

## ANALISIS PENGARUH FEEDING PADA PROSES GRINDING JOURNAL TERHADAP NILAI KUALITAS CAMSHAFT TYPE 2TNV70 PASCA *IQT*

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### ABSTRACT

Research in the field of machining in testing the level of roughness needs to be done to get good results in the machining process. The purpose of this study was to determine the effect of variations in feeding on the surface grinding process on the surface roughness and hardness of S45C carbon steel that has gone through processes including induction, quenching and tempering and to compare which feeding variation has the lowest level of roughness. The research method used is an experimental method in the form of giving a variety of feeding which is tested on 4 samples in the surface grinding process. The number of variations given is 0.2mm/min, 0.4mm/min, 0.8mm/min, 1.2mm/min. The test results obtained are in the form of roughness values and hardness values on specimens that have been previously tested. The results showed that there was a change in the roughness value that occurred during the grinding process by applying a 0.2mm/min feeding variation resulting in an average value of 1.33683333 $\mu$ , a feeding variation of 0.4mm/min producing an average value of 1.27068333 $\mu$ , a feeding variation of 0.8mm/min producing an average value of 1.27068333 $\mu$ . the average value is 1.29633333 $\mu$ , the variation of feeding 1.2mm/min produces an average value of 1.39458333 $\mu$  and there is no significant change in the surface hardness value in the surface grinding process. The tools used in this study were the Mitutoyo SV2100 roughness tester to determine the roughness value, and the Sonohard SH22 hardness tester to determine the hardness value. The data that has been obtained are then analyzed using descriptive statistics where the data are presented in the form of tables and graphs. after grinding. This shows that there is an effect of giving different variations of feeding the surface grinding process to the surface roughness value.

**Keyword :** Feeding, Surface Grinding, Camshaft, *IQT*, Steel Type S45C, Hardness, Roughness

### INTRODUCTION

The use of metal in the development of technology and industry as one of the supporting materials has a very large role. S45C carbon steel is one type of metal that is widely used in everyday life, especially in the fields of technology and industry. Many industries in the manufacturing sector use carbon steel as a material, both for components in production machines, as well as in manufactured materials. S45C carbon steel has a medium hardness level because it is included in the type of medium carbon steel. In the world of machining, the use of S45C carbon steel is not far from its very hard and wear-resistant physical properties. S4C5 carbon steel can be applied to, gears, chisel blades, railroads, shafts and more. To improve its physical properties, carbon steel is usually carried out by the *IQT* process to increase its

hardness<sup>1</sup>. To get a smooth surface it must go through a grinding process. Grinding process is a term used in modern manufacturing practice to describe working with high speed abrasive wheels, bearings and belts. There are several kinds of grinding machines, namely flat grinding machines, surface grinding machines and cylinder grinding machines. The surface grinding process is called surface grinding. This surface grinding process determines the surface roughness of an object to a certain (n) value<sup>3</sup>. The material that has been in IQT is then continued on the surface grinding guinea process to achieve the desired roughness and hardness, the process produces the criteria for hardness and roughness values in accordance with the product specifications requested by the customer. The focus of the problem to be studied in this research is the effect of feeding on the grinding journal process on the quality value of the type 2TNV70 camshaft after IQT. The results of the process then enter the hardness and roughness test stage to determine the final result of hardness and roughness on the camshaft type 2TNV70

## LITERATURE REVIEW

### Feeding

Feeding is one of the processes in the machining world, especially in types of machine tools such as lathes, grinding machines, milling machines and scrap machines. In the process of machine tools depending on the feeding or the resulting food. Feed can be expressed as the ratio of the motion of the workpiece to the rotary motion of the blade or grinding wheel of the machine tool. The blades of lathes and scrap machines are of the same type, namely chiseling knives, then for milling machines use a drill bit or end mill type knife, while for grinding machines use grinding stones as the feeder. In determining the feed, we must pay attention to the factors that affect the feed value, namely, the type of grinding stone, the depth of cut, the quality of the resulting surface, and the workpiece or type of material<sup>4</sup>

### S45C Steel

Steel is a metal alloy consisting of elements of iron (Fe), carbon (C) and other elements. What is meant by carbon steel is steel that only consists of iron (Fe) and carbon (C) without any alloying materials and other elements. sometimes found in carbon steels such as Si, Mn, P, and others. Carbon is one of the most important elements because it can increase the hardness and strength of steel. Broadly speaking, steel can be grouped into two, namely carbon steel and alloy steel. Carbon steel is divided into three types, namely: low carbon steel (0.55%C), medium carbon steel (0.25%C – 0.55%C), high carbon steel (>0.55%C). The use of each carbon steel varies based on the carbon content of the steel.

### Surface Grinding

Grinding is the process of cutting the workpiece using a grinding machine. In operation, the workpiece is held or gripped on a magnetic table which is moved back and forth or rotated under a rotating grinding wheel. The flat grinding machine is one of the most widely used types

of grinding machines for grinding workpieces with the aim of getting the flatness and smoothness of the surface as well as the desired workpiece size.

