ENSURING THE COST OF CNC MACHINES.

Gafurov Akmaljon Mavlonzhonovich
Fergana polytechnic insitute, PhD

Kuchkorov Sobirzhon Karimzhonovich
NamECI, PhD

Nomanjonov Sohibjon Nomanjon coals
Fergana polytechnic insitute, PhD

Matkarimov Behzod Bakhtiyorzhon coals
Fergana polytechnic insitute, PhD

Abstract. In order to achieve high performance from the equipment and all its major modules and components, it is important to understand that this can only be achieved with high quality and value.

Аннотация. Чтобы добиться высокой производительности оборудования и всех его основных модулей и компонентов, важно понимать, что этого можно добиться только при высоком качестве и стоимости.

Keywords: strength parameters, diagnostics, models, cutting area, strength, durability, stamping, stamping form, cutting parameters.

Ключевые слова: прочностные параметры, диагностика, модели, зона резания, прочность, долговечность, штамповка, форма штамповки, параметры резания.

In order to achieve high performance from the equipment and all its main modules and components, it is important to understand that this can only be achieved with the help of quality and accuracy of parts.

Considering various studies in this area, we see that the most difficult to manufacture are parts that have large dimensions.

The processing of parts of units at the stage of semi-finishing and finishing work, in the standard mode, is carried out mechanically, for which cutters are often used when turning, sharpening, facing, milling, etc. such an option as diamond-abrasive, finishing-ordered surface treatment of parts, which has a plastic structure, is also used.

The work of many well-known researchers of this issue is devoted to the influence of a metal-cutting machine on the accuracy of processing.

It is possible to ensure the accuracy of the parts of the unit only if such parameters as the accuracy of the configuration (shape), size and position of the surfaces of the part are set.

Considering many scientific papers on this topic, you can avoid common mistakes that can cause a violation of the geometric accuracy of the part. Here we include:

1. An error in the installation of the workpiece of the part, which is characterized by incorrect basing data, which manifested itself against the background of a discrepancy between the technology and the measurements taken; corrections of flaws that appeared due to the efforts that were made to install the workpiece and fix it; incorrect fastening, which follows directly from the quality of the fastening tools; wear of all elements, equipment support devices, etc.

2. Incorrect hardware settings.

3. Flaws that appear due to the use of old and worn out cutting elements.

4. Errors due to the effort required to set the desired cutting force.

5. Errors occurring against the background of deformation of the technological module due to exposure to high temperature.

6. Errors due to the residual stress of the processed element against the background of deformation of the technological base, as a result, their mutual position is violated.

7. Errors that occur against the background of geometric violations of the specified parameters, which include inaccuracies in the installation of equipment, obsolescence of the main components, wear of parts, cutters, etc.

In order to ensure the accuracy of the part, it is necessary to understand that the fluctuations in the total error should not exceed the allowable limits. You should also take into account such a moment as the shape of the part, shape tolerances, which often depend on which specific parts can be produced on this equipment. If there are no additional requirements in the instructions, then everyone applies the standard discrepancies - from 40 to 60% of the size tolerance.

Part of any of the errors that are included in the dimensional tolerances may differ from each other, many have dynamic (non-constant) parameters.

The temperature inaccuracy of each type of equipment is different from each other. It all depends on its configuration. The equipment taking part in the test is stacked vertically, as shown in Figure 1. Figure 2 clearly demonstrates the general concept of creating its thermal error and that of equipment that has similar technical parameters to it.

The temperature inaccuracy of equipment in a general sense can be considered as a block vector. To create this value, two pieces of equipment are used: tool direction one and tool direction second, as shown in Figure 2.3. In the process of creating inaccuracies in the direction of the tool, such structural elements as the vertical stand BC, the SHG spindle head, which is also called the drill head, the spindle assembly, the cutting part of the tool, etc., take part. In the part of the tool, there is also the surface of the equipment (table), additional equipment and the product itself, which should be processed. We note that the moving parts of the equipment are the spindle, table and head. Therefore, in order to put into practice workflows, drives should be used that will provide the on and off stages, as well as other parts of the equipment (vertical column drive, spindle head, etc.).

