it would automatically stop thereby preventing causalities.
- The sensors must be accurate and moreover digital sensors with clear dimension listing must be used to derive the accurate values.
- In case of VMC and CNC machine the programs must be set such that it corresponds to the home position of both the tool as well as the workpiece.
- A barcode system for the components must be introduced for making the embedded system with a central server more easy and job perfection.
- Operators must undergo training and must be able to understand the full concepts of the manufacturing process of the component as well as the working of the machines along with manual visual inspection.

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