### Quality Value

The level of smoothness of a surface is indeed a very important role in the planning of a machine component, especially regarding the problem of friction, lubrication, wear, resistance to fatigue and so on. Therefore, in planning and manufacturing it must be considered in advance which machine tools should be used to make it and how much it will cost. In order for the manufacturing process to avoid significant deviations, these surface characteristics must be understood by the engineer to the operator. For further discussion of surface roughness, it is necessary to first discuss the limitations and some important parameters related to surface roughness/smoothness which are still widely used in practice. Some of the equipment that can be used to check the smoothness of this surface will also be mentioned. In practice, the material used for the workpiece usually consists of iron or metal. Therefore, solid objects whose materials are made of soil, stone, wood and rubber will not be mentioned in the preparation of the final project regarding surface characteristics and measurements. A surface can basically be divided into two, namely a rough surface and a wavy surface. The rough surface is in the form of irregular short waves and occurs due to the vibration of the cutting blade (chisel) or an improper proportion of the cutting blade feed in the manufacturing process.

## DISCUSSION

### Grinding Calculation Results

The results of the calculation of the grinding of the workpiece are carried out in several stages by varying the feeding parameters, namely:

#### Stage 1 (Feeding 0.2 mm/min)

1. *The depth of cut is calculated using the following equation:*

$$D1 = \text{Initial diameter (mm)}$$

$$D2 = \text{Final diameter (mm)}$$

$$a = \text{Depth of cut (mm)}$$

$$a = (D1 - D2) / 2$$

$$= (40.35 - 39.95) / 2$$

$$= 0.2 \text{ mm}$$

2. *The average diameter is calculated using the following equation:*

$$D = (D1 + D2) / 2$$

$$= (40.35 + 39.95) / 2$$

$$= 40.15 \text{ mm}$$

3. *Cutting speed is calculated using the following equation:*

$$Cs = (\pi \cdot D \cdot n) / 1000$$

$$= (3.14 \cdot 40.15 \cdot 3600) / 1000$$

$$= 453.8556 \text{ mm/min}$$

4. *The grinding table movement speed is calculated using the following equation*

$$F = 0.2 \cdot n$$

$$= 0.2 \cdot 3600$$

$$= 720 \text{ mm/min}$$

5. *Machining time is calculated using the following equation:*

$$T_m = L / (f \cdot n)$$

$$= 308.5 / 720$$

$$= 0.4278 \text{ minutes}$$

### **Stage 2 (Feeding 0.4 mm/min)**

1. *The depth of cut is calculated using the following equation:*

$$D_1 = \text{Initial diameter (mm)}$$

$$D_2 = \text{Final diameter (mm)}$$

$$a = \text{Depth of cut (mm)}$$

$$a = (D_1 - D_2) / 2$$

$$= (40.35 - 39.95) / 2$$

$$= 0.2 \text{ mm}$$

2. *The average diameter is calculated using the following equation:*

$$D = (D_1 + D_2) / 2$$

$$= (40.35 + 39.95) / 2$$

$$= 40.15 \text{ mm}$$

3. *Cutting speed is calculated using the following equation:*

$$C_s = (\pi \cdot D \cdot n) / 1000$$

$$= (3.14 \cdot 40.15 \cdot 3600) / 1000$$

$$= 453.8556 \text{ mm/minute}$$

4. *The grinding table movement speed is calculated using the following equation:*

$$F = 0.4 \cdot n$$

$$= 0.4 \cdot 3600$$

$$= 1440 \text{ mm/min}$$

5. *Machining time is calculated using the following equation:*

$$T_m = L / (f \cdot n)$$

$$= (308.5) / 1440$$

$$= 0.2142 \text{ minutes}$$

### **Stage 3 (Feeding 0.8mm/min)**

1. *The depth of cut is calculated using the following equation:*

$$D_1 = \text{Initial diameter (mm)}$$

$$D_2 = \text{Final diameter (mm)}$$

$$a = \text{Depth of cut (mm)}$$

$$a = (D_1 - D_2) / 2$$

- $= (40.35-39.95 )/2$   
 $= 0.2 \text{ mm}$
2. *The average diameter is calculated using the following equation:*  
 $D=(D1+D2 )/2$   
 $= (40.35+39.95)/2$   
 $= 40.15\text{mm}$
3. *Cutting speed is calculated using the following equation:*  
 $Cs = (\pi.D.n )/1000$   
 $= (3.14 .40,15 .3600 )/1000$   
 $= 453.8556 \text{ mm/minute}$
4. *The grinding table movement speed is calculated using the following equation:*  
 $F = 0.8 . n$   
 $= 0.8 . 3600$   
 $= 2880\text{mm/min}$
5. *Machining time is calculated using the following equation:*  
 $Tm = L/(f.n )$   
 $= (308.5 )/2880$   
 $= 0.1071\text{minute}$