Studying this scheme for the appearance of temperature inaccuracies from the point of view of the operating control system, which is similar to the parameters of the tuning scheme and has feedback, then the control program will work as the main equipment, which is given the prerequisites for all settings of devices working with CNC. The control program consists of a variety of data about the directions in which the movement of all parts of the equipment. This data is converted into digital software, which is distributed into appropriate signals that appear on the feed drives along the verticals of the equipment, which helps to guide the work of the working parts of the equipment, while taking into account the inevitable transformation inaccuracies that will result from the automatic CNC system. The equipment is a three-coordinate machine, which operates due to three independent drives, each of which operates on its own coordinate axis. But the design features of the technique are such that there is a general inclusion of the drives of the vertical rack and the spindle head, as shown in Figure 2.2. This fact says that from one point of view, the drive of the vertical column and the spindle of the head come into operation in parallel, but then there is a moment when their signals are summed up and one of them takes part in the formation of inaccuracies. A spindle head that moves in a vertical direction relative to a vertical column receives the addition of signal inaccuracy in the face of the fact that the guiding parts of the equipment have finite rigidity. This situation leads to the fact that a new signal manifests itself. The spindle assembly is built into its head. Due to the fact that the unit has a sleeve design, the inaccuracy of the flange mounting, as well as the softness of the supports, cause an increase in the processing inaccuracy along the Z axis, which ultimately causes a signal violation. In order to apply the cutting process, it is important to use additional equipment, which is the cutting part and the mandrel, which is located in the spindle assembly in the direction of the conical plane. And this is also the reason for the development of additional inaccuracies in the new signal. The cutting part of the tool comes into contact with the mandrel at a certain compliance, which becomes the impetus for the appearance of a signal.

Therefore it turns out that:

$$X_T - X'_T - X_{П} - X_{Cm} - X_O - X_Д$$

The total processing error, excluding basing errors, can be defined as the length of the vector:

$$R(t) = \sqrt{\left(X - X'(t)\right)^2 + \left(Y - Y'(t)\right)^2 + \left(Z - Z'(t)\right)^2} + + \sqrt{\Delta X_u(t)^2 + \Delta Y_u(t)^2 + \Delta Z_u(t)^2}, \quad (1)$$

где $\sqrt{\Delta X_u(t)^2 + \Delta Y_u(t)^2 + \Delta Z_u(t)^2}$ - component of the machining error due to wear of the cutting edges of the tool.

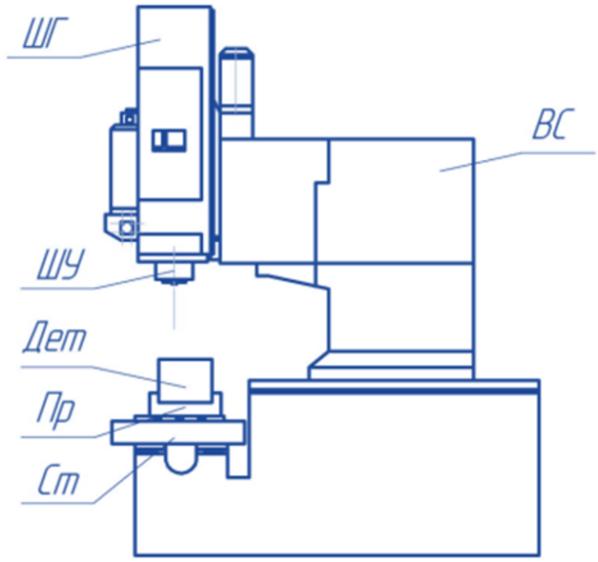

Figure 1. – Machine layout

УП- control program; CNC - numerical control system;

