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Study Accuracy "Roundness on Tester Machine" Production Laboratory Measurement on Mechanical Engineering Department Universitas Riau

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ABSTRACT

Accuracy is the closeness value of a measurement results to the actual value. In reality, it is impossible to gain a 100% presice value same as the actual value of measurement. Therefore that accuracy cannot be perfect, in designs they often specify tolerances that is, acceptable variations in precision. Instead of giving one precise value, a tolerance specifies a range of acceptable result, and allowed amount of variation. This is often given as a deviation (difference) of that from an absolute accurate value. Using a high accuracy measurement device will produce accurate measurement data set and other wise it will not meet desired standards of measurement value. This research aims to determine the value of the mandrel roundness deviation, roundness accuracy according to "Roundness Tester Machine (RTM)" data reading. As mandrel is a reference measured object, so the reading of that of the RTM will tell how good the RTM be considered as a roundness tester instrument. Deviation was determined based upon radius average value of mandrel rod circumscribed circle. The longest and the shortest radius of that are called outer circle radius and the inner circle radius consecutively. They are recognized as the outer deviation and inner deviation of the roundness. It is reported based on series measurement, that the accuracy value of roundness measuring instrument RTM for ten positions along the mandrel rod are as follows: in position 1 = 0,006 mm, position 2 = 0,006 mm, position 3 = 0,011 mm, position 4 = 0,018 mm, position 5 = 0,003 mm, position 6 = 0,018 mm, position 7 = 0,021 mm, position 8 = 0,031 mm, position 9 = 0,002 mm, position 10 = 0,001 mm. In percentage, error measuring instrument (instrument error) that the maximum error is 0,02944 mm or 18,871% and the minimum deviation is 0,00029 mm or 0,225%. Operator error or measuring (Human Error) for first test (human) 22%, second test 5,33%, third test 182%, fourth test 187%, fifth test 58%.

KEY WORDS:*accuracy, deviation, human error, Roundness Tester Machine.*

1.0 INTRODUCTION

The precision or accuracy is the closeness of the result to the true value. Accuracy can also mean measure that indicates closeness of the results of the analysis with the actual analysis content [3].
Accuracy describes a systematic error of the test results. Systematic error comes from disturbances which can be known exactly and constant. Source of error can be from moisture, reference material, uncertainty given by certificate, methods of analysis and others [9].
According to JIS (B0651 - 1984), "roundness is defined as the amount from deviation of a circular shape of a circle definite geometric. Here the circle form is a form which specified become a circle as a form field or cross section of a rotating surface. Roundness is determined by the difference between the radius of concentric circles close to the shape of a circle being considered as the minimum distance between two circles, expressed as roundness MM roundness or roundness UM.
To know the accuracy of measuring instruments and measurement results, surely there must be a baseline that serve as a clear reference, the traceability or source. Mandrel is a standard measuring object that has been calibrated and certified quality roundness by a calibration institution, that is PT. Global Quality Indonesia, the measurement data result of Mandel will

be created as a baseline to know the accuracy from the tool of Roundness Tester Machine.
Measurement mechanism of the RTM utilizes a principle based upon two centers as holder work object to be measured, and a movable instrument driven by a digital controlled dc motor. The instrument recorded and processed measurement data than send the data directly to a computer. Microsoft Excel and Sigma Round are used as data processing software. However the measurement accuracy of the RTM has not been tested yet. There for it needs a research to determine and ensure accuracy of the RTM through deviation value of measurement results. In addition, this research identifies also contribution of operator (human) error to measurement results deviation.

2.0 MATHOD

2.1 Flowchart of Research

Research flow chart is presented in Figure 2.1

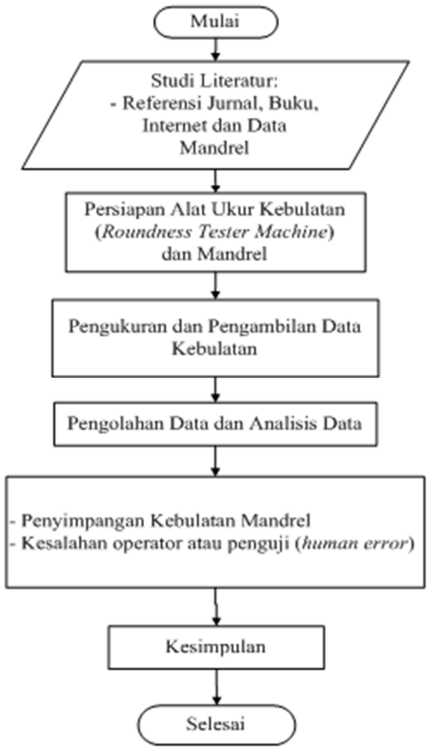

Figure 1: Research flow chart.

