

# Moskabelmet Group of Companies

Today, Moskabelmet GC ranks the TOP 5 of the Russian manufacturers of cable and wire products. The enterprise is trusted by such strategic partners as the Ministry of Defence of the Russian Federation, Rosatom, the Moscow Metro, Rosseti, the Russian leaders of the oil, energy, gas, mining and metallurgical industries, industrial giant enterprises, leading transformer plants.

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[www.mkm.ru](http://www.mkm.ru)

Moskabelmet Group of Companies



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**HISTORY OF THE COMPANY** begins on June 16, 1895, when the Decree was signed by the Emperor Nicholas II. The accumulated experience and the unchanging philosophy of production quality largely determine development of the cable industry.

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Moskabelmet Group of Companies is one of the leaders on the Russian market of cable and wire products.

# Moskabelmet Group of Companies



Central Entrance



Copper Rod Production at Southwire Unit

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**PARTNERS OF THE COMPANY are world leaders in the production of cable products: Prysmian Finland Oy, the Finnish company (Elkat LLC, the Russian joint company); Fujikura, the Japanese company (MKF JSC, the Russian joint company). Moskabelmet GC strictly adheres to the international and Russian safety standards and guarantees reliability of its products.**

You can find more details about operation, achievements and the range of products of Moskabelmet GC in this catalogue. We are sure that you will be convinced of our desire for constant development; you will see and appreciate daily work, dedication, initiative and responsibility of the Company in general and each employee.



## THE ETERNAL HISTORY

Moskabelmet is the oldest enterprise of the cable industry in Russia founded in 1895 and giving rise to emergence of the industry. The first who organized the mass production of cable in the country was Mikhail Podobedov, Industrial Engineer. His initiative allowed Russia to overcome its dependence on foreign manufacturers. Modern Moskabelmet Group of Companies continues the best traditions of the first cable production; every year it improves the design of existing cables and produces new products in response to the needs of the state, market and customers.

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## INDUSTRY LEADERS

Annually, the factories of Moskabelmet GC produce no less than 40,000 km of products which is equal to the circumference of the Earth. The product range includes more than 50,000 items. Today, Moskabelmet GC is one of the TOP 5 manufacturers of cable and wire products in Russia; it ranks first in the country in manufacturing CTC which have no domestic analogues.

The production sector of the Company covers the whole production cycle of the entire range of products: from copper rod to finished cable. Today, there are only three analogous companies in Russia which allows Moskabelmet GC to control quality of materials and products at all stages of production.

It is huge honour for Moskabelmet GC to supply products to the Ministry of Defence of the Russian Federation, Rosatom, the largest Russian plants and power plants. For over 80 years, the Moscow Metro and Mosgortrans have trusted us their most complex and voluminous orders.



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Wiredrawing and Wire Production

## OUR PHILOSOPHY

The activity of the enterprise is based on the philosophy and internal values which have been formed and remain unchanged since the foundation of the enterprise.

**M – refers to Maximum Quality.** Working with us you will be convinced that the attitude to quality is the basis of the Company's activity. We provide a high level of quality and create all conditions for the environmentally friendly production.

**C – refers to Client-Oriented.** A full cycle of production and continuous development allow us to be flexible and attentive to the needs of each client.

**Y – refers to Years of Experience.** Our long-term experience guarantees a stable position in the cable-wire products market, safe operation and long-term partnership.



## ENVIRONMENT PROTECTION

Moskabelmet GC responsibly addresses preservation of ecology. We are representatives of the cable industry and understand what harm can be caused by emissions from production in case of non-compliance with technologies, therefore we take all the exhaustive measures that comprehensively protect the environment. To prevent possible negative consequences the structure of Moskabelmet GC has established the Centre for Environmental Control responsible for the safety of production for humans and the environment. In Moscow, regular monitoring is conducted for the presence of chemical contaminants in the air and in the soil. The main task of the ongoing work is safety and health of the residents of the capital.



## UNITED POWER OF 19 STRUCTURES

Modern Moskabelmet is a Group of Companies managed by MKM CJSC. The enterprise unites 6 factories engaged in the direct manufacture of products, 7 trading and service enterprises, 3 social infrastructure facilities and 3 laboratories.

Moskabelmet GC has implemented a unified quality management system and an environmental management system certified according to ISO international standards which means compliance with the world-class service. General high quality standards are introduced for all products under the MKM brand. The Company and every individual employee work daily to ensure production of reliable and safe products on which the lives and health of millions of people depend.



## WIDEST PRODUCT RANGE

Combining the resources, experience, production capacities of several structures at once in the MKM brand allows Moskabelmet GC to produce the widest range of cable and wire products, to implement complex, voluminous and unique orders.

A number of products are produced due to the unique equipment. Thus, Austrian equipment MAG and MALI, which has no analogues in Russia, are used for the production of CTC. The unique MKD 18x800 line makes Moskabel-TsvetMet plant the only enterprise in Russia that produces a hollow conductor of the PA brand.

