ISNN 3030-3907

2026
MAY
ISSUE - 5
VOLUME - 4

DEVELOPMENT OF SCIENCE

scientific journal



Development of science

Ilmiy jurnal

MAY 2026
Issue - 5, VOLUME - 4

ISSN 3030 -3907

Ilmiy jurnal OAK rayosatining 2024 yil 27 sentabrdagi 361-son qaroriga asosan 02.00.00 kimyo fanlari hamda 2025 yil 12 fevral 367- son qaroriga asosan 05.00.00 texnika fanlari bo‘yicha falsafa doktori (PhD) va fan doktori (DSc) ilmiy darajasiga talabgorlarning dissertatsiya ishlari yuzasidan dissertatsiyalari asosiy ilmiy natijalarini chop etish tavsiya etilgan milliy ilmiy nashrlar ro‘yxatiga kiritilgan.

BOSH MUHARRIR:
Temirov Alisher Hoshim o‘g‘li – texnika fanlari falsafa doktori (PhD),Dotsent.
TAHRIRIYAT KENGASH RAISI:
Fozilov Sadriddin Fayzullayevich – texnika fanlari doktori, professor
TAHRIRIYAT KENGASH A’ZOLARI

TEXNIKA FANLARI/ TECHNICAL SCIENCES/ ТЕХНИЧЕСКИЕ НАУКИ

Bozorov G‘ayrat Rashidovich
Buxoro Davlat Texnika Universiteti, professor
Abdurahmonov Olim Rustamovich
Buxoro Davlat Texnika Universiteti, professor
Adizov Bobur Zamirovich
O‘zbekiston Respublikasi Fanlar akademiyasi Umumiy va noorganik kimyo instituti, professor
Hayitov Ruslan Rustamjonovich
Buxoro Davlat Texnika Universiteti, professor
Jumayev Qayum Karimovich
Buxoro Davlat Texnika Universiteti, professor.
Berdiyev Dorob Murodovich
Islom Karimov nomidagi Toshkent Davlat Texnika Universiteti, professor
Maxmudov Rafiq Amonovich
Buxoro Davlat Texnika Universiteti, professor.
Tilloyev Lochin Ismatilloyevich
Buxoro Davlat Texnika Universiteti, dotsent.
Raxmonov Qahramon Sanakulovich
Buxoro Davlat Texnika Universiteti, dotsent.
Barakayev Nusratullo Rajabovich
Islom Karimov nomidagi Toshkent Davlat Texnika Universiteti, professor.
Jo‘rayev Xayrullo Fayziyevich
Buxoro Davlat Texnika Universiteti, professor.
Panoyev Erali Rajabboyevich
Buxoro Davlat Texnika Universiteti, dotsent.
Ataullayev Sherzod Nabiullyevich
Buxoro Davlat Texnika Universiteti, dotsent.
Murodov Malik Negmurodovich
Buxoro Davlat Texnika Universiteti, dotsent.
Axmedova Ozoda Bahronovna
Islom Karimov nomidagi Toshkent Davlat Texnika Universiteti.
Safarov Bahri Jumayevich
Buxoro Davlat Texnika Universiteti, dotsent.
Xaydarov Axtam Amonovich
Buxoro Davlat Texnika Universiteti, dotsent.
Safarov Jasur Alijon o‘g‘li
Buxoro Davlat Texnika Universiteti, dotsent.

KIMYO FANLARI/ CHEMICAL SCIENCES/ ХИМИЧЕСКИЕ НАУКИ

Axmedov Voxid Nizomovich
Buxoro Davlat Texnika Universiteti, professor
Umarov Baqo Bafoyevich
Buxoro Davlat Universiteti, professor
Kodirov Abduaxad Abduraximovich
Qarshi davlat Universiteti, professor
Qurbonov Mingniqul Jumagulovich
Qarshi davlat Universiteti, dotsent
Turemuratov Sharibay Naurizbaevich
O‘zbekiston Respublikasi Fanlar akademiyasi Qoraqalpog‘iston bo‘limi Bosh ilmiy kotibi, professor
Tursunov Kaxor Shonazarovich
Qarshi davlat Universiteti, professor
Do‘stov Hamro
Buxoro Davlat Texnika Universiteti, professor
Panoyev Nodir Shavkatovich
Buxoro Davlat Texnika Universiteti, dotsent.
Olimov Bobur Bahodir o‘g‘li
Buxoro Davlat Texnika Universiteti, dotsent.
Kasimov Sherzod Abduazimovich
Termiz Davlat Universiteti, professor.
Aliqulov Rustam Valiyevich
Termiz Davlat Universiteti, professor
Tropov Xamza Tursunovich
Samarqand Davlat Universiteti, professor

IQTISODIYOT FANLARI/ ECONOMICS/ ЭКОНОМИЧЕСКИЕ НАУКИ

Nizamov Aslitdin Badreddinovich
Buxoro Davlat Texnika Universiteti, professor.
Boboyev Akmal Choriyevich
Buxoro Davlat Texnika Universiteti, professor.
Ergashxojayeva Shaxnoza Djasurovna
Toshkent davlat iqtisodiyot universiteti, professor
Saidaxmedova Nodira Ilxomovna
Toshkent davlat iqtisodiyot universiteti, professor
Muxsinov Bekzod Toxirovich
Buxoro Davlat Texnika Universiteti, dotsent.
Shakarov Qulmat Ashirovich
Renessans ta'lim universiteti,dotsent.
Jumaeva Zulfiya Qayumovna
Buxoro Davlat Texnika Universiteti, dotsent.
Norova Salomat Yusupovna
Buxoro Davlat Texnika Universiteti, dotsent.
Avezova Shaxnoza Maxmudjonovna
Buxoro Davlat Texnika Universiteti, dotsent.
Jalilov Jamshid G‘anijonovich
Toshkent davlat iqtisodiyot universiteti, dotsent
Xasanova Gulruh Djumanazarovna
Buxoro Davlat Texnika Universiteti, dotsent.

