

DEVELOPMENTS BY "SOVELMASH"



"SOVELMASH"

The Russian company "Sovelmash" specializes in:

- developing and putting into production energy efficient electric rotating machines with enhanced performance based on the "Slavyanka" combined winding technology.

Induction motors are used in all areas of human activity.

"Slavyanka" combined winding technology makes it possible to achieve the energy efficiency and performance in motors that exceed those of domestic and world counterparts.

The development and putting into production include:

- developing and making process equipment with the prospect of import substitution. Equipment to produce motors is developed taking into account all achievements in the field of technology and process control;
- setting up production facilities (construction of a plant designed in-house, building production lines, etc.).

"SLAVYANKA" COMBINED WINDING TECHNOLOGY

- The "Slavyanka" technology is used in general and special purpose motors, as well as in traction and built-in motors.
- More than 150 winding diagrams for different numbers of pole pairs, combinations of rotor and stator slot numbers, etc. have been created and tested in practice.
- There are scientific papers; a reference guide for mastering the technology.
- 56 R&D (research and development) projects launched.
- As of Q2 2022, there are 12 Russian patents for inventions, 11 patents for utility models, and 1 patent for an industrial design.
- The technology is constantly evolving.

The main advantages of using the "Slavyanka" combined winding technology are increased energy efficiency, reliability, increased service interval in induction motors, while material consumption does not increase.

Thus, there is an opportunity to create motors of higher energy efficiency classes IE3, IE4 (GOST IEC 60034-30-1) with the dimensions of class IE1, IE2 motors.

In addition to increased energy efficiency, the use of combined winding allows to (as compared to classic winding types):

1. Improve the electromechanical performance of a motor:

- 1.1 reducing specific power consumption;
- 1.2 increasing the overload capacity;
- 1.3 increasing specific power;
- 1.4 increasing multiplicity of starting and maximum torques;
- 1.5 reducing the multiplicity of inrush currents.

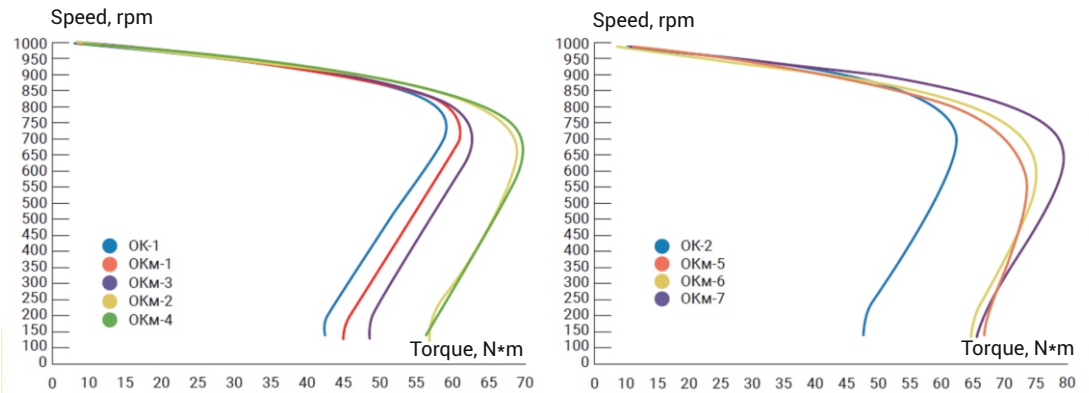
2. Reduce the negative impact on the power grid and electrical devices, which is especially relevant for facilities equipped with complex electronics and computing systems:

- 2.1 reducing the interference generated in the mains;
- 2.2 less distortion of the supply voltage waveform.