All technical equipment is regularly updated which allows not only to maintain and improve the quality of products at the level of the world's leading manufacturers, but also to constantly expand the range.



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## MAXIMUM QUALITY



Despite all the variety of products of Moskabelmet GC they are united by one – invariably high quality which meets the Russian and international requirements and norms. The nature of the final product is laid at the very beginning of production.

In the future, the products are monitored at all stages of the production in the accredited Testing Centre of cable products of Moskabelmet which is included in the Unified Register of Testing Laboratories of the Customs Union which gives the right to conduct tests of cable and wire products at the international level.

There is a system to select suppliers of materials built and maintained for many years at the enterprise and a strict quality control of their goods is carried out. Even those materials that have a certificate are subject to inspection as Moskabelmet GC is 100% responsible for the final product.



The Process of Manufacturing Optic Cables



Measuring Diameter of a Copper Rod

## NEW DEVELOPMENTS AND INNOVATIONS



Moskabelmet GC reacts promptly to all changes in the market of cable and wire products. In this regard, the Company's technological services are constantly working to expand the range of the already existing range of products and create designs with completely new properties. Today, more than 40 products are patented.

The enterprise is the country's only manufacturer of CTC, KSET and KASET cables for electrified transport designed specifically for Mosgortrans and special-purpose optic cables are included in the Electronic Component Database of the Ministry of Defence of the country.

## RELIABLE SUPPLIER



We are proud that our regular partners are state corporations, giant plants and enterprises from the priority sectors of the country: the Ministry of Defence, Rosatom, the Moscow Metro, Mosgortrans, RZhd, Metrogiprotrans, Rosseti, Norilsk Nickel, Gazprom, Lukoil, NPO Energomash, Rosatomflot, Electrozavod, Togliatti Transformer, Elektrosila, Siemens, ABB, MTS, Rostelecom and many others.

The enterprise successfully develops foreign economic activity with the CIS countries including the countries of the Customs Union (Belarus, Kazakhstan, Armenia, and Kyrgyzstan), trade relations with Uzbekistan, Tajikistan and other countries. Moskabelmet GC delivers high-quality products complete with all the necessary technical documentation and facilitates the organization of prompt customs clearance of goods.



**MOSKABELMET**  
Group of Companies

**ZAVOD MOSKABEL LLC** has been established in 2002 as a result of organizational transformations of Moskabelmet Group of Companies. The Company has its history since 1895 – the time when the cable plant in Moscow was founded. Production of power cables for the main sectors of the country's economy is a priority task of the enterprise.

Zavod Moskabel LLC is one of the three largest Russian manufacturers of power cables with paper impregnated insulation for medium voltage. Due to the quality of the manufactured products the enterprise is entrusted with the execution of state orders. It is a great honour for the plant to receive a certificate from the Ministry of Defence of the Russian Federation and a license to supply products for nuclear power plants. For more than 80 years the Company has provided the needs of the Moscow Metro and Mosgortrans.

Zavod Moskabel Limited Liability Company (Zavod Moskabel LLC)

# Zavod Moskabel



Drying and Impregnation Section

## KEY CLIENTS AND PARTNERS

Zavod Moskabel LLC provides the needs of the largest enterprises of the energy system of Russia, machine building, oil and gas industry, transport and construction industries. The partners and customers of the plant are Rosseti, Rosenergoatom, the Ministry of Defence as well as enterprises of the CIS countries.

Zavod Moskabel LLC is a traditional supplier of cables for fixed installation of medium voltage and polymeric insulated cables for the Moscow Metro. The enterprise closely cooperates with Metrogiprotrans OJSC and Mosgortrans SUE.

## QUALITY MANAGEMENT SYSTEM

The company has a quality management system common to the Group of Companies certified in accordance with GOST R ISO 9001-2015 and an environmental management system that meets the requirements of GOST R ISO 14001-2007 (ISO 14001:2004) and unified production standards under the MKM brand.

The quality management system of Zavod Moskabel LLC is also certified for compliance with the requirements of GOST RV 0015-002-2012 in the «Military Register» Voluntary Certification System for the design, development, manufacture and supply of power and control cables, insulated wires.

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## EQUIPMENT

**Modern and constantly updated equipment of the plant allows producing a wide range of products: power cables, fireproof cables, mine cables, control cables with various types of insulation, wires for lighting, self-supporting insulated wires and household wires.**

Zavod Moskabel LLC has all the necessary technological equipment and regularly updates the park. Two new universal extrusion lines have been installed at the enterprise in 2012 and 2013 which process various polymers including highly filled halogen free compositions making it possible to produce a wide range of cable products of various designs to meet the requirements of consumers. At the beginning of 2017, DrumTwister, new equipment for twisting isolated cores is put into operation which will allow to increase productivity of «total twisting» operation by 1.5 times as well as the volume of production.

## RAW MATERIALS

At the enterprise there is a strict system of selection of suppliers of materials and 100% incoming quality control. The experience of many years of cooperation with reliable suppliers of materials such as aluminium, lead, steel tapes, cable paper and others allows guaranteeing the production of high quality products.

