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QUALITY AND RELIABILITY ANALYSIS OF LATHE MACHINE MECHANICAL WORKSHOP STATE POLYTECHNIC OF MEDAN THROUGH STATIC GEOMETRC TEST ACCORDING TO ISO 1708 STANDARD

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***Abstract*:** The purpose of this study was to determine the condition and accuracy of the lathe through static geometric tests according to ISO-1708 standards. The tests include measuring the level of the machine base, sloping straightness towards the horizontal plane, alignment of the motion of the loosehead in the horizontal and vertical planes, accuracy of the main axis, alignment of the supporting shaft launchers to the movement of the nose spindle irregularities, alignment of the nose spindles and alignment of the main axes in horizontal and vertical directions. Tests are carried out by measuring the quality and reliability of the machine to find out how many accuracy deviations that occur in the main part of the lathe. Quality measurements using a precise measuring instrument that is the spirit level, dial indicator, micrometer, and supporting flashlight and mandrel shaft. The results achieved from this study indicate that the condition-, and the quality of the lathe Maximat V13 and the Celtic I4 lathe at the mechanical workshop have decreased. Only 50% of machines can still be operated. The components contained in each engine have been damaged and incomplete. For the number of 7 Maximat V13 lathes, the condition is not optimal, only 3 units of the machine still operate and its reliability has decreased. The results of the inspection of the main parts such as the fixed head, speed control lever, speed control lever, screw movement control lever, machine base, and longitudinal slides are still good but the other parts are damaged and incomplete. For the number of 6 Celtic14 lathe units, 3 machines were still in operation and the engine components were still complete while 3 other machines were damaged and incomplete. This machine condition will affect the quality of the products and the time of machining process practices and for producing precision products.

***Keywords*:** Testing, measurement, lathe, condition, reliability, quality

Introduction

Machine tools such as lathes, milling machines, and grinding machines are indispensable for the engineering industry to repair and form high-quality machine and equipment components. At the Medan Polytechnic mechanical workshop, the machine tools are not only used for student practicum activities but also are used to produce machinery and

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equipment components ordered by several industries and factories around the city of Medan. Types of precision machine tools found in mechanical workshops are Lathe, Milling machine, scrap machine, Drilling machine, and Grinding machine.

These machine tools have been operated since 1983 until now. In such a long time of using a machine, it is certainly suspected that there has been a decline in quality in the form of accuracy and precision. Meanwhile, to produce quality machinery and equipment components, these machine tools must be maintained in quality. How big the deviation that occurs in the main part of the machine needs to be examined using testing based on applicable standards. If the deviation exceeds the allowable tolerance limit, then maintenance must be carried out by resetting the position of the main part of the machine until the replacement of engine components. Among machine tools used for practicum in Polmed mechanical workshop is a turning machine. Based on the observation of the condition of the lathe at this time there has been a degradation or a decrease in quality. Some of these machines are not functioning properly, which is around 40-50% of the amount. While the rest can still be operated the precision and accuracy have decreased due to workloads that are quite dense.

This condition can affect the quality of the product to be produced and the achievement of practical learning. To find out how much has decreased the quality and reliability of the machine, testing and measurement of accuracy are required. The test will analyze the quality of the machine and find out the deviation of accuracy that occurs in the main engine. The desired result of this study is to find out the condition of the lathe in detail and encourage them to be used specifically in the practicum program.

From the existing problems, what will be examined are 1. How far the condition, quality, and precision of the lathe found in the workshop Polmed mechanics. 2. What percentage of the number of lathes are still suitable to be used by student practicums and produce precision products?

Based on the above, the limitations of this study are: 1. The machine tools used as the object of this study are the maximat V13 lathe and the Celtic 14 lathe found in the Polmed Mechanical Engineering Workshop 2. The measuring instruments used are adjusted to the existing measurement tools in the Polmed Mechanical Engineering workshop and those conducted by researchers according to the existing budget.

Methodology

The research begins by examining and collecting the condition of the engine by grouping machines that are still functioning for testing. Furthermore, geometric testing using equipment that has been prepared. Tests that will be carried out include, alignment of the engine base and table, sloping motion alignment, alignment of the motion of the head off, the deviation of the main spindle, and other major components. Retrieval of data for each test object is carried out 3 (three) times, then proceed with data processing and analysis. The final stage is to get a conclusion.

