ISSN No:-2456-2165

Study of Thickness and Clearance of Dies Blanking to Improve the Quality Appearance Part: A Case Study Improvement Part Washer Compressor

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Abstract:- Burry is important issue in the operation of cutting sheet metal material. If any burry at the product will be became problem quality such as appearance and also safety. The purpose of this research is to find how influence thickness sheet material and clearance dies blanking against the burry during the process of cutting to make part washer compressor and explain how to prevent or avoid the problem.

The study is done by making part washer compressor, make a test sample with die blanking and processed with a press machine 15 tons. Thickness of sheet material SGCC JIS G3320 Z12 made by making 4 variation thickness material: 0.6 mm, 0.8 mm, 1.0 mm and 1.2 mm. As for clearance set 5 variation: 0.025 mm, 0.050 mm, 0.075 mm, 0.100 mm and 0.125 mm by making variation dimensions of punch used.

The result of research showed that the thinner or thick of sheet material will likely cause burry are large. And the small or bigger clearance die would cause burry are large also. Minimum burry obtained from thickness sheet 1.2 mm material and clearance 0.050 mm. And burry maximum obtained from thickness sheet 0.6 mm material and clearance 0.025 mm. In general, the optimum burry obtained range die clearance of 0.050 mm - 0.100 mm or 4.16% - 6.26% of the material thickness.

Keywords:- *Washer Compressor Part, Clearance, Sheet Material, Burry.*

I. INTRODUCTION

In the joining industry, the name of the washer was familiar. Washer is often called a ring is a cover ring used between bolt or nut or others component of parts or components that are bound. Its needs evolve in accordance with the development of joining technology that is increasing as well.

Based on the function washer there are several forms, namely:

- Plain Washer, Distribute the binding load with a wider surface and prevent damage to the surface of the bonded part.
- Helical Spring Washer, Used to ensure that bolt or nut is firm (not easily lax) in part of receiving vibration.
- Toothed Lock Washer, Used to ensure the bolt or nut is not easily loosened by vibration. This application is similar to helical spring washer, toothed lock washer itself is widely used in the installation of nut in the cable terminal.

Although the function of the washer is quite simple, but the quality of the washer should be noted. The quality problems that often arise in the washer, especially the type of plain washer is the burry that comes from cutting. The existence of this burry in addition to reducing its main function can also result in the occurrence of cuts.

According to Lewis J.L in the early 19th century publication in Die and Die Making it was stated that a good washer is if the quality of the burry's height due to cutting is 10% of the thickness of the sheet metal material. This standard then became a reference for existing washer manufacturing industries until now, including also becoming a reference for designers in determining which washer to be used.

The washer application in general is very large, but will not be separated from the application for joining or connection with the type of connection type that varies according to the development of joining or connection industry. The functions and needs of the washer component is very large, then made efforts to manufacture washer components with a relatively fast time, uniform shape and dimensions and have good quality with minimal burry that is by press tool blanking dies process by considering the material thickness and clearance dies. Rizza Muhammad Akhlis (2014), has conducted research to investigate the analysis of blanking process with simple press tools.

II. LITERATURE REVIEW

A. Burry

Burry is a defect on the side of the piece of sheet metal products in the form of sharpening that affects the quality. The burry formation and burry height are determined by the material factor of the product and the sharpness of the tool, and are also affected by the effect of wear edges wear and the clearance between the punch and the correct mold (optimum clearance).

B. Clearance

Clearance is the gap between punch and die permitted, the magnitude measured on one side. The dimension of clearance depends on the type of material to be used as the

product and also the thickness material. The dimension of clearance can affect:

- Age of punch and die
- Cutting force
- Cutting Quality

According to Baudoin (2003), that the percentage of general clearance is 2% - 10% of the material thickness. According to Frank W Wilson, Clearance used for the cutting process is as follows:

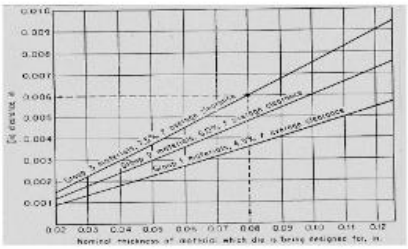

Fig 1:- Graphic Clearance
(Frank . W .Wilson, 175 -176)

- Group I: Average clearance 4,5 % of material clearance, Recommended for piercing and blanking. Types of aluminum alloy materials
- Group II: Average clearance 6% of material thickness, for piercing and blanking. Types of aluminum alloy, brass, cold rolled steel and soft stainless steel.
- Group III: Average clearance 7.5% of material thickness, recommended for piercing and blanking. cold roll, soft stainless steel and medium stainless steel.

