Justification of requirements to quality and accuracy of blank for precision stamping

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Abstract. The dispersion of blank masses depending on the accuracy class of the initial metal rolling is estimated. The influence of the method of the initial blank segments on the stamping process is described.

The accuracy of mass and geometric parameters of the used blanks is of great importance for precision stamping [1]. In this regard, the study was conducted which aim was to reveal the influence on the result of stamping of the dispersion of blank masses with different surface quality and it ends. The deviation of the volume of the stamped blank and the quality of the surface of the blank ends, affecting its centering in the die, mainly depends on the type of rolled products used and the method of its cutting into dimensional blanks. According to the accuracy of hot-rolled steel round is distinguished according to GOST 2590[2]. To improve the quality and accuracy of the surface of the rods according to GOST 14955-77[3], turning, grinding, lug calibration is carried out, and therefore the accuracy of h8-11 is achieved.

In some cases, for precision stamping blankis used (figure 1, b) of rolled conventional precision, which is ground part of the length \( l_1 \approx 1/2 \) \( l \), and it is used for making of the untreated part of the forging cutting. Figure 1 and table 1 show the types of blank and information on the mass deviation \( \Delta G \) of the blank, depending on the accuracy of the rolled products used. Mass varies from 0.021 to 0.176 kg. The effect of variation in the mass (volume) of the blank on the variation of the deformation force is shown in Figure 2. Simulation is carried out in QForm V8 for metal standard-accuracy B1. For blank with a diameter of \( \varnothing 60 \), the following diameter tolerances are accepted: +0.5 and -1.1 mm. Based on the tolerances, the volume of the accepted blank is calculated for the minimum \( V_{\text{min}} \) and the maximum \( V_{\text{max}} \) possible tolerances.

From the graphs of deformation forces (Figure 2), obtained by simulating the process of stamping from blanks of various volumes at 1200 °C, it is clear that the stamping forces in the final transition for the nominal \( V_{\text{nom}} \) and the maximum \( V_{\text{max}} \) possible blank volume are relatively close and they are 9.1 MN. The reduction of the force to 8.2 MN for the minimum \( V_{\text{min}} \) of the possible volume of the blank is associated with a decrease in the width of the backwater on the side of the ramming bridge.

The method of cutting rolled products on dimensional blanks also affects the mass accuracy. The most efficient in labor costs and common in mass production is cutting on press shears. For the case of cutting on press shears, the maximum permissible deviations of the shape and size of the blanks are presented in Figure 3. The mass difference between the minimum and maximum possible deviations of
the shape of the blank is ~0.1 kg. In this case, we can observe a significant distortion of the geometry of the end parts of the blank.

![Diagram of blanks](image)

**Figure 1** - Types of used blanks: a - according to GOST 2590, b - partially turned from a blank, GOST 2590; c - in accordance with GOST 14955-77 according to h11 quality

**Table 1** - Deviation of the mass of the blank depending on the accuracy of the blank

| Blank Type | Deviation ΔGbil (kg) from the nominal value of weight of the blank |
|------------|--------------------------------------------------|
| Ø60×150mm  | Accuracy group                                   | fig.1, a | fig.1, b | fig.1, c |
| A          | 0.110                                            | 0.109    |          | 0.021    |
| B          | 0.154                                            | 0.152    | 0.176    | 0.175    |

In the case of cutting the blank on a disc cutting machine, the accuracy of the metal feed is higher, in addition, the crushing and mowing of the cutting ends of the blank are minimized. Deviations of the shape and size of the blank for this case are shown in figure 4. The difference in weight between the minimum and maximum possible deviations of the form is ~0.02 kg.

The influence of the state of the end surface of the blank on the stability and axisymmetric semi-finished with the lees (the first transfer stamping) was evaluated in the simulation in QForm environment (figure 5). As follows from the simulation results, during the draft of the chopped blank due to a significant distortion of the geometry of the ends during the draft, an uneven flow of the metal of the deposited part of the blank occurs, leading to distortion (eccentricity) relative to the die axis[4].
Figure 2- Graphs of stamping force changes for different volumes (V) of the blank

1. Dimensions with an asterisk (*) apply to both ends of the blank
2. Dimensions are given in cold condition

Figure 3- The blank obtained by the operation of the segment (cutting) on the press shears: a) schematic image, b) the actual state of the end in the cutting zone.

Figure 4- The blank obtained by the operation of the segment (sawing) on the disk cutting machine.
Figure 5 - Distribution of metals in the sediment of chopped blanks: $e$–eccentricity of the deposited part of the blank relative to the die axis.

Smaller deviation on the bevel of the blank end for the case of cutting on saws provides better stability of the blank during the operation of precipitation, which minimizes the risk of uneven distribution of the metal ($e\approx0$) in the formation of transitions and resulting differences in the height of forging[5]. In turn, this directly affects the accuracy of the product obtained by precision stamping[6].

Conclusions
1. The shape of the ends of the blank should provide a unique laying of the deposited semi-finished product in the stream of the next stamping transition, which is achieved by cutting on the saws.
2. The minimum deviation of the blank weight is achieved by using a sharpened rolled and cutting dimensional blanks on saws.

References
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[2] GOST 2590-2006 Hot-rolled steel round
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