improvement [4].

1. Knowing the type of defect that causes the front fork in the upper area.

2. Identify the biggest factor causing the front fork in the upper area.

3. Formulate corrective actions and make improvements in the company to eliminate the leaky front fork problem in the upper area.

4. Comparing CP / CPk before and after repairs.

Based on previous research, my research this time is at the measurement stage, I use process capability tools because the analysis that will be carried out ensures that the process capability of a machine is up to standard or not. And the second difference is in the control tools stage that is used using SPC (Statistical Process Control) where from this control the consistency of improvement can be controlled every day.

2. RESEARCH AND METHOD

Six Sigma is a method used to identify problems in the production process and describe burdensome defects in terms of time, money, customers, and opportunities (Supriyadi, 2017). Kibria, Kabir, & Boby (2014) revealed that Six Sigma increases profit margins, improves financial conditions by minimizing the level of product defects. Researchers used the DMAIC method, where there are steps to reduce defects and variations carried out systematically by defining, measuring, analyzing, improving, and controlling which are known as the 5 phases of DMAIC (Define, Measure, Analysis, Improvement, Control). Research and data collection were taken from one of the claim market cases at PT. XYZ and PT Astra Honda Motor from January to December 2019.

3. RESULTS

3.1. Define

In 2019, consumer complaints (Claim Market) were found with complaints received due to the front fork leaking in the upper area which can be seen in table 1. below this

Table 1: Total Customers Complaints Relate to Front Fork Leak Upper Area in 2019

	Tahun 2019												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Motor Matic	86	74	89	81	85	80	75	82	78	77	83	70	960
Motor Manual	15	18	22	17	24	21	24	15	21	26	14	13	230
Jumlah	101	92	111	98	109	101	99	97	99	103	97	83	1190

Oil leaks in the front fork can be caused by several things. To see the possible causes of oil leakage, you can see the Logic Tree Diagram in Figure 2 for the process of defining the cause of oil leakage in the upper front fork area, and in Figure 3 are the parts in the upper front fork area

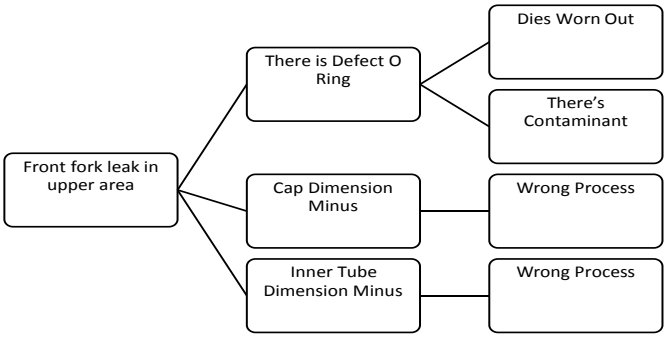


Figure 2: Logic Tree Diagram Penyebab Front Fork Bocor Area Upper

Figure 3: Front Fork Upper Area

To define the process of the front fork components and parts associated with the front fork, starting from material suppliers, sub-parts, front fork assy, assy units, output distribution to consumers, a map of Supplier, Input, Process, Output, Customers (SIPOC) will be made diagram which can be seen in Figure 4 below

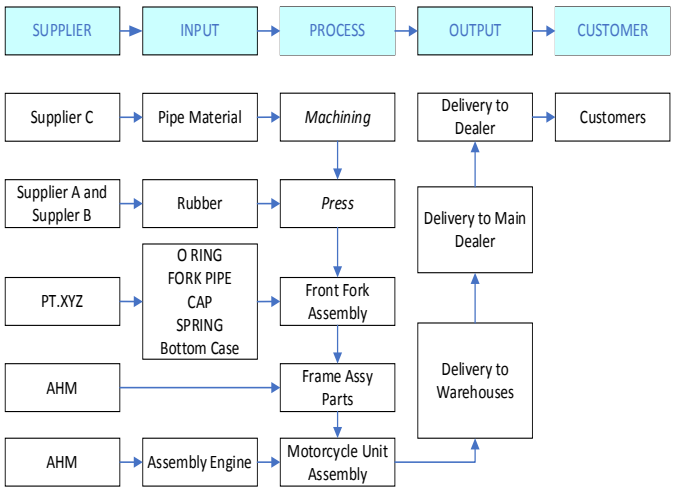


Figure 4: SIPOC Diagram

3.2. Measure

At the Measure stage, the main activity carried out is the measurement of calculating the capability process condition where the output is the value of Cp, Cpk. The processing capability will be calculated first by mapping the part process,

then determining the critical point by making a logic tree diagram on the part process. The processing capability that will be calculated includes:

1. O Ring Dimensions

2. Inner Tube Dimensions

3. Cap Dimensions

Dimensional Measurement of O Ring

Measurement of process capability that is measured is the points that affect the density with the inner tuber, including:

1. Inside Diameter

2. Ring Diameter

For CP o-ring measurement, it will involve 2 suppliers, namely Supplier A and Supplier B. Standard dimensions of the inside diameter and ring diameter can be seen in Figure 5 below.