C. Cutting Operation

Cutting sheet material is adjusted by cutting action between two cutting blades. Cutting action there are four stages as shown in Fig. 2:

1. Before the punch (the top blade) touches the sheet (work piece) where the speed of the punch moves with speed V = 0 without load.
2. Punch begins to infiltrate the surface and moves toward the mold with v1 velocity and force of F. The stay inner knife holds the punch pressure against the work piece and plastic deformation occurs on the work piece.
3. Punch continues to move pressing and hacking into work, then this section will be obtained a finer cutting surface. In general, the infiltration area is estimated to be 1/3 of the sheet thickness of the work piece.
4. When the emphasis is forwarded to the work piece there will be a fracture against side cutting work piece. If clearances between punch and die are correctly and accurately determined then the two crack lines will meet, the results of the separation of the two objects are relatively clean, or there is very little sharp part on the cut.

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At the bottom of the work piece surface of the cut will form a radius and this area is called a rollover or also called edge draw in. This occurs because of the initial emphasis on the surface of the plate / work piece to the mold so that there is a change in shape to the surface called plastic deformation.

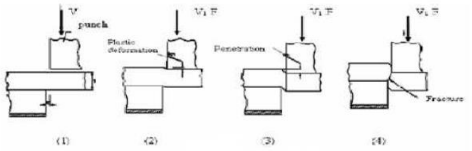

Fig 2:- Cutting process sheet metal material

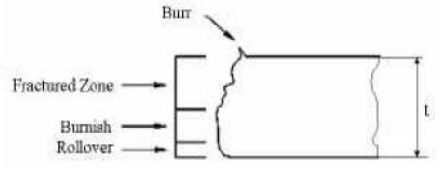

Fig 3:- Characteristics of the cutting edge

III. RESEARCH METHOD

Methodology of research was by experimental by making test sample and made by specifying the variation of the test sample from the material thickness and clearance die parameters by making variations in the size of the punch used and the stages in testing, measuring and analysis.

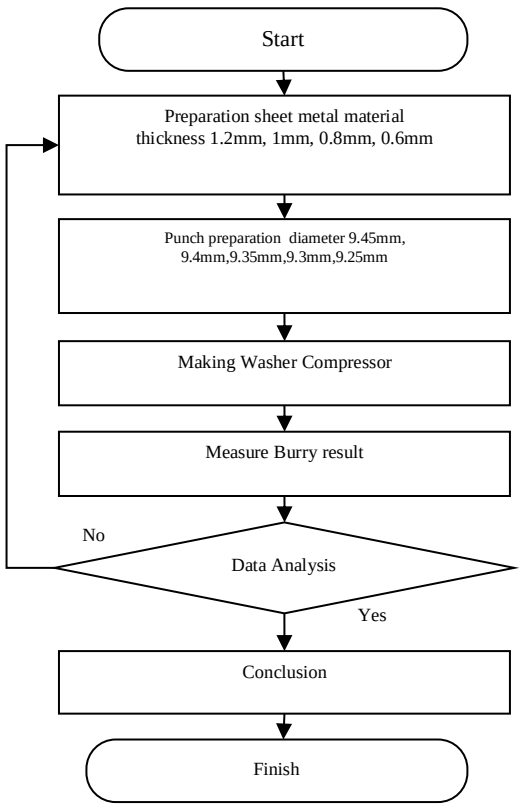

Fig 4:- Flow Chart

ISSN No:-2456-2165

IV. RESULT

A. Result testing material 0.6 mm

In the process of cutting sheet material with a thickness of 0.6 mm obtained part washer compressor with the smallest burry with dimensions of burry height of 0.033 mm and clearance 0.100 mm while the washer compressor with the largest burry with a burry height of 0.0130 mm at 0.025 mm clearance. This is clearly as illustrated in the fig. 5 and fig. 6.