1. Research Subjects

Based on the problems studied, the model and type of this study use a method survey in the field to get data on engine conditions at the Polmed Mechanical Engineering workshop. Next, do the inspection using the inspection form and test machines using standard inspection equipment.

2. Research Design.

This study uses a qualitative approach in the form of evaluation using a direct approach that aims to maintain the integrity of the object of research. The collected data is studied as a single unit whose purpose is to develop in-depth knowledge of the object under study. The data

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obtained in this study is data that is directly obtained from the object of the implementation of this research, which is testing the measurement of geometric accuracy on the lathe tool and analyzing the condition of the lathe. Observations in this study by measuring the main part of the lathe. Measurements were made on the runway, spindles, engine slides, the main axis with the head axis released, and the motion of the head shaft released.

3. Research Samples.

The research sample is 7 units of Maximat V13 lathe made in Australia and 6 units of Indonesian Celtic 14 lathe. This sampling is under the condition of the machine that has been used for quite a long time since 1983.

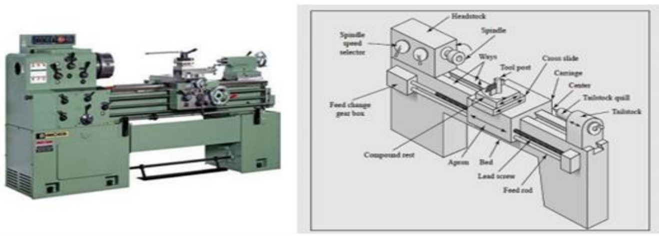
Literature Review

Definition of Machine Tools

Machine tools are a combination group or arrangement of various parts of machine elements, each of which has a specific function, which is then jointly put together so that they can function as tools or machines (Suarman Makhzu, 2014) What is meant by these machine tools are turning, milling, scrap machine or planer machine, cylindrical and flat grinders, and other machine tools whose function is to form machine component products. These machine tools also function as forming various components of industrial equipment where these components will later be assembled or assembled.

Therefore, the accuracy of the size, shape, and dimensions of the results of the formation of these components must be under the design, resulting in a standard and efficient assembly.

Figure 1
Turning Machine Tools



Machine Tool Accuracy Test

The machine components produced by the machining process have certain qualities that can be seen from the accuracy of the dimensions, the accuracy of the shape, and the smoothness of the surface of the component. Accuracy deviations can cause components to be imperfect, it can be seen from the size and surface smoothness of the components that are not under the desired design. The differences in the components produced are closely related to the accuracy conditions on the machine tools that make up the components with incisions. Differences in accuracy on machine tools can be known through a true and appropriate test.

This section described matters relating to the process of testing the geometric accuracy of conventional machine tools. As most machine tool users know, the concept of machine tool geometric accuracy has been around for a long time. To determine the geometric accuracy of a machine tool, it is necessary to test according to existing procedures. Improvements to this procedure have been carried out since 1901 by Schlesinger in an attempt to produce a standard

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of suitability for machine tools. Various machine inspection procedures have been recognized by all users and machine manufacturers and the International Standards Organization (ISO) is the standard guide. Measurement procedure carried out based on the test chart (chart test) contained in the book Testing Machines Tool by Dr.Georg Schlesinger and published in ISO recommendation no. R 230 (about test code), R 1708 (for lathes).

Machine Tool Precision

The precision of the machine is the accuracy of the main parts of the machine and its components (Slamet Riyad, 2016). A machine is composed of several parts that have several geometric shapes, so the precision of the fundamental measurements of the machine elements is very important, for example, the flatness and straightness of the guide surfaces, the position or alignment of the gripping parts, and parallelism. from the axes to the guides, the perpendicularity of the main axis to the gripping surface on the machine table, and so on. Matching with the static accuracy of the manufacturing and assembly processes of machine parts and several points on the machine becomes the static precision of the machine. This is called geometric accuracy. The geometric accuracy of the machine is the precision of the shape and position of each part. To find out how far the accuracy is owned by the machine, it is necessary to carry out a test on the machine (Bagiasna,Komang,1999). Determination of the geometric quality of conventional machine tools can be done by testing the geometric quality of machine tools according to ISO 1708 standard