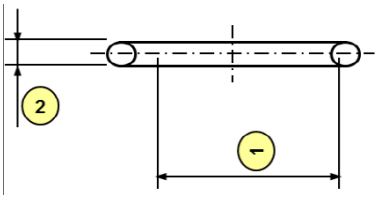


Figure 5: Standard Dimension O Ring

The results information based on the Cp and Cpk values are as follows:

• Bad Process: Cpk or Cp <0.67

• Enough Process: 0.67 <Cpk or Cp <1

• Good Process: 1 <Cpk or Cp <1.33

• Very Good Process: Cpk or Cp> 1.33

The calculation of Cp, Cpk begins with the calculation of the inside diameter of the ring for supplier A which can be seen in Figure 6 below.

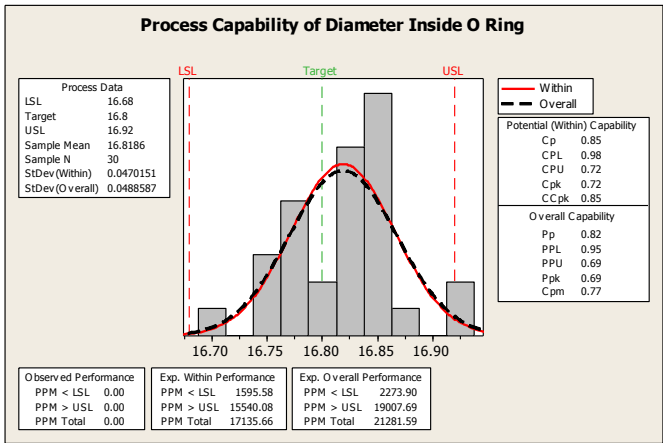


Figure 6: Graphic Data Cp, Cpk Diameter Inside O Ring Supplier A

Based on the above calculations, the Cp value is 0.85 and the Cpk is 0.72, with the Cp Cpk value obtained, it can be concluded that the results of the Process are Enough and it is decided OK.

Next, taking Cp, Cpk, calculating the ring diameter for supplier A can be seen in Figure 7 below.

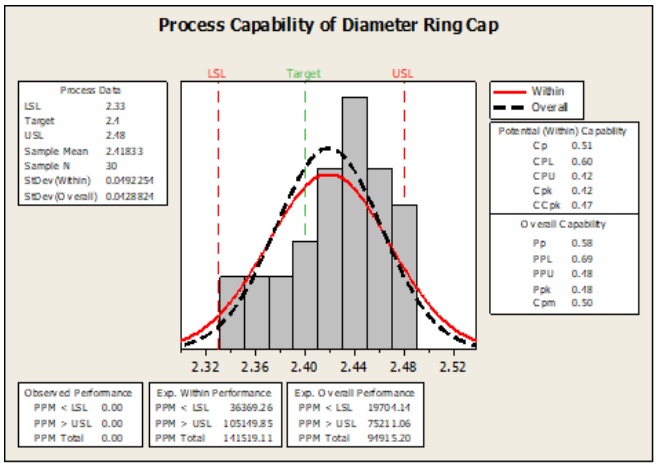


Figure 7: Graphic Data Cp, Cpk Ring Diameter O-Ring Supplier A

Based on the above calculations, the Cp value is 0.62 and Cpk 0.58. From these results, it can be decided that the process is not good and it is decided by NG.

Furthermore, the calculation of Cp, Cpk starts on the diameter of the ring cap for supplier B which can be seen in Figure 8 below.