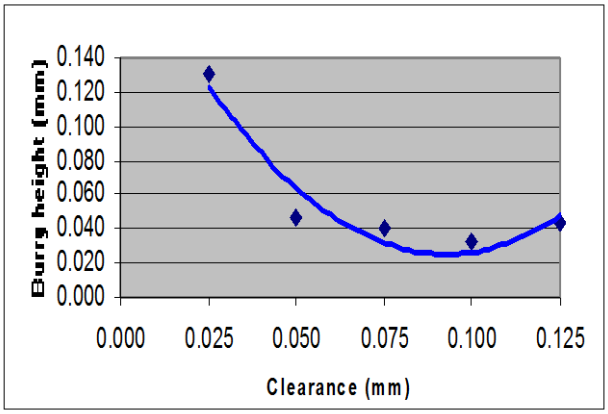

Fig. 5: Burry dimension graph against 0.6 mm material clearance

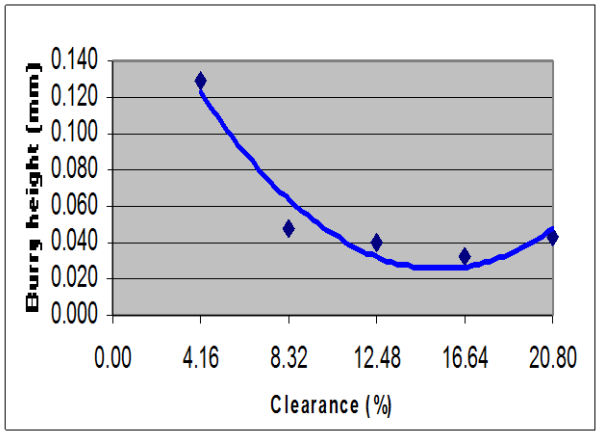

Fig. 6:- Burry dimension graph of 0.6mm material clearance percentage

Based on the data in Fig 5. and Fig. 6. it can be concluded that on thin sheet material with small clearance will cause a very large burry height. This is due to the cutting force that works will make friction sheet material with die and cause material in pinched and acquiring conditions excessive deformation. This condition makes the occurrence of a large burry height. At 0.6 mm sheet thickness of this material the optimum burry height occurs at 0.033 mm at clearance of 16.66%.

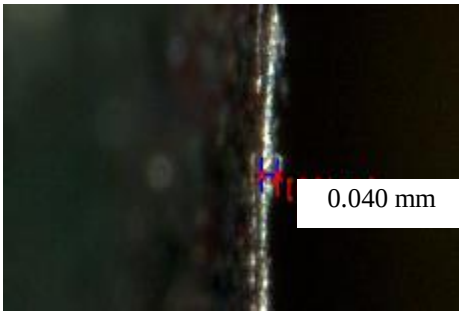

Fig. 7:- Smallest Burry dimension at material 0.6 mm

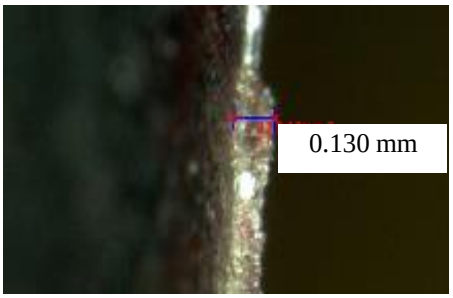

Fig. 8:- Biggest Burry dimension at material 0.6 mm

B. Result testing material 0.8 mm

In the process of cutting sheet material with a thickness of 0.8 mm obtained part washer compressor with the smallest burry with dimension of burry height of 0.040 mm at 0.050 mm clearance. While the compressor washer part with the largest burry with a burry height of 0.097 mm at clearance 0.025 mm. This is clearly as illustrated in Fig. 9 and Fig. 10.