3. Improve motor performance parameters:

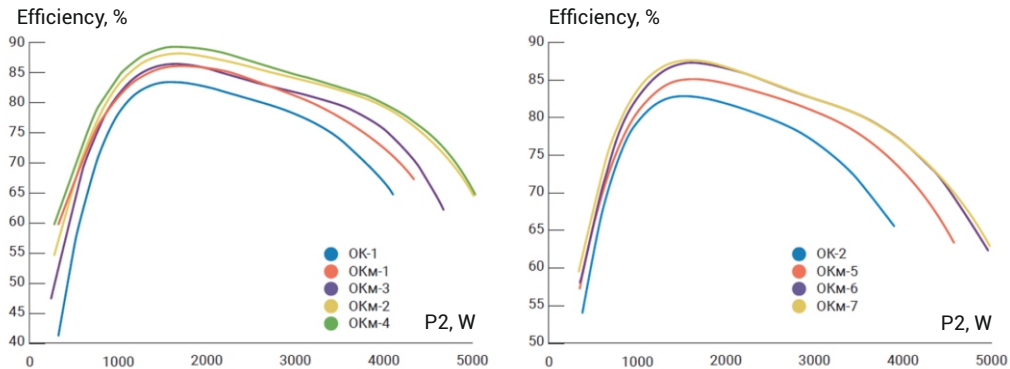
- 3.1 increasing the reliability and service life between repairs;
- 3.2 reducing noise level;
- 3.3 reducing vibrations.

Example of improved mechanical performance



Mechanical performance curves

Example of improved energy efficiency



Dependence of efficiency on output power

OK-1, OK-2 - standard induction motors of ADM-100L6 and AIR-100L6 types

OKM-1 - OKM-7 - modernized

INDUCTION HUB MOTOR

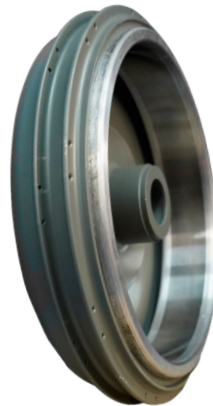
A hub motor with an induction motor based on the "Slavyanka" combined winding technology has been developed to demonstrate the potential of applying the technology.

Performance:

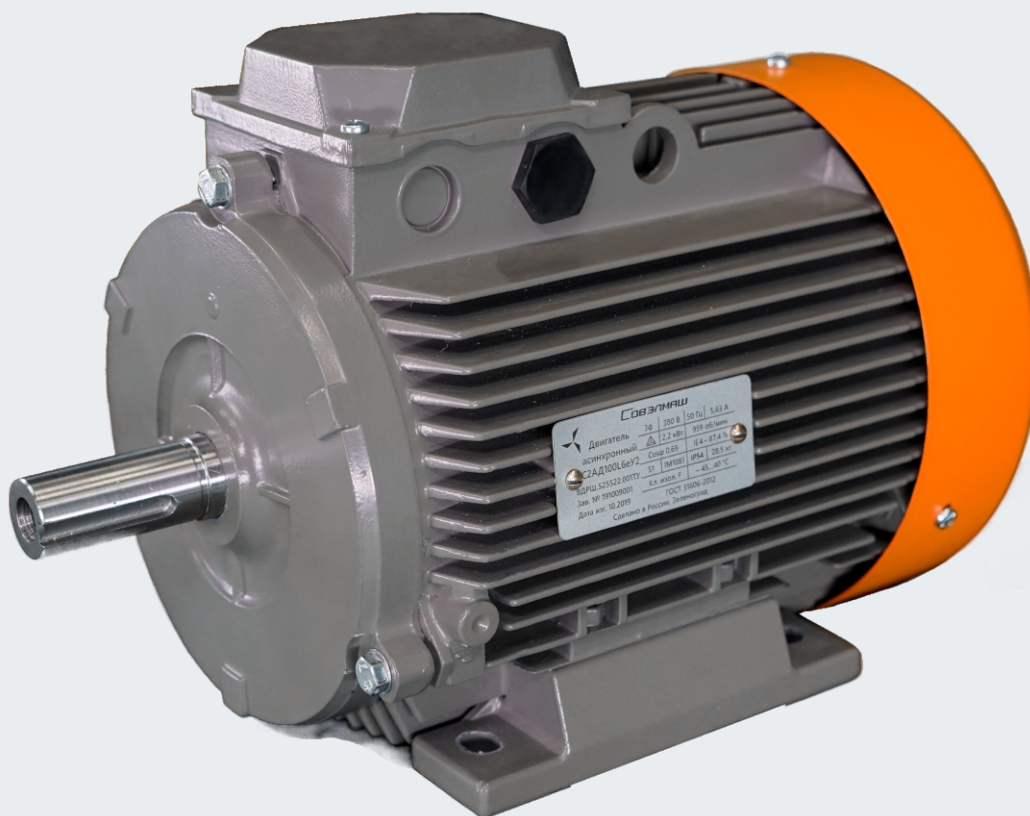
- maximum torque - 200 N*m;
- maximum power - 20 kW;
- maximum effective speed - 1000 rpm;
- weight of a hub motor complete with a tire - 16 kg;
- overall dimensions - Ø318x98.