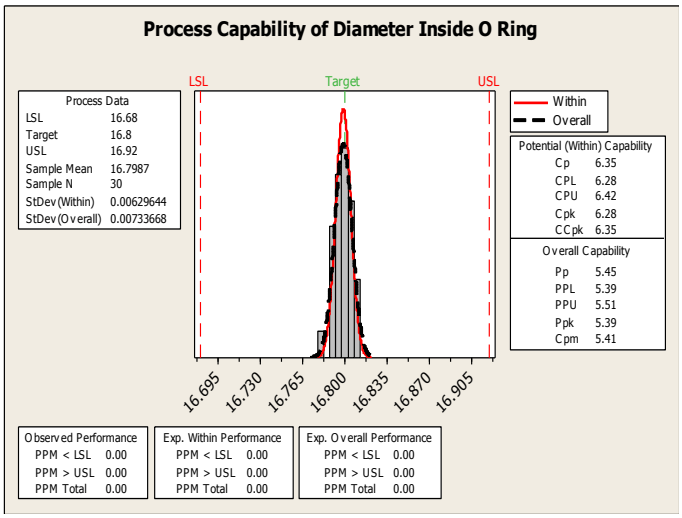


Figure 8: Graphic Data Cp, Cpk Diameter Inside O Ring Supplier Based on calculations on supplier B, the Cp value is 5.34 and the Cpk value is 5.28, with the Cp Cpk value obtained, it can be concluded that the results of the Process are Very Good and it is decided that the results of the process are OK

And taking Cp, Cpk, the last calculation is done on the ring diameter for supplier B which can be seen in Figure 9 below

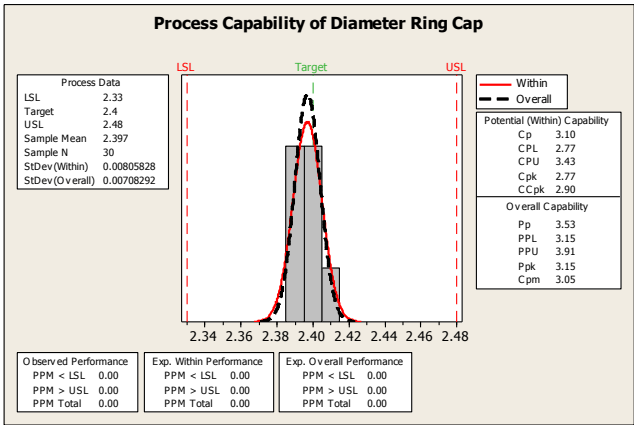


Figure 9: Graphic Data Cp, Cpk Diameter Inside O Ring Supplier B

Based on calculations on supplier B, the Cp value is 5.34 and the Cpk value is 5.28, with the Cp Cpk value obtained, it can be concluded that the results of the Process are Very Good and it is decided that the results of the process are OK

And taking Cp, Cpk, the last calculation is done on the ring diameter for supplier B which can be seen in Figure 10 below

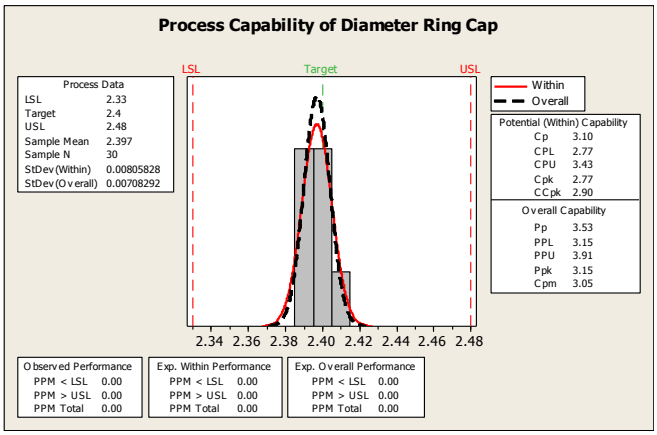


Figure 10: Graphic Data Cp, Cpk Diameter Ring O Ring Supplier B

Based on the latest calculations for the ring diameter at supplier B, the Cp value is 3.10 and the Cpk value is 2.77. Thus it can be concluded that the result of the Process is Very Good and it was decided OK.

Inner Tube Dimension Measurement

Measurement of process capability is measured on the inner tuber part, namely the inside upper diameter as seen in Figure 11 below

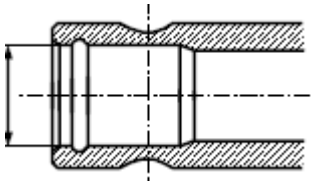


Figure 11: Standard Dimension Inside Upper Diameter

Calculation of Cp, Cpk on the inside upper diameter can be seen in Figure 12 below.

