DESIGN OF TECHNOLOGICAL PROCESSES FOR MANUFACTURING PARTS BY COLD PRESSING

Mihaela-Claudia IVĂNOIU[1]

Rezumat. *Orice activitate tehnică implică o tehnologie. Prin tehnologie se înțelege o succesiune de acțiuni care vizează atingerea scopului propus în cadrul oricărei activități, cum ar fi, de exemplu, crearea unui produs sau serviciu, dobândirea de cunoștințe, efectuarea unei cercetări experimentale etc. În cazul creării unui produs, tehnologia se realizează printr-un proces tehnologic ca formă de sistematizare a acțiunilor gândite pentru atingerea scopului propus. Prelucrarea prin deformare la rece a materialelor metalice este metoda de prelucrare prin așchiere, deformare sau combinații ale acestora, fără îndepărtarea așchiilor și fără încălzirea prealabilă a materialelor. În construcția de mașini, ca și în alte domenii industriale, controlul calității produselor este organizat sub două forme: după prelucrare (numit și pasiv) sau în timpul prelucrării (activ). Fluxul de realizare a unui produs în trei etape este: PROIECTAREA - acordând atenție în primul rând funcționalității produsului finit; TEHNOLOGIA - care trebuie să stabilească procesul de fabricație și SDV-urile necesare; EXECUȚIA – ultima fază care realizează produsul.*

Abstract. *Any activity is carried out through a technology. By technology is understood a sequence of actions aimed at achieving the proposed goal within any activity, such as, for example, creating a product or service, acquiring knowledge, conducting an experimental research, etc. In the case of the creation of a product, the technology is realized through a technological process as a form of systematization of the actions thought to achieve the proposed goal. The processing by cold deformation of metallic materials is the method of processing by cutting, deformation or their combinations, without removing the chips and without prior heating of the materials. In machine building, as in other industrial fields, product quality control is organized in two forms: after processing (also called passive) or during processing (active). The content flow of making a product in three steps is : DESIGN - paying attention to first of all functionality of the finished product; TECHNOLOGY that must establish the manufacturing process and the necessary SDVs; EXECUTION – the last phase that realizes the product.*

Keywords: *Design, Technological process, Parts manufacturing, Machine tool, Cold pressing.*

1. Introduction

Quality is undoubtedly an essential factor from the perspective of globalization and international competition. According to SR EN ISO 9001:2015,

[1] Master CMP student, U.N.S.T. POLITEHNICA Bucharest, Spl. Independentei 313, sector 6, Bucharest Zip Code 060042. E-mail: miha.ivanoiu@yahoo.com

quality is: "The extent to which a set of intrinsic characteristics meet the requirements. There is no quality in itself, only entities possessing quality."

To improve the industry, new optimization methods are introduced every day: *the pressing process; the design process; the tool manufacturing process*

To optimize the design process, nowadays Computer-Aided tools (CAD/CAE) are widely used, which contribute to shortening the product design cycle [1], [2], [3]. **The objectives of the theme** refer to the development of a new product called "connecting wire" and its launch in series production under good conditions. The present paper, by thematics, the way of approaching and solving the problems, clarifies a series of aspects regarding the launch of the landmark "Connecting wire" into series production. The role of the connecting wire is to make the connection between the seat and the backrest of a seat mounted on the vehicle and to allow the backrest to be folded.

The part analyzed in Fig. 1 is used for the project: RF90 - Logan station wagon (Fig. 2). The role of the part is to connect the seat and the backrest as exemplified in Fig. 3.