Hub motor assembly



*Rotor with an aluminum
"squirrel cage"*



General-purpose industrial motors employing the "Slavyanka" combined winding technology of the highest energy efficiency classes

GENERAL-PURPOSE INDUSTRIAL ELECTRIC MOTORS

General-purpose industrial motors manufactured by applying the "Sovelmash" technologies are distinguished by:

- reduced power consumption under real-world operating conditions;
- higher efficiency;
- higher torque and starting torque;
- lower vibration level;
- ability to withstand high overloads;
- lower winding heating temperature, which minimizes the risk of winding burnout during operation;
- enhanced reliability.

Also, the use of motors manufactured by applying the "Sovelmash" technologies can reduce the load on the power grid by reducing inrush currents.



Traction electric motors employing the "Slavyanka" combined winding technology of the highest energy efficiency classes

TRACTION ELECTRIC MOTORS

Traction (modernized general-purpose industrial) motors have been successfully tested and demonstrated high efficiency.

For example, in 2013, the "Era" electric locomotive in Donetsk was equipped with a size-112 motor, modernized by applying the "Slavyanka" technology, instead of the regular DRT-13.

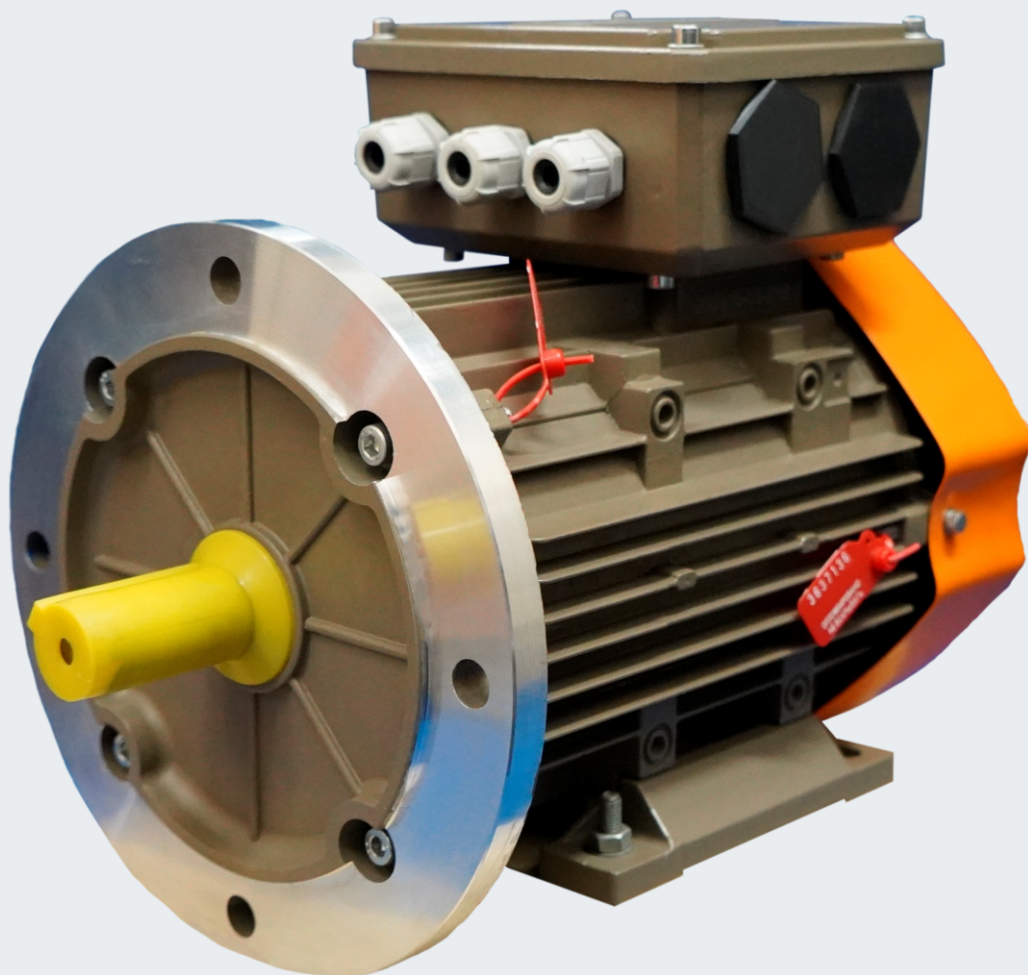


In the performance tests, the electric locomotive demonstrated the following features:

- it pulled 11 coal cars, while the standard motor pulled 5 cars;
- speed - 12 km/h on a level surface and 7 km/h on an uphill slope;
- during transportation of 100 tons of coal the motor did not overheat in spite of a double load increase.



Traction controller designed by "Sovelmash"