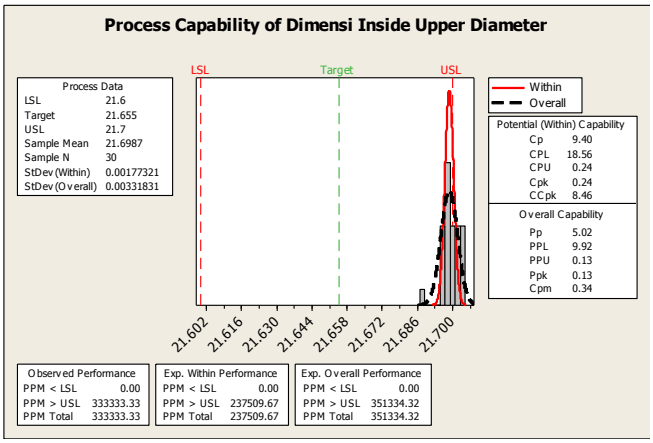


Figure 12: Graphic Data Cp, Cpk Inside Upper Diameter

Based on the calculation of Cp, Cpk, the value of Cp is 9.4 and Cpk is 0.24. Because the Cpk value is below 0.67, it can be stated that the result of the process is not good and it is decided by NG

Measurement of Cap Dimensions

The measurement of the front fork cap, especially on the outside diameter, is carried out on the part claim, in this part measurement, the process capability measurement is not carried out and the process mapping is carried out because the components of this part are imported so that the manufacturing process cannot be analyzed, if a problem is found on the dimensions then a claim or rejection will be made to the part maker. The measured part claim can be seen in Figure 13 below and the results of measuring part claim as many as 10 parts can be seen in Table 2

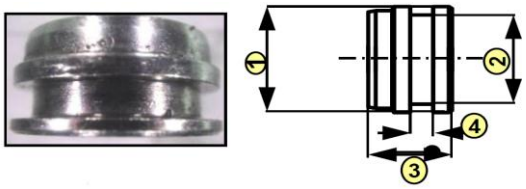


Figure 13: Cap Front Fork Illustration

Table 2: Measurement Data Market Claim Front Fork Part

No	Inspection Item	Standard	Measurement Result										Judge
			1	2	3	4	5	6	7	8	9	10	
1	Out Side Diameter	Ø21.6 -0.1 -0.3	21.39	21.38	21.39	21.39	21.38	21.41	21.4	21.38	21.4	21.39	OK
3	Grooving Diameter	Ø 17.6 0 -0.06	17.58	17.57	17.59	17.58	17.59	17.57	17.58	17.58	17.59	17.58	OK
4	Total Length	10 ± 2	10.02	10.12	10.13	10.18	10.8	10.12	10.13	10.13	10.05	10.12	OK
5	Width of Grooving	3.2 +0.1 0	3.24	3.24	3.21	3.22	3.21	3.21	3.24	3.24	3.21	3.22	OK

Based on the above measurement data, especially in the diameter grooving area where the o ring is installed, dimensionally there are no dimensional problems so that the conclusion on the front fork cap part is declared OK and no further analysis is needed.

3.3. Analyze

The main activity at the Analyze stage is to determine the factors that affect the front fork leak in the upper area based on the results of the previous stage, namely measurement. The following is a technical analysis based on measurement results on part components that affect the performance of the front fork which can cause the front fork to leak in the upper area

Tabel 3: Technical Analysis for Front Fork Leak Upper Area

Main Problem	Potential Problem	Judge (measurement)	Description
Front Fork Leak Upper Area	O Ring Supplier A → Inside O Ring Diameter	OK	Supplier Measurement-Based
	O Ring Supplier A → Cap Diameter	NG	Supplier Measurement-Based
	O Ring Supplier B → Inside O Ring Dimension	OK	Supplier Measurement-Based
	O Ring Supplier B → Cap Diameter	OK	Supplier Measurement-Based
	Inner Tube Dimension → Dimensi Inside Upper Diameter	NG	Supplier Measurement-Based
	Cap Dimension → Dimension	OK	Measurement Part Claim Based

To resolve the indication of the front fork leak in the upper area based on the technical analysis table above, the analysis stage, the main tool to be used is as follows:

• Cause and Effect Diagram (Fishbone Diagram)

• Failure Tree Analysis (FTA)

• Failure Mode Effect and Analysis (FMEA)

Analysis of O Ring Defects

For the analysis of o ring defects using a cause and effect diagram to find the dominant factor that allows arising based on 5M + 1E, in this diagram, the 5M + 1E factor to be analyzed is the pressing process where the process greatly affects the quality of the o ring which can be seen in Figure 14 below

