

## Technological standardization

I. Kirichenko<sup>1</sup>, M. Morneva<sup>1</sup>, A. Kashura<sup>1</sup>, S. Popov<sup>2</sup>

<sup>1</sup> Volodymyr Dahl East-Ukrainian national university, e-mail: i\_kir@ukr.net,

<sup>2</sup> Poltava national technical Yuri Kondratyuk university, e-mail: psv26@mail.ru

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Summary. The article presents the analysis of modern principles of technological standardization. The output of the main tasks and issues to solve technological standardization, the objects of its activity. Highlight that different types of serial production can use the same principles of standardization and unification, but on a fundamentally different technology machine tool equipment. The output stages of the process, which is used standardization - unification, typification. The selected criteria for evaluation of the effectiveness of standardization, in particular - impact on the technological cycle of production. Solved most progressive use of the preparation process in parallel with the current or the partial mitigation for the release of resources for a new process. The methodology standards development processes - separation from complex to simple to obtain the smallest indivisible elements of technology in compliance with the technological sequence of the entire process, creating databases of standards, the standard process maps, route maps.

Key words: standardization, interchangeability, typification, unified standards, unification, conformity assessment.

### INTRODUCTION

With the increasing complexity and pace of improving the design of machines produced in modern engineering technologies identified two trends on equipment. In mass and large-scale engineering increased use of special automated equipment design virtually irretrievable. This is because the machine is taken in the process chain for limited operations and no need for machine have some functional additional features. Small-scale production can be characterized by multiproduct, frequent turnover and continuous improvement of manufactured products. This requires the use of a universal process equipment, which has great functionality and can provide high-quality processing of different materials, types and products and their components. The cost of universal equipment is much higher than the cost of special. The result is that small and medium businesses are forced to buy more expensive equipment.

### THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

Standardization and block design eliminates the need for each construction equipment separately. A certain number of standardized parts, being the basis of repeated

structural and technological turnover, constructed so that they are included in the appropriate rows, details of which can be manufactured using recustomized process of equipment and tooling [1-5].

The idea of typification processes belongs to prof. Sokolowski. The idea is that the processes are developed not on individual products, and the types of products. Each type of product solves complex technological issues common to all products of this type. Typification processes based on engineering and technological classification of parts, components and installation of machinery typical representatives with the greatest number of features specific to parts and assemblies of this type.

Process of standardization solve the problem:

Unification of structural elements of non-standard equipment and facilities:

- standardization and typification processes,
- implementation of the standard of technical quality control,
- the use of standardized tools, packaging, etc. [6-8].
- The results are recorded in technological standardization effort, technological, regulatory, technical documentation and catalogs. The objects of technological standardization and unification on the basis of common purpose and conditions of individual parts and components, equipment are:
  - cutting, measuring and auxiliary tools,
  - stamps for cold and hot stamping,
  - casting molds,
  - power tools,
  - some elements of parts and components that are often repeated in the designs devices and technological equipment,
  - block construction equipment and tooling.

### THE MAIN RESULTS OF THE RESEARCH

In practice unification under the technological standardization leads to limiting the number of different types in design and size, but equally by their functional parts and assemblies. This creates the opportunity for comprehensive mechanization and automation of technological processes, increasing productivity and quality of products, saving material and labor resources, and consequently reduce costs.

Process of standardization applies not only to the final products, but also for blanks and semi-finished products, in separate operations. For example, multi-

spindle tools, many-stamps, etc. One of the main indicators of efficiency of technological standardization and unification is the technological cycle of production.

Technological preparation of production includes series of works that are associated with the development of manufacturing processes and controls, with design and manufacturing of production, preparation of applications for materials, components of products, equipment, cutting and measuring tools. In addition, if necessary, preparation of production may be associated with the planning or redevelopment of industrial premises, reconstruction, expansion of production facilities, modernization or capital construction. The scale of technological preparation of production depends on the complexity and purpose of reclaimed products, such as production, production adjustment methods [9-13].

The most progressive method of restructuring the production process is a method in which technological preparation of production of new products is carried out in parallel with the acting, without reduction or partial reduction. In the latter case, the resources released to accelerate the technological preparation of production.

Structure technological preparation of production (TPP) - this is the cost for certain types of work to total expenses expressed as a percentage. The main indicator of TPP is cycle, which look like:

$$D = q_1 \cdot T_1 + q_2 \cdot T_2 + \dots + q_{10} \cdot T_{10},$$

where:  $q_1$  – time correction factors that take into account the method works on STP (serial, parallel, series-parallel);  $T_1$  – time for obtaining complete design documentation for new products;  $T_2$  – time to develop plans for organizational and technical measures to reduce the timing of STP;  $T_5$  – time for the development of technological processes of manufacture of parts, assemblies, units of the new product as a whole;  $T_{10}$  – time for the development of manufacturing technology parts, components, assemblies, assembly, testing the first batch of products.