**Stage 4 (Feeding 1.2 mm/min)**

1. *The depth of cut is calculated using the following equation:*  
 $D1 = \text{Initial diameter (mm)}$   
 $D2 = \text{Final diameter (mm)}$   
 $a = \text{Depth of cut (mm)}$   
 $a=(D1-D2)/2$   
 $= (40.35-39.95 )/2$   
 $= 0.2 \text{ mm}$
2. *The average diameter is calculated using the following equation:*  
 $D=(D1+D2 )/2$   
 $= (40.35+39.95 )/2$   
 $= 40.15\text{mm}$
3. *Cutting speed is calculated using the following equation:*  
 $Cs =(\pi.D.n )/1000$   
 $= (3.14 .40,15 .3600 )/1000$   
 $= 453.8556 \text{ mm/minute}$
4. *The grinding table movement speed is calculated using the following equation:*  
 $F = 1.2 . n$   
 $= 1.2 . 3600$   
 $= 4320\text{mm/min}$
5. *Machining time is calculated using the following equation:*  
 $Tm = L/(f.n )$

$$= (308.5) / 4320$$

$$= 0.0714 \text{ minutes}$$

The results of measuring the surface roughness of the workpiece with the grinding process are grouped based on the variety of feeding used in this study, namely 0.2mm/min, 0.4mm/min, 0.8mm/min, 1.2mm/min with the materials used are S45C and CBN grinding stones.

PT Morita Tjokro Gearindo Quality Assurance Department		Date : 24 March, 2021 00:03:51	Inspected	Checked	Judgment			
Quality Control CHECK RESULT		Part Name : CAM SHAFT Type : 2 TNV 70 Process : Shift :			OK NG			
Meas Cont	Meas Value	Nom Value	Error	U Tol	L Tol	Out Tol	TolRslt	Judg
Roughness 2D<SurfAnalysis_1> Profile=RLS_JIS - Section=[1]								
Rz	1.7663um			3.5000um	0.0000um			OK
Roughness 2D<SurfAnalysis_2> Profile=RLS_JIS - Section=[1]								
Rz	1.2834um			3.5000um	0.0000um			OK
Roughness 2D<SurfAnalysis_3> Profile=RLS_JIS - Section=[1]								
Rz	1.3121um			3.5000um	0.0000um			OK
Roughness 2D<SurfAnalysis_4> Profile=RLS_JIS - Section=[1]								
Rz	1.0972um			3.5000um	0.0000um			OK
Roughness 2D<SurfAnalysis_5> Profile=RLS_JIS - Section=[1]								
Rz	1.2810um			3.5000um	0.0000um			OK

Figure 1. Roughness Test Results With 0.2mm/min Feeding

PT Morita Tjokro Gearindo Quality Assurance Department		Date : 24 March, 2021 00:07:22	Inspected	Checked	Judgment			
Quality Control CHECK RESULT		Part Name : CAM SHAFT Type : 2 TNV 70 Process : Shift :			OK NG			
Meas Cont	Meas Value	Nom Value	Error	U Tol	L Tol	Out Tol	TolRslt	Judg
Roughness 2D<SurfAnalysis_1> Profile=RLS_JIS - Section=[1]								
Rz	1.5207um			3.5000um	0.0000um			OK
Roughness 2D<SurfAnalysis_2> Profile=RLS_JIS - Section=[1]								
Rz	1.2312um			3.5000um	0.0000um			OK
Roughness 2D<SurfAnalysis_4> Profile=RLS_JIS - Section=[1]								
Rz	1.0663um			3.5000um	0.0000um			OK
Roughness 2D<SurfAnalysis_5> Profile=RLS_JIS - Section=[1]								
Rz	1.2289um			3.5000um	0.0000um			OK
Roughness 2D<SurfAnalysis_6> Profile=RLS_JIS - Section=[1]								
Rz	1.2885um			3.5000um	0.0000um			OK

Figure 2. Roughness Test Results With 0.4mm/min Feeding

## CONCLUSION

Based on the results of research conducted on the effect of feeding on the hardness and surface roughness of S45C steel after IQT in the surface grinding process, it can be concluded that:

1. The feeding method used affects the roughness value of the grinding journal with a feeding speed of 0.2mm/min producing an average value of 1.33683333 $\mu$ , 0.4mm/min producing an average value of 1.27068333 $\mu$ , 0.8mm/min producing an average value of 1.29633333 and 1.2mm/min yield an average value of 1.39458333 $\mu$ .
2. The feeding method used has no significant effect on the hardness value of the grinding journal with a feeding speed of 0.2mm/min with an average value of 60.2 HRC, 0.4mm/min producing an average value of 59.6 HRC, 0.8mm/min producing an average value averaging 61.1HRC, 1.2mm/min resulting in an average value of 60 HRC.
3. The best feeding method results can be achieved in the grinding process, namely the feeding parameter is 0.4mm/min with a value of 1.27068333 $\mu$

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