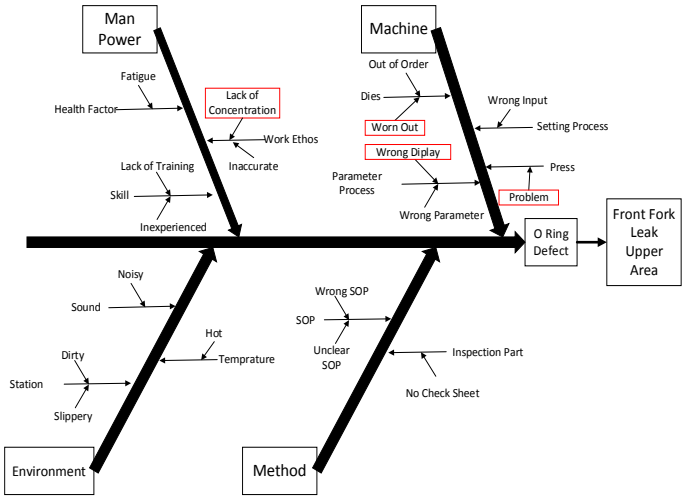


Figure 14: Fishbone Diagram O Ring Defect

After obtaining the causal diagram, the next step is to calculate the failure mode effect and analysis (FMEA). Failure Mode and Effect Analysis (FMEA) is used to see which part of the process is the most dominant in producing process failures where this time the process is in the pressing process. From the Failure Mode and Effect Analysis (FMEA), a table will be created to see the grouping carried out in Table 4 below. Tabel 4:. Failure Mode Effect and Analysis (FMEA) Press Process

Table 4: Minus Inner Tube Diameter Analysis

No	Process Step	Potential Failure Mode	Potenntial Failure Effect	SEV	Potential Causes	OCC	Current Control	DET	RPN
1	Dies Process	Dies Worn Out	O-Ring Defect	8	Maintenace not Done	10	No Inspection	8	640
2	Parameter Process	Out of Order Display	O-Ring Defect	5	Maintenace not Done	2	Incomplet Control	5	50
3	Press Process	Lack of press	Oval O-Ring	5	Setting parameter process	4	Part Incpection	5	100
4	Dies Process	Dirty Dies	O-Ring Defect	5	Cleancing was not Done	10	Man Power don't Follow SOP	5	250

The analysis is also carried out the same as the previous part using the fishbone diagram. In the Fishbone Diagram for the minus inner tube problem, the same as the previous diagram the dominant factors that cause problems based on 5M + 1E will be analyzed based on the machining process. The cause and effect diagram of the minus inner tube can be seen in Figure 15 below.

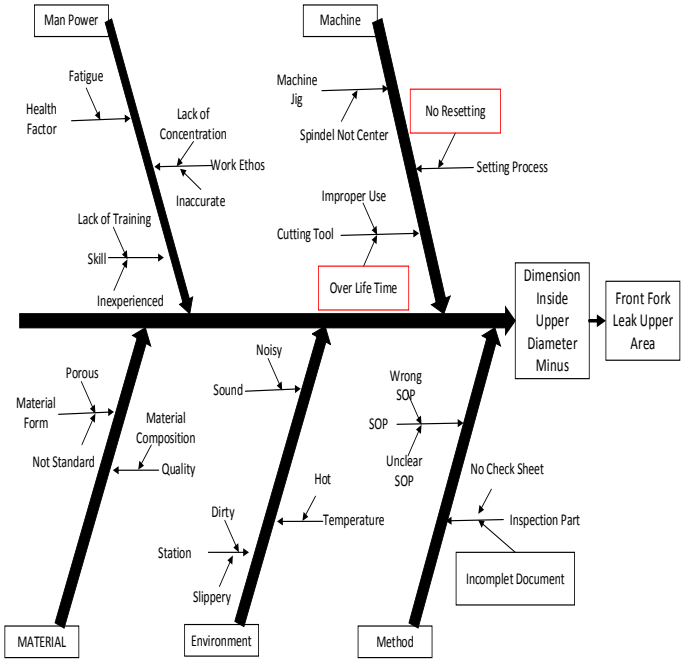


Figure 15: Fishbone Diagram Diameter Inner Tube Minus

Table Failure Mode Effect and Analysis (FMEA) Machining Process

The last analysis process is calculating the Failure Mode Effect and Analysis (FMEA) Machining Process after the previous

process the causes of the minus inner tube diameter have been obtained through the analysis of the causal diagram (Fishbone Diagram). The calculation of Failure Mode Effect and Analysis (FMEA) can be seen in Table 5 below.