ТП – machine temperature error

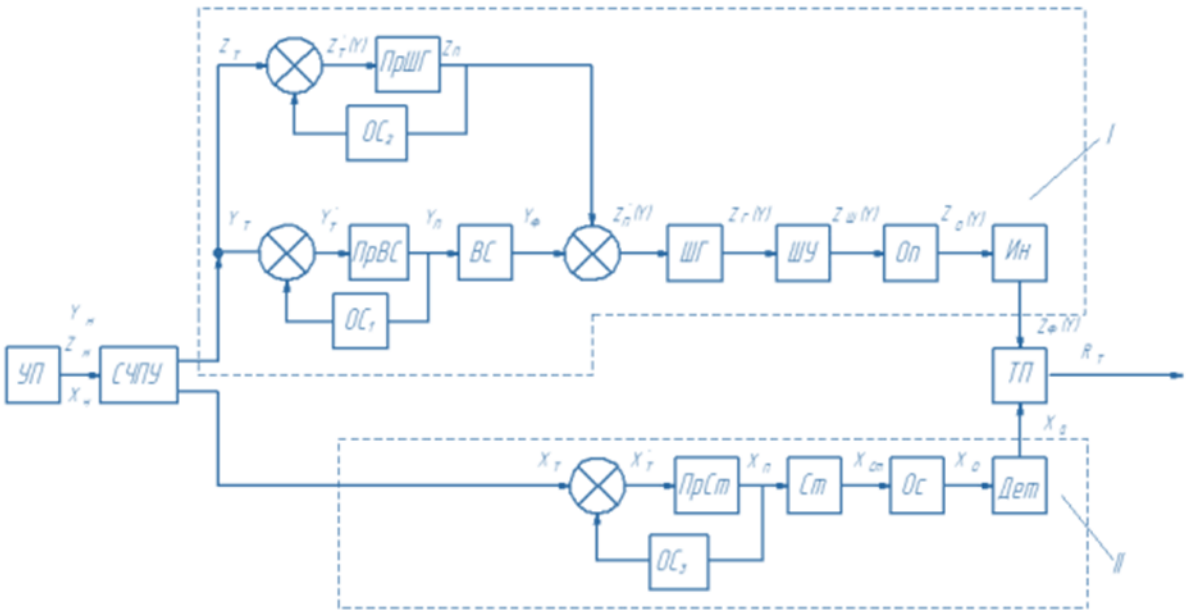

Figure 2. – Functional diagram of the formation of temperature inaccuracy of equipment

The absence of a load from the cutting process creates a machining error R_o that differs from the machining error R:

$$R_o(t) = \sqrt{\left(X - X'(t)\right)^2 + \left(Y - Y'(t)\right)^2 + \left(Z - Z'(t)\right)^2} \quad (2)$$

$X'(t), Y'(t), Z'(t)$ - the actual coordinates of the reference points, formed on idle moves of the machine.

In equations (1) and (2), the actual coordinates are functions of time, which is due to the metalworking technology. The discrepancy between the values of the actual coordinates is due to elastic processes in the technological system during cutting:

$$\Delta X_y(t) = X'(t) - X_T'(t), \Delta Y_y(t) = Y'(t) - Y_T'(t), \Delta Z_y(t) = Z'(t) - Z_T'(t), \quad (3)$$

$\Delta X_y, \Delta Y_y, \Delta Z_y$ – displacement of the actual coordinate values due to elastic processes during cutting.

The tests carried out by the researcher showed that the cutting forces do not lead to additional heat generation. And under the conditions of slight fluctuations in the value of the removed layer of material with a small chip thickness, one can accept the constancy of displacements ΔX_y, ΔY_y, ΔZ_y. If we introduce a load as an argument in the functions ΔX_y, ΔY_y, ΔZ_y, then we can accept:

$$\Delta X_y(t, P) = const; \; \Delta Y_y(t, P) = const; \; \Delta Z_y(t, P) = const \quad (4)$$

If the influence of tool wear is excluded in the evaluation of the machining errors of the part, then the error of the machine tool operating under load can be estimated as follows:

$$R_{CT}(t) = \sqrt{\left(X - X'(t)\right)^2 + \left(Y - Y'(t)\right)^2 + \left(Z - Z'(t)\right)^2} \quad (5)$$

or taking into account (3) and (4) can be rewritten as:

$$R_{CT}(t) = \sqrt{\left(X - \Delta X_y - X_T'(t)\right)^2 + \left(Y - \Delta Y - Y_T'(t)\right)^2 + \left(Z - \Delta Z_y - Z_T'(t)\right)^2} \quad (6)$$

In expression (6), the components ΔX_y, ΔY_y, ΔZ_y are taken not as functions, but as fixed values obtained taking into account the results of field experiments.

We introduce new notation:

$$\Delta X_T = X - X_T'; \; \Delta Y_T = Y - Y_T'; \; \Delta Z_T = Z - Z_T'; \quad (7)$$

Based on the physical principle of forming the coordinates 〚X,X〛_T', 〚Y,Y〛_T' and 〚Z,Z〛_T', the introduced designations (7) represent coordinate temperature displacements at machine idle. Taking into account the accepted notation (8), we obtain:

$$R_{CT}(t) = \sqrt{\left(\Delta X_T(t) - \Delta X_y\right)^2 + \left(\Delta Y_T(t) - \Delta Y_y\right)^2 + \left(\Delta Z_T(t) - \Delta Z_y\right)^2} \quad (8)$$

Thus, the error of a machine operating under load can be determined from the values of the coordinate components of compliance and coordinate temperature displacements.