Machine Tool Geometric Testing

Geometric testing of machine tools is intended to test the dimensions and shape and position of machine components between one another, for example, perpendicularity between two planes, parallel between two movements, parallel between two planes, and others. Geometric testing of a machine tool can be divided into three classifications of accuracy being tested, including:

a) Machine tool geometric accuracy (manufacturing accuracy), which is how much the actual (measured) size of the machine in an unloaded state approaches a certain standard size.

b) The geometric accuracy of dynamic machine tools (working accuracy), which is a measure that can be measured from the machine in a state of load or a working state approaching a certain standard size.

c) Geometric accuracy of the machine work (performance accuracy), namely the size of the geometric workpiece produced by the machine against a certain standard size.

Findings & Discussion

The data source obtained in this study is primary data obtained directly from the research object, which is checking the condition of the main parts of the lathe and testing the measurement of geometric accuracy on the Maximat V13 and Celtic 14 lathes contained in the Polmed Mechanical Workshop. Data on the results of the lathe reliability condition are shown in the following tables 1 and 2.

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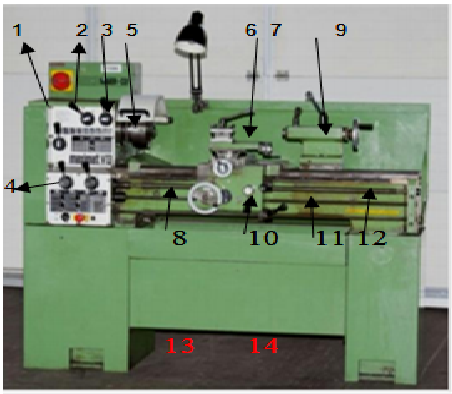
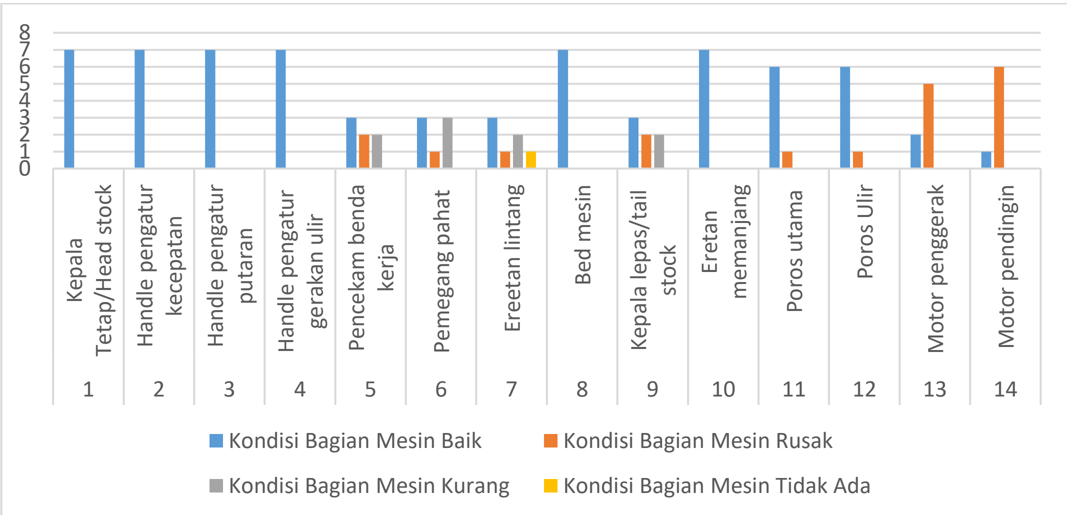
Table 1.
Data reliability conditions of Maximat V13 lathe

No	Nama Bagian	B	R	K	T	Gambar Mesin
1	Kepala Tetap	7				
2	Handel pengatur kecepatan	7				
3	Handel pengatur putaran	7				
4	Handel pengatur gerakan ulir	7				
5	Pencekam benda kerja	3	2	2		
6	Pemegang pahat	3	1	3		
7	Eretan lintang	3	1	2	1	
8	Bed mesin	7				
9	Kepala lepas	3	2	2		
10	Eretan memanjang	7				
11	Poros utama	6	1			
12	Poros Ulir	6	1			
13	Motor penggerak	2	5			
14	Motor pendingin	1	6			
B : Baik K : Kurang T : Tidak ada R: Rusak						



1. Analysis of the Reliability Conditions of Maximat V13 Lathe.
From the table1 data on the condition of the reliability of the above shows that from the number of 7 Maximat V13 lathes available, the lathe condition is not optimal and the reliability has decreased. From the results of the inspection of the condition of the lathe parts, only a few are still fully well, namely the fixed head, speed control handle, rotation control handle, screw movement control handle, engine base, and longitudinal slack as shown in graph 1 below.