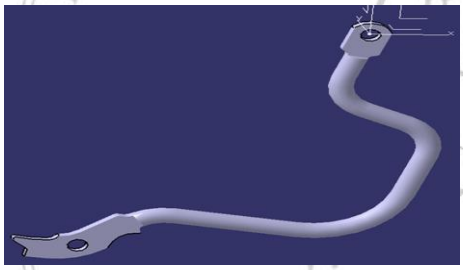


Fig. 1. 3D Part Model – Tie Wire

Fig. 2. The car on which the analyzed part is mounted

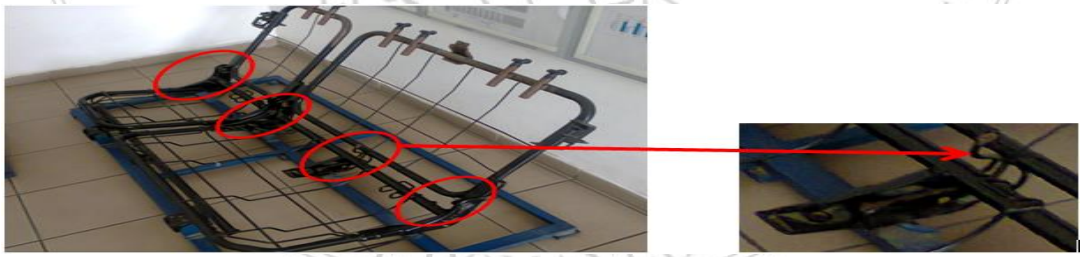


Fig. 3. The assembly including the part

2. Current state

Description of operation 10 Bending - cutting

This operation is carried out with the help of the Wafios bending machine. To make the semi-finished product, it is necessary to enter the coordinates of the

semi-finished product, (Fig. 4), in the memory director of the Wafios bending machine. With the help of a coil of wire and the Wafios CNC bending machine, operation is carried out. The wire is unwound from the coil, in a counter-clockwise direction, reaching the CNC machine (Fig. 5). Depending on the previously entered coordinates, the existing bending head on the machine, figure 5, performs the operation.

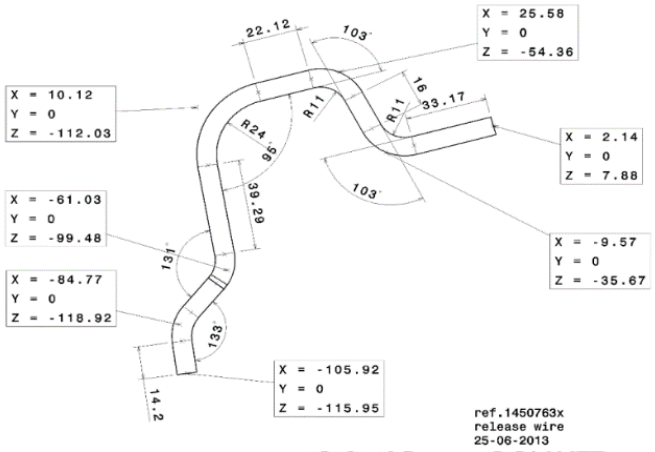


Fig. 4. Coordinates of semi-finished product

Fig. 5. Wafios bending machine & wire coil

Figure 6 shows the semi-finished product of operation 20, respectively the piece made in operation 10 (Fig. 7). Its compliance is verified using the control device shown in Figure 8.

The project of the control device was made by a specialized person from the CAD design service and released for execution to the mold department.

Fig. 6. Semi-finished operation 20

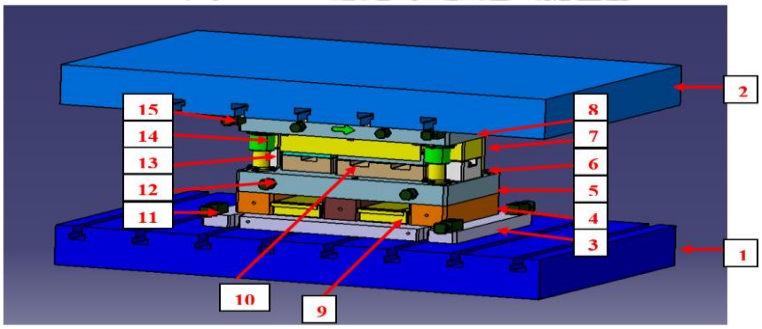
Fig. 7. Wire control device, operation 10

a) b) c)

Fig. 8. Phases of verification on the control device

Description of operation 20 Flattening - perforation – trimming

Considering the shape of the semi-finished product and the operation with the respective sequences, a multi-station punch will be used. Operation 20 is a successive combined operation. The semi-finished product moves through the device from one workstation to another, and the part is obtained after three active strokes of the ram. Figure 9 shows the 3D model of the punch.



1 – Press table, 2 – press ram, 3 – lower addition plate,
4 - spacer, 5 – lower support, 6 – lower buffer,
7 – upper buffer, 8 – upper support, 9 – waste drawer,
10 - drawer, 11 - support for lifting, 12 – support for lifting the lower part,
13 – guide column, 14 - bushing, 15 - support for lifting the upper part;

Fig. 9. The 3D model of multi-post punch.