In the manufacture of cable products a wide range of polymer materials (silane cross-linked polyethylene, PVC and halogen-free compositions) from the leading manufacturers are used.



Step-by-Step Product Quality Control

# Zavod Moskabel has been a constant supplier of high-quality cables for the Moscow Metro for more than **80** years



The Process of Applying Protective Coatings on Cables with Paper Impregnated Insulation

## 1. POWER CABLES WITH PAPER IMPREGNATED INSULATION

Power cables with paper insulation impregnated with a viscous or non-curable compound with a copper or aluminium core, in a lead or aluminium shell are designed for transmission and distribution of electric power in stationary installations in electrical networks at ambient temperatures ranging from minus 50 to plus 50 °C and relative air humidity up to 98 % at a temperature of up to 35 °C.



### a) In a lead shell with viscous impregnation.

Trademarks: АСБ, АСБл, АСБ2л, АСБГ, АСБ2лГ, АСБШв, АСБлШв, АСБ2лШв, АСШв, АСГ, СБ, СБл, СБ2л, СБГ, СБ2лГ, СБШв, СБлШв, СБ2лШв, СШв, СГ.

### b) In a lead shell with non-curable impregnation.

Trademarks: ЦАСБ, ЦАСБл, ЦАСБ2л, ЦАСБГ, ЦАСБШв, ЦАСБлШв, ЦАСБ2лШв, ЦАСШв, ЦСБ, ЦСБл, ЦСБ2л, ЦСБГ, ЦСБШв, ЦСБлШв, ЦСБ2лШв, ЦСШв.

### c) In an aluminium shell with a viscous impregnation.

Trademarks: ААБл, ААБ2л, ААБ2лШв, ААБ2лШп, ААБлГ, ААБлГ, ААШв, ААШп, ААГ, ААБв, ААБвГ, ААШнг.

### d) In an aluminium shell with non-curable impregnation.

Trademarks: ЦААБл, ЦААБ2л, ЦААБлГ, ЦААШв, ЦААБлГ, ЦААБв, ЦААШнг.

#### Key parameters

Nominal voltage	1, 6, 10 kV
Nominal cross-section area of current-carrying conductor	25 to 240 mm <sup>2</sup> . Single core cables up to 800 mm <sup>2</sup>
Cable conductor continuous heating temperature	Voltage 1 and 6 kV - 80 °C Voltage 10 kV - 70 °C

## 2. CABLES FOR ELECTRIFIED TRANSPORT

Power cables with paper insulation impregnated with a non-curable compound with a copper or aluminium core in a shell of lead alloy with an outer protective cover are intended for transmission and distribution of electric power in electrified transport networks for a nominal DC voltage of 1 kV and a nominal AC voltage of 10 kV with a frequency of 50 Hz.



Trademarks: КСЭТ, КАСЭТ, КСЭТнг(A)-LS, КАСЭТнг(A)-LS

#### Key parameters

Nominal voltage	1, 10 kV
Nominal cross-section area of current-carrying conductor	Three-core cables of 70 to 240 mm <sup>2</sup> . Single core cables of 240 to 800 mm <sup>2</sup> with 2 or 4 insulated control strands of 1.5 mm <sup>2</sup> cross-section in the outer layer of a current-conducting core
Cable conductor continuous heating temperature	Voltage 1 kV - 80 °C Voltage 10 kV - 70 °C
Category of cables flame retardance of KSETng(A)-LS, KSETng(A)-LS brands	A



The Process of Applying Protective Coatings on Cables with Paper Impregnated Insulation

## PRODUCTS

The Company is specialized in the production of a wide range of power cables with paper impregnated insulation, power and control cables with polymer insulation, installation and household wires, self-supporting insulated wires for overhead transmission lines, bars pressed from AVE alloy.

Zavod Moskabel constantly develops the range of products offering not only traditional products, but also unique developments customized for clients.

Especially for the order of Mosgortrans, КСЭТ and КАСЭТ cables for electrified transport were designed. One of the latest developments of the Company is cables with paper impregnated insulation with ng(A)-HF index with protective coatings not containing halogens for the Moscow Metro. The enterprise successfully solves the state task of import substitution: 99% components used in the production of power cables with paper impregnated insulation are manufactured in Russia.

Since 1935, the Company has supplied more than **10 000** km of cables for the underground

### 3. POWER CABLES WITH PVC INSULATION

Power cables with PVC insulation of armoured and non-armoured type with a copper or aluminium core are designed for transmission and distribution of electric power in stationary installations in electrical networks at ambient temperatures from minus 50 or minus 60 (for HL version) to plus 50 °C and relative air humidity up to 98 % at a temperature of up to 35 °C.