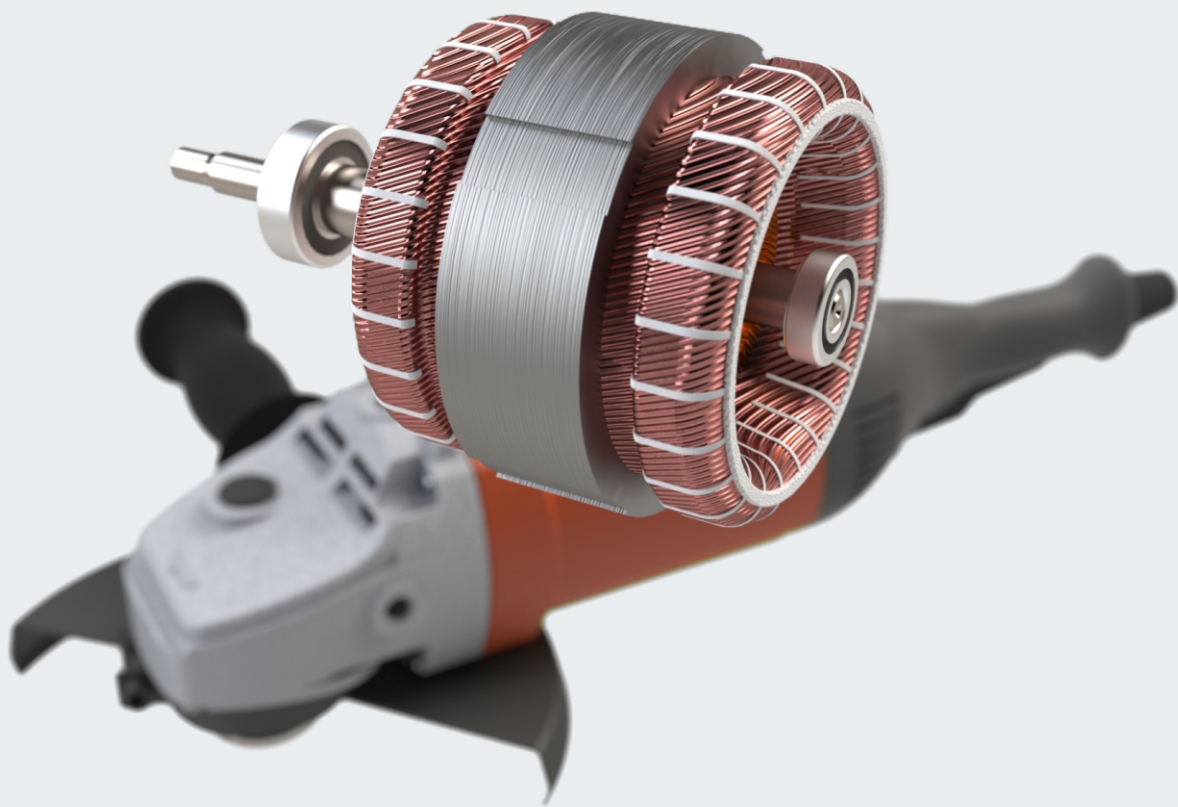


DAT-100L6 series induction traction motors

Main performance specifications of the DAT-100L6 series traction motors:

- supply voltage: 17 V or 29 V (depending on the version);
- power frequency: 50 Hz;
- useful power: 2.2 kW;
- speed: 960 rpm;
- torque: 22 N·m;
- maximum torque: 72 N·m;
- phase current: 120 A or 70 A (depending on the version)
- slip: 4.2 %;
- efficiency: 86.5 %;
- energy efficiency class according to GOST IEC 60034-30-1: IE3, IE4;
- power factor: 0.73;
- weight: 30.2 kg.

The prototypes were successfully tested in the vehicles of the customer company.



*Universal built-in induction drive for power tools and household appliances developed by
"Sovelmash"*

BUILT-IN INDUCTION DRIVE

"Sovelmash" developed a universal built-in induction drive based on the "Slavyanka" technology.

The drive is designed for power tools (angle grinders, mitre and circular saws, etc.) and household appliances (vacuum cleaners, meat grinders, food processors, lawnmowers, etc.), and is a significant competition to the standard commutator and commutatorless drives used in these types of products.