Graph 1. Reliability condition of Maximat V13 Lathe machine components

2. Analysis of the Reliability Conditions of Celtic 14 Lathe.
From table 1 the condition data of engine reliability above shows that from the number of 6 Celtic 14 lathe units, 3 machines can still operate and machine components are still complete, while 3 other machines are no longer in operation and their reliability has decreased. From the results of the inspection of the condition of the engine parts, only a few are still fully well, namely the fixed head, the rotary regulating handle, the engine base and the longitudinal slitting, main shaft, and screw shaft as shown in graph 2 below.

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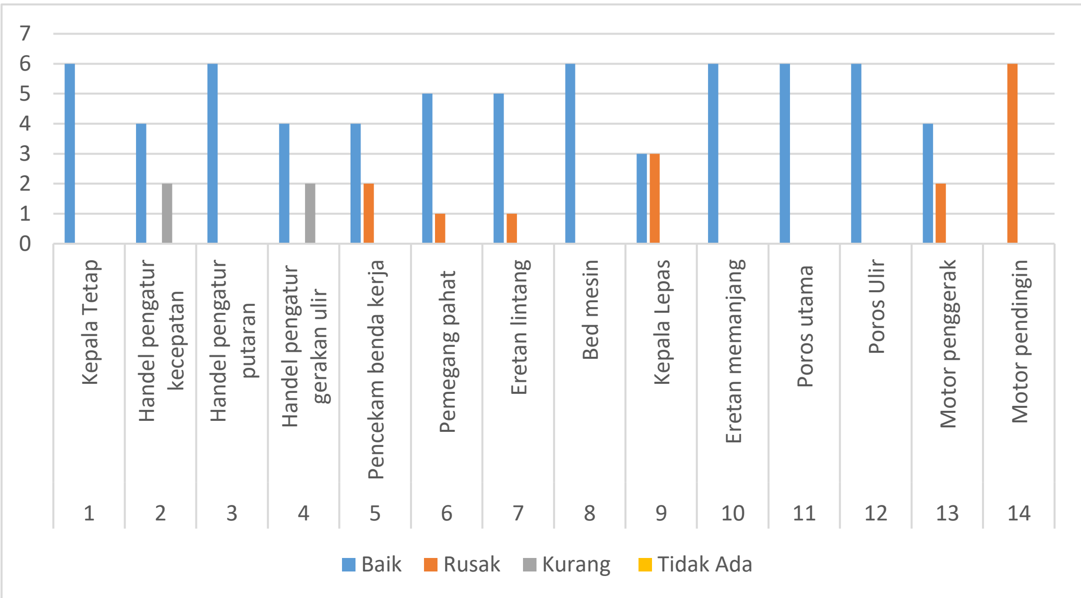
Table 2.
Data reliability conditions of Celtic 14 lathe

No	Nama Bagian	Nama Mesin : Celtic 14				Jumlah : 6 Unit
		B	R	K	T	Gambar Mesin
1	Fixed Head	6				
2	Speed control handle	4		2		
3	Rotation handle	6				
4	Thread movement control handle	4		2		
5	Workpiece gripper	4	2			
6	chisel holder	5	1			
7	Star sled	5	1			
8	Machine bed	6				
9	Head Off	3	3			
10	Long sled	6				
11	Main shaft	6				
12	Threaded Shaft	6				
13	Drive motor	4	2			
14	Cooling motor		6			
Keterangan B : Baik K : Kurang T : Tidak Ada R : Rusak						



Graph 2. Reliability condition of Celtic 14 Lathe machine components

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Quality Testing.

