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A NEW SHEET METAL PARTS CLASSIFICATION AND CODING SYSTEM

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Abstract: *Variant process planning uses a principle of grouping of similar products into families. One of the existing formal method of machine parts classifying for the group technology (GT) applications is the coding and classification. The reserchers have developed many different GT coding schemes, which precisly describe the design characteristics of the parts, but many of them do not explicitly describe the process plan. The paper presents a new approach to the sheet metal part coding and classification with plan-based attributes implementation in accordance with the standard STN 226001.*
Key words: *forming, sheet metal, group technology,CAPP*

1. INTRODUCTION

Group technology (GT) philosophy, used in modern V-CAPP systems, is a method that improves manufacturing efficiency by classifying similar products into families based on their attributes. Usually, these attributes are based on geometric and/or production process characteristics. A major problem of this approach is the lack of adequate models of technology-based similarity evaluation. Application of GT principle needs a design similarity measure that identifies machine part with similar process plans. The part similarity measure should correspond to the process plan. Two parts should be similar if and only if their process plans are similar. (Sugar, 1999).

One of the most popular manner of similar parts group formation is classification and coding. The classification system oftentimes apart from classification based on geometrical properties of the part and next the classification continues in classification based on the non-geometrical properties such as weight, tolerances, etc. (Kuric, 2007). Although part similarity measure based on group technology code is useful for finding generally similar parts, these measures can not be precise enough for process planning since there is no explicit relation between process plans and GT codes.

In the field of sheet metal forming process plan design we cannot see so significant utilization of the automated process planning systems compared to the machining processes planning. Usually these are oriented on specific, separate problem of forming technology (for example: robotic sheet metal bending) and mainly are based on generative principle (Duflou, 2005; Kang, 2002; Misaki, 2003).

To overcome some limitations of variant process planning of sheet metal parts production, a new technology-based part similarity classification and coding system is presented in the article.

2. SHEET METAL PARTS CLASSIFICATION SYSTEM

Based on the analysis of design-technological features of parts, a new classification coding system was created with respect to the standard STN 226001, defining the structure of sheet metal forming operations. The general structure of the classification code is shown in the Fig. 1.

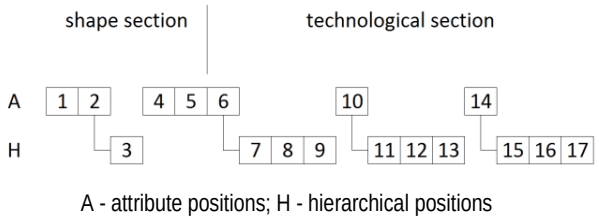

Fig. 1. Organization and hierarchy of classification code

The meaning of the shape positions of the classification code are defined in the Table 1. In the following Table 2 is recorded technological section of the classification code.

Attribute positions				Hierarchical positions			
Position		Position options		Position		Position options	
1	bottom shape	**0**	no				
		1	plane				
		2	chamfer				
		3	hemisphere				
		4	with groove				
		5	semicircle				
		6	conical				
		7	general				
2	rotation	**1**	rotary part	**3**	wall shape	**0**	no
						1	cylinder
						2	cone
						3	ellipse
						4	shaped
		2	non-rotary part	**3**	number of walls	**0**	no
						1	1 wall
						2	2 walls
						3	3 walls
						4	4 walls
4	tilt wall	**0**	no				
		1	30°				
		2	45°				
		3	60°				
		4	90°				
		5	120°				
		6	135°				
		7	150°				
5	flange	**1**	with flange				
		2	without flange				

Tab. 1. Optional values of shape positions of the code

Attribute positions				Hierarchical position			
Position		Position options		Position		Position options	
6 **10** **14**	basic work	**0**	no				
		1	**shearing**	**7,8** **9** **11** **12** **13** **15** **16** **17**	basic operations	**0**	no
						1	blanking
						2	punching / notching
						3	lancing / slitting
						4	trimming
						5	shaving
						6	parting
						7	fine shearing
		2	**drawing**	**7,8** **9** **11** **12** **13** **15** **16** **17**	basic operations	**0**	no
						1	deep drawing
						2	reverse drawing
						3	ironing
						4	spreading
						5	necking
						6	grooving / doming
		3	**bending**	**7,8** **9** **11** **12** **13** **15** **16** **17**	basic operations	**0**	no
						1	air bending
						2	offset
						3	straightening
						4	roll bending
						5	hemming
						6	beading
						7	shouldering
						8	setting-out
						9	seaming
		4	**metal spinning**	**7,8** **9** **11** **12** **13** **15** **16** **17**	basic operations	**0**	no
						1	without wall thickness reduction
						2	with wall thickness reduction
						3	beading
						4	flanging
						5	spreading
						6	necking
						7	grooving

Tab. 2. Optional values of technological positions of the code

The first five positions of the classification code (Tab. 1) determine the shape of a part, based on the fact, that if it is possible, always the one from walls of the part is considered to be the bottom. Then the first position we might call "bottom shape". Furthermore, it is necessary to determine whether a part is rotational or not, so there is a position "rotation". In contrast to the first two positions, the third will be hierarchical, even its meaning will be changing in dependence on the previous position. So, if a part is rotational, the third position in the code is "shape of the wall", if the part is non-rotational, the third position in the code is named "number of walls". Assuming that a part has a bottom and at the same time it is not single surface of the part, other surfaces can be called “walls of the part”. Between the wall and the bottom may be arbitrary angle and so another position in the code is "tilt wall". Finally, the fifth attribute position called "flange" determines, whether a part has flange or not.

However, the shapes of the machine part are just one part of the classification system. It is necessary to define manufacturing attributes and incorporate them into the classification and coding system. The simplest way to define manufacturing technology is to determine a few coding positions for "basic technological procedures" and also a few positions for "basic technological operations".

11141	**110021003500**	**11141**	**114022000000**
11141	**110022700000**	**11141**	**112421300000**

Fig. 2. Classification code for different types of parts – example

3. CONCLUSIONS

Purpose of this paper is to contribute to the subject of sheet metal process planning. A new method of technology-based classification and coding of sheet metal parts was proposed, which can improve the quality of technological similarity assesment in variant process planning systems by removing the disadvantages of the classification based only on the geometrical and material attributes of the parts.

4. ACKNOWLEDGEMENTS

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