Cutting tool standardization

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Abstract. The article aims to determine the role of standardization in the engineering industry and for cutting tools in general. This paper explains the basic principles of standardization. The technical committee for standardization of cutting tools (TC 95 ‘Tools’) was presented. The main directions of work and functions of TC 95 ‘Tools’ are explained. Harmonization of standards in Russia is presented on the example of ISO 13399 international standard. The work reveals positive aspects of officially translated versions of standards for enterprises. The article also describes the role of standardized tools when working in computer-aided design systems (CAD).

For a long period of time, the machine-building industry has been one of the priority areas of society development. It is this industry that provides production with all the necessary equipment, tools, machines and other products.

Modern machine-building production imposes very stringent requirements on cutting tools with respect to accuracy and consistency of the dimensions of workpieces, and high durability of metalworking tools [1].

Metal cutting equipment is used in a wide variety of industries and enables the use of various types of cutting tools. Due to the large number of tool types, it is possible to choose the cutting tool that will be the best to perform corresponding operations.

The main criteria for the tool classification are:

- design of the cutting tool;
- type of surface (processed surface);
- principle of interchangeability with the material;
- method of connection with the machine;
- method of application.

To reduce and ensure uniformity and quality, all production elements are standardized in enterprises, and cutting tools are no exception. The requirements of the standards form the quality and competitiveness of engineering products [2]. The main principles in standardization at present are achieving mutual understanding of all interested parties, realizing the possibility of monitoring compliance with the requirements of the standard, compliance of the provisions of the standards with international treaties and the modern level of development of science, and technology, as well as consistency of standards with each other. One of the important tasks of modern standardization is to understand and explain how different standards interact [3].

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It is thanks to standardization through harmonization of regulatory documents and convergence of technical legislation of interested states that technical barriers are eliminated and trade relations between countries expand in various directions, including in the field of mechanical engineering [4].

In the Russian Federation, the work on tool standardization is carried out by TC 95 ‘Tools’ Technical Committee for Standardization. This committee conducts work on harmonization of national standards (GOST R) and interstate (GOST) standards with international (ISO) and regional (EN) standards, and also develops and examines national tool standards. The developed and implemented standards reflect current requirements and characteristics of the cutting tool.

TC 95 ‘Tools’ is a counterpart of ISO TC 29 ‘Tools’ International Organization for Standardization. The TC 95 ‘Tools’ Committee for Standardization includes 8 subcommittees for solving certain tasks related to this area [5]. The composition of the TC 95 ‘Tools’ Committee is shown in Figure 1.

| TC 95 'Tools' | SC 1 'Metal-cutting tool' |
|--------------|---------------------------|
| SC 2 'Bench and assembly tool' |
| SC 3 'Diamond tool' |
| SC 4 'Wood cutting tool' |
| SC 5 'Abrasive tool' |
| SC 6 'Auxiliary tool' |
| SC 7 'Carbide tool and insert blanks' |
| SC 8 'Mechanical processing technology' |

**Fig. 1.** Composition of the TC 95 ‘Tools’ Committee for Standardization

As can be seen from Figure 1, SC 1 subcommittee ‘Metal-cutting tool’ is engaged in the standardization of metal-cutting tools. It corresponds to two technical committees of ISO international organization:

- ISO TC 29/SC2 ‘High-speed cutting steel tools and accessories to them’;
- ISO TC 29/SC9 ‘Tools with cutting edges made of hard cutting materials’.

SC 1 ‘Metal-cutting tool’ specializes in the products presented in Table 1.
Currently, special standards have been developed for the products presented in Table 1. They contain product design standards, basic parameters and characteristics, as well as quality level, methods and conditions of tool operation.

Application of standards enables for mass or large-scale production of cutting tools.

All standards for cutting tools are subdivided into group and local ones. Group standards are designed for specialized cutting tools. They include several different types of such products, which in turn can also be subdivided into standard sizes. Local (brand) standards are intended for one specific product or for the standard sizes of a certain product.