Table 5: Failure Mode Effect and Analysis (FMEA) Machining Process

No	Process Step	Potential Failure Mode	Potenntial Failure Effect	SEV	Potential Causes	OCC	Current Control	DET	RPN
1	Inner Diameter	Resetting was not done	Minus Diameter	8	Cutting tool over use	10	No Resetting	8	640
2	Inner Diameter	Excessive life time	Minus Diameter	5	Blunt Cutting tool	2	Periodic Inspection	5	50
3	Dimension	Dimension out of spec	Minus Diameter	8	Cutting tool over use	10	Incomplet Final Inspection	5	400

3.4. Improve

Based on the FMEA table that has been created, the following table of technical analysis (5-why method) and priority based on the value of the Risk Priority Number (RPN) on the factors that cause front fork leaks in the upper area can be seen in Table 6.

Table 6: 5 Why Method Front Fork Leak Upper Area

Symptoms	Why?	Why?	Why?	Why?	Why?	RPN
Front Fork Leak Upper Area	O Ring Defect	Diameter O Ring out of standard	Worn Out Dies	Maintenance not Done	Tidak ada dies inspeksi	640
			Dirty Dies	Cleancing was not Done	Man Power don't Follow SOP	250
	There's Gap in inner tube	Inner Tube Dimension Minus	No resetting when in repair period	Cutting tool over	No Resetting	640
					Incomplet Final Inspection	400

Improved Dies Use Control During O-Ring Making Process and SOP Socialization

In the press process of making an O ring, there are important things that have been previously discussed at the analysis stage that the use of dies is very important in manufacturing. After analysis, the cause of the CP / CPK NG on the ring diameter was caused by the use of the dies itself. When checking the dies, a worn condition is found which can be seen in Figure 16

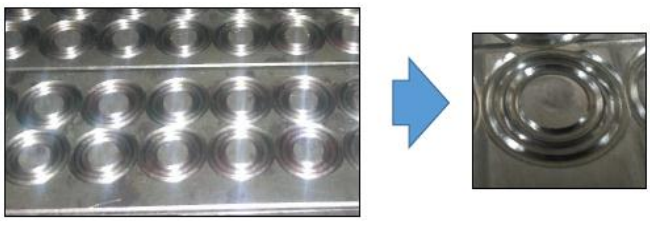


Figure 16: Dies at Press Process

With the condition of the dies that are worn out, when the pressing process takes place the result of the ¬o ring is defective. This defect in the o ring causes oil to come out. The cause of the worn condition of the dies due to the usage that exceeds the lifetime, this condition can be seen in Figure 17 where the condition of the dies exceeds the lifetime.

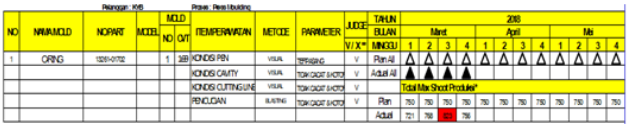


Figure 17: Check Sheet dan Maintenance Schedule Dies

From the above findings, it can be seen that in the 3rd week of March, there were conditions for the use of dies that exceeded the plan or standards set by production. From the condition of the dies that exceed the lifetime, the parts produced have visual defects which can be seen in Figure 18 below

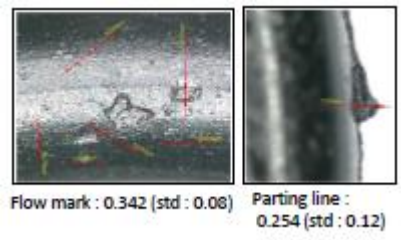


Figure 18: Defect Rubber Trigger by Worn Out Dies

With the discovery of worn-out dies conditions that were not detected by the operator, it is necessary to improve the control of the use of dies to avoid the reoccurrence of worn-out dies.

Apart from that, the conditions that need to be maintained by the operator are related to the cleanliness of the dies, the condition of the dies where the remaining burry from the previous process can also cause the condition of the o ring to have defects. So that re-socialization is needed for operators so that no important processes in the SOP are missed. Re-socialization has been carried out and can be seen in Figure 19

Figure 19: SOP Press Process Socialization

Improved Control of Tool Change and Addition of Final Inspections

Repair activities that will be carried out this time are to fix problems that occur in the inner tube dimension. The inner tube

dimension itself is found in the bar in (inside diameter) process, which has a gradual infeed

After the analysis was carried out, there was a finding that when the tools were replaced, the operator did not set the offset wear, which caused an insert over to be carried out at the beginning of the feeding process. This is found when the operator has replaced the worn insert with a new insert, the operator does not set the offset wear and is shown on the monitor parameter setting in Figure 20 below

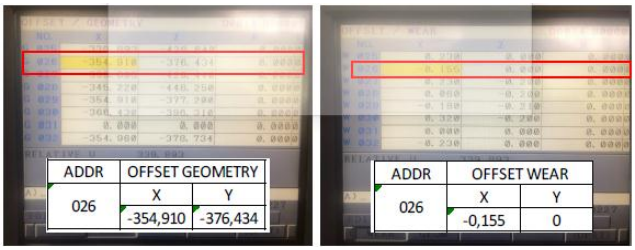


Figure 20: Monitor Setting Parameter Before dan After Change Insert

From the above findings, when a new insert is not set the offset wear is set, it will cause when the initial infeed process is carried out the result of the part dimensions will be minus. For the standard diameter itself between 21.6 - 21.7, if the operator compares the results of the insert insertion before it is replaced and after the insert is replaced.