Time correction coefficient established experimental studies and depend on a large number of industrial, technical, organizational and economic factors that are specific to the product and production. Different companies absolute value may vary in large limits, but will always be less than one.

TPP cycle time affects the value of resources (labor, material and financial) spent determines the value of the cost of manufactured products. Reducing the duration technological preparation of production is the subject of constant technical officers. One of the areas of these activities is to increase standardization and harmonization of products of primary production and process technology, process equipment, instruments and equipment at all.

Typification processes - a set of works, which includes systematization and analysis of possible technological solutions in the manufacture of products from each classification group; optima; development for these operating conditions, typical process of manufacturing products each classification group while solving all complex of technological problems. Common

to parts of a typical process, which has only one plan for basic processing operations, the same type of equipment and tooling.

Development of a model of the process can be done in two ways:

- the basis of a specific technological process of manufacturing parts, subject to the option of choice optimal representative,
  - typical manufacturing process developed again.
- The criterion of choice is progressive technology and rational sequence of technological operations.

This standardization of processes performed in two ways:

- typing complex manufacturing processes similar products,
- standardization and standardization of separate technological operations of processing various products.

A typical workflow may be operative and promising.

Operational typical workflow technology reflects the advanced state now.

Promising typical production process involves the further improvement of production taking into account the development of science and technology in the field of technology [14-17]. Typical processes are based on the use of standard equipment.

The basis for the development of standard business processes and operations are typical processes and standards for manufacturing operations. Development of business processes include:

- workpiece classification according to the process of the classifier the appropriate classification group,
- typical for code selection process,
- clarify the structure and sequence of technological operations,
- specification of technological equipment.

When developing processes to original or different types of products using separate standards for manufacturing operations, including the operations of group processing method. Developing standard equipment and, if necessary - special equipment. The introduction of standard working processes carried out according to the procedure established by the company.

To produce different types of parts using typical processes working group developed treatment processes. In the group of machining selecting of technological equipment determined community produced form processing or assembly by group operations, warehouse operations groups, their total labor, structural and technological characteristics of processed products or elements: size, grade of material, shape, elements of home and so on.

Special tooling design based on standard components, assemblies and units.

To develop standard classification processes produce manufacturing operations by separating them from complex to simple to obtain the smallest indivisible elements of technology in compliance with the technological sequence of the process. Each indivisible element or transaction process standard developed by the company in the prescribed form, often in the form of standard flow chart. The standard established a comprehensive description of all the passages of which

formed this elementary operation, with all necessary explanations and notes. The paper presents drawings or sketches, taking into account design features, specified equipment, tools, industrial equipment, processing modes, materials, technical means and methods of quality control.

Besides common standards on processes that are completely filled with the necessary data, create database standards, with partial filling [10, 18-21]. They indicated only technological sequence of works. Counts for equipment, tools, industrial equipment, processing modes, materials, tools and methods of quality control remain vacant. For details of every size column filled with pure technologist.

To get a comprehensive standard technology in some form of work includes route maps, defining the standards of the enterprise operating room. Standardized typical workflow operation or set of operations, and individual treatment of surfaces, called the technological standard of the company.

As an example, consider the method of developing standards on typical production processes billets by casting. Analysis of the nomenclature of castings and their production processes shows that 80 to 90% of the Count process maps filled with identical data repeated. Regardless of the type of product and type casting developed technological documentation for: model making kit, kit assembly, production and application of refractory coatings, refractory coating drying, production of molding compounds, metal smelting and casting, cleaning preparations, heat treatment and quality control. Because technological standards on full production castings are equipped with standard postoperative processes. If necessary, some typical operations are projected in several variants.

The basis of the method of aggregation is geometric and functional interchangeability separate units, each of it can be used when you are creating layouts of equipment of the same dimension-type series. Block is a logical continuation of the development and unification.

Under the unification according to GOST 2395 means "bringing products to establish uniformity based on their varieties rational number." The goal of unification is to reduce the diversity of products, machines, components, assemblies and parts to reduce the diversity of systems in which these facilities are made or used. So block based on research opportunities reusable uniform and standard elements in different combinations and creating with them a large variety of design solutions that provide the functionality.

Technological equipment based on an interchangeable standard and uniform elements, which has the property of turnover due to repeated re-use of the same elements in the new layout by changing the design or replacement of the processed product.