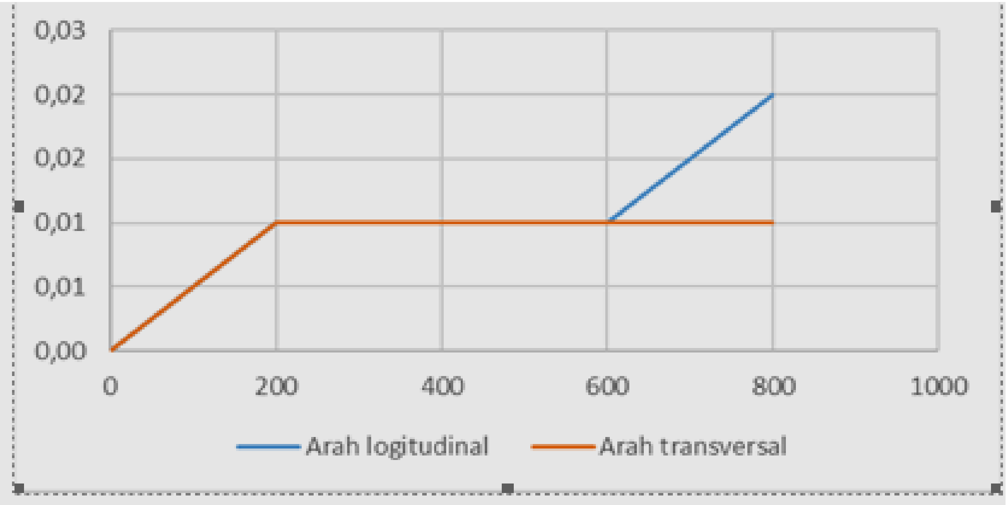
Testing the quality of geometric accuracy of Maximat V13 and Celtic 14 lathes as follows:

1. Maximat V13 Lathe

Table 3.
Flat runway quality data

Machine No.08	**500≤ DC≤1000**					Permissible deviations
Testing Position	**0**	**200**	**400**	**600**	**800**	
Logitudinal Direction	0.0	0.01	0.01	0.01	0.01	0.02 mm/m
Transversal Direction	0.0	0.01	0.01	0.01	0.02	0.02 mm/m

From the above table For machine No.08, the results of the flatness runway quality test are still good and the deviations that occur are still within the allowable limit, namely for the longitudinal direction of 0.01mm/m and the maximum transversal direction of 0.02 mm /m under the permitted deviations. As shown in the following graph 3.



Graph32 The flatness of flat runway Machine No.08

Table 4.
Flat runway quality data

Machine No.09	**500≤ DC≤1000**					Permissible deviations
Testing Position	**0**	**200**	**400**	**600**	**800**	
Logitudinal Direction	0.0	0.01	0.01	0.01	0.04	0.02 mm/m
Transversal Direction	0.02	0.04	0.06	0.08	0.08	0.02 mm/m

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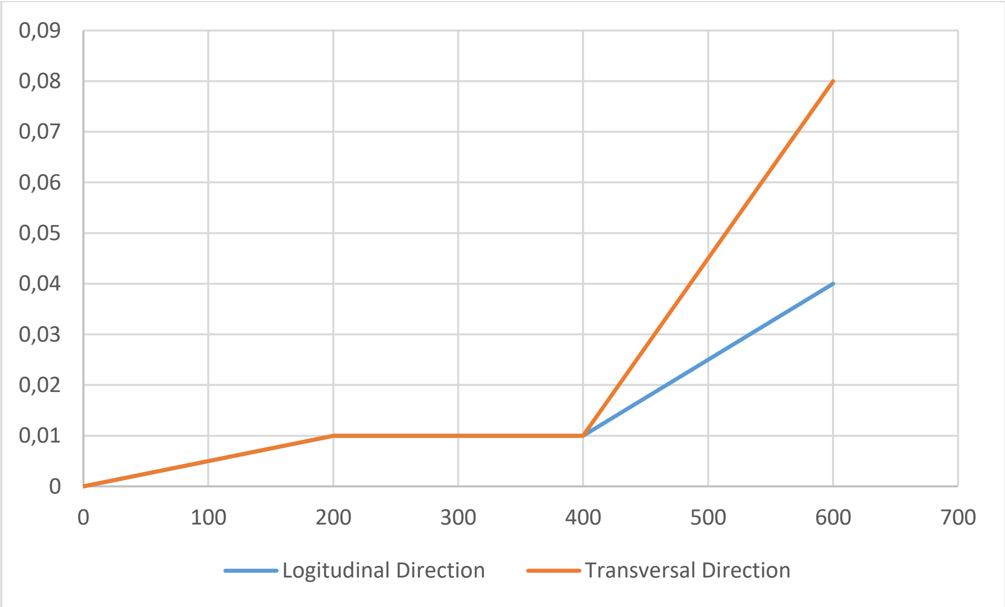
From the above table, the results of the flatness runway quality test show that the runway position has experienced deviations whose magnitude exceeds the allowable deviation limit, ie for the longitudinal direction reaching 0.04 mm / m over the standard of 0.02 mm / m, while for the transverse direction reaching 0.08 mm / m over the allowable limit. As shown in the following Graph 3.

