Journal of Engineering and Architecture
December 2015, Vol. 3, No. 2, pp. 125-131
ISSN: 2334-2986 (Print), 2334-2994 (Online)

Published by American Research Institute for Policy Development
DOI: 10.15640/jea.v3n2a14
URL: http://dx.doi.org/10.15640/jea.v3n2a14

Contact Electric Manufacturing in Brasssheet through Processing Die

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Abstract

A large variety of stamped processes are applied in a press working of sheet metal, which is used in the automotive industry (Yanwu, 2006) for México. For this Country, this industry is very important, because this sector contributes 3.0% of Gross National Product (GNP) and total 17.2% of GNP Manufacturing. For that reason it is very important to have an infrastructure for the design and manufacture of tools for sheet metal processing, but unfortunately it does not. In this work, we present the design of a set of die for making electrical terminal automotive part, which is to explain a methodology to take decisions on how to bending sheet metal and the respective tools to perform an electrical terminal automotive part, which is to detail a methodology to take decisions on how to bend sheet and the respective dies to perform it.

Keywords: Die, bending, stamping, sheet metal.

1. Introduction

Given the technological complexity of the forming process is not simple to classify them, taking into account the specific purpose of the process, we consider two categories(Boljanovic, Metal Shaping Processes:Casting and Molding, Particulate Processing, Deformation Processes, Metal removal, 2009): primary and secondary processing. The primers are related to the initial state of the material to be processed. Secondary processes provide the final product, the surface obtained precisely to meet the requirements and dimensions.

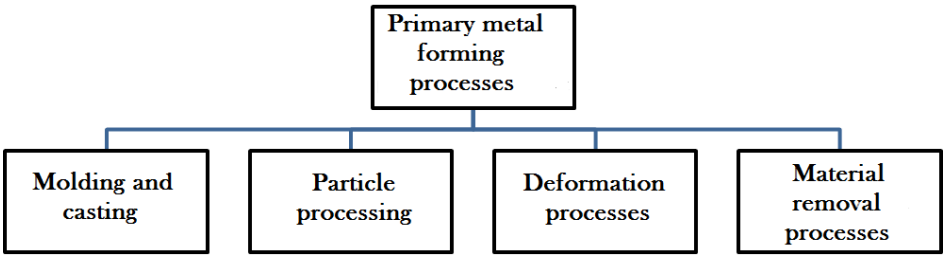

Figure 1: Classification of primary forming processes (Boljanovic, Metal Shaping Processes:Casting and Molding, Particulate Processing, Deformation Processes, Metal removal, 2009).

- The casting mold and requires materials in liquid form.
- Powder metallurgy processing of particles.
- Deformation processes produce parts from solid materials that are deformed to obtain useful compounds.

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- In material removal processes are obtained by chipping geometries (machined).
- In more detail, in the process of deformation the material is solid. Initial shaping the work piece is carried out through the application of forces on the work piece.

Strains and stresses are developed, which causes distortion of ways. These types of forming process are called as "deformation".

This may in turn classified (Mielnik, 1991) in the process of deformation of blocks (rolling, extrusion and forging) and sheet metal forming process (sheets) for example, bending, stamping. Both surfaces of the material deformed and tools developed by contact and friction between them. The latter two cases are part of group of secondary processes.

The characteristics of a deformation process blocks are:

- Work piece reaches large plastic deformations, resulting in a significant change in the cross section of the piece.
- The portion of the work piece reaches permanent plastic deformation. Is generally much greater than the elastic deformation portion. Hence, recovery from deformation is negligible.

The deformation characteristics of veneers are:

- The work piece is a part made of sheet or foil. The deformation usually causes significant changes in form but not cross section.
- In some cases, the amounts of plastic and elastic deformation are similar, so that the elastic recovery is significant.

The particular type of equipment and specific thetools used in manufacturing, dependent of the process (specific primary process). Machine tools (traditional and CNC) are extremely versatile for the production of the necessary equipment. Not only are used to fabricate devices, dice, and die, but also components of other products. Similarly presses and hammers are required for deformation processes.

Productivity, reliability and cost of the equipment used for the forming process are extremely important factors since they determine the economic and practical application of a process.

For example, both formed of boards and blocks. Parts of complex or irregular geometric shape, but having the characteristic of these materials comprised of a nearly uniform thickness can be obtained by a succession of “patterns". The practical realization of these operations is achieved by special devices called dies (dies or stamps). The machines where working dies are commonly called presses. The metal forming operations, as a system, covering all the input variables: the shaping material (geometry and properties), the tool (geometry, materials, treatments, etc.) Interface conditions in the tool material, plastic deformation mechanisms, the available equipment, the characteristics of the final product, and the workplace in which the process is being run.