The built-in drive based on an induction motor can replace drives based on commutator and commutatorless motors. This will enable the following features to be achieved:

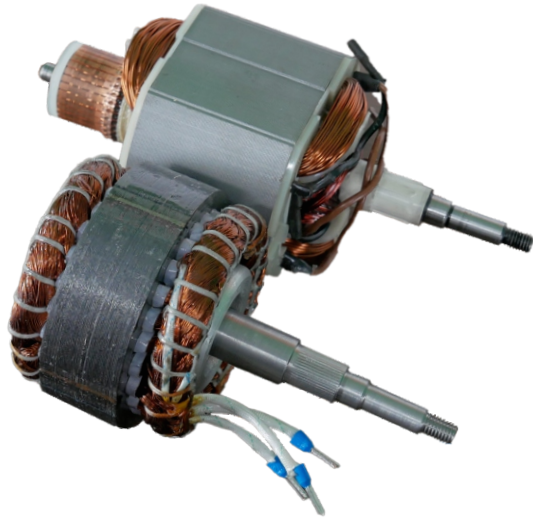
- high efficiency values over a wide load range;
- reduced power consumption in no-load mode;
- increased reliability, absence of sparks and dust formation due to the absence of a commutator unit in the design;
- stable rpm under load.



Angle grinder (commutatorless, without permanent magnets) 2.3 kW with an induction motor and controller by "Sovelmash"

The first project in this area was the development of angle grinders as the most complex products suitable for testing technical solutions. Samples of such angle grinders are currently being tested. Agreements with a production partner in China have been made.

Depending on the configuration it is possible to produce a version of the angle grinder with a quick-stop system, soft start and the ability to regulate the speed. The "Sovelmash" built-in drive also has a reduced load on the power grid and meets the highest energy efficiency classes.