PEDAGOGIKA FANLARI/ PEDAGOGICAL SCIENCES / ПЕДАГОГИЧЕСКИЕ НАУКИ

Siddiqova Sadoqat G‘afforovna
Buxoro Davlat Texnika Universiteti, dotsent.
Zoyirov Erkin Xalilovich
Buxoro Davlat Texnika Universiteti, DSc, professor
Gaffarov Feruz Hasanovich
Puchon Universiteti, *professor*
Ruziyev Davron Yuldashevich
Buxoro Davlat Universiteti, professor
Muradova Firuza Rashidovna
Buxoro Davlat Texnika Universiteti, professor.
Yunusova Gulandon Samiyevna
Buxoro Davlat Texnika Universiteti, professor.
To‘xtayeva Zebo Sharifovna
Buxoro Davlat Texnika Universiteti, professor.
Navro‘zova Gulchixra Nigmatovna
Buxoro Davlat Texnika Universiteti, dotsent.
Uzoqova Laylo Polvonovna
Buxoro muhandislik – texnologiya instituti, dotsent.
To‘raqulova Marjona Qiyom qizi
Buxoro Davlat Texnika Universiteti, dotsent.
Muradova Zarina Rashidovna
Buxoro Davlat Texnika Universiteti, dotsent.
Murodov Sanjar Aslonovich
Buxoro Davlat Texnika Universiteti, dotsent.
Shodiyev Jahongir Jo‘raqulovich
Buxoro Davlat Texnika Universiteti, dotsent
Gaffarov Laziz Hasanovich
Buxoro muhandislik – texnologiya instituti, dotsent.

Tahririyat a’zolarning to‘liq ro‘yxati jurnalning www.devos.uz saytida keltirilgan.

Tahririyat hay’ati a’zolarining tarkibini o‘zgartirish hamda qo‘shimcha kiritish yoki tahririyat a’zoligidan chiqarish bosh muharrir tomonidan amalga oshiriladi.

ISSN 3030-3907

Development of science ilmiy jurnali 2024 yil 15 aprel kuni №256445 sonli guvohnoma bilan Davlat ro‘yxatidan o‘tgan.

To‘plam elektron ko‘rinishda (pdf formatida) mualliflarga taqdim etiladi. To‘plamga kiritiladigan maqolalarning mazmuni, ulardagi statistik ma’lumotlar va me’yoriy hujjatlarning to‘g‘riligiga hamda har qanday fikr - mulohazalarga mualliflarning o‘zlari mas’ul hisoblanadilar. Talablarga javob bermaydigan maqolalar to‘plamga kiritilmaydi. Tashkiliy qo‘mita maqola matnini qisqartirish, qisman tuzatish kiritish, seksiyalarga joylashtirish huquqiga ega.

ISSN 3030-3907

MODERNIZATION OF THE CARRIAGE ASSEMBLY OF THE NF-630 MILLING MACHINE TO INCREASE THE MACHINING ENVELOPE IN THE NF-1200 MODEL

Artikov Narmurad Nortajiyevich
Chief Designer of the Design Department of JSC "NMMC" Navoi Machine-Building Plant.
Oripov Dostonjon
Navoi State University of Mining and Technologies, Master's student
G'aybulloyev Nusrat Sunatullo o'g'li
Design Engineer of the Design Department of JSC "NMMC" Navoi Machine-Building Plant.
Turdinov To'lqin Abriyevich
Deputy Chief Designer of the Design Department, Navoi Machine-Building Plant, JSC "NMMC".

Abstract. This article analyzes the structural and technological solutions implemented during the modernization of the NF-630 milling machine into the NF-1200 model. The main focus of the study is on the redesign of the carriage assembly, which plays a key role in increasing the machining envelope of the machine tool. Since the structural capabilities of the existing NF-630 machine were not sufficient for machining large-sized parts, its carriage-table system was modernized in accordance with the requirements of the NF-1200 model. According to the passport data of the NF-1200 milling machine, it is designed to perform milling, drilling, boring, and threading operations on housing-type and base-type parts made of ferrous and non-ferrous metals, as well as some plastic materials. As a result of the modernization, the working table surface was increased to 1200 × 500 mm, while the maximum dimensions of the workpiece were expanded to 1200 × 500 × 500 mm. In addition, the machine became capable of machining workpieces weighing up to 800 kg and provides travel distances of 1000 mm, 450 mm, and 500 mm along the X, Y, and Z axes, respectively. In the study, the drawings of the NF-630 and NF-1200 carriage assemblies were compared, and it was determined that the support base, fastening points, guiding elements, and table connection surfaces were redesigned in the new carriage structure. The obtained results show that the development of the NF-1200 model based on the NF-630 machine expands the technological capability of machining large-sized parts under production conditions.

Keywords: NF-630, NF-1200, milling machine, carriage assembly, modernization, large-sized workpiece, working table, structural improvement, CNC, mechanical engineering.