Trademarks: **ВВГ, ВВГЭ, АВВГ, АВВГЭ, ВБШв, АВБШв.**

#### Key parameters

Nominal voltage	0.66, 1, 3, 6 kV
Number of cores	1, 2, 3, 4, 5
Nominal cross-section area of current-carrying conductor	Multi-core cables with copper cores 1.5 to 240 mm <sup>2</sup> . With aluminium cores 2.5 to 240 mm <sup>2</sup> . Single core cables to 800 mm <sup>2</sup>
Cable conductor continuous heating temperature	70 °C
Climate version	UHL, HL

### 4. POWER CABLES WITH INSULATION FROM SILANE CROSS-LINKED POLYETHYLENE

Power cables with insulation from silane cross-linked polyethylene of armoured and non-armoured type with copper or aluminium core are designed for transmission and distribution of electric power in stationary installations in electrical networks at ambient temperatures from minus 50 to plus 50 °C and relative humidity up to 98 % at a temperature of up to 35 °C.



Trademarks: **ПвВГ, ПвВГЭ, АПвВГ, АПвВГЭ, ПвБШв, ПвБШп, АПвБШв, АПвБШп, ПвБШп(г), АПвБШп(г).**

#### Key parameters

Nominal voltage	0.66, 1, 3 kV
Number of cores	1, 2, 3, 4, 5
Nominal cross-section area of current-carrying conductor	Multi-core cables with copper cores 1.5 to 240 mm <sup>2</sup> . With aluminium cores 2.5 to 240 mm <sup>2</sup> . Single core cables to 800 mm <sup>2</sup>
Cable conductor continuous heating temperature	90 °C



Cable with Paper Impregnated Insulation after the Technological Operation of Applying a Lead Shell

### 6. FIREPROOF CABLES AND WIRES

Intended for laying in cable constructions and premises including in fire dangerous areas.

**6.1. CABLES NOT SPREADING COMBUSTION WITH LOW SMOKE AND GAS EVOLUTION**, with a copper or aluminium core. They are used to power the electrical equipment of subways, nuclear power plants, residential and public buildings, control cables for monitoring electrical equipment.

*a) With paper insulation.*



Trademarks: **СБВнг(A)-LS, АСБВнг(A)-LS, ЦСБВнг(A)-LS, ЦАСБВнг(A)-LS.**

#### Key parameters

Nominal voltage	6, 10 kV
Nominal cross-section area of cores	25-240 mm <sup>2</sup>
Flame retardance category	A

*b) With polymer insulation of armoured or non-armoured type.*



Trademarks: of power cables: **ВВГнг(A)-LS, АВВГнг(A)-LS, ВВГЭнг(A)-LS, АВВГЭнг(A)-LS, ВБВнг(A)-LS, АВБВнг(A)-LS, ВБШвнг(A)-LS, АВБШвнг(A)-LS, ПвВГнг(A)-LS, АПвВГнг(A)-LS, ПвБВнг(A)-LS, АПвБВнг(A)-LS, ПвБШвнг(A)-LS, АПвБШвнг(A)-LS.**

#### Key parameters

Nominal voltage	0.66, 1, 3 kV
Number of cores	1, 2, 3, 4, 5
Nominal cross-section area of current-carrying conductor	Multi-core cables with copper cores 1.5 to 240 mm <sup>2</sup> . With aluminium cores 2.5 to 240 mm <sup>2</sup> . Single core cables to 800 mm <sup>2</sup>
Flame retardance category	A

Trademarks: of control cables: **КВВГнг(A)-LS, КВВГЭнг(A)-LS, КВБВнг(A)-LS.**

#### Key parameters

Nominal voltage	0.66 kV
Number of cores	4, 5, 7, 10, 14, 19, 27, 37, 52
Nominal cross-section area of current-carrying conductor	1-6 mm <sup>2</sup>
Flame retardance category	A

### 5. CONTROL CABLES

Control cables with copper or aluminium core with PVC insulation of armoured or non-armoured type are designed for fixed connection to electrical appliances, devices, assemblies of clamps of electrical switchgears.

Trademarks: **КВВГ, КВВГЭ, АКВВГ, АКВВГЭ, КВБШв, АКВБШв.**

#### Key parameters

Nominal voltage	0.66 kV
Number of cores	4, 5, 7, 10, 14, 19, 27, 37, 52
Nominal cross-section area of current-carrying conductor	With copper cores 1 to 6 mm <sup>2</sup> . With aluminium cores 2.5 to 10 mm <sup>2</sup>



Extrusion Line for Processing Polymer Compositions

**6.2. CABLES NOT SPREADING COMBUSTION WITH SHELL FROM HALOGEN-FREE COMPOSITIONS**

with a copper core; used to power and control the electrical equipment of nuclear power plants, in metro facilities, premises equipped with computer and microprocessor equipment.