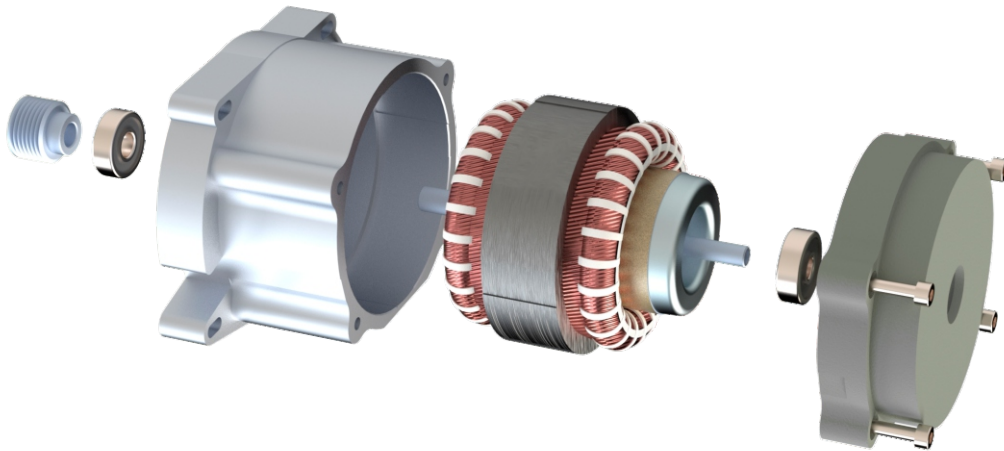


Induction motor in the "Sovelmash" angle grinder drive in comparison with a commutator motor

The built-in motor and controller developed at "Sovelmash" are versatile. Thanks to their dimensions, they can be used in a large number of different types of tools, including household appliances.



Comparing the stator dimensions of a "Sovelmash" mitre saw with the stator of a standard winding motor



Mitre saw with a drive designed by "Sovelmash"

Advantages of the mitre saw with a built-in induction motor designed by "Sovelmash":

- no shock currents are generated when the saw blade accelerates;
- the ability to adjust the speed, which will be useful for cutting different materials, such as aluminum, wood, etc;
- provision of a safety system;
- stable rpm under load;
- reduction of power consumption.



Lawnmower with a drive designed by "Sovelmash"

The "Sovelmash" specialists used a developed universal built-in induction motor with the "Slavyanka" combined winding and a controller to operate the motor.

The result:

- same dimensions, but higher efficiency and operational reliability;
- high speed stability under load - speed over 3,000 rpm, which allows you to mow young lawns.



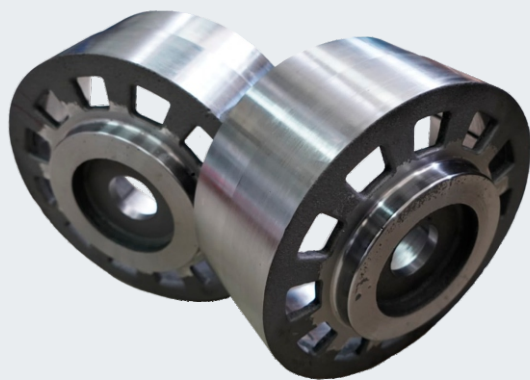
*Comparing the stators for a lawnmower:
"Sovelmash" induction motor (in the foreground), followed
by a commutator lawnmower motor*



Stator housing



Rotor housing in stator housing



Rotor housing



Gearless elevator winch stator

GEARLESS ELEVATOR WINCHES

A gearless elevator winch with an induction motor can be used in passenger, cargo-passenger, freight, hospital elevators and other lifting devices operated in buildings and facilities. Its motor design relies on technical solutions previously used and elaborated in the induction hub motor, created by applying the "Slavyanka" technology. The motor is modernized, it also features its own implemented rotor production technology.

Advantages:

- enhanced weight and dimensions;
- high energy efficiency, reliability;
- improved torque characteristics.