Any aggregate machine can be assembled with standard and standardized units and at least includes: base, spindle, gear drive spindle, a table of the power supply, drive supply, runners of desktop power supply, pitch table drive sled, units and control panels etc. Such equipment may be in the short term partly or completely dismantled, and included in his uniform and standard elements used in new combinations to create new equipment. That is, the present set of elements can get the

opportunity of turning, vertically and horizontally Milling, drilling and grinding.

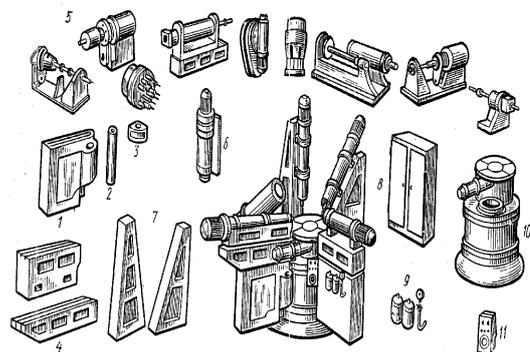
One of the progressive trends of standardization and aggregation process equipment is creation of quickly retuning specialized tools and automatic transfer lines with their layout standardized and unified units, assemblies and parts. These lines provide for their rapid readjustment to produce similar products. For example, the use of specialized manufacturing center firm "Mauser" in PA "Hydraulics" replaced a machine shop job processing shaft, which was equipped with special metal-cutting machine tools. The use of such equipment is effective when the products now produced a classification group. Fast readjustment line allows to make all the details of a classification group.

The greatest effect of the use paclaged processing equipment can be obtained when processed before designing sizes based on the classification analysis in related groups of products. Experience in aggregation process equipment shows that the level of standardization and unification of design elements such equipment may be reduced to 85-90% of total input in these units, assemblies and parts.

The major advantage of the method of block based on standardization and unification of elements are:

- reduction ten times existing diversity of types and sizes of all the main structural elements,
- concentration of production of the same type of uniform and standardized elements at specialized enterprises with the provision of high quality,
- reducing the cost of complex equipment 3 - 4 times for the manufacturing of products,
- reducing the time to create special tools 2 - 3 times,
- increase productivity,
- reduce the cost of products,
- shortening process cycle of technological preparation of production.

Fig. 1 shows the separation of metal-cutting machine.



**Fig. 1.** Scheme of separation metal-cutting machine into individual interchangeable units: 1 – ground, 2 – axle, 3 – shoes, 4 – intermediate plate, 5 – nozzles, 6 – power head, 7 – tilting brackets, 8 – electrical cabinet, 9 – filter for oil tank, 10 – pitch table, 11 – benchboard

Unification machine tool adaptations applies to types of construction, basic dimensions and parameters of devices and systems, components, materials, coatings,

standards of accuracy, etc. Appropriate standardization of machine tool adaptations elements: details, if they are designed for one purpose, units that perform the same functions with minor differences in sizes, dimensions and operating parameters, configurations for the production of standard parts close to the dimensions provided identity-based schemes during processing; accessories for rigging typical operations, if they are similar in design schemes, operating conditions and dimensions.

Machine-tool accessories, their parts and components considered standardized if their design provides:

- equipping the optimal number of transactions,
- layout corresponds to a typical and unified,
- unified in design and mounting base surface and size.

A complex machine tool adaptations considered uniform if the minimum range of standardized designs provides standard solutions based on the maximum number of operations for the manufacture of various parts.

Integrated unification of devices includes:

- dimensional unification of similar devices, components and parts from different main and connecting parameters and provides efficient reduction of size options similar functionality,
- typical unification of devices, parts and components with the same basic parameters, but various design modifications,
- reduction in the types of devices similar functionality,
- size-typical unification of devices, components and parts that have no structural similarity and different basic parameters,
- Modification unification of basic models by the layout of devices of different types.

Machine-tool accessories classified according to various criteria.

With comprehensive destination unification installed devices:

- in appearance timber processing: turning, milling, etc.,
- on the range of products and blanks specifics of their home,
- in appearance and range of operations: special adjustment, universal, specialized, etc.,
- on the number of simultaneously machined blanks: single device, multi.

According to the principle of building construction accessories are divided by: the method of collection, detailed hotel, and blended aggregate.

Product design adjustments are determined by:

- spatial configuration and dimensions of machined pieces,
- coordinating pieces during processing axis of the cutting tool,
- specific deployment schemes,
- functional parts of the device are determined by the nature of their contact with the workpiece. On this basis the parts are divided into basic, clamping and base case design.