In the course of a full-scale experiment, when using traditional contact measuring instruments, for example, indicator heads, information about the temperature deformations of the machine carrier system comes in the form of separate coordinate shifts:

$$\Delta X_{T_y}(t) = \Delta X_T(t) - \Delta X_y;\ \Delta Y_{T_y}(t) = \Delta Y_T(t) - \Delta Y_y;\ \Delta Z_{T_y}(t) = \Delta Z_T(t) - \Delta Z_y\ , \quad (9)$$

$\Delta X_{T_y}(t), \Delta Y_{T_y}(t), \Delta Z_{T_y}(t)$ - thermoelastic coordinate displacements.

Thus, from relations (9) it follows that the temperature error of the machine can be estimated by separate components ΔX_Ty (t), ΔY_Ty (t) and ΔZ_Ty (t). Accordingly, the compensation of the temperature error of the machine can be implemented by introducing the correction of the coordinates of reference points [193] in the control program by the following values: ΔX_Ty (t), ΔY_Ty (t) and ΔZ_Ty (t).

At the same time, if the temperature displacements ΔX_T (t), ΔY_T (t) and ΔZ_T (t) for a particular machine are sufficiently invariant values and fall within a certain tolerance, then the values of the elastic components ΔX_y (t), ΔY_y (t) and ΔZ_y (t) are dependent on many factors associated with the cutting process. Among the most significant factors are the depth of cut, cutting speed, feed, as well as the geometric parameters of the tool, the physical properties of the processed and tool materials.

REFERENCES

1. Ш.Н.Файзиматов., Гафуров А.М. Support of Software Projects at Local Industrial Enterprises. International Journal of Advanced Research in Science, Engineering and Technology Vol. 6, Issue 12, December 2019, 12320-12328 p.

2. Ш.Н.Файзиматов., Гафуров А.М. Investigation of the manufacturing process of stamp forms in mechanical Engineering. International Journal of Advanced Research in IT and Engineering Vol. 10, Issue 12, December 2021, ISSN: 2278-6244 Impact Factor: 7.436 82-90 p.

3. Гафуров А.М., С.Ш.Рахмонов., А.А.Мусажонов. Study of the efficiency of methods of reconstruction of shaped faces. International Journal of Advanced Research in IT and Engineering Vol. 10, Issue 12, December 2021, ISSN: 2278-6244 Impact Factor: 7.436 101-112 p.

4. Ш.Н.Файзиматов., С.Б.Булгаков., Гафуров А.М. Ways to increase stability of stamps in improving working designs. Tashkent state Technical University named after Islam Karimov, Technical Science and Innovation, Tashkent 2021, №3(09)/2021., 263-267 p.

5. Ш.Н.Файзиматов., С.М.Юсупов., Гафуров А.М. Махаллий ишлаб-чиқариш корхоналарида автоматлаштирилган лойиҳалаш тизимлари. Фарғона политехника институти «Илмий-техника журнали» ФарПИ махсус сони №1. Том 24. 2021 йил, 52-56 бетлар.

6. Ш.Н.Файзиматов., С.М.Юсупов., Гафуров А.М. Автоматлаштирилган

лойихалаш тизимларидан фойдаланиб мураккаб юзали деталларга ишлов бериш усуллари. Фарғона политехника институти «Илмий-техника журнали» ФарПИ махсус сони №1. Том 24. 2021 йил, 56-60 бетлар.

7. Ш.Н.Файзиматов., Гафуров А.М. РДБ дастгохларида мураккаб сиртларни кўп координатали фрезалаш самарадорлигини ошириш истиқболлари. Андижон машинасозлик институти «Илмий-техника журнали» АндМИ 2020 йил, 1-сон август 37-43 бетлар.

8. Ш.Н.Файзиматов., Гафуров А.М. Improving the productivity of methods for processing shaped surfaces. Наманган мухандислик-қурилиш Институти «Механика ва технология илмий журнали» 2021 йил. №2, 104-110 бетлар.

9. Ш.Н.Файзиматов., Гафуров А.М. The importance of CAD/CAM/CAE application development. Наманган мухандислик-қурилиш Институти «Механика ва технология илмий журнали» 2021 йил. №2, 110-116 бетлар.

10. Гафуров А.М., С.Ш.Рахмонов., А.А.Мусажонов. Automated design systems in local manufacturing plants. INNOVATIVE ACHIEVEMENTS IN SCIENCE 2021*:* a collection scientific works of the International scientific conference (9th November, 2021) – Chelyabinsk, Russia : "CESS", 2021. Part 3, Issue 1 – 105-112 p.