Hybrid all-terrain vehicle BTR-80 with motors made by applying the "Slavyanka" technology



DUAL-PURPOSE TECHNOLOGY

Electrifying the demilitarized BTR-80 - electric drive for off-road vehicles.

Wheels of the hybrid BTR-80 are driven by individual motors created by applying the "Slavyanka" technology.

Improved performance:

- part of the mechanical transmission was replaced by gearboxes with electric motors (independent electric drive of each wheel - greater reliability);
- due to the independent electric drive control system, the overall maneuverability of the hybrid all-terrain vehicle and its durability increase;
- the option of silent running.



Magnetizing unit designed by "Sovelmash"

MAGNETIZING UNIT AND ENCODERS

The magnetizing unit designed by "Sovelmash" allows you to create a magnetic field in magnetizable materials (in particular, rubber ferrite) of the required shape, along the desired outline, as well as to demagnetize such materials.

Advantages:

- simplicity,
- maintainability,
- failure-free performance,
- high range of magnetizing force regulation.

The in-house produced encoders open up additional opportunities to create induction motors. With the help of this unit, it is possible to produce sensors in batches of about 30-40 thousand per month.



Encoder parts: sleeves, discs and cylinders made of rubber ferrite developed by "Sovelmash"

A magnetic disc or cylinder has a certain number of pole pairs arranged radially. Such discs (cylinders) are used in encoders designed by "Sovelmash".

As compared to their counterparts, these encoders are distinguished by manufacturing simplicity, competitive price and increased maintainability.

ROTORS



Prototypes of modernized induction motor rotors: early model with copper "squirrel cage" on the right, new model with a "squirrel cage" cast in aluminum on the left

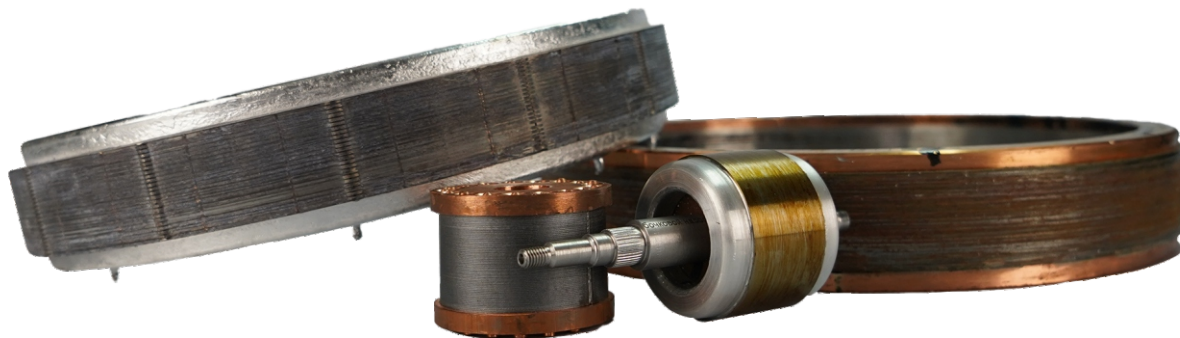
The company has mastered the technology of casting short-circuited rotors in aluminum and the vacuum die casting technology.

Thanks to these technologies, it's become possible to obtain high-quality products that are free of oxide inclusions and impurities.



Rotors for a universal built-in drive designed by "Sovelmash"

The final products, in which "Sovelmash" motors are to be used, will have high consumer qualities. The benchmark for the end result has been an optimal price-quality ratio.



Electric motor rotors for various applications designed by "Sovelmash"

Rotors for power tools, hub motors and gearless elevator winches. The copper "squirrel cage" rods are connected to the short-circuited rings by soldering, and the aluminum "squirrel cage" is made by pouring aluminum into the grooves of the rotor core.

In addition to the presented designs, "Sovelmash" is working in various areas, including the construction project in the SEZ "Technopolis "Moscow", the "Alabushevo" site, to erect the design and engineering technology department (D&E) of 17,000 square meters, and its commissioning will enable the company to reach its full capacity.





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