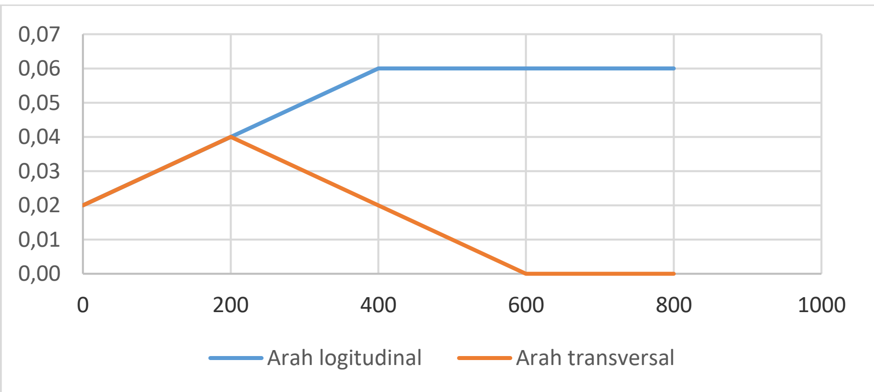


Graph 4. The flatness of flat runway Machine No.09

Table 5.
Surface Quality of Slides

Mesin No.12	**500≤ DC≤1000**					Permissible deviations
Kedudukan	**0**	**200**	**400**	**600**	**800**	
Logitudinal Direction	0.02	0.04	0.06	0.06	0.06	0.02 mm/m
Transversal Direction	0.02	0.04	0.02	0.00	0.00	0.02 mm/m

For machine No.12, the flatness runway quality maximum deviation that occurs is for the longitudinal direction reaching 0.06 mm/m and the transversal direction of 0.04 mm/m past the allowable deviation limit. As shown in the following graph 5.



Graph 5. The flatness of flat runway Machine No.12

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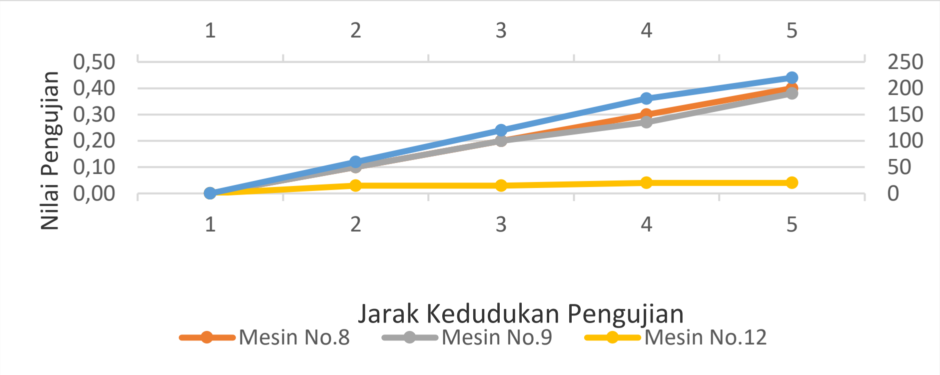
Quality of straightness

Table 6.
Quality of sled straightness

Position	60	120	160	220	Permissible deviations
Mesin No. 8	0.1	0.2	0.3	0.4	0.02 mm
Mesin No. 9	0.1	0.2	0.27	0.38	
Mesin No. 12	0.03	0.03	0.04	0.04	