The forming of sheets in general, and in particular die, usually associated with a relatively simple mechanical process of low technological input and low complexity. However, the reality is very different, and that this work, like other mechanical processes, encompassing a full range of technical virtuosity and mastery. Expert’s stampers, also called ' adjusters ' are recognized and respected throughout the metal industry - mechanical abilities and skills comparable to the famous Swiss watchmakers. It is a painstaking work, where there is no option for improvisation. It is a process that consists of several stages, ranging from the design of the sequence of work configuration, construction and commissioning of the die itself. All involve precision and perfection. There are many everyday household goods, parts of equipment or machinery components manufactured by “dies“. Can be seen, the tremendous difficulty of manufacture. Its simplicity or complexity depends on how simple or complex that was the part that were intended to obtain.

Punching is a metal-mechanical art of great importance to the industry, focused mainly productivity was due to manufacture products always looking for more efficient, resilient, and economic quality than those obtained with any other production process such as casting, forging or machining. It is used in a variety of sectors: appliances (white goods), automotive, aerospace, shipbuilding, electronics and information and aims at maximizing the material to make as many pieces in less time and cost.

The automotive industry plays a strategic role in the Mexican economy has a large grocery and globally competitive advantages in skilled labor and competitive, it's privileged geographical position and preferential access to major markets worldwide. Mexico is ranked No. 9 in the world as a producer of cars and is the sixth largest exporter in the world of this type of property. This sector contributes 3.0 % of gross domestic product (GNP) total and 17.2 % of manufacturing GNP. Direct employment generated representing 16.4 % of total manufacturing(México, 2013). However, one area that has not responded adequately to the needs of the Mexican automotive industry is the design of tools for sheet metal processing , including in Mexico any engineering education center in their offers educational contemplates a specialty dedicated to teaching design these tools , much less a career to cover the profile die design engineer .

There is not a wide bibliography available about sheet metal processes. The design handbook (Smith, 1990) published in 1990, is the book with the major information about this subject, including the design of tools for each sheet metal and progressive sheet metal. The recent works of Boljanovic(Boljanovic, Metal Shaping Processes:Casting and Molding, Particulate Processing, Deformation Processes, Metal removal, 2009)(Boljanovic & J.R., Die Design Fundamentals, 2005)(Boljanovic, Sheet Metal Stamping Dies: Die Design and Die-Making Practice, 2012)(Boljanovic, Sheet Metal Forming Processes and Die Design, 2014) it's about specialized courses for this topic. Cheok y Nee(Cheok, Foong, & Nee, An intelligent planning aid for the design of progressive dies proceedings of the Institute of Mechanical Engineering, 1996)(Cheok, Foong, Nee, & C.H., Some aspects of a knowledge-based approach for automating progressive metal stamping die design, 1994) in 1998 describes the modern application of the CAD/CAM (CNC) for the automatization of the progressive sheet metal processes, focusing on the 3D technic to select the number of phases for complex pieces. In this work it is presented the sheet metal process, to generate a brass piece that requires complex bends in the manufacturing process.

Two traditional ways to fold sheets, Figure 2 shows the case where frictional bending the sheet is held against the die and punch pushes it to attempt a 90° bend. Figure 3 shows the case of folding in "V" where a punch pushes the clearing of the plate against the matrix.

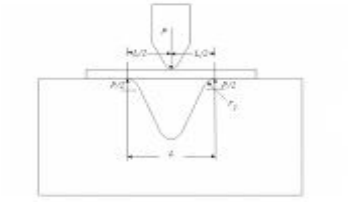


Figure 2: Bending friction

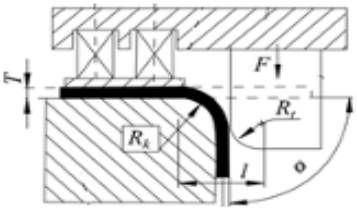


Figure 3: Bending in "v".

Upon completion of the bending of the sheet will always be an elastic recovery as shown in Figure 4, wherein when removing the punch recovering a portion of the sheet bending angle, this must be considered when designing the dies where bends required in the plate.