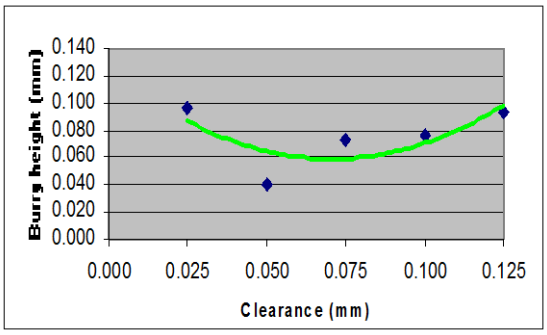

Fig. 9:- Burry dimension graph against 0.8 mm material clearance

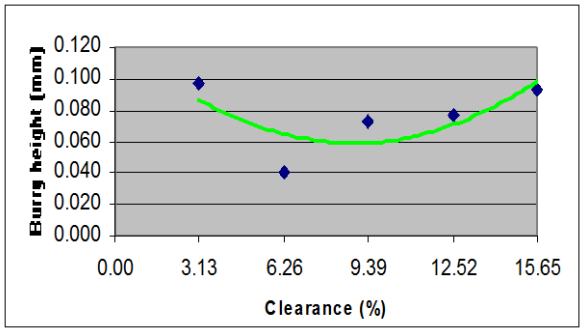

Fig. 10:- Burry dimension graph of 0.8 mm material clearance percentage

Based on the data in fig. 9. and 10. then it can be obtained data tendency that if the clearance is getting smaller or bigger then the dimension of burry height that occurs will also be greater. For large clearances, on sheet material there will be greater shear force and shear deformation.

Besides, from the properties of ductile material sheets will also result in the occurrence of broken at area punch and die. In the thickness of 0.8 mm material sheet the optimum burry height is 0.040 mm at clearance of 6.26%.

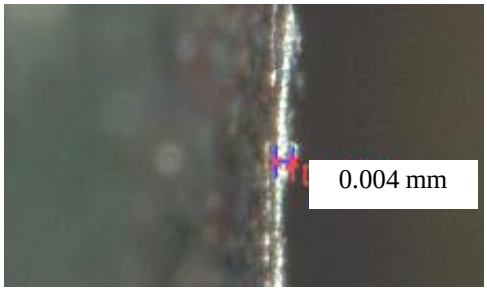

Fig. 11:- Smallest Burry dimension at material 0.8 mm

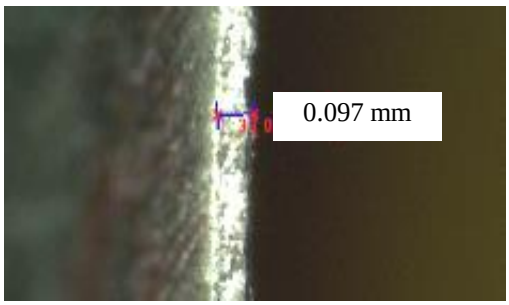

Fig. 12:- Biggest Burry dimension at material 0.8 mm

C. Result testing material 1.0 mm

In the process of cutting sheet material with a thickness of 1.0 mm obtained part washer compressor with the smallest burry with dimensions of burry height of 0.040 mm at clearance 0.050 mm. While the compressor washer part with the largest burry with a burry height of 0.100 mm at a clearance of 0.025 mm. This is clearly as illustrated in fig. 13. and fig. 14.