**a) With paper insulation.**

Trademarks: **ЦСБПнг(А)-HF, ЦАСБПнг(А)-HF.**

**Key parameters**

Nominal voltage	6, 10 kV
Nominal cross-section area of cores	25–240 mm <sup>2</sup>
Flame retardance category	A
The amount of released gases of halogen acids in terms of HCl	NMT 5.0 mg/g

**b) With polymer insulation from a halogen-free composition or silane cross-linked polyethylene of armoured or non-armoured type.**



Trademarks: of power cables: **ППГнг(А)-HF, ППГЭнг(А)-HF, ПБПнг(А)-HF, ПвПнг(А)-HF, ПвПЭнг(А)-HF, ПвПГнг(А)-HF, ПвБПнг(А)-HF.**

**Key parameters**

Nominal voltage	0.66, 1 kV
Number of cores	1, 2, 3, 4, 5
Nominal cross-section area of current-carrying conductor	Multi-core cables 1.5 to 240 mm <sup>2</sup> Single core cables 1.5 to 800 mm <sup>2</sup>
Flame retardance category	A
The amount of released gases of halogen acids in terms of HCl	NMT 5.0 mg/g

Trademarks: of control cables: **КППГнг(А)-HF, КППГЭнг(А)-HF, КБПнг(А)-HF.**

**Key parameters**

Nominal voltage	0.66 kV
Number of cores	4, 5, 7, 10, 14, 19, 27, 37, 52
Nominal cross-section area of cores	1–6 mm <sup>2</sup>
Flame retardance category	A

**6.3. FIREPROOF CABLES** with a copper core are designed to ensure the operability of cable lines in a fire.

**a) With low smoke and gas evolution.**



Trademarks: of cables with paper insulation: **СБВнг(А)-FRLS, ЦСБВнг(А)-FRLS.**

**Key parameters**

Nominal voltage	6, 10 kV
Nominal cross-section area of cores	25–240 mm <sup>2</sup>
Flame retardance category	A
Fire resistance grading	60 min

Trademarks: of power cables with insulation of PVC composition of armoured or non-armoured type: **ВВГнг(А)-FRLS, ВВГЭнг(А)-FRLS, ВБВнг(А)-FRLS, ВБШВнг(А)-FRLS.**

**Key parameters**

Nominal voltage	0.66, 1, 3 kV
Number of cores	1, 2, 3, 4, 5
Nominal cross-section area of current-carrying conductor	Multi-core cables 1.5 to 240 mm <sup>2</sup> Single core cables 1.5 to 800 mm <sup>2</sup>
Flame retardance category	A
Fire resistance grading	180 min



The Process of Applying Inner Shell on Cables with Polymer Insulation

Trademarks: of control cables: **КБВГнг(А)-FRLS, КБВГЭнг(А)-FRLS, КББВнг(А)-FRLS.**

**Key parameters**

Nominal voltage	0.66 kV
Number of cores	4, 5, 7, 10, 14, 19, 27, 37, 52
Nominal cross-section area of current-carrying conductor	1–6 mm <sup>2</sup>
Flame retardance category	A
Fire resistance grading	180 min

**b) With a shell of halogens-free compositions,** with a copper core, with insulation from a halogen-free composition or silane cross-linked polyethylene of armoured or non-armoured type.

Trademarks: of power cables: **ППГнг(А)-FRHF, ППГЭнг(А)-FRHF, ПБПнг(А)-FRHF, ПвПнг(А)-FRHF, ПвПЭнг(А)-FRHF, ПвПГнг(А)-FRHF, ПвБПнг(А)-FRHF.**

**Key parameters**

Nominal voltage	0.66, 1 kV
Number of cores	1, 2, 3, 4, 5
Nominal cross-section area of current-carrying conductor	Multi-core cables 1.5 to 240 mm <sup>2</sup> Single core cables 1.5 to 800 mm <sup>2</sup>
Flame retardance category	A
Fire resistance grading	180 min



The Operation of Applying a Shell of Polymer Composition

Trademarks: of control cables: **КППГнг(А)-FRHF, КППГЭнг(А)-FRHF, КПБПнг(А)-FRHF.**

#### Key parameters

Nominal voltage	0.66 kV
Number of cores	4, 5, 7, 10, 14, 19, 27, 37, 52
Nominal cross-section area of current-carrying conductor	1-6 mm <sup>2</sup>
Flame retardance category	A
Fire resistance grading	180 min

**c) Power and control cables with low toxicity of combustion products** are designed for transmission and distribution of electric power and electric signals in stationary installations in buildings of functional fire hazard of F1-F3 grades including in buildings and facilities with a large number of people and for NPP facilities outside of the hermetic zone.

Trademarks: **ВВГнг(А)-LSLTx, ВВГЭнг(А)-LSLTx, АВВГнг(А)-LSLTx, ВВГнг(А)-FRLSLTx, ВВГЭнг(А)-FRLSLTx, ВБШВнг(А)-LSLTx, АВБШВнг(А)-LSLTx, ВБШВнг(А)-FRLSLTx, КВВГнг(А)-LSLTx, КВВГЭнг(А)-LSLTx, КВВГнг(А)-FRLSLTx, КВВГЭнг(А)-FRLSLTx.**