The flowchart describes the research work process.

- Literature review includes gathering process of information from various references that discuss related subjects and materials from previous research. Those may come from journals, books, and internet.
- Measurement Preparation. Set up the RTM, ensure its components, has been properly assembled then place the mandrel on the tool holders. Make sure that the mandrel is aligned.
- Measurement and collecting roundness data. An appropriate testing procedure is implemented. The device records and saves measurement data automatically in numerical format. The measurement is intended to obtain data corresponding roundness close to measurement data obtain by PT. Global Quality Indonesia.
- Data Processing and Data Analysis Doing the Data Processing and Data Analysis based circular references roundness (outer circle minimum, Circle in the maximum, Circle of minimum area and Circle of least squares) to know roundness mandrel deviations based on four circular references, Knowing accuracy Measuring roundness (Roundness Tester Machine) and large deviations by measuring instrument (Instrument Error), Calculating the size of the operator error or estimator (Human Error).
- Roundness deviation, operator error (human error). After processing the data and data analysis are obtained roundness deviation value by four circular references and, after the roundness deviation value is obtained then the value of the smallest deviation or aberration value closest mandrel roundness deviation of data values used as the value of precision measuring tools roundness RTM. Furthermore, it is known major operator error (human error).

2.2 Research Variables

The variable is an attribute or attitude aspects of people or objects that have a certain variation variable applied by researchers to be learned and drawn the conclusions. The variables included in this study are:

- Independent Variable, The independent variable in this study is a number operators and amount of data retrieval.
- Dependent Variable, The dependent variable in this study is a roundness deviation on the mandrel based reference data, and a set of measurement results deviation on RTM as roundness measuring instrument due to instrument error and operator errors (human error).
- Control Variable, Control Variables in this study are as follows:
  - ✓ Mandrel.
  - ✓ Measuring roundness (Roundness Tester Machine).

2.3 Research Variables

The data collecting method is mention as follows.

a. Library Method
That is the process of collecting data supporting the theory that can be obtained from various kinds of books, Journals, and publications related to the research topic.

b. Testing Method
That is to test the measuring instrument roundness (Roundness Tester Machine) that This test data obtained deviation determination on measuring tool which will then be studied and discussed, after calculation or data processing then obtained deviation roundness approaching the data mandrel which is used as reference in this study so that from calculations and discussion conducted will derive conclusions.

c. Observation Method
Namely conduct an observation and recording of work object that have been tested so as to produce the data.

2.4 Materials Research

Here is a picture of the research materials standard

Figure 2: Mandrel

2.5 Research Tools

The tools are used in this study as follows:

- *Roundness Tester Machine Tool*

Figure 3: Measuring roundness (Roundness Tester Machine)

- *Thermometer*
  Figure 2.4 shows thermometer that used to measure the temperature on this research.

Figure 4: Thermometer

- *Combination Wrench*
  Combination wrench used in this study is 10 mm size.

Figure 5: Combination Spanner.

3.0 RESULTS

3.1 Deviation roundness of mandrel

1. The outer circle minimum

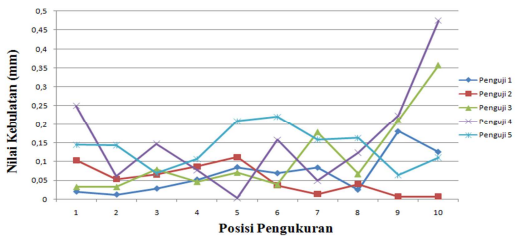

Figure 6: Comparison of roundness deviation graph Based on Minimum out of Circle

2. Circle in the maximum

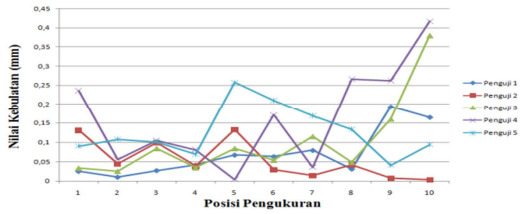

Figure 7: Comparison of roundness deviation graph Based on Maximum in of Circle.

