STUDY ON RELATIONSHIP BETWEEN BURR AND CUTTING CLEARANCE OF COMMONLY USED SHEET METALS IN AUTOMOTIVE INDUSTRY IN MALAYSIA IN RELATION TO PIERCING AND BLANKING PROCESSES

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DEDICATION

I would like to dedicate this project report to my beloved mother and father who have blessed me the confidence to overcome all the obstacles on my journey to success.

I would also dedicate this project report to management and staff of Oriental Summit Industries Sdn Bhd Shah Alam Selangor (OSI) especially R&D Division who has given me opportunity to carryout this study, cooperation, supports and access of relevant informations which I think other company hardly to give.

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ABSTRACT

This thesis paper presents a study on the relationship between burr and cutting clearance of commonly used sheet metal in automotive industry in Malaysia in relation to piercing and blanking processes. It reviews the result between mechanical and hydraulic presses and between SPCC (Cold rolled material) and SPHC (Hot rolled material) which are commonly used in automotive industry. The chosen of these two materials are because of its high usage in automotive industries in Malaysia. SPCC is most popular because of its attractive surface finished. It is suitable for bending and simple drawing operations. For SPHC, suitable mainly for flat sheets or simple bending operations and simple drawing operations are also possible.

Keywords:-
Sheet metal, piercing and blanking processes, burr height, cutting clearance.

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LIST OF SYMBOLS AND ABBREVIATIONS

ABBREVIATIONS	TITLE	PAGE NUMBER
OSI	Oriental Summit industries Sdn Bhd	12
GMI	German Malaysian Institute	1, 25
EDM	Electric Discharge Machine	5
D_P	Punch diameter	5
D_D	Die diameter	5
C	Cutting clearance	5
JIS	Japanese industrial standards	10,11,45
MS	Microsoft	33

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CHAPTER I

INTRODUCTION

1.1 BACKGROUND OF PROJECT

The research work was carried out in German Malaysian Institute (GMI). Main equipment used was hydraulic Oehlgass press machine training kit, mechanical hand press and Digital Micrometer. The thesis was done on experiment on actual piercing and blanking processes whereby testing done on different types of material used in automotive industry in Malaysia. The sheet materials used were from hot rolled and cold rolled. Preparation of sheet metal materials and machining is crucial in this project. Hence, comparing the result will show that how much run out / different and this conclusion can be used for future reference for selected materials.

1.2 OBJECTIVES

The objectives of this thesis are:-

- To understand the relationship between burr and cutting clearance of selected sheet metal materials related to piercing and blanking processes.
- To establish a standard table or simple database of selected material that is commonly used in automotive industry in Malaysia as future reference.
- To better understand what actually happens to these sheet metal materials during piercing and blanking processes.

1.3 HYPOTHESIS

- What is the optimum cutting clearance for piercing and blanking processes?
- What are the factors contributed to the burr?

1.4 PROBLEMS STATEMENT

Die designers are facing problem to determine the optimum punch and die design to meet customer requirements on crucial matter such as maximum allowable burr height of sheet metal product that are normally stated in customer's product design or drawing. This is due to database on this parameters is hardly available in Malaysia.

LIMITATIONS OF THE STUDY

The limitations of this study are summarized as follows:-

- Difficult to get constant pressing force for hand mechanical press
- It is assumed that the equipment and machine used are in a good condition (calibrated).
- There are many other factors involved in piercing and blanking processes. This study will focus on factors of cutting clearance, burr height, sheet metal thickness and speed of penetration during stamping process.

CHAPTER II

LITERATURE REVIEW

The metal stamping processes are defined or known as alteration or deformation of sheet metal material in many ways. Parts may be blanked, pierced, drawn, formed or embossed, just to name a few basic operations. Each of these processes exerts its influence upon the structure of the material: the part and the scrap metal cutting is a process used for separating a piece of material of predetermined shape and size from the remaining portion of a strip or sheet of metal. It is one of the most extensively used processes throughout die and sheet metal work (Suchy, 1998).

In piercing, the cut-out portion is a scrap which gets disposed of while the product part travels on through the remainder of the die. The actual task of cutting is subject to many concerns. The quality of surface of the cut, condition of the remaining part, straightness of the edge, amount of burr, dimensional stability-all these are quite complex areas of interest, well known to those involved in a sheet metal work (Suchy,1998).

Most of these concerns are based upon the condition of the tooling and its geometry, material thickness per metal-cutting clearance, material composition, amount of press force, accurate locating under proper tooling, and a host of additional minor criteria. These may affect the production of thousands of metal-stamped parts (Suchy, 1998)

The actual cutting of the opening in the stock material is done by punch. Therefore, the size of a punched opening is determined by the punch. This relationship enables the die maker to know which cutting members must be made to piece-part size and which one should have the cutting clearance applied to them.

2.1 BURRS

There are no universally accepted definitions for "burr" and "deburred." To many companies and quality departments, "burr-free" means no loose material at an edge. To others it means nothing visible to the naked eye. To some it means an edge condition that will not cause any functional problem in the next assembly, even though the supplier often does not know the requirements for the next assembly. Some researchers even call edge breakout (missing material) a burr. Some call EDM resolidified material a burr, some see flash as a burr, and some feel plating build-up at edges is a burr. A bump of rounded metal at an edge is a burr to some and not to others (www.diamondman.com, 2002).

A burr is a slight draw of material (see Figure 1). It occurs on the bottom side as a result of separating material during perforating and shearing. Hole burrs may end up being pushed back into their hole during roller levelling, causing the holes to look less clean.

