UDC 621.91.04

LABORATORY TESTS OF THE IMPROVED DESIGN OF THE BLOCK-MODULAR FACE MILLING CUTTER

ANDREI MAKSIMCHUK, NIKOLAI POPOK
Polotsk State University, Belarus

The results of laboratory tests of the advanced design of the block-modular face milling cutter are presented. Conclusions about the operability and tool life, based on the obtained wear values of the cutting inserts were made.

The analysis of the design of prefabricated face milling cutters by the world's leading manufacturers shows a tendency to use structures consisting of interchangeable structural modules. The interchangeability of structural modules is ensured by the unification of the basic connecting surfaces (cutting inserts in cutting blocks, cutting blocks in the cutting tools body, cutting tools for fixing in the spindle of the machine). It allows in a short period of time to assemble and adapt cutting tools to the production of new products and new technological processes. When using the modular principle, the flexibility of the plant's tool system increases, the productivity and reliability of the tool, and the operating conditions are improved through the use of optimal designs and the reduction of their variety. In addition, the modular design reduces the time and complexity of developing a new tool with the available standard unified modules.

On the department of technology and equipment of machine-building production, a block-modular face milling cutter with a unified cutter block was designed and manufactured [1, 2]. The efficiency and reliability of the developed design is considered in [3, 4]. At the same time, based on the results of the experimental research of the developed design of the block-modular face milling cutter, recommendations were given on the possible improvement of the tool design resulting in the design of a block-modular face milling cutter with cutting blocks "drowned" into the tool module to increase the rigidity and accuracy of the mill.

A variant of the design of the block-modular face milling cutter is proposed (Figure 1). The peculiarity of this design is that the cutting block *1* is "drowned" in the body module *3* and the block is installed on two cylindrical surfaces, which allows, firstly, to increase the rigidity of the block-modular face milling cutter during processing, and secondly, to increase accuracy of processing due to more accurate installation of the cutting blocks in the body module.

Laboratory tests of the experimental sample of the block-modular face milling cutter were carried out in accordance with the recommendations of GOST 23726 and GOST 26595 [5, 6].

At laboratory tests of the improved design of the block-modular face milling cutter, the following cutting conditions were used:

- feed $S_м$= 210 mm/min;
- depth of cut t = 0,5..3 mm (step change 0,5 мм);
- rotation frequency n= 400 мин$^{-1}$

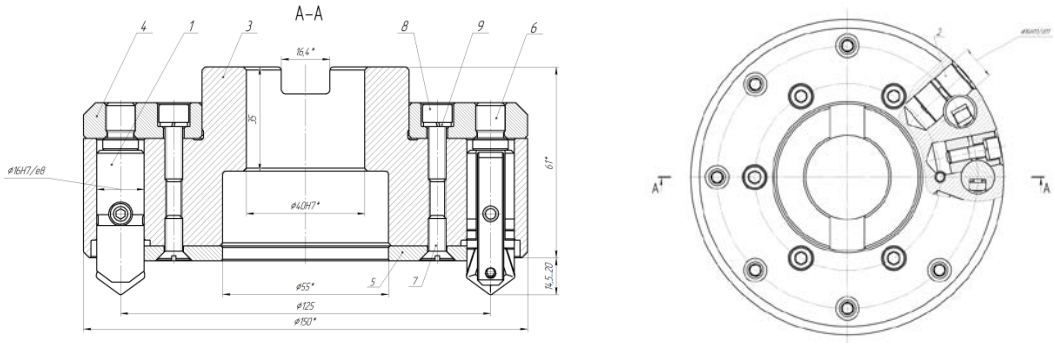

Fig. 1. The improved design of the block-modular face milling cutter

The tests were carried out on the vertical milling machine model 6R11, the material of the workpiece - steel 40H GOST 4543, the hardness of the workpiece - HB179 ... 229.