Figure 10 shows the lower part of the multi-station punch (three stations in the punch). Because it has a great influence on the quality of the part, Figure 11 shows 3D, the existing positions, and Figure 12 shows how the part is placed in the three existing positions in the die.
Figure 13 shows the part obtained in operation 20. Its conformity is checked with the help of the control device shown in Figure 14.

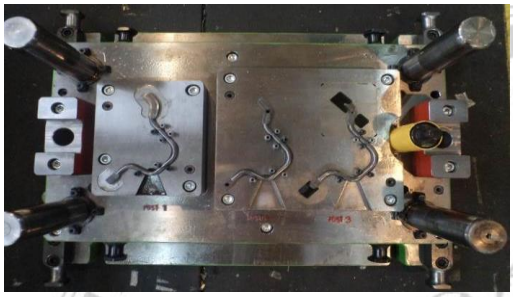


Fig. 10. The lower part of the multi-post die

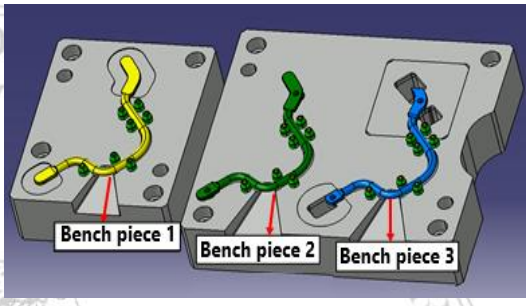


Fig. 11. 3D part model

Fig. 12. The piece placed in the multi-post die

Fig. 13. The piece after the operation 20

Fig. 14. 3D Measuring Device (Romer Arm)

Description of operation 30 - Painting

According to the 2D plan, there must be no paint on some areas of the part. To protect these unpainted areas, it is necessary to apply the SLEEVE protection over the flattened area and insert the DOP CONIC protection into the Ø6.4 perforation (Fig. 15). Before the pieces are painted, they undergo

preliminary surface preparation. When leaving the painting facility (Fig. 16), the parts are unloaded from the conveyor, the protections are removed and a 100% visual self-check is performed (Fig. 17).

Fig. 15. Sleeve protection, conical plug protection.

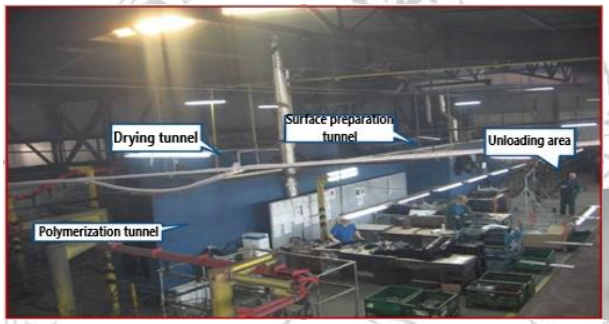


Fig. 16. The painting plant

Fig. 17. Connecting wire landmark

Control of the connecting wire piece

The part is subjected to non-destructive testing methods. Technical control is performed on the entire technological flow.

The visual control is done with the aim of identifying surface defects (processing defects) (Fig. 18, Fig. 19, Fig.20). Dimensional control – consists in checking the dimensions of the finished piece compared to those existing on the execution drawing.

Fig. 18. Visible marks on the piece.

Fig. 19. Defect on the part – off - center hole and missing perforation.

Fig. 20. Defect of painted part.

Multi-post punch redesign

In order to respect the position of the holes imposed by the client through the execution drawing, in station 2 - perforation, plates were fixed in the flattened areas of the part, these have the role of preventing the wire from moving in the station, ensuring the centering of the hole (Fig. 21)

In post 3 – trimming, two pins were added with the role of centering the hole in the piece, made in the punching post, thus ensuring a much more precise fixation of the piece in the post, implicitly ensuring the conformity of the piece in post 3 (Fig. 22, Fig. 23).

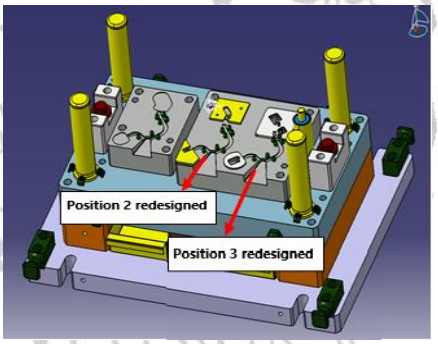


Fig. 21. The 3D model - station 2 and station 3 redesigned.