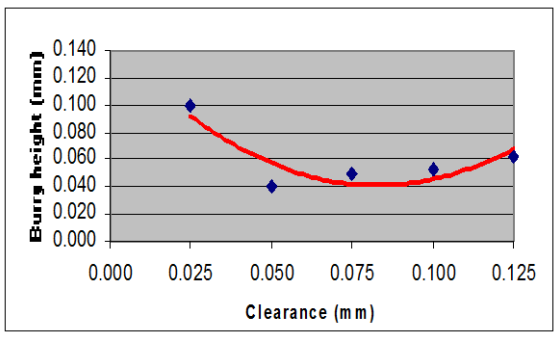

Fig. 13:- Burry dimension graph against 1.0 mm material clearance

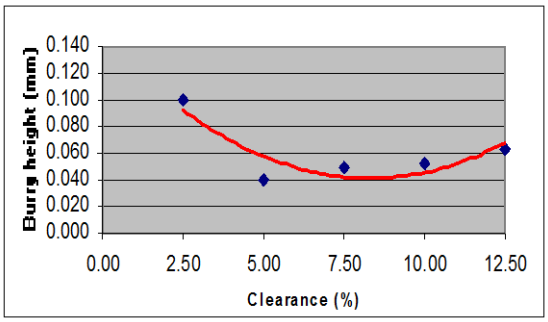

Fig. 14:- Burry dimension graph of 1.0 mm material clearance percentage

Based on the data in fig. 13. and 14. it can be obtained data on the tendency that if the clearance is getting smaller or bigger then the dimension of burry height that occurs will also be greater. for large clearances, on sheet material there will be greater shear force and shear deformation. Besides, from the properties of ductile material sheets will also result in the occurrence of broken at the area punch and die. At 1.0mm thickness of material the optimum burry height occurs at 0.040mm at clearance of 5.0%.

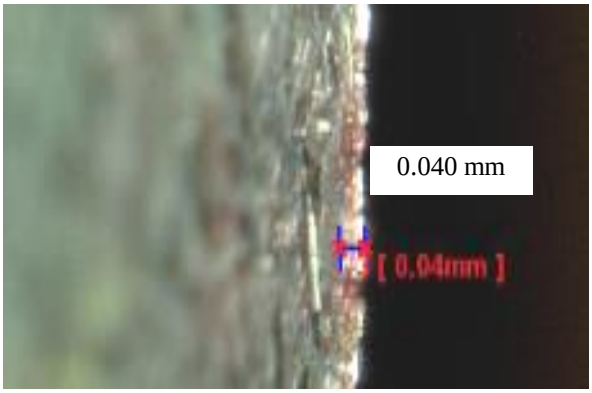

Fig. 15:- Smallest Burry dimension at material 1.0 mm

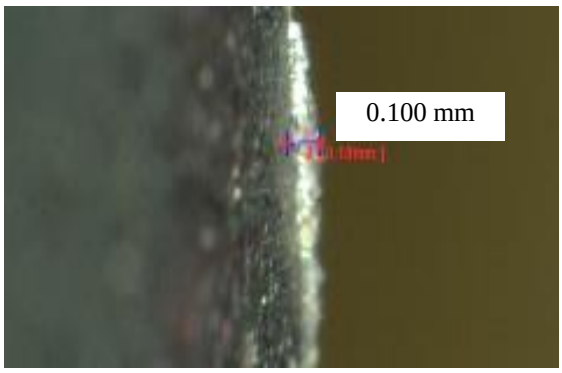

Fig. 16:- Biggest Burry dimension at material 1.0 mm

D. Result testing material 1.2 mm

In the process of cutting sheet material with a thickness of 1.2 mm obtained part washer compressor with the smallest burry with a burry height of 0.030 mm at clearance 0.050 mm. While the compressor washer part with the largest burry with a burry height of 0.097 mm at clearance 0.025 mm. This is clearly as illustrated in the graphic fig. 17. and graphic fig. 18.

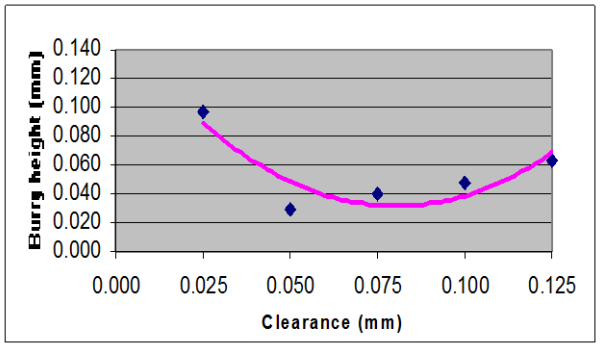

Fig. 17:- Burry dimension graph against 1.2 mm material clearance

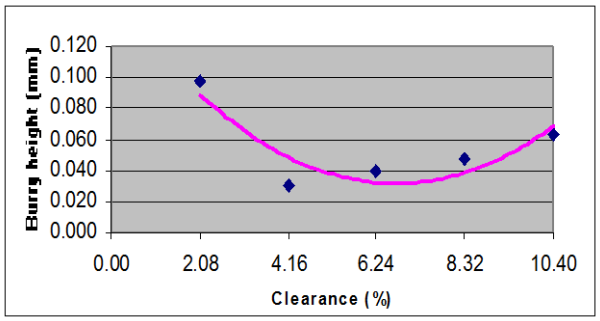

Fig. 18:- Burry dimension graph of 1.2mm material clearance percentage

Based on the data in fig. 17. and fig. 18. it can be obtained data on the tendency that if the clearance is getting smaller or bigger then the dimension of burry height that occurs will also be greater. For large clearances, on sheet material there will be greater shear force and shear deformation. At 1.2 mm thick material thickness the optimum burry height occurred at 0.030 mm at clearance of 4.16%.