Аннотация. В данной статье проанализированы конструктивно-технологические решения, реализованные в процессе модернизации фрезерного станка NF-630 в модель NF-1200. Основное внимание в исследовании уделено перепроектированию узла каретки, который играет ключевую роль в увеличении габарита обработки станка. Поскольку конструктивные возможности существующего станка NF-630 были недостаточны для обработки крупногабаритных деталей, его система «каретка–стол» была модернизирована в соответствии с требованиями модели NF-1200. Согласно паспортным данным фрезерного станка NF-1200, он предназначен для выполнения операций фрезерования, сверления, растачивания и нарезания резьбы при обработке корпусных и базовых деталей, изготовленных из черных и цветных металлов, а также некоторых пластмассовых материалов. В результате модернизации площадь рабочего стола была увеличена до 1200 × 500 мм**,** а максимальные размеры обрабатываемой детали — до 1200 × 500 × 500 мм**.** Кроме того, станок получил возможность обрабатывать детали массой до 800 кг и обеспечивает перемещения по осям X, Y и Z соответственно на 1000 мм, 450 мм и 500 мм**.** В ходе исследования были сравнены чертежи узлов каретки NF-630 и NF-1200. Установлено, что в новой конструкции каретки были переработаны опорная база, точки крепления, направляющие элементы и поверхности соединения со столом. Полученные результаты показывают, что создание модели NF-1200 на базе станка NF-630 расширяет технологические возможности обработки крупногабаритных деталей в производственных условиях.

Ключевые слова: NF-630, NF-1200, фрезерный станок, узел каретки, модернизация, крупногабаритная деталь, рабочий стол, конструктивное совершенствование, ЧПУ, машиностроение.

Annotatsiya. Ushbu maqolada NF-630 frezalash dastgohini NF-1200 modeliga modernizatsiya qilish jarayonida amalga oshirilgan konstruktiv-texnologik yechimlar tahlil qilingan. Tadqiqotning asosiy e’tibori stanokning ishlov berish gabaritini oshirishda muhim rol o‘ynaydigan karetka uzelini qayta loyihalash masalasiga qaratilgan. Mavjud NF-630 dastgohining konstruktiv imkoniyatlari yirik gabaritli detallarni qayta ishlash uchun yetarli bo‘lmaganligi sababli, uning karetka-stol tizimi NF-1200 modeli talablariga muvofiq modernizatsiya qilingan. NF-1200 frezalash stanogining pasport ma’lumotlariga ko‘ra, u qora va rangli metallar hamda ayrim plastmassa materiallardan tayyorlangan korpus va baza tipidagi detallarni frezalash, parmalash, rastochkalash va rezba ochish operatsiyalarini bajarishga mo‘ljallangan. Modernizatsiya natijasida ishchi stol

ISSN 3030-3907

yuzasi 1200 × 500 mm ga, ishlov beriladigan detalning eng katta o‘lchamlari esa 1200 × 500 × 500 mm ga yetkazilgan. Bundan tashqari, stanok 800 kg gacha bo‘lgan detallarni qayta ishlash imkoniyatiga ega bo‘lib, X, Y va Z o‘qlari bo‘yicha mos ravishda 1000 mm, 450 mm va 500 mm harakatlanish masofasini ta’minlaydi. Tadqiqot davomida NF-630 va NF-1200 karetka uzellarining chizmalari o‘zaro solishtirildi. Natijada yangi karetka konstruksiyasida tayanch bazasi, mahkamlash nuqtalari, yo‘naltiruvchi elementlar va stol bilan bog‘lanish yuzalari qayta ishlab chiqilgani aniqlandi. Olingan natijalar NF-630 dastgohi bazasida NF-1200 modelini yaratish ishlab chiqarish sharoitida yirik gabaritli detallarni qayta ishlashning texnologik imkoniyatlarini kengaytirishini ko‘rsatadi.

Kalit so‘zlar: NF-630, NF-1200, frezalash stanogi, karetka uzeli, modernizatsiya, yirik gabaritli detal, ishchi stol, konstruktiv takomillashtirish, CNC, mashinasozlik.

INTRODUCTION.

In modern mechanical engineering production, high-precision machining of large-sized housing, support, base, and plate-type parts is one of the important technological tasks. Since such parts usually have large dimensions and relatively high mass, the size of the machine working table, travel distances along the coordinate axes, rigidity of the carriage-table system, positioning accuracy, and structural stability are of particular importance during machining. In particular, performing milling, drilling, boring, and threading operations on a single machine makes it possible to increase production efficiency and reduce additional setup and re-basing operations.

Under production conditions, the effective use of the existing machine-tool fleet and the expansion of its technological capabilities are often considered more economically and technically feasible than purchasing new machines. From this point of view, the development of the NF-1200 model, intended for machining larger parts through the structural modernization of the existing NF-630 milling machine, is regarded as an urgent practical issue. The main essence of this modernization is to increase the machining envelope of the workpieces, expand the size of the working table, and redesign the carriage assembly in accordance with these changes.

According to the operating documentation of the NF-1200 milling machine, it is designed for the complex machining of housing-type and base-type parts made of ferrous and non-ferrous metals, as well as certain plastic materials. The machine is intended to perform milling, drilling, boring, and threading operations based on a computer numerical control system. Its working units are controlled along three coordinate axes: movement of the table with the workpiece is provided

ISSN 3030-3907

along the X-axis, movement of the carriage-table system along the Y-axis, and vertical movement of the spindle head with the cutting tool along the Z-axis.[1]

One of the most important structural solutions in the modernization process is the redesign of the carriage assembly. This is because increasing the working table size to **1200 × 500 mm** and enabling the machining of workpieces with dimensions up to **1200 × 500 × 500 mm** and a mass of up to **800 kg** increase the static and dynamic loads acting on the carriage-table system. Therefore, in the new NF-1200 model, the support base of the carriage assembly, the connection scheme with the guiding elements, the fastening holes, and the contact surfaces interacting with the table were reconsidered.