The burrs are a very sharp projection caused by a dull edge on the punch or die or by incorrect punch and die opening alignment. The degree of burrs on the piece parts indicates whether the die is ready for sharpening (Donaldson *et al.,* 1993)

Burr height is determined by taking the difference of the measurement of the thickness of the material with and without the burr. These measurements should be taken reasonably close to each other so that they are not influenced by any variation in the thickness of the material (www.diamondman.com, 2002).

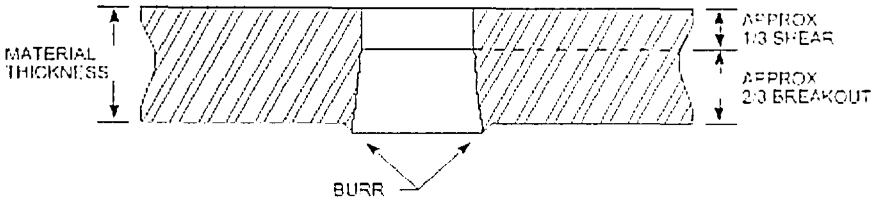

Figure 1 Burr

2.2 CUTTING CLEARANCE, C (PER SIDE)

Cutting clearance is the clearance between the punch and the side of the die, that is, $c = (D_d - D_p)/2$. D_d represents the die diameter and D_p represents the punch diameter (see Figure 2). A suitable clearance is one which causes fractures generated by the punch and cutting edge of the die during shearing to coincide exactly midway along the work piece (David, 1990). Cutting clearance should be expressed in terms of percentage of stock material thickness per side. This is term used in this research work.

2.3 DIE CLEARANCE (BOTH SIDE)

Die clearance is the clearance between the punch and the die (both side), that is, $2c = (D_d - D_p)$. D_d represents the die diameter and D_p represents the punch diameter (see Figure 2).

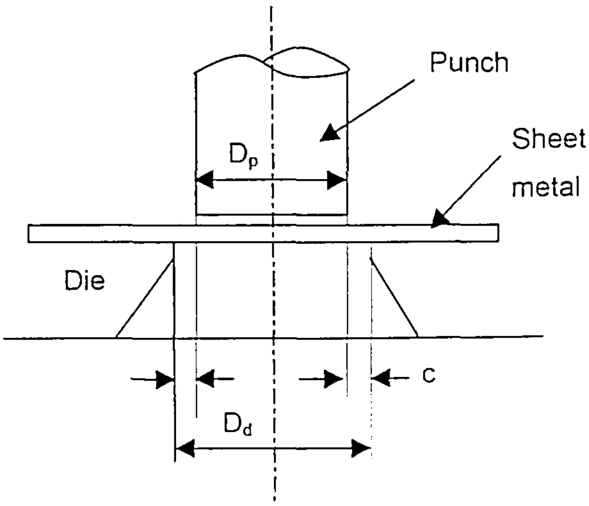

FIGURE 2: Relationship between cutting clearance and die clearance

2.4 IMPORTANCE OF CUTTING CLEARANCE.

Proper cutting clearance is necessary to the life of the die and the quality of the piece part. Excessive cutting clearance results in objectionable piece part characteristics; insufficient cutting clearance causes undue stress and wear on the cutting members of the tool because of the greater punching effort required.

However, round cutting members can operate successfully with less than normal cutting clearance. Reduced cutting clearance is used in some cases to overcome the hazard of slug pulling. In other cases it is used where a wider cut band on the piece part is desirable.

In addition, fragile punches and die sections often benefit from using slightly greater than normal cutting clearance. Less punching force is required, and this, of course, reduces the stresses on the cutting members (Donaldson *et al.*, 1993).

2.5 DETERMINING CUTTING CLEARANCE.

The physical properties and the thickness of the stock material are the factors that determine the amount of cutting clearance. The thickness is easily measured, but the physical properties in relation to cutting clearance are not. Therefore, the optimum clearance must often be determined by actual experiment. Always keep in mind that it is relatively simple to increase the amount of cutting clearance, but to decrease it may require the remaking of an entire punch or die block. When in doubt. The tool and die maker starts out with less cutting clearance than he estimates to be necessary. He then makes trial punching in the proper stock material and "opens up" or increases the cutting clearance by removing stock from the punch or die opening, whichever is appropriate. (Paquin, 1962).

Cutting clearance should be expressed in terms of percentage of stock material thickness per side. The percentage varies with the properties of the material. A suggested list of percentage for various materials is given in Table 1. Mica, fibre materials, plastics etc, generally requires less cutting clearance than any of the metals (Paquin, 1962).

TABLE 1 : Cutting clearance per side (percentage of stock thickness)

Material	**Irregulars contour**	**Round**
Aluminium		
• Soft, less than 3/5 " thick	3%	2%
• Soft , more than 3/5" thick	5%	3%
• Hard	5% - 8%	4% - 6%
Brass and copper		
• Soft	3%	2%
• Medium	4%	3%
• Hard	5% - 6%	4%
Steel		
• Low carbon soft	3%	2%
• Medium	4%	2%
• Hard	5%	3%
• Silicon steel	4% - 5%	3%
• Stainless steel	5% - 8%	4% - 6%

There is another result of the necessity for cutting clearance that must be studied and thoroughly understood by the tool and die maker. This is the effect of cutting clearance on the actual dimensions of the piece part as shown in Figure 3.