In carrying out the unification of machine devices should:

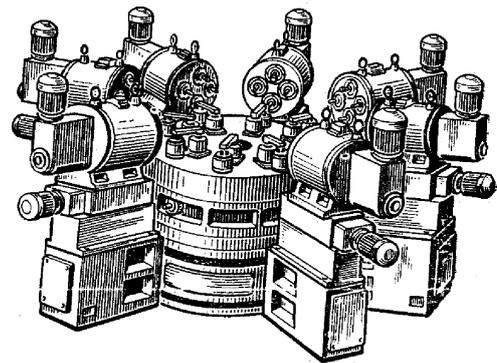
- perform analysis of the technical literature and documentation,
- select options, which made unification,
- select from among the main parameters of unification,
- to establish the most efficient number of dimensions for the types and structures,
- choose the most advanced design and on their basis to develop standardized,
- develop proposals for the organization of production,
- perform a comparative analysis of standardized structures and devices that previously used.

Unification of technological devices is most effective in the complex work related to the unification of elements typical processes on the basis of a single system of classification and coding. Factory unification tool machine adaptations seen in a single enterprise scale.

In unification it is supposed to work on specific machining equipment, which is designed to equip a separate production area.

Unified system of technological preparation of production involves the creation, production and use of technical equipment, than recustomizing. This is because 60% of the cost of production technological preparation and formulation of new products to manufacture concerned with the design and manufacturing of industrial equipment. Experience of advanced industrial technology shows that an advanced engineering company form of organization is the use of different types of universal collective technological equipment (UCTE), which reduces the cycle of technological preparation of production in 2 - 3 times.

In quicky adjustable layout tools are used revolving drum head and rotary table that is running timber, as shown in fig. 2.



**Fig. 2.** Assembly quicky adjustable with drum machines revolving heads and rotary table

The difference between these machines pagled of process equipment that changes to functionality no need to perform assembly and folding operations for the preparation of such equipment. To perform operations for processing workpieces at a facility required the unified and standardized tooling.

Technological equipment level of standardization and harmonization divided into two categories. The first is cutting, measuring, and auxiliary instrument for which developed national standards and enterprise standards.

The second category consists of all kinds of stamps, foundry and forge equipment, machine tools, assembly and welding accessories. These types of equipment in engineering have a low level of standardization and harmonization of less than 10%.

Standard accessories form a versatile team of special technological equipment. Mainly used ten such systems.

1. A special not folding machine accessories, standard parts and pieces complexes (NMA) containing standard parts, components, assemblies blanks for different devices. The use of this system appliances ensures high performance and precision machined blanks and deployment products.

2. The system of special universal modular machine accessories adaptations of standard parts and units (UMA). Equipment manufacturing operations adaptations PSM requires designing and manufacturing. UMA (fig. 3) contains complex parts and assemblies with universal base surface for assembly and configurations turning, milling, grinding, welding, assembly and other devices.

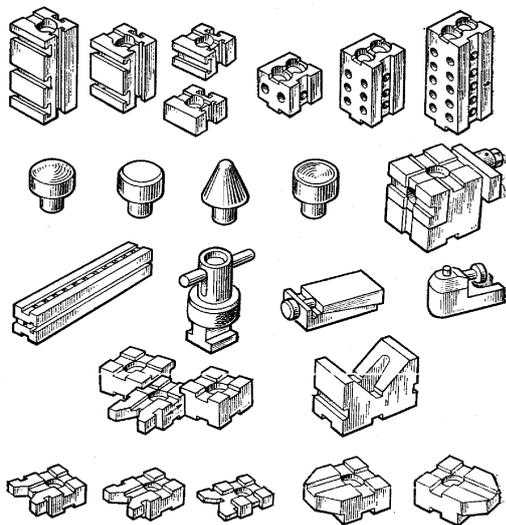


Fig. 3. Elements universal modular system UMA machine tool adaptations

Fig. 4 shows the assembly UMA.

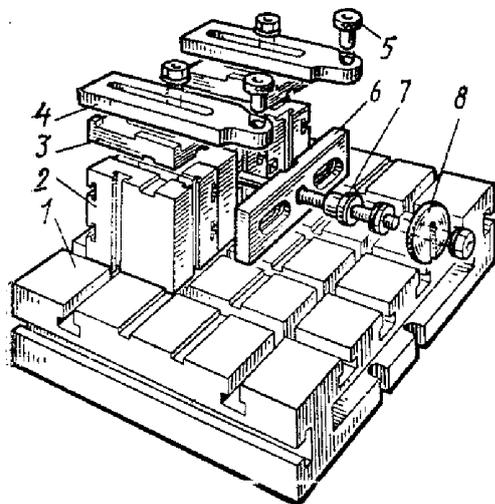


Fig. 4. Scheme build prefabricated universal machine tool accessories: 1 – square plate, 2 – rectangular pillar, 3 – support,

4 – installation plate, 5 – quick-sleeve, 6 – adjusting plate, 7 – adjusting finger, 8 – quick-washer

3. The system of special collapsible machine tool adaptations of the standard units complexes containing units with universal basic and specialized surfaces for assembly configurations milling, turning, grinding and other devices. Provides accurate deployment machined workpieces, quick readjustment and recompaining.