Finding these conditions can cause the inner tube diameter to be minus and cause a leak in the front fork. In the IK (Work Instructions) document, the replacement of the insert tool is not written in detail, so it needs to be revised for the point of adding the insert tool settings when the replacement is made

After repairs have been made which causes the inner tube diameter to be minus, it is followed by inspection of the parts so that if the same problem occurs, the operator can catch the NG part. To better control the production results maximally, improvements were made by adding 100% plug gauge checks and when there was a change of inserts, the dimensions were checked which can be seen in Figure 21 below

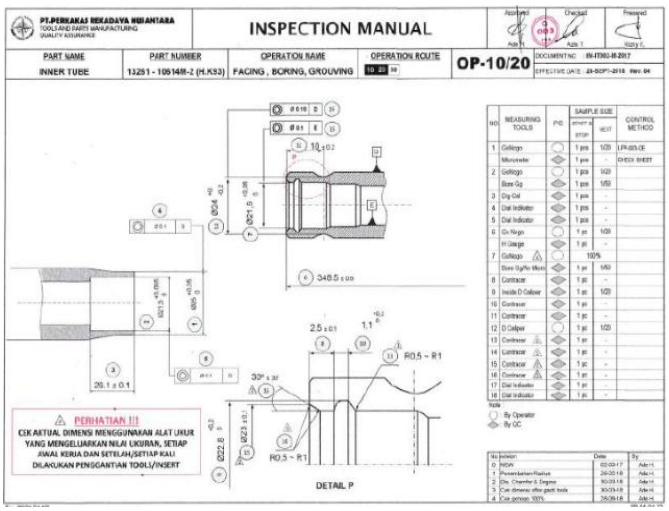


Figure 21: Inspection Manual Revision Inner Tube Part

3.5. Control

The main activity in the control stage is to maintain and maintain the condition of the repair results. Process control is carried out using tools from SPC (Statistical Process Control), using the X-R Control Chart. The points to be controlled include:

Ring Diameter O Ring on the Front Fork which can be seen in Table 7

Table 7: X-R Control Chart Ring Diameter O Ring

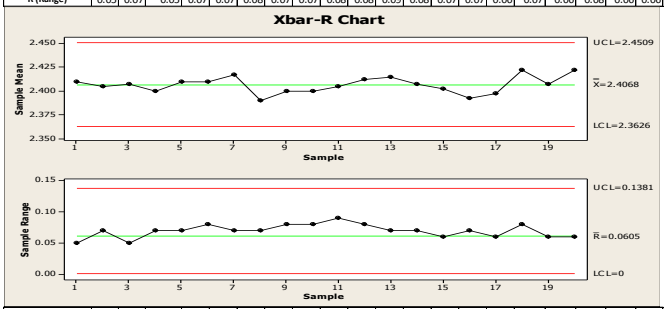
Check Point
1. CL
2. UCL, LCL

Model : All Type
Month : September 2020

X - R Control Chart

Prepared by	Checked by

DATE		3	4	7	8	9	10	11	14	15	16	17	18	21	22	23	24	25	28	29	30
LOT	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Sample (n)	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
CHECK VALUE	X1	2.38	2.37	2.38	2.36	2.37	2.37	2.38	2.35	2.36	2.36	2.36	2.37	2.38	2.37	2.37	2.36	2.37	2.38	2.38	2.39
	X2	2.42	2.4	2.41	2.4	2.41	2.4	2.41	2.39	2.39	2.4	2.4	2.41	2.41	2.4	2.41	2.39	2.4	2.42	2.4	2.42
	X3	2.43	2.41	2.41	2.41	2.42	2.42	2.43	2.4	2.41	2.4	2.41	2.42	2.42	2.42	2.4	2.39	2.39	2.43	2.41	2.43
	X4	2.41	2.44	2.43	2.43	2.44	2.45	2.45	2.42	2.44	2.44	2.45	2.45	2.45	2.44	2.43	2.43	2.43	2.46	2.44	2.45
TOTAL		9.64	9.62	9.63	9.6	9.64	9.64	9.67	9.56	9.6	9.6	9.62	9.65	9.66	9.63	9.61	9.57	9.59	9.69	9.63	9.69
X (Average)		2.41	2.41	2.41	2.40	2.41	2.41	2.42	2.39	2.40	2.40	2.41	2.41	2.42	2.41	2.40	2.39	2.40	2.42	2.41	2.42
R (Range)		0.05	0.07	0.05	0.07	0.07	0.08	0.07	0.07	0.08	0.08	0.09	0.08	0.07	0.07	0.06	0.07	0.06	0.08	0.06	0.06