The purpose of this study is to analyze the structural changes in the carriage assembly during the modernization of the NF-630 milling machine into the NF-1200 model and to clarify the technological basis for increasing the machining envelope up to **1200 mm**. In the study, the drawings of the NF-630 and NF-1200 carriage assemblies are compared, and the main structural differences resulting from the modernization are identified. In addition, based on the passport data of the NF-1200 machine, its technological capabilities for machining large-sized parts are evaluated.[2]

MATERIALS AND METHODS.

The existing carriage assembly of the NF-630 milling machine and the carriage-table system of the NF-1200 milling machine, developed on the basis of its modernization, were selected as the research object. The subject of the study consists of the structural and technological changes aimed at increasing the machining envelope during the transition from the NF-630 model to the NF-1200 model.

The operating manual of the NF-1200 milling machine, the technical drawing of the NF-630 carriage assembly, the modernized drawing of the NF-1200 carriage assembly, and the general assembly drawing of the NF-1200 machine were used as the main technical sources in the study. The passport data of the NF-1200 provides information about the purpose of the machine, its main technical specifications, structural components, movement scheme along the coordinate axes, carriage-table system, spindle head, electrical equipment, and auxiliary systems.

Formula (1). Coefficient of increase in the machining envelope

$$K_g = \frac{L_{NF-1200}}{L_{NF-630}}$$

where:

ISSN 3030-3907

K_g

— coefficient of increase in the machining envelope;

$$L_{NF-1200} = 1200 \text{ mm}$$

— machining length after the modernization;

$$L_{NF-630} = 630 \text{ mm}$$

— machining length before modernization.
Calculation:

$$K_g = \frac{1200}{630} = 1.90$$

The study was carried out in the following stages. In the first stage, the existing carriage design of the NF-630 milling machine was analyzed. The existing carriage assembly of the NF-630 milling machine was designed in accordance with the initial working envelope and table dimensions, and its structural configuration is shown in Figure 1. At this stage, the general shape of the carriage, support surfaces, fastening holes, connection points with the guiding elements, and structural components ensuring table movement were studied. As a result, it was determined that the existing carriage was adapted to the working envelope of the NF-630 model and required additional structural modifications to operate with a larger table.

ISSN 3030-3907

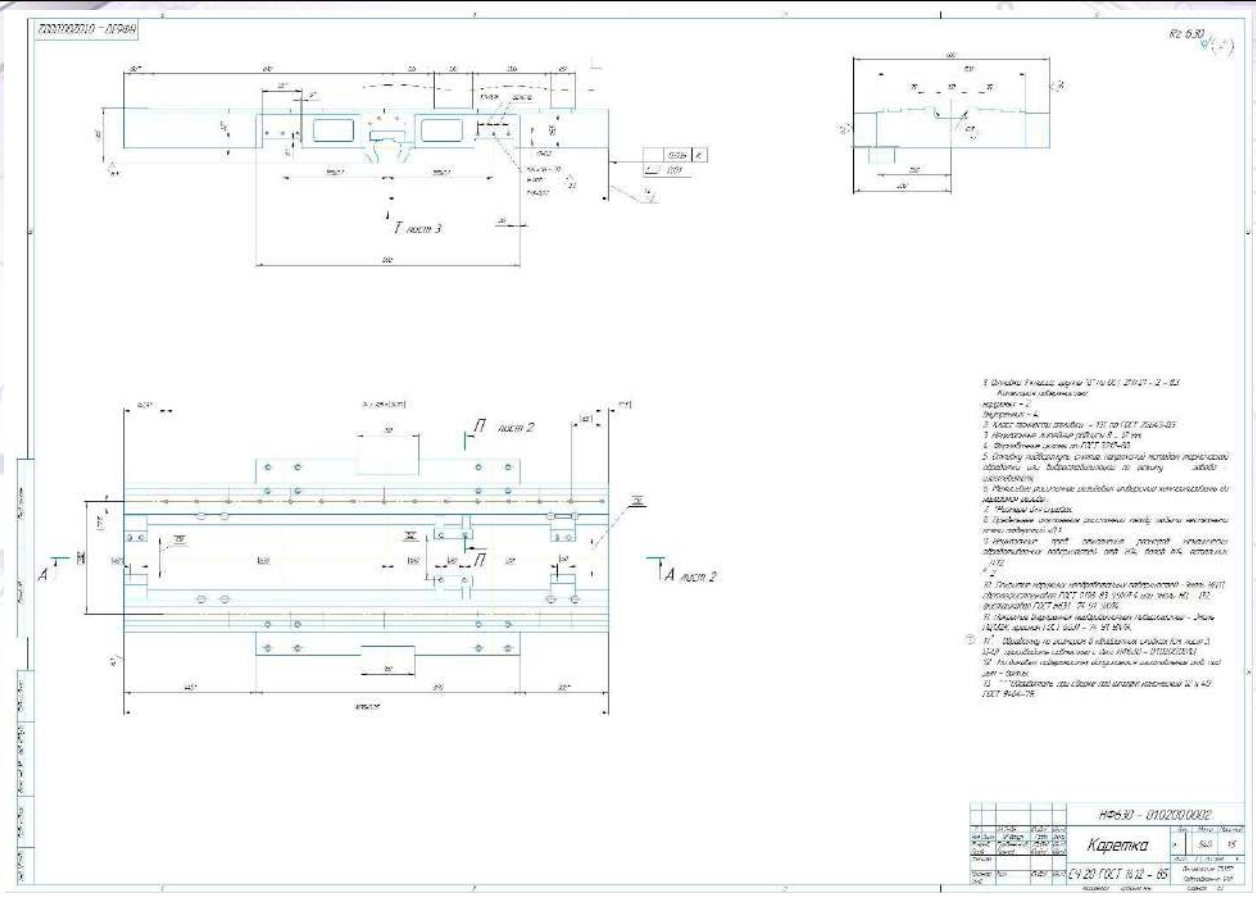


Figure 1. Structure of the existing carriage assembly of the NF-630 milling machine