#### Key parameters

Nominal voltage	0.66, 1 kV
Number of cores	Power cables - 1, 2, 3, 4, 5 Control cables - 4, 5, 7, 10, 14, 19, 27, 37, 52
Nominal cross-section area of current-carrying conductor	Power cables Multi-core cables 1.5 to 240 mm <sup>2</sup> Single core cables 1.5 to 800 mm <sup>2</sup> Control cables 1 to 6 mm <sup>2</sup>
Flame retardance category	A
Fire resistance grading	180 min (for cables with FRLSLTx index)
Value of the equivalent toxicity index of combustion products of cables	More than 120 g/m <sup>3</sup>
Hydrogen chloride weight fraction	Insulation - NMT 100 mg/m Inner shell - NMT 50 mg/m Outer shell - NMT 80 mg/m



Operation of General Twisting of Cables with Polymer Insulation

**6.4. CABLES AND WIRES WITHOUT COMBUSTION, FOR ELECTRICAL INSTALLATIONS** with copper multi-wire core, with insulation of halogen-free or PVC-free flame-retardant compositions; intended for use in electrical installations for stationary laying in AC lighting networks within transport and pedestrian tunnels.

Trademarks: **КПнг(А)-HF, КПнг(А)-FRHF, КВнг(А)-LS, КВнг(А)-FRLS, ППнг(А)-HF, ППнг(А)-FRHF, ПВнг(А)-LS, ПВнг(А)-FRLS.**

#### Key parameters

Nominal voltage	1 kV
Number of cores	1, 2, 3, 4, 5
Nominal cross-section area of current-carrying conductor	1,5-400 mm <sup>2</sup>
Flame retardance category	A
Fire resistance grading	180 min (for cables with FRHF, FRLS index)



Operation of Pressing Aluminium Power Cores

## 7. MINE CABLES

Cables with a copper core are designed for transmission and distribution of electric power in mine electrical networks.

Trademarks: **КШВБШв, КГШВБШв, КШВБШв(г), КШВБШвнг(А)-LS, КГШВБШвнг(А)-LS, КШВБШвнг(А)-FRLS, КГШВБШвнг(А)-FRLS, КШВБШвнг(А)-LSLTx, КШВБШвнг(А)-FRLSLTx.**

#### Key parameters

Nominal voltage	6 kV
Number of cores	Main - 3; earth lead - 1 Auxiliary cores are allowed
Nominal cross-section area of main power cores	Main 25 to 240 mm <sup>2</sup>
Flame retardance category	A (for cables with LS, FRLS, FRLSLTx, LSLTx index)
Fire resistance grading	180 min (for cables with FRLS, FRLSLTx index)

## 8. FLEXIBLE CABLES

Cables with copper flexible core are designed for non-stationary connection of mobile machines, mechanisms and equipment to electrical networks.

Trademarks: **КГ, КГ-ХЛ.**

#### Key parameters

Nominal voltage	380 V, 660 V
Number of cores	1, 2, 3, 4, 5 Auxiliary cores are allowed
Nominal cross-section area of current-carrying conductor	Single core cable 2.5 to 400 mm <sup>2</sup> Multi-core cable 0.75 to 240 mm <sup>2</sup>
Climate version	UHL, HL

## 9. SELF-SUPPORTING INSULATED WIRES

Wires with a core of aluminium and aluminium alloy insulated with silane cross-linked polyethylene are designed for overhead transmission lines.

Trademarks: СИП-1, СИП-2, СИП-3, СИП-4, СИПг-1, СИПг-2, СИПг-3, СИПг-4.

### Key parameters

Nominal voltage	0.66/1 kV (СИП-1, СИП-2, СИП-4); 20 kV и 35 kV (СИП-3)
Number of cores	(3+1) (СИП-1, СИП-2); 2, 4 (СИП-4); 1 (СИП-3)
Nominal cross-section area of current-carrying conductor	16-240 mm <sup>2</sup>
Climate version	V

## 10. INSTALLATION WIRES AND CABLES

Wires and cables with copper cores with insulation of PVC plastic are intended for electrical installations for stationary laying in lighting and power networks as well as for the installation of electrical equipment, machinery, mechanisms and machines.



Trademarks: ПуВ, ПуГВ, ПуВВ, ПуГВВ, КуВВ, КуГВВ.

### Key parameters

Nominal voltage	Wires: AC voltage – 450/750 V (frequency of up to 400 Hz); DC voltage – 1000 V Cables: AC voltage – 300/500 V (frequency of up to 400 Hz)
Number of cores	1, 2, 3, 4, 5
Nominal cross-section area of current-carrying conductor	0.75-400 mm <sup>2</sup>
Cores flexibility class	ПуВ, ПуВВ, КуВВ – 1 or 2; ПуГВ, ПуГВВ, КуГВВ – 5

## 11. HOUSEHOLD WIRES

Wires with a copper or aluminum core with PVC plastic insulation are designed for wiring, for connecting electrical and household appliances and similar applications in the electrical network.

Trademarks: ПВС, ПБППГ, ПБПП, АПБПП.