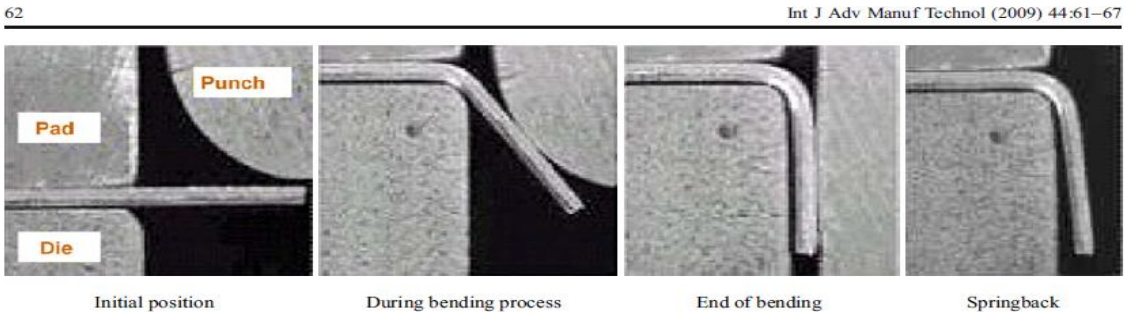


Figure 4: Phases of the folding process friction and elastic recovery end (Farsi & Arezoo, 2009).

When a part requires more than two folds, it is difficult to decide the sequence of folding operations. Requires punching operations plan looking most practical and economical solution (with fewer tools and punched fewest possible), ie the sequence of folds is the biggest problem in designing dies. Persian and Arezoo (Farsi & Arezoo, 2009)proposed a methodology to develop a reliable sequence of operations adapted to our case arises phases develop in Figure 5.

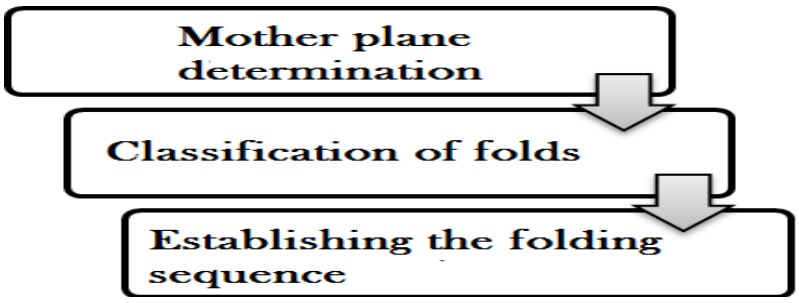


Figure 5: Phases of a bending sequence. Adaptedfrom Farsi, Arezoo(Farsi & Arezoo, 2009).

2. Description Of The Part To Die

This description is the same as presented in LACCEI Congress 2012(Campos, 2012), which indicated the development of the matrix to obtain the shape of the part shown in Figure 6, pending the folds, which are performed in two tools. Said figure shows the isometric piece by punching. We can't provide the complete picture, by confidentiality requirements of the applicant. The part is manufactured in 70-30 brass sheet, size # 22 and whose tolerances are ± 0.005 thousandths of an inch and ± 0.30 'of angular deviation.

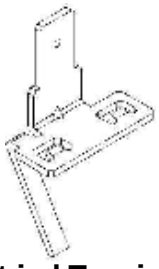


Figure 6: Electrical Terminals, isometrics

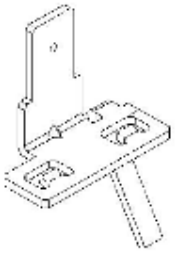


Figure 7: Electrical Terminals, isometrics

The front and side indicates the folds required to obtain the piece practice. One can observe that it requires a bending at 90° and another at 68° to the horizontal.

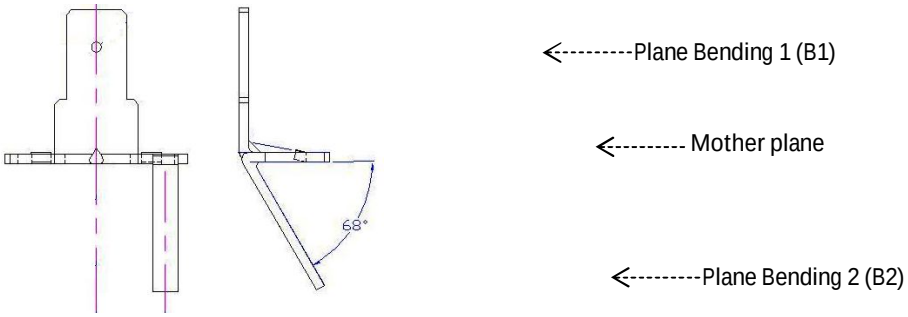


Figure 8: Front and side view of the electrical terminal and their respective planes mentioned nomenclature according Farsi and Arezoo (Farsi & Arezoo, 2009).

3. Determination the Sequence of Operations.

The first step according to Figure 5, is the determination of mother plane, ie the plane that is considered fixed on the bending sequence, which has the following characteristics: is a plane that is surrounded by the planes bent or central plane of bending, is the largest flat piece.

In Figure 6 it is clear that the horizontal corresponds to the steam plane.