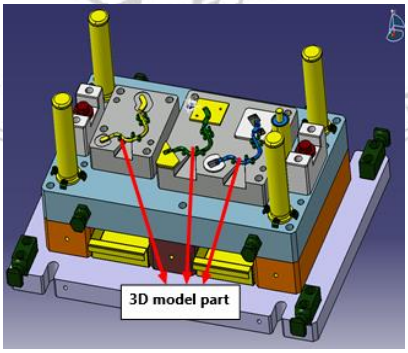


Fig. 22. The 3D model of the part placed in the redesigned multi-post die.

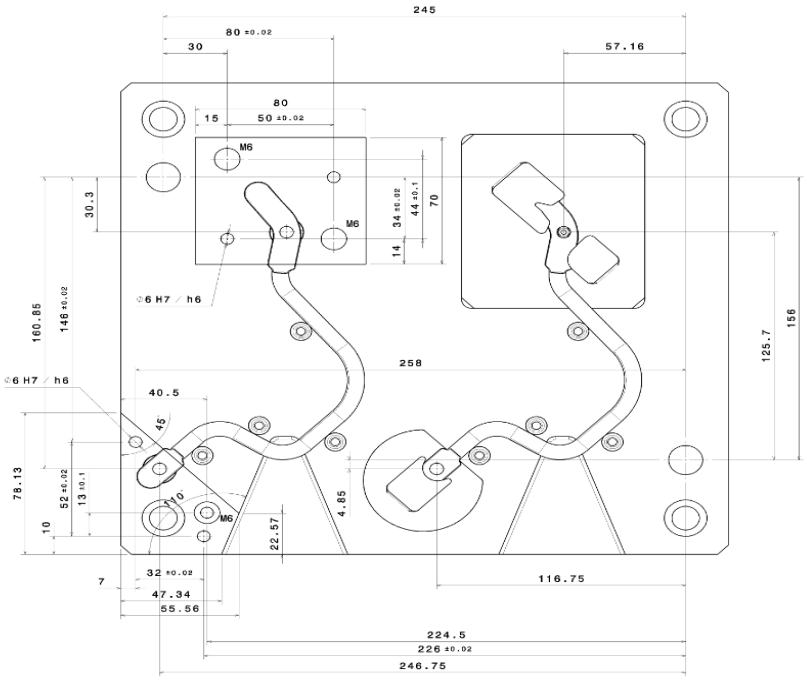


Fig. 23. Dimensions and positioning of new elements.

Figure 24 shows the piece made in operation 20 after station 2 (perforation) and station 3 (trimming) of the multi-station punch that was redesigned.

Following the redesign of the multi-post die and the production of the parts, a control report was prepared that demonstrates the product's compliance and the remediation of existing problems.

Fig. 24. New designed elements.

GIC NOSAG metal — Control report No. 271

Nom		XYZ...	XYZ...	Tol+	Tol-	Deviations	
Piesa 1							
6 4 A1	Lng	6,4000	6,4324	0,10	0,00	0,0324	
6 4 A2	Lng	6,4000	6,4164	0,10	0,00	0,0164	
4	Lng	4,0000	3,9200	0,20	-0,20	-0,0800	
143 5	Lng	143,5000	143,4444	0,20	-0,20	-0,0556	
154 27	Lng	154,2700	154,4524	0,20	-0,20	0,1824	
15 08	Lng	15,0800	14,4770	1,00	-1,00	-0,6030	
PLAN 0 4	Lng	0,4000	0,0390				
PLAN 0 4	Lng	0,4000	0,0322				

Fig. 25. Control report

The control report presented in Figure 25, contains the nominal dimensions imposed by the customer, the dimensions obtained in operation 20 - after the positions of the redesigned punch, the lower tolerance, the upper tolerance and the deviation of the piece are indicated. The green color represents the size that conforms to the customer's requirement.

Given the fact that the parts are according to the 2D plan, the Connecting Wire part can be released into series production.

Observations regarding operation 20 within the technological process.

The multi-station die used initially, at operation 20 of the technological process, made parts that did not comply with the customer's requirements (Fig. 26), the number of scraps being very high.

Fig. 26. Part not conforming to the customer's requirements.

The parts made in this operation have the following requirements:

- High consumption of material;
- Large containers for collecting rejected or defective parts;
- High level of additional time required to fulfill customer orders;
- Low confidence in appointments;

To eliminate these inconveniences, the redesign of post 2 and post 3 of the multi-post punch was proposed as an improvement method. The redesigned multi-station punch allows the production of parts in the conformity with all customer's requirements. The benefits are: reducing the amount of material used to make the batch of parts; improving customer satisfaction; lower costs with rework (retouching and scrap removal); less extra-time.