In the second stage, the modernized carriage drawing developed for the NF-1200 model was analyzed. In this stage, the changes in the new carriage design, including its length, support base, fastening points, connection locations with the guide rails, and the repositioning of the surfaces supporting the table, were evaluated using a comparative method. In the NF-1200 model, the carriage was considered not only as a geometrically enlarged component, but also as a structural element adapted to support a **1200 × 500 mm** working table and to accommodate a workpiece mass of up to **800 kg**. In order to increase the machining envelope in the NF-1200 model, the carriage assembly was redesigned. The structure of the modernized carriage is shown in **Figure2**.

ISSN 3030-3907

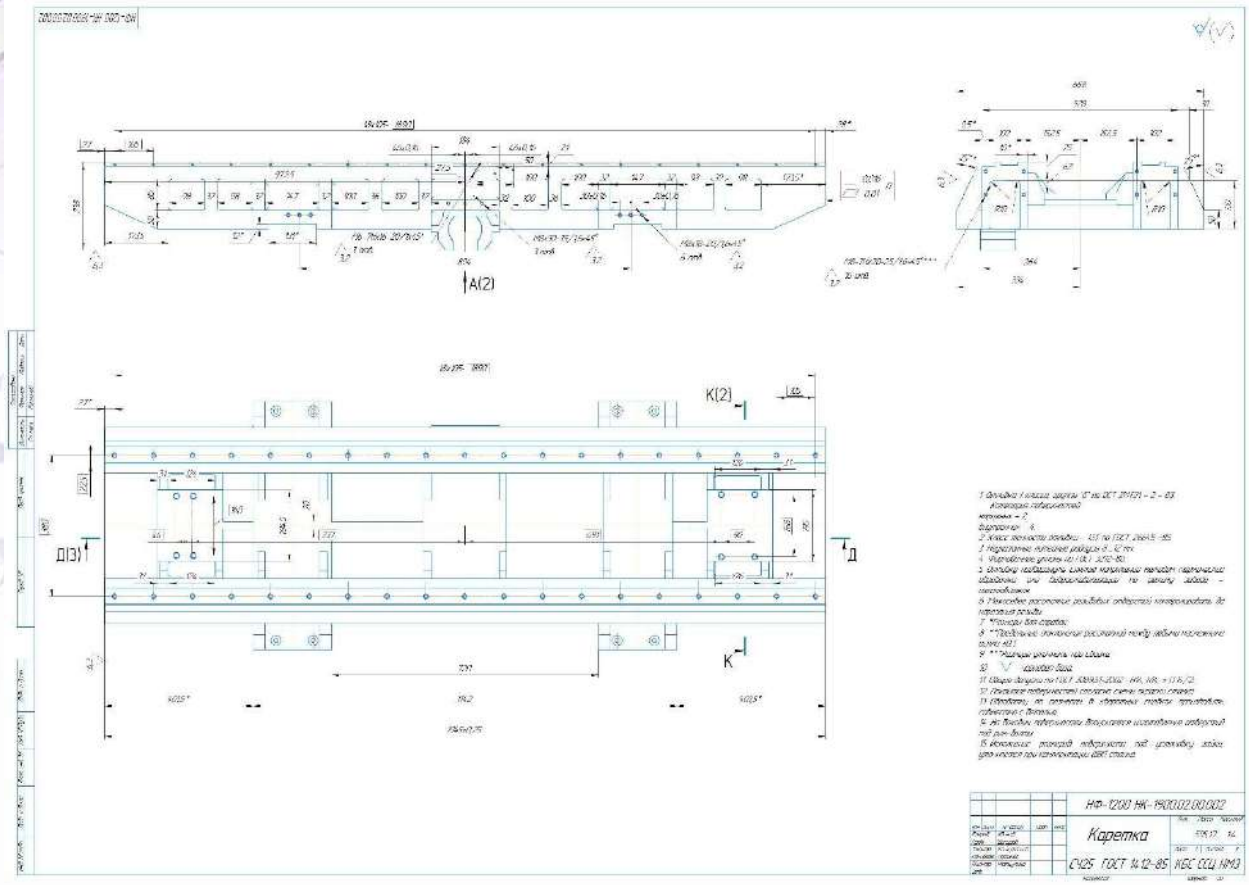


Figure 2. Structure of the modernized carriage assembly developed for the NF-1200 milling machine

The main focus of the study was placed on the comparative structural analysis of the NF-630 and NF-1200 carriage assemblies. By comparing the carriage drawings, the main structural changes related to increasing the working table size, expanding the support base, and adapting the connection scheme with the guiding elements were identified. This approach made it possible to justify that the modernization process is not simply the replacement of a single component, but rather a comprehensive structural solution aimed at expanding the working zone of the machine tool.[3]

A structural-comparative analysis method was used in the study. Using this method, the carriage drawings of the NF-630 and NF-1200 models were compared, and the main differences resulting from the modernization were identified. The comparison was carried out according to the following criteria: overall dimensions of the carriage, support base, contact surfaces with the table, arrangement of fastening holes, compatibility with guiding elements, and influence on the machining of large-sized parts.