The second step is to determine the type of fold required. For the fold of the upper plane, the mother is required plane bending at 90°, which is achieved by the use of friction bending shown in Figure 1. In the case below the plane bend mother is achieved by the folding mechanism in a "V" shown in Figure 2.

The third step is to establish the sequence of operations. One aspect not mentioned Farsi and Arezoo (Farsi & Arezoo, 2009)are to remember to use the mechanism to develop folds die. The press continues to work in alternative linear paths. One must take into account the three steps, the sequence of operations described in Table 1.

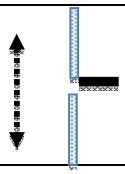
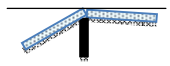
Schematic	Description of the sequence and the respective die
	The silhouette is initially flat part. The blue section is where the fold, the black matches the plane mother.
	The arrow indicates the reciprocation of the die to perform the bending. By bending friction are lowered corresponding to the two planes B1 and B2 shown in Figure 6
	B1 corresponding to the plane is not 90° by the elastic recovery and the plane B2 is 68°, thus requiring another punch to obtain the required angles, it is considered in the third die, which will compensate for the spring back which is done with a double "V ".

Table 1: Sequence folding operations

4. Die Description Processing

Table 2 summarizes the stamping process is followed to finally obtain the part. In the first column the number of stage sets, usually indicated by numbers multiples of 10, the second column is a photo showing the cut or plate deformation suffered during the process, in the third column briefly describes the process stamping for each phase, and finally, add comments.

PHASE	DIAGRAM EXPLAINING	PROCESS	COMMENTS
10		Cut the sheet into strips by shear.	Made of machine shearing.
20		Silhouette punching phase. This processing corresponds to punching a progressive die.	Made in hydraulic press Described in LACCEI 2012
30		Two folds are made, the tongue of each, one has to consider the path of the press ram is linear reciprocating. From this die is designed for stage 20.	Made in hydraulic press
40		Folds are tuned and made two notches to reinforce the fold initiated in step 20. This phase should take into account the elastic recovery of the material.	Made in hydraulic press

Table2. Phasespunchingprocesses

5. Description of Phase 30 And 40.

Once the sequence is folded operations could design and manufacture the dies. Figures 9 and 10 show the stage 30. Figure 9 shows already placed the silhouette of the electrical terminal (brass piece), you have two because one end corresponds to the fold right and the other left bend, and then the upper die descends deforming piece. In Figure 10, the brass has suffered folds, the folds can be seen B2 plane, and the plane B1 is not visible as it is inside the recess of the matrix. This completes the phase 30.

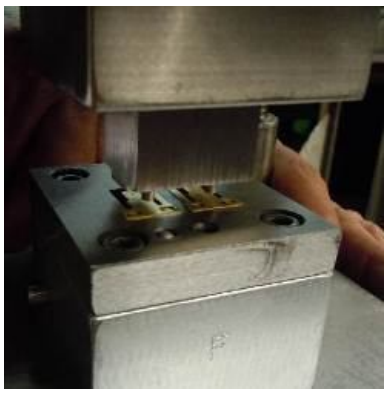


Figure 9.Die phase 30 without bending.

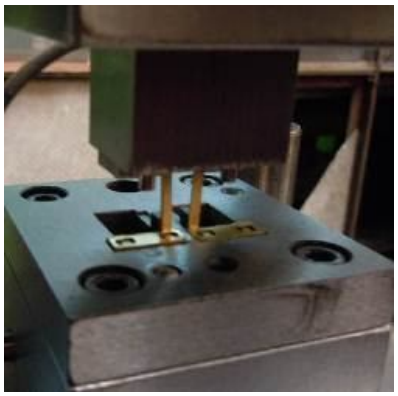


Figure 9. Die phase 30 with bends.

In Figures 11 and 12 show the stage 40. Figure 11 shows as electrical terminal but placed the mother plane is upright (not visible), note that the B2 plane had a remarkable elastic recovery folds are also performed for the left and right terminal, then the upper die descends deforming the workpiece. In Figure 12, the brass has suffered folds eventually required. B1 corresponding to the plane is not horizontal die has a slight angle of 1° to compensate for the elastic recovery phase suffered at 30, so that in step 40 to obtain the required 90° angle in the specifications of the workpiece.

Figure 11: Die Phase 40 without second bending.

Figure 12: Die phase 40 with final bending's.

6. Discussion

• The sequence of operations here led to the design of certain tools such that I can obtain the shaped piece and tolerances.
• The methodology suggested by Farsi and Arezoo, although it is recommended for progressive die operations, it is useful and convenient for blanks in different tools.
• One of the rules of the methodology states that the mother plane is larger, for this work was not the case; the mother plane has the largest area, obtaining the product successfully.

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