Graph 6. Quality of sled straightness

Quality of Alignment of Head Motion

Table 7.
Movement Head Alignment

Mesin No.	08	09	12	Permissible deviations
Test Result	0.01	0.01	0.05	0.03 mm

Table 8.
Axial slip irregularities in the spindle

Mesin No.	08	09	12	Permissible deviations
Test Result	0.00	0.01	0.01	0.01 mm

Table 9.
Faceplate source irregularities

Mesin No.	08	09	12	Permissible deviations
Test Result	0.01	0.03	0.00	0.01 mm

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Table 10.
Spidle nose deviation

Mesin No.	08	09	12	Permissible deviation
Test Result	0.01	0.01	0.01	0.01 mm

Table 11.
Spidle nose deviation at 300 mm

Mesin No.	08	09	12	Permissible deviation
Test Result	0.02	0.02	0.02	0.01 mm

Conclusion

From the results of the analysis condition of the reliability of the machine and testing of the quality of the machine, the following conclusions are obtained.

1. From 7 units of Maximat V13 lathe installed at the lathe section location, it was found that the condition of the machine is not optimal, only 3 units can operate and its reliability has decreased. The results of the inspection of the condition of the engine component parts are only a few that are still completely good, namely the fixed head, speed control handle, rotation control handle, thread movement control handle, engine base and longitudinal sled.

2. From 6 units of the existing Celtic 14 lathe, 3 machines are still able to operate and the engine components are still complete while the other 3 machines are no longer operational and their reliability has decreased. The results of the inspection of the condition of the engine component parts are only a few that are still completely good, namely the fixed head, rotation control handle, engine base and longitudinal sled, main shaft, and threaded shaft.

3. Testing the quality of geometric accuracy on the Maximat V13 and Celtic 14 lathes at the Medan State Polytechnic Machinery workshop. For machines, No.9 and No.12, the quality of the flats experienced deviations that exceeded the allowable deviation limits, namely for the longitudinal direction it reached 0.04 – 0.06 mm/m exceeding the standard, namely 0.02 mm/m, and for the transverse direction it reached 0.08 mm/m. . The quality for engine no. 08 is still good. Meanwhile, for the other qualities, most of them are still good, only the quality of sledding and alignment of the head-off movement has deviations from what is permitted by ISO 1078 Standard

4. For the quality of the precision geometric lathe Celtic 14, namely for machine no. 20, 21, and 22 also experienced deviations whose magnitude exceeded the allowable limits, namely the quality of the Flatness of the Slide, the Quality of Sledding in the longitudinal and transverse directions.

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Reference

Ade Sumpena, Ardi Suharto, 2010, Study of Ability and Reliability of F4 Milling Machines Through Static Characteristics Testing According to ISO 1701 Standard, Journal of Politechnology, Vol. 9 NO. 3, Jakarta State Polytechnic.

Bagiasna, K. 2000, Introduction to Geometric Accuracy Testing of Machine Tools, Mechanical Production Engineering, Bandung Institute of Technology.

Dublin dan Ernest O, (1993), Measurement System Application and Design, 2nd edition, New York, McGraw-Hill Company.

International Standard Organization, 1987, Standard Hand Book 5, 2nd edition, ISBN 92-67-101334, Switzerland

Joshi, PH, 2007, Machine Tools Handbook, New York, McGraw Hill

Rochim, T. 1985, Machining Process, Mechanical Production Engineering Laboratory, Bandung Institute of Technology.

Rendy Revo, Jan Soukotta and Rudy Poeng, 2015, Analysis of Capabilities and Reliability of Weiller Primus Lathes Through Static Characteristic Testing According to ISO 1708 Standards, Online Journal of Mechanical Engineering Shafts Volume 4 Number 1, Sam Ratulangi University.

Schlesinger, Goerge, 1986, Testing Machine Tolls, 8th edition, Pergamon Press Ltd, Hiding Town Hill Hall, Oxford, England.

Slamet Riyadi, Rochim Suratman, and Muki Satya Permana, 2016, Geometro Measurement of Lathe Components Using the Schlesinger Method.Suarman Makhzu.2014. A MODEL PREVENTIVE MAINTENANCE CONTROL IN THE MACHINE TOOLS, Journal of Mechanical Engineering Education Department of Mechanical Engineering, Faculty of Engineering, Padang State University.

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