When evaluating the technical capabilities of the NF-1200 machine, the main indicators given in the passport data were taken as a basis. In particular, the working table surface of **1200 × 500 mm**, the maximum workpiece dimensions of **1200 × 500 × 500 mm**, the maximum workpiece mass of **800 kg**, the travel

ISSN 3030-3907

distances of **1000 mm along the X-axis**, **450 mm along the Y-axis**, and **500 mm along the Z-axis**, as well as the positioning accuracy of **0.02 mm** and positioning repeatability of **0.01 mm**, were accepted as the main technical criteria for evaluating the effectiveness of the modernization.[4]

In addition, the study applied methods such as analysis of technical documentation, comparison of structural elements based on drawings, assessment of technological capabilities according to passport specifications, and generalization of the parameters achieved as a result of modernization. These methods made it possible to determine exactly which structural changes contributed to increasing the machining envelope during the transition from the NF-630 machine to the NF-1200 model.[5]

RESULTS.

As a result of the structural analysis carried out for the modernization of the NF-630 milling machine into the NF-1200 model, it was determined that the main change was related to the redesign of the carriage-table system. During the modernization process, the initial working envelope of the machine was adapted to the requirements for machining large-sized parts. For this purpose, instead of the existing NF-630 carriage assembly, a new carriage design was developed to support and move the **1200 × 500 mm** working table of the NF-1200 model.

A comparison of Figures 1 and 2 shows that the carriage assembly developed for the NF-1200 model has a longer support base than the existing carriage design of the NF-630 machine. In the new design, the support surfaces connected to the table were expanded, the fastening holes were repositioned, and the interaction scheme with the guiding elements was adapted to the movement of a larger working table. These changes make it possible to increase the working surface of the table and maintain stability during the machining process.

According to the passport data of the NF-1200 milling machine, the working table surface is **1200 × 500 mm**. The maximum dimensions of the workpiece that can be machined on the machine are **1200 × 500 × 500 mm**, while the maximum workpiece mass is specified as **800 kg**. The travel distances along the **X, Y, and Z coordinate axes** are **1000 mm, 450 mm, and 500 mm**, respectively. The positioning accuracy is **0.02 mm**, and the positioning repeatability is **0.01 mm**. These indicators show that the modernized NF-1200 model is capable of accurately machining large-sized parts.

Formula (2). Determination of the working table surface area

$$S = L \cdot B$$

where: S

ISSN 3030-3907

— S working table surface area, mm²;
L=1200mm table length;
B=500 mm — table width.

Calculation:

$$S = 1200 \cdot 500 = 600000 \text{ mm}^2$$

or:

$$S = 0.6 \text{ m}^2$$

In the NF-1200 model, the working table surface area was evaluated using the following formula:

$$S = L \cdot B = 1200 \cdot 500 = 600000 \text{ mm}^2 = 0.6 \text{ m}^2$$

Thus, the working table surface area of the NF-1200 milling machine is **0.6 m²**. This expands the possibility of positioning and fastening large-sized parts.

Table 1.

Main technical specifications of the NF-1200 milling machine

Indicator name	Value
Working table surface area	1200 × 500 mm
Maximum dimensions of the workpiece to be machined	1200 × 500 × 500 mm
Maximum workpiece mass	800 kg
Travel distance along the X-axis	1000 mm
Travel distance along the Y-axis	450 mm
Travel distance along the Z-axis	500 mm
Feed range	1–4000 mm/min
Positioning accuracy	0.02 mm
Positioning repeatability	0.01 mm
Continuous feed force	11000 N
Spindle rotation speed	80–3550 rpm
Maximum torque	500 N·m
Number of simultaneously controlled coordinates	3
Machine mass	7000 kg

ISSN 3030-3907

As a result of the modernization, the machining capability of the NF-630 machine was significantly expanded. The main technological result is that the machine was adapted to machine workpieces with a length of up to **1200 mm**.