### Key parameters

Nominal voltage	ПВС – 380 V (frequency of 50 Hz) ПБППГ, ПБПП, АПБПП – 250 V (frequency of 50 Hz)
Number of cores	ПБППГ, ПБПП, АПБПП 2, 3; ПВС – 2, 3, 4, 5
Nominal cross-section area of current-carrying conductor	ПБППГ, ПБПП – 1.5-6 mm <sup>2</sup> ; АПБПП – 2.5-6 mm <sup>2</sup> ; ПВС – 0.75-2.5 mm <sup>2</sup>
Cores flexibility class	ПБПП, АПБПП – 1; ПБППГ, ПВС – 5



Maillefer Extrusion Line

## 12. PRESSED BARS OF ALUMINUM ALLOYS

Bars made of AVE aluminium alloy are designed for manufacturing carrying and conductive cores of СИП wires. Trademark: ПСАВЕ.

### Key parameters

Nominal diameter	9.5-12 mm
Ultimate tensile strength, NLT	118 MPa
Extension strain, NLT	15 %





MOSKABELMET  
Group of Companies



### AO MOSKABEL-FUJIKURA

was founded in 1999 by  
ZAO Moskabelmet as a joint venture  
with Fujikura Ltd. (Japan).

During many years AO MKF develops  
innovations and holds leading positions  
at the market of communication optical  
cables in Russia and the CIS.

The enterprise specializes in production  
of optical cables for backbone and local  
communication networks.

The production capacities are up to  
35 000 km of cable annually.

Stock company Moskabel-Fujikura

# Moskabel- Fujikura



26 Production capabilities of AO MKF make it possible to produce optical cable with fiber count up to 1152.

Optical cables manufactured by AO MKF are included into the List of Electronic Components Base and admitted to delivery for the needs of the Ministry of Defense of the Russian Federation.

Our production is characterized by the staff of high qualification, up-to-date equipment and materials of leading Russian and foreign manufacturers.

Tubing line

## EQUIPMENT

The Company is in possession of production equipment of such leading world manufacturers as Nextrom (Finland), Maillefer (Finland), Rosendahl (Austria), Mali (Austria), Medek & Schorner (Austria), Dunst (Austria), Sket (Germany).

## MATERIALS

Optical fiber made by Fujikura Ltd. (Japan) and materials of other well-known foreign companies: Borealis (Denmark), Du Pont (the USA), Herkula (Germany, etc. are used for cable manufacturing. Optical fiber corresponds to Recommendations of ITU, ITU-T (G.651, G.652, G.653, G.654, G.655, G.657), and other international standards.



Pay-offs of optical fiber

## QUALITY MANAGEMENT SYSTEM (QMS)

The enterprise has developed, introduced and effectively employs the QMS covering the whole production process from cable designing to product delivery to the customer.

The QMS of the enterprise is certified:

- in the international system of voluntary certification AFNOR and IQNet (Certificate of Conformity of the QMS to requirements of ISO 9001:2015);
- in the system of voluntary certification Register of Management Systems (Certificate of Conformity of the QMS to requirements of ISO 9001:2015);
- in the system of voluntary certification Military Register (Certificate of Conformity of the QMS to requirements of ISO 9001:2015 and GOST RV 0015-002-2012).

Ecological Management System that complies with requirements of GOST R ISO 14001-2007 (ISO 14001:2004) has been implemented and successfully functions at the enterprise with the aim of protecting the environment and health.

High quality of optical cables is confirmed with available certificates and declarations on conformity of products to requirements of the Federal communication service. The optical cables made by MKF also have:

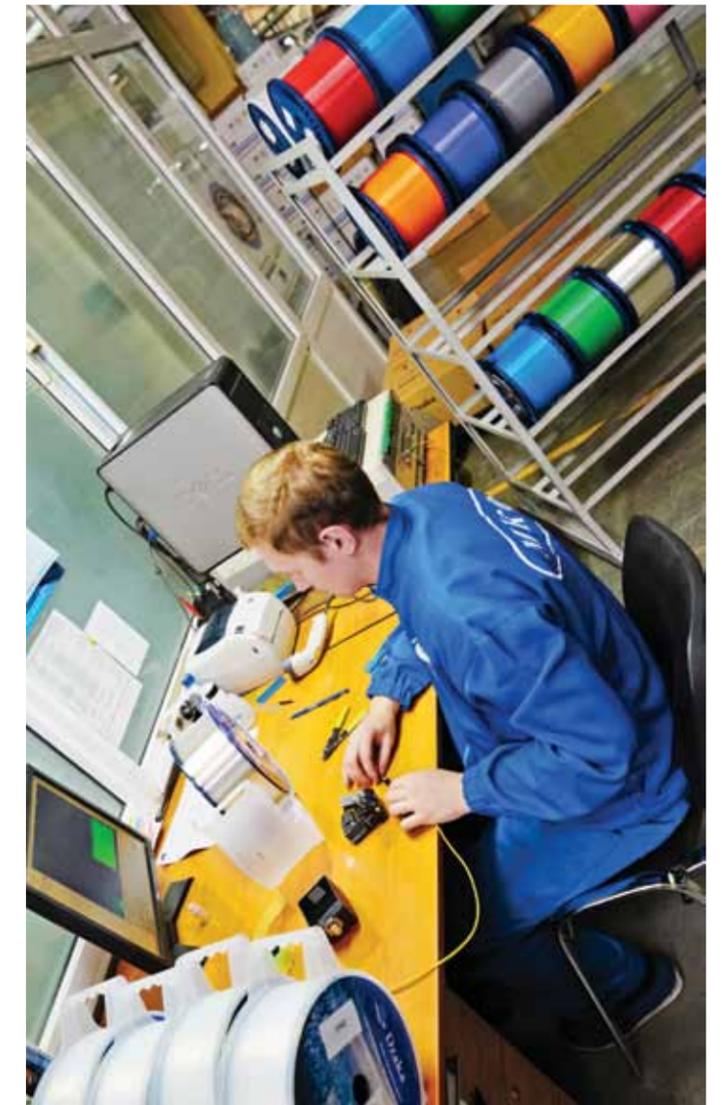
- Certificate of Conformity in the system of voluntary certification Military Register;
- Conclusion for the cable of OKSD type on conformance to requirements of PAO Rosseti.