Checked by																					
Remark by : Chief																					

Section	Part Comp.	Parts Name	Specific of Quality	Tooling	Sampling
FINAL INSPECTION		O RING	DIAMETER O RING	CALIPER RUBBER	4 PCS

Dimensions of Inside Upper Diameter on the Front Fork which can be seen in Table 8.

Table 8: X-R Control Chart Dimension Inside Upper Diameter

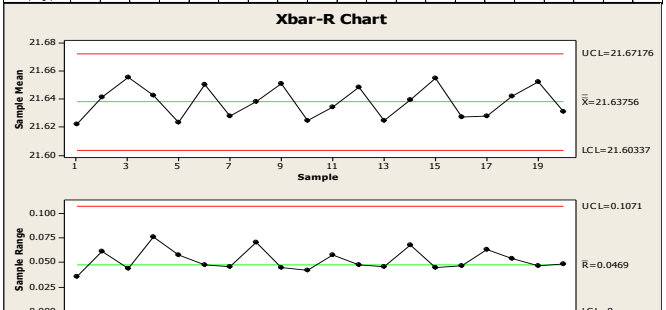
Check Point
1. CL
2. UCL, LCL

Model : All Type
Month : September 2020

X - R Control Chart

Prepared by	Checked by

DATE		3	4	7	8	9	10	11	14	15	16	17	18	21	22	23	24	25	28	29	30
LOT	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Sample (n)	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
CHECK VALUE	X1	21.605	21.65	21.635	21.679	21.66	21.626	21.604	21.651	21.627	21.604	21.648	21.625	21.603	21.651	21.631	21.603	21.667	21.635	21.628	21.606
	X2	21.62	21.671	21.652	21.603	21.603	21.649	21.627	21.673	21.651	21.622	21.661	21.646	21.621	21.672	21.655	21.626	21.604	21.659	21.651	21.629
	X3	21.622	21.61	21.655	21.631	21.605	21.652	21.631	21.603	21.653	21.624	21.604	21.649	21.624	21.605	21.658	21.63	21.608	21.663	21.655	21.633
	X4	21.64	21.632	21.678	21.656	21.624	21.673	21.649	21.625	21.671	21.646	21.623	21.672	21.648	21.628	21.675	21.649	21.631	21.609	21.674	21.654
TOTAL		86.49	86.56	86.62	86.57	86.49	86.60	86.51	86.55	86.60	86.50	86.54	86.59	86.50	86.56	86.62	86.51	86.51	86.57	86.61	86.52
X (Average)		21.62	21.64	21.66	21.64	21.62	21.65	21.63	21.64	21.65	21.62	21.63	21.65	21.62	21.64	21.65	21.63	21.63	21.64	21.65	21.63
R (Range)																					



Checked by																					
Remark by :																					

Section	Part Comp.	Parts Name	Specific of Quality	Tooling	Sampling
MACHINING		FORK PIPE	INSIDE UPPER DIAMETER	CALIPER	4 PCS

From the results of the X-R Chart, it can be seen that the data retrieval was carried out 4 times a day for 1 month, showing very good results. This control can be a reference that the improvements made can run well.

4. SUMMARY AND CONCLUSION

From the Define, Measurement and Analyze processes, researchers found 2 factors that caused the front fork to leak in the upper area. Where the first cause is due to a defective o-ring condition and the second cause is the minus dimensions of the inner tube. For this reason, the researcher carried out an improvement process, namely for the cause of the defect o-ring, control of the use of dies was carried out during the o-ring manufacturing process and carried out re-socialization for the SOP in the dies cleaning process after the pressing process was complete. And other causes related to the minus inner tube dimensions, improvements were made to control tool change in the machining process, and the addition of final inspection controls for the results of the machining process.

It is hoped that PT. XYZ will pay more attention and improve the performance of workers so that it can reduce defects in the production process. The need for PT XYZ's involvement and providing training for employees to be able to participate in improving the six sigma method.

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