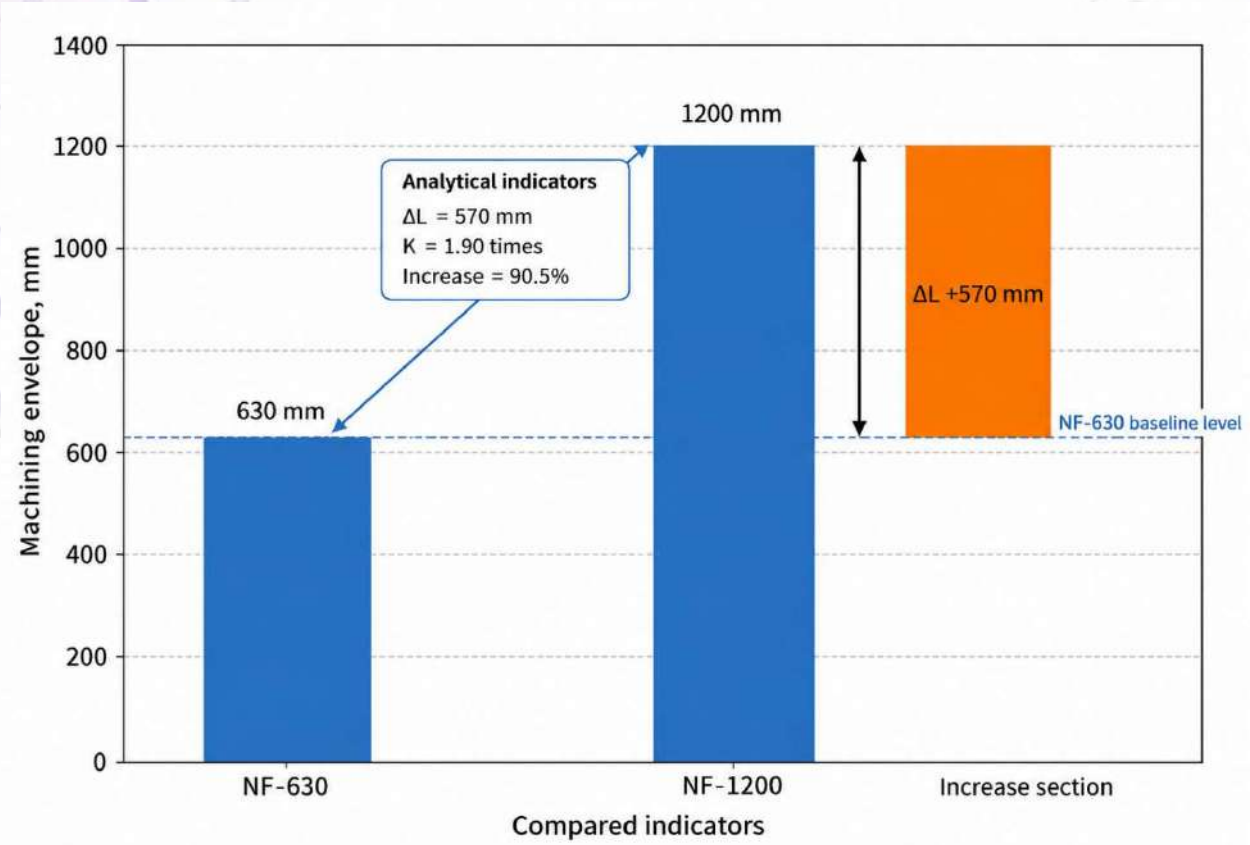


Figure 3. Comparative diagram of the machining envelope of the NF-630 and NF-1200 milling machines

This makes it possible to perform milling, drilling, boring, and threading operations on large housing-type, support, base, and plate-type parts in a single setup.

Table 2.

Comparative structural analysis of the NF-630 and NF-1200 carriage assemblies

Compared feature	**NF-630 carriage assembly**	**NF-1200 carriage assembly**
Structural function	Supporting and moving the existing working table	Supporting and moving the enlarged 1200 × 500 mm working table
Machining envelope	Suitable for the working zone of the NF-630	Adapted for workpieces up to 1200 × 500 × 500 mm

ISSN 3030-3907

Support base	Corresponds to the initial design	Extended and expanded
Fastening holes	Correspond to the old table layout	Repositioned according to the new table and guiding elements
Connection with guiding elements	Corresponds to the existing carriage movement scheme	Adapted to the movement and load of the enlarged table
Technological result	Machining of standard-sized parts	Capability of machining large-sized parts

The comparison of the NF-630 and NF-1200 carriage drawings shows that, during the modernization process, the carriage-table system was adapted to a larger working table and to a workpiece mass of up to **800 kg**. In this system, the working table, carriage, column, spindle head, main drive, control panel, and auxiliary systems are arranged in a coordinated manner. This confirms that the modernization is not merely the replacement of a single component, but a comprehensive structural solution aimed at expanding the working zone of the machine tool.

The passport data of the NF-1200 model indicate that the machine is designed to perform milling, drilling, boring, and threading operations on housing-type and base-type parts made of ferrous and non-ferrous metals, as well as certain plastic materials. In addition, the machine is controlled along three coordinate axes: movement of the table with the workpiece is provided along the **X-axis**, movement of the carriage-table system along the **Y-axis**, and movement of the spindle head with the cutting tool along the **Z-axis**.

The obtained results show that the redesign of the carriage assembly was the main structural solution in the modernization of the NF-630 milling machine into the NF-1200 model. In particular, the expansion of the carriage base and the redesign of the connection scheme with the table made it possible to increase the maximum workpiece dimensions up to **1200 × 500 × 500 mm**. At the same time, the preservation of positioning accuracy at **0.02 mm** and positioning repeatability at **0.01 mm** indicates that the modernized structure is technologically justified.

DISCUSSION.

The results of modernizing the NF-630 milling machine into the NF-1200 model show that increasing the machining envelope is not limited only to enlarging the dimensions of the working table. In such modernization, the

ISSN 3030-3907

structural stability of the carriage assembly, which supports, guides, and moves the table, is one of the key factors. This is because when the working table size is increased to **1200 × 500 mm** and the workpiece mass is increased up to **800 kg**, the static and dynamic loads acting on the carriage-table system also increase.

As can be seen from the comparison of Figures 1 and 2, the carriage assembly developed for the NF-1200 model is adapted to the requirements of a larger working zone compared with the existing NF-630 carriage design. In the new carriage structure, the expansion of the support base, the redesign of the surfaces connected to the table, and the arrangement of fastening holes according to a new scheme are important structural solutions of the modernization. These solutions help ensure stable table movement, withstand the loads caused by the mass of large-sized workpieces, and maintain machining accuracy.

If only the table size had been increased in the NF-630 machine while the carriage assembly remained unchanged, several problems could have occurred during the machining process. In particular, there could have been a risk of table deflection, uneven loading on the guiding elements, increased vibrations, reduced positioning accuracy, and increased geometric errors on the machined surface. Therefore, in the NF-1200 model, the redesign of the carriage assembly is considered the main structural condition for increasing the machining envelope.

The modernized carriage assembly is aimed at ensuring coordinated operation with the working table, guiding elements, and coordinate movements of the NF-1200 model. This solution increases the possibility of stable positioning and machining of large-sized parts. The overall arrangement of the working table, carriage, column, spindle head, main drive, and control panel provides the possibility of positioning large-sized workpieces and machining them along three coordinate axes. This shows that the modernization was carried out not at the level of a single component, but at the level of the entire machine-tool system.

$$q = \frac{m}{S}$$

where: q

— specific load acting on the table surface, kg/m²;

M=800kg

— maximum workpiece mass;

$$S = 0.6\ \text{m}^2$$

— working table surface area.