The standards library currently contains over 500 standards for general purpose cutting tools. These standards establish:

- main constructive working dimensions and tool tolerances;
- basic and connecting dimensions of the installation of tools on the machine;
- parameters and technical requirements that determine quality and performance.

The standards also set out methods for controlling the testing and reliability of the cutting tool. In addition, the standards provide for the stamping and packaging of cutting tools.

Standardization has made it possible to manufacture various cutting tools in large batches, since design parameters and dimensions of the tools are standardized and generally accepted.

Currently, ISO 13399 International Standard is widespread. This standard regulates information about the cutting tool and provides information in a neutral format (independent of the manufacturer).

The ISO 13399 standard makes it possible to seamlessly transfer and exchange data between systems, as well as regulate databases from CAD.

ISO 13399 standards ensure the provision of tool data through an information database and facilitate the use and exchange of these data in the design, manufacture and production, as well as distribution and use of tools.

The ISO 13399 standard can be divided into two large groups, which are shown in Figure 2.

### Table 1. SC specialization by type of product, Russian Classification of Products by Economic Activities code 2, area of activity

| Name of TC (SC) | Code RCPEA 2 | SC specialization by type of product (field of activity) |
|-----------------|--------------|--------------------------------------------------------|
| SC 1 ‘Metal-cutting tool’ | 25.73.40.110 | drills |
| | 25.73.40.120 | marking tools |
| | 25.73.40.130 | threading dies |
| | 25.73.40.140 | multiflute drills and counterbore tools |
| | 25.73.40.150 | reamers |
| | 25.73.40.160 | cutters |
| | 25.73.40.170 | circular saws |
| | 25.73.40.180 | broaches |
| | 25.73.40.190 | gear cutting tool |
| | 25.73.40.220 | thread rolling heads and dies |
| | 25.73.40.230 | threading heads |
| | 25.73.40.240 | thread rollers for machine tools |
| | 25.73.40.250 | pipe and oil treatment tool |
| | 25.73.40.260 | blades |
| | 25.73.40.270 | cutting bits and replaceable plates for them |
This division of ISO 13399 standard complex is explained by the fact that the first group contains general information on the cutting tool, and the second group includes reference dictionaries for:

- cutting tools;
- cutter elements;
- adaptive elements;
- prefabricated elements;
- reference systems and general concepts;
- connection systems.

The second group also includes the ISO 13399-100 standard, which provides definitions, principles and methods for reference dictionaries.

ISO 13399 is actively used for data exchange between CAD/CAM systems, PDM/EDM, (MRP) or (ERP) and other computer technologies (CAx) and systems.

The use of this standard simplifies the exchange of data on cutting tools, which in turn can reduce the cost of managing information about tools and more efficiently use production resources.

The ISO 13399-100 International Standard is identical to the GOST R 55341-2012 National Standard of the Russian Federation ‘Representation and exchange of data on cutting tools. Definitions, principles and methods of using the reference dictionary’.

The use of international standards by the world’s leading cutting tool companies enables them to manufacture and sell products in various countries, as these products (cutting tools) are standardized according to international standards, which are used in original versions or harmonized in the national standards of the country.

Having an official translated version also offers certain advantages. One of the positive aspects is description of the cutting tool data in a standardized way. When naming cutting tools, the same parameters and definitions are used, which in turn simplifies the transfer of tool data between different software components.

Summing up, it can be noted that standardization in the engineering industry is a key condition for ensuring safety, quality assurance, and product interchangeability. The widespread use of cutting tools is also the result of application of standardization in manufacturing. A standardized tool facilitates the process of replacing it in production, makes it possible to reduce the economic costs of the enterprise.

A standard tool is included in all equipment information bases. Standardization in the design of products in CAD enables one to choose the most suitable tool at the design stages, as well as calculate all necessary parameters (accuracy, rigidity, vibration resistance, etc.).
It should also be noted that technical committees for standardization play one of the important roles, as they contribute to the development of national standardization systems.

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