Drilling holes with a cutting tool without a transverse edge and their effect on the accuracy of the machined hole

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In general, the accuracy of machining is understood as the degree of correspondence of the machined part to its geometrically correct prototype or sample. Considering the accuracy of processing a particular part, distinguish:

1) the accuracy of the dimensions of the surfaces of the part in relation to the processing of holes, this corresponds to the size of the diameter of the hole and its depth;

2) the accuracy of the shape of the surfaces, for holes, by this we mean the degree of their correspondence to the geometrically regular surface of a circular cylinder, and in the cross section to a geometrically regular circle;

3) the accuracy of the relative positioning of the surfaces of the part when processing holes, it includes coordinate errors characterizing the location of the hole, the removal of the axis of the hole, deviation from the alignment of the location of sections of stepped or intermittent holes, etc. [1].

An axial tool in a real process makes a complex movement relative to the work piece. Additional relative tool movements associated with deviations from the kinematic cutting pattern are the main factor determining the error of the machined hole. The deviation of the real axis of rotation of the tool from the axis of rotation defined by the machine spindle represents a precession, and the deviation of the diameter of the real hole from the size of the tool is a breakdown. The hole breakdown can be represented as the result of the complex effect of the precession of the tool axis and the natural vibration of the tool relative to its axis. The study showed that with an increase in cutting speed, the size of the breakdown of the hole first increases and then falls, both in the case of a spiral drill and in the case of a new one. In all cases, the size of the hole breakdown after drilling with the developed drill is less than after spiral processing in the entire studied range of speeds. This is due to the absence of a transverse edge and, as a consequence, a sharp decrease in axial forces of the projected drill. Axial forces, especially their difference, have a rather large impact on the accuracy of the resulting holes. The study of the effect of feed on the accuracy of the obtained holes showed that when processing all materials with increasing feed, the size of the hole breakdown also increases [2].

Drilling of sheet material is carried out in the vast majority of cases through the hole. Therefore, a number of additional requirements are imposed on drills. The main ones are: reduction or complete absence of burrs on the exit and entry sides of the hole, absence of indentation and warping of the material during drilling (especially sheets of non-ferrous material), absence of burns to the sides of the hole when drilling, for example, plastics, obtaining the correct shape of the hole in the drilling process without securing the work piece, the absence of torn edges of the hole when drilling, for example, plywood and plastics. These requirements can be met when working with drills with special sharpening of the cutting part and subject to the recommended cutting conditions and processing conditions.

Drilling relatively small holes in sheet materials is associated with certain difficulties that arise when inserting and exiting the drill from the material [3]. When drilling, the sheet material experiences significant deformations along the axis of the drill and for processing a quality hole, it is necessary to choose the type of drill used and the shape of the sharpening of the cutting part.

Spiral drills are considered the most used tool for drilling. However, the most common among them are twist drills of small diameters, which are most widely used when drilling holes in sheet materials. The company National Twist Drill Co (USA) found that on average 90% of drills are in the diameters of 1.25 ... 12.0 mm and only 5% in dimensionally higher or lower than this interval. Characteristically, drills with a diameter above 19 mm made up only 1% of the total number of drills.

Although spiral drills are manufactured within fairly tight tolerances, they are not an accurate tool and are intended, in essence, for pre-machining holes. If we consider the working conditions of a spiral drill, then its cutting part consists of two elements that differ in the nature of the work - two main cutting edges and one transverse cutting edge. If the work of the main cutting edges is, in general, similar to the work of the cutting edges of other metal cutting tools, then the mechanism for removing material with a transverse edge is extremely complex [1]. As you approach the center of the drill, the work of the transverse edge becomes more like the work of a blunt wedge shaped indenter, pressed into the material being processed. In this small area, severe deformation of the material displaced into the chip grooves takes place. As a result of this, almost half of the axial force of the drill with diameters up to 12 mm falls on the transverse cutting edge, the length of which is determined by the thickness of the core of the drill. [2].

One of the biggest problems in using small tools is the fact that the stiffness of a cylindrical rod is inversely proportional to the fourth power of its diameter.

According to the methods of changing the cutting part, drills can be divided into three main groups:

a) drills with a cut transverse edge;

c) drills for drilling sheet materials;

e) drills with different sharpening to separate chips.

The selection of drills for processing holes in sheet materials and a separate group is mainly associated with the desire to reduce axial force, which is the main parameter determining the execution of a technological operation. The slump is measured by a needle-tipped indicator whose direction of movement is parallel to the axis of the drill. (FIGURE 1).

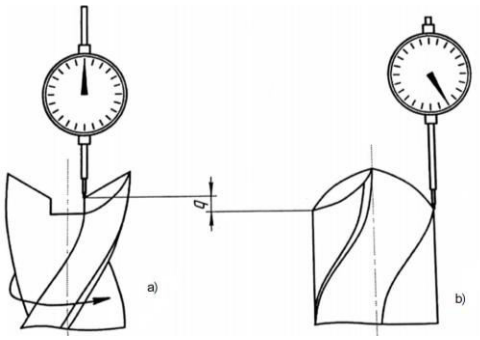


FIGURE 1. Scheme for controlling the amount of decline of the rear surface: a - initial and b - final positions.

The drill tip angle 2φ (FIGURE 1) is located between the projections of the main edges onto the axial plane of the drill, parallel to them.

1. Analysis of the schemes, sharpening of drills showed that the design of drills with a V-shaped cutting part can be operated according to traditional schemes on existing equipment.

2.The process at the beginning of hole processing with new drills is more stable and occurs without deformation of the workpieces.

3.The accuracy of hole processing with new drills is 40-60% higher than with hole processing with traditional drills.

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