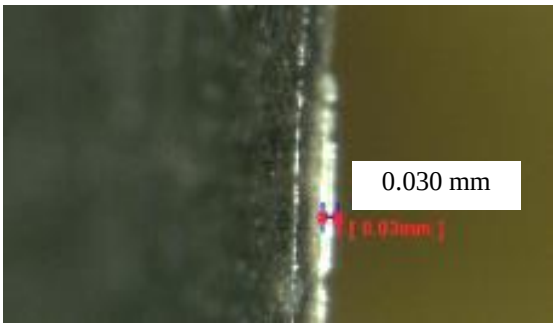

Fig. 19:- Smallest Burry dimension at material 1.2 mm

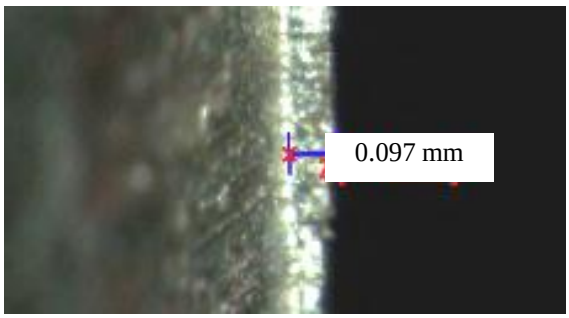

Fig. 20:- Biggest Burry dimension at material 1.2 mm

E. Summary data and burry height analysis on material thickness and clearance

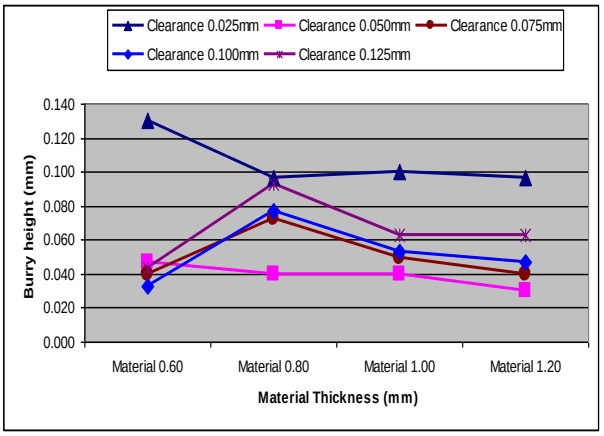

Fig. 21:- Graph of burry height against material thickness and clearance (mm)

V. CONCLUSION

From the results of research that has been done to obtain the following conclusions :

1. Thick sheet material greatly affect the quality of burry part washer compressor. In the same die clearance, the thinner or thicker the material will cause the burry height to increase. From the results of this study, the smallest burry height is 0.030 mm with a thickness of 1.20 mm material sheet.
2. Clearance die also affects the occurrence of burry on compressor washer products. The smaller or larger the die clearance will cause the burry height to increase as well. From the results of this study, the smallest burry height is 0.030 mm with clearance 0.050 mm or 4.16%.
3. In this study the optimum clearance die occurred at the clearance range of 0.050mm - 0.100mm or 4.16% - 6.26% of the thickness of the sheet material. This is still in accordance with the statement of Frank. W. Wilson (175-176)

RECOMMENDATION

In this research, in addition to getting the result of analysis of the effect of sheet material thickness and clearance die, can also be utilized as follows:

1. Provide input to the management where we work that for the compressor washer product that is produced now can be changed from the thickness of 1.0 mm to 0.8 mm, by considering the burry which is still within the tolerance range. Obviously with this change will be able to lower the cost of production, especially from the cost or material price.
2. The theme of this research can still be developed into several sub themes that can be done by other colleagues who are interested in the theme of die process.
3. Test data is standardized with international standards such as Standard ASTM.

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