3. Circle in minimum area

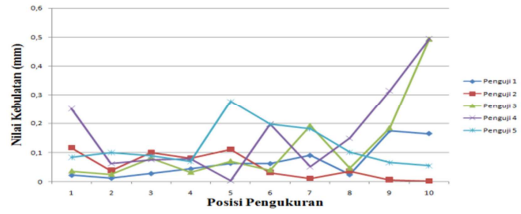

Figure 8: Comparison of roundness deviation graph Based on Minimum Circle Area.

1) Circle under Least Square

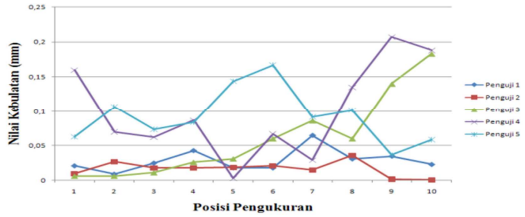

Figure 9: Comparison of roundness deviation graph Based on Least Square circle.

3.2 Accuracy of roundness measuring instrument.

(Roundness Tester Machine) and errors of the measuring instrument

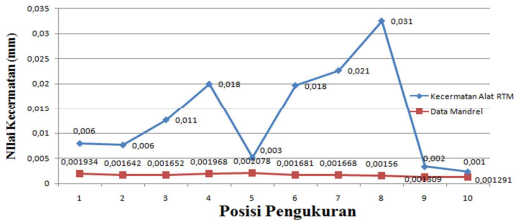

Figure 10: Graph of Accuracy Measuring roundness (Roundness Tester Machine)

Table 1: Below is data table of instrument errors.

Posisi	*e* (mm)	*e* (%)
1	0,00406	2,103
2	0,00436	2,655
3	0,00448	2,711
4	0,0160	8,130
5	0,00922	4,437
6	0,0163	9,696
7	0,0193	11,571
8	0,02944	18,871
9	0,00069	0,527
10	0,00029	0,225

Table 1. Deviation in mm and percentage error due to instrument

3.3 Human Error

Error due to operator during measurement is a typical of human error. Regarding that is given on table below.

Table 2: The first operator error table.

Posisi	*e* (mm)	*e* (%)
1	0,015	2,5
2	0,003	0,5
3	0,014	1,273
4	0,025	1,389
5	0,015	5
6	0	0
7	0,044	2,095
8	0	0
9	0,033	16,5
10	0,022	22

Table 3: Second operator error table.

Posisi	*e* (mm)	*e* (%)
1	0,004	0,67
2	0,021	3,5
3	0,007	0,636
4	0	0
5	0,016	5,33
6	0,003	0,167
7	0	0
8	0,005	0,161
9	0	0
10	0	0

Table 4: Third operator error table.

Posisi	*e* (mm)	*e* (%)
1	0	0
2	0	0
3	0	0
4	0,008	0,44
5	0,028	9,33
6	0,006	0,33
7	0,065	3,09
8	0,021	0,677
9	0,138	69
10	0,182	182

Table 5. The fourth operator error table.

Posisi	*e* (mm)	*e* (%)
1	0,154	25,7
2	0,064	10,7
3	0,051	4,64
4	0,069	3,83
5	0	0
6	0,049	2,72
7	0,008	0,38
8	0,104	3,35
9	0,205	102,5
10	0,187	187

Table 6. The fifth operator error table.

