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Process of Drilling Manufacture Using Spindle Speed Variation on The Precision and Accuracy of Drilling Process in Radial Arm Drilling Machine RD-1600

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ABSTRACT

Radial Arm Drilling is a tool used to perforate an object. Radial Arm Drilling is designed for large work and work where the workpiece does not allow rotating. This machine consists of a vertical pole which supports an arm carrying a drill head. Its arms can rotate around to any position on the work bench, and the drill head has an adjustment along this arm. This radial arm drilling machine has automatic feeding, so in the drilling process the operator no longer needs to press the spindle to the workpiece. The selection of feeding on the radial arm drilling machine is in accordance with the size of the drill bit used on the material to be drilled. For the selection of spindle speed rotation has 2 types, namely high (50 hz and 60 hz) and low (50 hz and 60 hz).

KEY WORDS: *Radial Arm Drilling, Feeding, Spindle Rotation Speed*.

1.0 INTRODUCTION

In general, precision and accuracy are similar, but for the people involved in the measurement, these two things convey different meanings. Accuracy is how close the measurement is to the actual value, while precision is how consistent the results are obtained when the measurement is repeated. In the drilling process, accuracy and precision are needed to get the right and consistent hole size if done repeatedly.

Drilling machine is a tool or tool used to punch holes in an object. Drilling process is also the simplest machining process among other machining processes. Usually in a workshop or workshop this process is called the drill process, even though this term is actually not quite right.

The drilling process is intended as a process of cutting work using drill bits to produce round holes in solid metal or non-metal material or perforated material. While the drilling process is the process of expanding / enlarging a hole made with a boring bar.

The working principle of the drilling machine is by turning the drill bit (blade) at a certain speed and pressed into the workpiece. This drill bit has 2 helix grooves for the chips exit while the workpiece is being cut. In the drilling process, the burr (chips) must come out through the helix groove of the drilling tool into the hole. The tool tip is attached to the cut workpiece, so the cooling process becomes relatively difficult. The cooling process is usually done by watering the workpiece which is perforated with coolant, sprayed with coolant, or coolant is introduced through a hole in the center of the drill bit.

The results of the drilling process require high precision and accuracy, because if the results of the drilling process are not even precise and accurate, then a component cannot be used. The drilling process in the manufacture of many components is very vulnerable to the precision and accuracy of these components. To prevent these problems, the drilling process should be carried out with the help of production aids, namely jigs and fixtures. Jigs and fixtures are drilling production aids that are used to accurately manufacture many components.

Radial Arm Drilling is designed for large work and work where the workpiece does not allow rotating. This machine consists of a vertical pole which supports an arm carrying a drill head. The arm can rotate around to any position on the work bench, and the drill head has an adjustment along this arm. This

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adjustment allows the operator to place the drill head quickly at any point above the workpiece. This radial arm drilling machine has automatic feeding, so in the drilling process the operator no longer needs to press the spindle to the workpiece. The selection of feeding on the radial arm drilling machine is in accordance with the size of the drill bit used on the material to be drilled. For the selection of spindle speed rotation has 2 types, namely high (50 hz and 60 hz) and low (50 hz and 60 hz).

2.0 EXPERIMENTAL METHOD

These experimental research activities are carried out at PT. RAPP in the Workshop Mill Department sector, in the area of Pangkalan Kerinci, Pelalawan, Riau. The workpiece to be used is a carbon steel plate with a thickness of 42 mm, a length of 420 mm, and a width of 210 mm. Radial Arm Drilling Machine RD-1600 and 25 mm drill bits are used to drill the plates. In detail the workpiece and the equipment used, shown in the following figure:

1. Equipment

Figure 1: *Radial Arm Drilling and Brill Bit*

2. Workpiece

igure 2: Base Plate

2.1 Jig and Fixture

Jigs and fixtures are used as production aids in the drilling process as a way to produce accurate and precise mass products. This production aid is not only placed on the object but also directs the cutting tool when the work process is running. This means we do not need to re-measure the position of the hole that we want to work on because of this production aid will direct the drill bit to the component to be drilled.