3. Conclusions and contributions

In order to complete the objective of the theme, which refers to the development of a new product called "connecting wire" and its launch in series production in good conditions, during the development of the project we strictly followed all the stages necessary for the development and fulfillment of this activities.

The present paper, by thematics, the way of approaching and solving the problems, clarifies a series of aspects regarding the launch of the part "Connecting wire" into series production.

Personal contributions are:

- Elaboration of bibliographic studies on cold plastic deformation.
- Presenting in an original way the development of a new product.
- Analyzing the input data, in order to launch a new benchmark with a high quality level into series production.
- Participation in the meetings established in order to clarify the client's requirements and project planning.
- Establishing the processing necessary to achieve the milestone, and their succession.
- Establishing the necessary operations to achieve the milestone.
- Realization of the technological flow of obtaining the finished part
- Participation in the development of the tools necessary to make the product,
- Participation in tests performed with the developed punch.
- Measuring 5 parts made with the originally developed die and finding that it produces parts that do not conform to the customer's requirement.
- Making the Ishikawa diagram (cause – effect)

R E F E R E N C E S

[1]. Anania Florea Dorel, *Introduction to integrated design*, Course notes, 2022.

[2]. Bălan Emilia, *Product certification,* Course notes, 2022.

[3]. Ciocârdia, C., Drăgănescu, F., Cicârdia-Carp, C., Sindilă, G., Pârvu, C. (1991) *Cold pressing technology*. Bucharest: Didactic and Pedagogical Publishing House.

[4]. Cirilo, A., Picoş, C., Bohoşievici, C. *Cold stamping and stamping technology*. Didactic and Pedagogical Publishing House, Bucharest, 1966.

[5]. Dobrescu, I. (2007). *Cold forming technologies*. University of Pitesti Publishing House.

[6]. Gryna F.M. jr., J. M. Juran - *Product quality - Practical treatise on planning, design, implementation and control,* Technical Publishing House, 1973.

[7]. Ghinea Mihai, *Integrated manufacturing systems*, Course notes, 2022;

[8]. Ghionea I., *Assisted design in Catia V5,* Bren Publishing House, 2007.

[9]. International standard SR EN 10016-2.

[10]. N. Balinschi and D. Mîntulescu, *Heat Treatment Technology*, Didactic and Pedagogical Publishing House, Bucharest, 1963.

[11]. RegieLive.ro Library, *Mechanical Courses, Modern Control Methods and Techniques*, https://biblioteca.regielive.ro/cursuri/mecanica/metode-si-tehnici-moderne-de-control-230388.html.

[12]. Rizea A. *Quality management*. Unpublished university course. Pitesti State University.

[14]. Sindilă Gh. *Cold pressing manufacturing technologies*, Printech, Bucharest, 1999.

[16]. Teodorescu, M., Slag, G. *Cold pressing technology*. Didactic and Pedagogical Publishing Huse, Bucharest, 1980.

[17]. Teodorescu M., et al. *Cold plastic deformation processing*, Technical Publishing House, Bucharest, 1987.

[18]. Tilina Dana, *Product and service quality management*, Course notes, 2022.

[19]. Zapciu Miron, *Productica*, Course Notes, 2022.

[20]. https://www.sciencedirect.com/science/article/abs/pii/S0020722520301853.

[21]. https://www.sciencedirect.com/science/article/pii/S1877050921014319.

[22]. https://www.sciencedirect.com/science/article/pii/S0141635921002518.

[23].https://biblioteca.regielive.ro/proiecte/organe-de-masini/tehnologii-de-presare-la-rece-315377.html

[24]. https://biblioteca.utcluj.ro/files/carti-online-cu-coperta/353-0.pdf.

[25]. https://ro.wikipedia.org/wiki/Ambutisare.

[26]. https://www.academia.edu/24060191/PROCESE_TEHNOLOGICE.

[27]. https://www.agir.ro/buletine/1878.pdf.

[28]. https://www.britannica.com/technology/machine-tool/Basic-machine-tools.

[29]. https://ro.wikipedia.org/wiki/Diagrama_Ishikawa.

[30]. https://fdocumente.com/document/curs-conceptie-integrata.html?page=5.