CALCULATION:

ISSN 3030-3907

$$q = \frac{800}{0.6} = 1333.3 \text{ kg/m}^2$$

When positioning a large-sized workpiece, the specific load acting on the working table was evaluated as follows:

$$q = \frac{m}{S} = \frac{800}{0.6} = 1333.3 \text{ kg/m}^2$$

This value indicates the need to adapt the carriage-table system to accommodate workpieces weighing up to **800 kg**. Therefore, in the NF-1200 model, the support base of the carriage assembly and the connection scheme with the guiding elements were redesigned.

According to the passport data of the NF-1200, the machine has travel distances of **1000 mm, 450 mm, and 500 mm** along the **X, Y, and Z coordinate axes**, respectively. These travel ranges provide the working zone required for machining workpieces with dimensions of **1200 × 500 × 500 mm**. In addition, the positioning accuracy of **0.02 mm** and positioning repeatability of **0.01 mm** make it possible to maintain the required accuracy when machining large-sized parts.

As a result of the modernization, the machining envelope of the workpiece was expanded while preserving the capability of the NF-1200 machine to perform milling, drilling, boring, and threading operations. This has important practical significance under production conditions. Instead of machining large housing-type and base-type parts on several machines or repeatedly resetting them, it becomes possible to perform complex machining on a single machine. As a result, additional basing errors are reduced, the machining process is simplified, and production productivity is increased.

Another advantage of the modernization approach is that the NF-1200 model with new technological capabilities is developed using the existing base of the NF-630 machine. This approach may be more practical and efficient than developing or purchasing a completely new machine. In this case, the main task is to correctly assess the resource of the existing structure, strengthen the load-bearing units, and develop structural solutions that meet the requirements of the new working zone.

Based on this, it can be stated that the redesign of the carriage assembly served as the main factor expanding the technological capabilities during the modernization of the NF-630 machine into the NF-1200 model. The new carriage design was developed in accordance with the enlarged dimensions of the working table, the increased workpiece mass, and the accuracy requirements along the

ISSN 3030-3907

coordinate axes. This confirms that the NF-1200 model is a technologically justified modernized milling machine suitable for machining large-sized parts.

CONCLUSION.

As a result of the conducted structural-comparative analysis, it was determined that the main technical solution in the modernization of the NF-630 milling machine into the NF-1200 model is related to the redesign of the carriage-table system. During the modernization process, the existing NF-630 carriage assembly was adapted to the requirements of machining large-sized parts, and a new structural solution was developed for the NF-1200 model.

According to the passport data of the NF-1200 milling machine, the working table surface is **1200 × 500 mm**, the maximum dimensions of the workpiece to be machined are **1200 × 500 × 500 mm**, and the maximum workpiece mass is **800 kg**. The travel distances along the **X, Y, and Z axes** are **1000 mm, 450 mm, and 500 mm**, respectively. These parameters provide the possibility of machining large housing-type, support, base, and plate-type parts on the machine.

The comparison of the NF-630 and NF-1200 carriage drawings showed that, in the modernized carriage assembly, the support base was expanded, the contact surfaces with the table were redesigned, and the arrangement of fastening holes and guiding elements was adapted to the dimensions of the new working table. These changes ensure stable movement of the **1200 × 500 mm** working table and allow the system to withstand the loads caused by the mass of large-sized workpieces.

As a result of the modernization, the machining envelope of the NF-1200 model was significantly expanded while preserving the capability to perform milling, drilling, boring, and threading operations. The positioning accuracy of **0.02 mm** and positioning repeatability of **0.01 mm** help ensure the accuracy required for machining large-sized parts.

In general, the modernization of the NF-630 milling machine into the NF-1200 model has practical significance in terms of efficient use of the existing machine base, complex machining of large-sized parts on a single machine, and expansion of production technological capabilities. The research results show that structural improvement of the carriage-table system is one of the main directions for increasing the machining envelope of milling machines.

REFERENCES

1. Ataullaev A., Ataullaev O., Juraev N., Isaev D. Control Mechanism for the Rotational Support System of an Antenna // Proceedings of the IV International Conference on Advances in Materials, Earth Science, and Technology AIP Conf. Proc. 3390, 060030-1–060030-8; https://doi.org/10.1063/5.0322334.

ISSN 3030-3907

2. Isaev D., Khamidov B., Ataullaev A., Ravshanov J., Juraev N. Comparative Analysis of Wear-Resistant Coating on Carbide end Mills Using Vibrodiagnostic Method // Proceedings of the IV International Conference on Advances in Materials, Earth Science, and Technology AIP Conf. Proc. 3390, 020016-1–020016-7; https://doi.org/10.1063/5.0322333
3. A.O. Ataullaev, O.X. Ataullaev, F.A. Ergashev Automated rectification of pulse response characteristics in radio engineering two-stage amplifiers //E3S Web of Conferences. – EDP Sciences, 2023. – T. 417. – pp. 05007
4. Sheina N. et al. Assessment of uncertainty and quality control in agricultural infrastructure //American Institute of Physics Conference Series. – 2024. – T. 3244. – №. 1. – C. 040014.
5. Ataullaev A. O., Kayumov B. B., Asadova M. A. Implementation of the Intelligent Tracking System With Wave Channels //International Scientific Journal Theoretical & Applied Science, Philadelphia, USA. – 2020. – №. 89. – C. 328-331.

ISSN 3030-3907