4. The system of universal standard machine tool adaptations requires design and production, and provides complex supply universal devices, lathe chucks, machine vise, rotary tables and dividing and racks, magnetic, electromagnetic devices and other devices complete with equipment. The adaptation of the system provide basing machined blanks with subsequent control of the installation.

5. The system universal standard adjusting tool machine adaptations complexes containing milling, sverlilnyh, boring, turning and other devices with a universal base surfaces, providing installation and deployment naladok to consolidate different pieces. This system can produce rapid readjustment to equip new technological operations.

6. The system of standard commissioning specialized machine tool adaptations (contains complexes of turning, grinding, milling and other devices with specialized base surfaces. This system provides accurate deployment machined workpieces, high performance and rapid transition to new equipment manufacturing operations.

7. The system of standard machine tool fixtures mechanization facilities include mechanized and automatic components and assemblies, drives, drive devices, hopper, mechanical and other components. This system provides increased productivity and product quality.

8. System standard folding special equipment for foundry production includes special folding systems standard equipment and special items for manufacturing sandy forms, bars, devices for casting metal. System of standard parts and pieces for production complexes containing the standard components, blocks, stamps, blanks packages, punches, matrices and others.

9. The system of standard debugging the specialized equipment for injection molding and dies billet production complexes contain standard debugging the specialized equipment for manufacturing sandy forms production rods for casting under pressure and under replaceable units stamps packages blocks molds, variable packages molds and dies.

10. The system of universal collective equipping of standard parts and units includes complex parts and assemblies with universal base surface for assembly equipment configurations and adaptations, as well as blocks of stamps with runners speakers without them, bracket like bags and packages variables open.

CONCLUSIONS

1. The main areas of cycle times of technological preparation of production are: getting the design documentation for new products; drawing up plans for organizational and technical measures in all departments of the company; use of statistics cycle time of

technological preparation of production; drawings use uniform standard and non-standard items of equipment, technological equipment, cutting and measuring tools; standardization processes of manufacturing parts, components, assemblies, new products in general; technologists parallel operation of main and auxiliary production; use of standard, uniform units, parts and components, involving the production of non-standard equipment, tooling, cutting and measuring tools main production.

2. Overall organization of technological preparation of production - multifaceted task that can be solved at different times, with different resources.

3. Typification and grouping processes allow standardized technical requirements for the design of products and their components; significantly reduce the amount of technical documentation, reduce the length and complexity of development processes; increase specialization of production. All together would reduce the length of technological preparation of production. Handling the details on models and group manufacturing processes makes it possible to widely implement equipment with numerical control, variable-flow line and specialized processing details.

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#### ТЕХНОЛОГИЧЕСКАЯ СТАНДАРТИЗАЦИЯ

И. Кириченко, М. Морнева, А. Кашура, С. Попов

Аннотация. В статье приведен анализ современных принципов технологической стандартизации. Выведены основные задачи и вопросы, которые должна решать технологическая стандартизация, объекты ее деятельности.

Выделено, что для разных видов серийного производства могут использовать одинаковые принципы стандартизации и унификации, но на принципиально различном технологическом станочном оборудовании. Выведены этапы технологических процессов, на которых применяется стандартизация - унификация, типизация. Выделенные критерии оценки эффективности применения стандартизации, в частности - влияние на продолжительность цикла технологической подготовки производства. Раскрыто наиболее прогрессивное использование подготовки технологического процесса параллельно с действующим или при частичном его снижении для высвобождения части ресурсов для нового технологического процесса. Проанализирована структура технологического процесса. Приведены понятия оперативности и перспективности технологических процессов. Рассмотрена методология разработки стандартов технологических процессов - разделение от сложного к простому до получения мельчайших неделимых элементов технологии с соблюдением технологической последовательности всего процесса, создание баз стандартов, стандартных технологических карт, маршрутных карт.

Ключевые слова: стандартизация, взаимозаменяемость, типизации, единые стандарты, унификация, оценка соответствия.