Methods of testing:

1. Carry out adjustment of the machine;
2. Install and fasten the cutting tool;
3. Set the cycle of the machine: depth of cut t = 0,5 mm, feed $S_м$= 210 mm/min, rotation frequency n = 400 min^{-1};
4. Process the workpiece for 10 cycles on the modes of step 3 (if necessary, replace the workpiece);
5. Change the depth of cut by 0.5 mm;
6. Process the workpiece for 10 cycles with a changed cutting depth;
7. Repeat steps 4-6 until the depth of cutting is 3 mm inclusive;

Thus, when carrying out laboratory tests of the improved design of the block-modular face milling cutter with " drowned " blocks, the surface of the workpieces was processed during 60 passes of the tool, which can provide an indicative assessment of the operability and stability of this improved design.

After the end of the laboratory tests, the wear of the cutting inserts was measured. Figure 2 shows the wear values of cutting inserts.

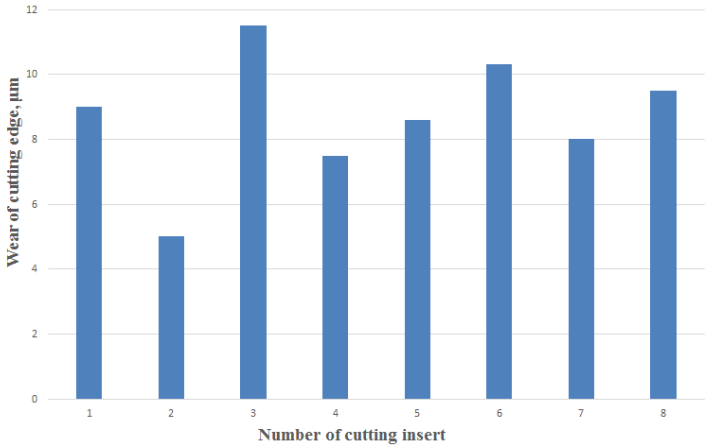

Fig. 2. The diagram of wear values of cutting inserts after laboratory tests

Analyzing the obtained values of wear of cutting inserts after laboratory tests of the improved design of the block-modular face milling cutter, it can be concluded that when machining on the cutting conditions specified in the methods of testing, this tool design remains operational for at least 130-150 minutes.

Conclusion. On the basis of experimental research, an improved design of block-modular face milling cutter has been developed and laboratory tests have been carried out. A feature of this design is that the cutting block is installed along a cylindrical surface with an stop in the bead, which increases the stiffness of the entire structure. The results of tests of the improved design showed its operability.

REFERENCES

1. Способ установки сменной режущей пластины в режущем инструменте : пат. a2011025 / Н.Н. Попок, В.А Терентьев., Р.С. Хмельницкий, А.В. Сидикевич, И.Я. Сопиков ; дата публ. 12.12.2014.
2. Режущий инструмент : пат. a2011026 / Н.Н. Попок, В.А. Терентьев, Р.С. Хмельницкий, А.В. Сидикевич, И.Я. Сопиков ; дата публ. 12.12.2014.
3. Попок, Н.Н. Совершенствование системы закрепления пластин режущих и блоков резцовых в блочно-модульных режущих инструментах / Н.Н. Попок, А.С. Максимчук, С.А. Портянко // Вестник ПГУ. Сер. В. – 2015. – № 3. – С. 16–22.
4. Попок, Н.Н. Совершенствование конструкций блочно-модульных торцовых фрез на основе исследования характеристик процесса резания / Н.Н. Попок, А.С. Максимчук, С.А. Портянко // Вестник ПГУ. Сер. В. – 2017. – № 3. – С. 22–28.
5. Инструмент металлорежущий. Правила приемки : ГОСТ 23726– 79. – М. : Изд-во стандартов, 1979. – 136 с.
6. Фрезы торцовые с механическим креплением многогранных пластин. Типы и основные размеры : ГОСТ 26595 – 85. – М. : Стандартинформ, 2010. – 8 с.