Posisi	*e* (mm)	*e* (%)
1	0,057	9,5
2	0,101	16,83
3	0,063	5,73
4	0,113	6,28
5	0,141	47
6	0,149	8,28
7	0,071	3,38
8	0,035	1,13
9	0,035	17,5
10	0,058	58

4.0 DISCUSSION

From calculation result of roundness deviation for each test can be concluded that the outer circle minimum reference circle (Figure 6) there are differences in roundness deviation measurement results, can be seen at position 10 the greater the deviation value reaching 0,474 mm. At in circle maximum (Figure 7) can be seen in this graph roundness deviation value difference is not too big of between 0,001 mm-0,417 mm, meaning that the maximum calculation results in a better circle of the outer circle minimum. The minimum area on a circle (Figure 8) roundness deviation value for each test is similar to the in circle of a minimum of between 0,001 mm-0,495 mm. At least square circle (Figure 9) the value of irregularities roundness of each test is between 0,001 mm-0,207 mm, meaning that the circle of least quadratic is much better to determine the value of deviation roundness of the work object, it is evident because basically ISO recommends to use smallest circle quadratic as a circle reference. Rated accuracy is based (Figure 10) on position 1, 2, and 3 approach value of data mandrel is the result of test 3, at the 4 position approach value of data mandrel is the result of test 2, at position 5 approach value of data mandrel is the result of testers 4 , at position 6 approach value of data is the result of test mandrel 1, at position 7, 9, 10 values are approaching the data testers mandrel is 2, and the position value approaching 8 data mandrel is first testers. From the results of calculations and graphs on (Figure 10) obtained average value accuracy for LSC (Roundness Tester Machine), That is 0.0117 mm and LSC (PT. Global Quality Indonesia) is 0,0017 mm, to obtain the value of tolerance for roundness measuring instrument Roundness Tester Machine of 0,01 mm. It can be seen from the large

deviation value determination at position 1 in get value accuracy of 0,006 mm while the value of precision to be achieved is 0,001934 mm means that there is a deviation or error of 0,00406 mm or 2,10%, the largest deviation is found in position 8 in the amount of 0,02944 mm or 18,871% and the smallest deviation that is contained in the 10 position that is equal to 0,00029 mm, or 0,225%, theoretically such deviations may occur because of several reasons such as the vibration of the motor of the sensor and the work object, humidity, the noise level and the discussion of these factors are ignored because of the limitations of the tools used. And the deviation is also caused by the construction of the measuring instrument that is in the second position of the center, in this section difficult to make the second part of this center of the axis (alignment) so it takes precision testers when placing or installing the work object in both the center.

According to the error of calculation by the operator can be concluded that operator error or a big influence on the measurement results roundness generated and the accuracy of measuring devices roundness (roundness tester machine), the greater the operator error or test the greater the deviation determination at yield and the percentage of precision tools measuring roundness (roundness tester machine) will be smaller. In the first test operator error reached 0,022 mm or 22%. In the second test the value of the error or errors resulting lower at 0,016 mm, or 5,33%. For the third test operator error, reaching 0,182 mm or 182%. For the fourth test operator error or testers, reaching 0,187 mm or 187%, while for the fifth operator error testers or testers, reaching 0,058 mm or 58%. Of the overall results of the calculation of operator error or testers can be seen that the results of roundness testers both better than the testers others because of operator error generated by testing both lower than testers other and it can be concluded that the accuracy and skill of the examiner or the operator greatly affect the final result of the measurement.

4.0 CONCLUSIONS

Based on calculations and data analysis it can be concluded as follows:

1. The value of roundness madrel on test results and roundness tester instrument row machine is as the following table:

Lingkaran referensi/ Posisi	LSC RTM	LSC PT. GQI
1	0,006	0,001934
2	0,006	0,001642
3	0,011	0,001652
4	0,018	0,001968
5	0,003	0,002078
6	0,018	0,001681
7	0,021	0,001668
8	0,031	0,001560
9	0,002	0,001309
10	0,001	0,001291

From the data table above the average values obtained accuracy for LSC (Roundness Tester Machine) is 0,0117 mm and LSC (PT. Global Quality Indonesia) is 0,0017 mm, to obtain the value of tolerance for roundness measuring instrument Roundness Tester Machine for 0,01 mm.

2. The measurement results which provided by the operator to give the value of the roundness deviation between 5,33% - 187%, this indicates that the operator accounts for inaccuracy measuring devices are quite large.

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