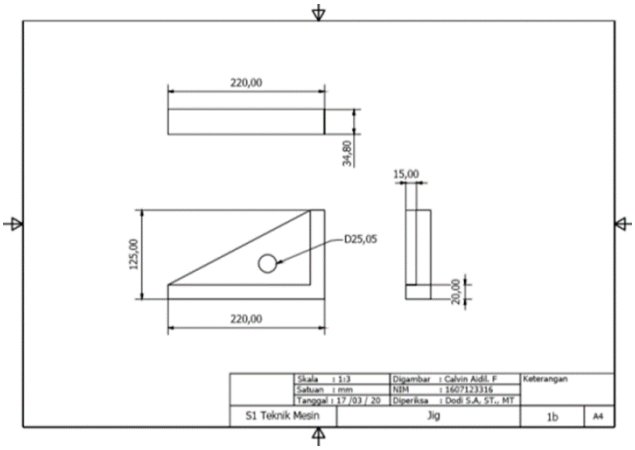

Figure 3: Design Jig dan Fixture

Jig and fixture are designed to position and direct the workpiece so that the drilling process can be more effective and efficient, according to specification limits. In addition, jigs and fixtures can also function so that product quality can be maintained as specified quality. Jig and Fixture can help the drilling process without changing the geometric of the workpiece. By using these tools and in accordance with the shape of the product produced has high accuracy and precise precision in accordance with the desired product shape. With the jig and fixture no longer required operator skills in the manufacturing process, in other words, the manufacturing process will be easier to get a higher quality product and also a higher production rate.

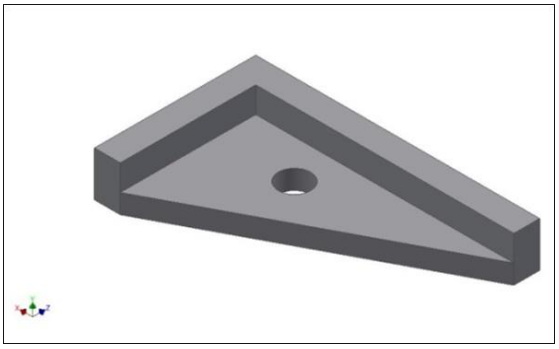

Figure 4: Jig and Fixture

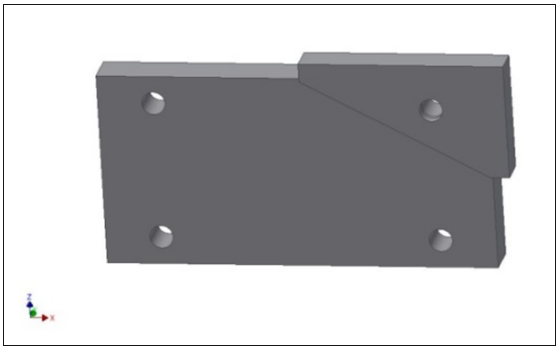

Figure 5: Application on the workpiece

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2.2 Stages of the Production Process

In this process, 4 holes were made using a drilling process at each corner of the workpiece with a diameter of 25 mm. The feed used is 0.21 and its spindle rotation speed starts at 29 rpm, 66 rpm, 129 rpm and 279 rpm. Here are the workmanship designs on the workpiece:

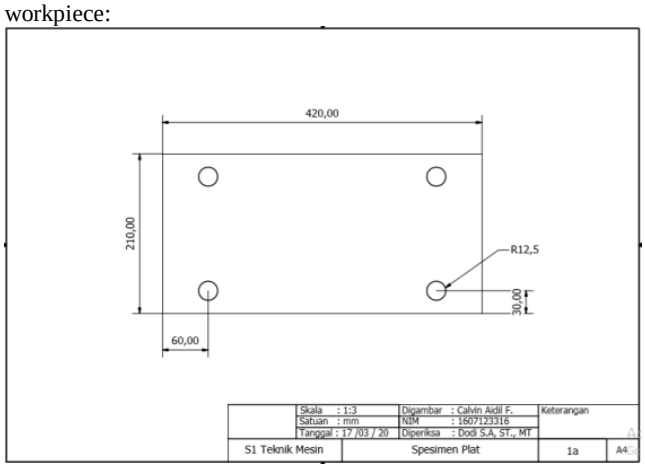

Figure 6: Design Workpiece

The stages in the drilling process are:

1. Turn on the contact in the panel box

Figure 7: Turn on Contacts

2. The workpiece is clamped until it is balanced and level, so that during the drilling process it does not cause vibrations that cause the drilling results to be inaccurate.

Figure 8: Clamp on thr Workpiece

3. Installation of the chuck center on the spindle, this center serves as a midpoint marker on the workpiece. The workpiece is slightly pressed by this center in the middle to get the middle position in the drilling process later. Then lock the drill head so that the position of the drill head does not change.

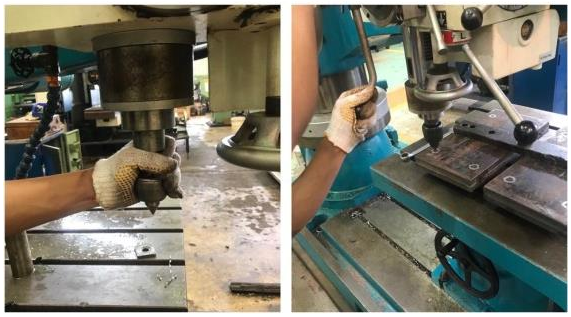

Figure 9: Centering the spindle with the workpiece

4. After giving the center is given, then remove the center tool. Then attach the drill bit to the spindle. The drill used is 25 mm in diameter. Make sure the corner of the drill bit is in the middle point that has been given.

Figure 10: Installation of Drill Bit on the Spindle

5. Adjust the feed motion and spindle speed. For this process, the feeding used in this process is 0.21, and for the spindle rotation speed it varies, which is 29 rpm, 66 rpm, 129 rpm and 279 rpm.

Figure 11: Adjust the Motion and Feeding Speed on the Spindle

6. Before running the drilling process, attach the dial indicator near the spindle and attach the sensor dial indicator to the spindle surface. Dial indicator installation must be in a safe place so as not to disturb the drilling process.

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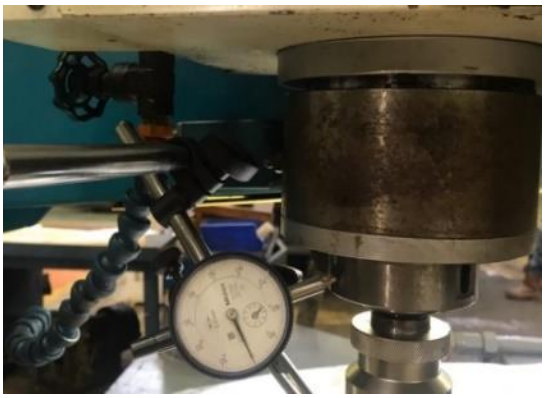

Figure 12: Installation of Dial Indicator

7. Then run the drilling process by moving the spindle lever to the right and lowering the automatic feeding lever.

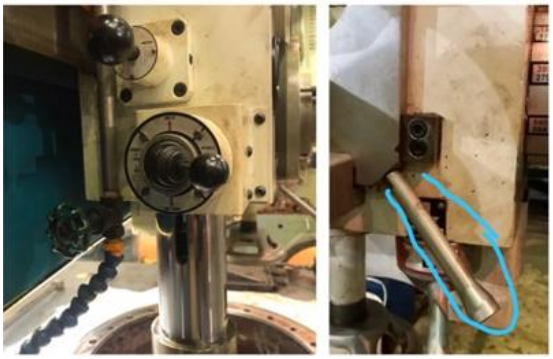

Figure 13: Running the Drilling Process

8. When the drilling is operational, turn on the coolant to cool the workpiece.

Figure 14: Turn on the Coolant

3.0 RESULT AND DISCUSSION

These experimental research activities out to determine whether variations in rotational speed on the spindle affect the precision and accuracy of the RD-1600 radial arm drilling machine. The following table 1. is the experimental data obtained:

Table 1: Experimental Results Data

Test	Test Specification	The Size of The Resulting Hole	Test Time
1	Feed = 0.12 Spindle Speed = 29 rpm	25 mm	10 minute, 03 second
2	Feed = 0.21 Spindle Speed = 66 rpm	25 mm	7 minute, 48 second
3	Feed = 0.21 Spindle Speed = 129 rpm	25 mm	4 minute, 32 second
4	Feed = 0.21 Spindle Speed = 279	25,05 mm	1 minute, 35 second

After this experiment, it can be seen that at a rotational speed of 29 rpm, 66 rpm and 129 rpm produce an accurate and precise hole of 25 mm. The clock indicator on the dial indicator does not move in all three attempts of the drilling process, which means that during the drilling process no vibration occurred in the spindle rotation. The difference between the three experiments is the time of the experiment. In the experimental spindle rotation speed of 29 rpm requires the longest time to do the drilling process that is 10 minutes 03 seconds.

While in terms of all experiments conducted, the spindle rotation speed of 279 rpm is the shortest process, which is 1 minute 35 seconds, but the resulting hole size in this process is 25.05 mm and the resulting hole size becomes inaccurate and accurate. In the use of spindle rotation speed 279 rpm, there is a slight vibration on the spindle, this is known from the clock hand on the dial indicator which moves slightly during the process of this experiment. This causes the resulting hole size to be less precise and accurate, because the vibrations in the spindle cause the drill bits to shake when feeding and affect the precision and accuracy of the drilling process and even the drill bits can become broken. During this process also occurs the friction of the drill bit cut surface on the workpiece surface is greater, as a result the drill bit and the workpiece surface become hot and smoky even though coolant has been given. The workpiece surface which is deformed due to heat from the drill bit friction will increase the cutting force on the drill bit, this causes the resulting hole size at the spindle rotation speed of 279 rpm to be less precise and accurate. This also affects the life of the drill bit because it makes the drill bit quickly wear out and blunt.

		1			2		
H	50HZ	1575	840	395	183	96	46
	60HZ	1890	1010	475	220	115	55
L	50HZ	1106	594	279	129	66	29
	60HZ	1330	715	335	155	80	35
Drill Ø MM	steel	1-6	6-14	14-24	24-36	36-50	50-66
	cast iron	1-8	8-18	18-30	30-44	44-60	60-78
MM / REV		0.96	0.56	0.31	0.21	0.12	0.07

Figure 15: Table of selection feeding and spindle rotation speed

5.0 CONCLUSION

From the results of the analysis above, it can be concluded that the spindle rotation speed limit to get the accuracy and precision of the hole size made at feeding 0.21, ie the spindle rotation speed 129 rpm, because if the speed is higher than this causes the resulting holes to become less accurate and precise.

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Spindle rotation speed variations apparently affect the precision and accuracy of the resulting hole. Spindle rotation speed that is too high in the feeding that is used causes the results of drilling to be less accurate and precise, it occurs because the vibration of the spindle makes the drill bit become a little rocking during the drilling process. Spindle rotation speed that is too high also causes friction and the surface of the workpiece is deformed which results in cutting force of the drill bit on the workpiece surface getting bigger. This is what causes the resulting hole size to be less precise and accurate. The use of spindle rotation speed that is too low in feeding does not affect the accuracy and precision but requires a long time when the drilling process is carried out that can hamper the time of the production rate.

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