### TEST LABORATORY AND PRODUCT CONTROL

Our factory set up the income control of materials, production process and acceptance control which is the guaranty of manufacturing of products of high quality.

## KEY CLIENTS

PAO Rostelecom, the Ministry of Defense of the Russian Federation, PAO Mobile TeleSystems, Megaphone, PAO Vympelcom, PAO Transneft, PAO Gazprom, PAO Lukoil, national operator of Belorussia PO Beltelecom, the Federal state unitary enterprise «Moscow Underground Railways», and many others are among our regular clients.



Monitoring of optical fiber at each operation

## PRODUCTS

Technological capabilities of MKF enable it to manufacture optical cables with up to 1152 fibers of various classes of fire safety (-n, -ng(A), ng(A)-HF, ng(A)-LS, ng(A)-FR, ng(A)-LTx and their combinations), which is confirmed by available certificates, as well as to manufacture any types of optical cables with regard to additional requirements of the customers.

# More than **5 000 000** km of optical fiber are laid into the cables made by MKF

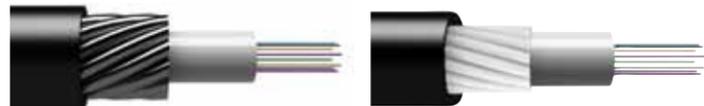
## 1. OPTICAL CABLES FOR BACKBONE AND DISTRIBUTION NETWORKS

### 1.1 BURIED CABLES



Trademarks: **OKGM, OKGMd.** TU 3587-006-51172458-10

Backbone optical cable of tube design, with a central strength member made of glass-reinforced plastic (GRP), steel strand, or steel wire, with intermediate PE sheath, with armor made of steel wires or GRP rods. The cable is designed for laying in soils of all categories, cable channels, collectors, tunnels, shafts, in water when crossing swamps, lakes, and rivers.



Trademarks: **OKGTS, OKGTSd.** TU 3587-006-51172458-10

Backbone optical cable with a central tube containing up to 48 optical fibers, with armor made of steel wires or GRP rod. The cable is designed for laying in soils of all categories, cable channels, collectors, tunnels, shafts, in water when crossing swamps, lakes, and rivers.

#### Main characteristics

Parameters	OKGM, OKGMd	OKGTS, OKGTSd
Number of optical fibers	4-288	2-48
Cable diameter	12.2-26.9 mm	7.6-20.2 mm
Allowable tensile force	4.0-80.0 kN	
Service temperature for the cable	from -60 to 70 °C	
Min. allowable temperature for laying	-30 °C	

### 1.2. OPTICAL CABLES FOR LAYING IN CABLE CHANNELS



Trademark: **OKKM.** TU 3587-006-51172458-10

Distribution optical cable of tube design, with a central strength member made of GRP rod, steel strand, or steel wire, with intermediate PE sheath or without it, with a water-blocking tape, with light-weight armor made of corrugated steel tape. The cable is designed for laying in cable channels, pipes, blocks, collectors, tunnels along bridges, and in shafts.



Trademark: **OKKTS.** TU 3587-006-51172458-10

Distribution optical cable with a central tube containing up to 48 optical fibers, with strength members of steel wire, water-blocking filament, and light-weight armor of corrugated steel armor. The cable is designed for laying in cable channels, pipes, blocks, collectors, tunnels, along bridges, and in shafts.

#### Main characteristics

Parameters	OKKM	OKKTS
Number of optical fibers	4-576	2-48
Cable diameter	10.9-24.0 mm	from 8.1 mm
Allowable tensile force	1.0-3.5 kN	
Service temperature for the cable	from -40 to 70 °C	
Min. allowable temperature for laying	-30 °C	

### 1.3. OPTICAL CABLES FOR LAYING IN PLASTIC PIPES THROUGH PNEUMATIC BLOWING AND INDOOR INSTALLATION



Trademark: **OKTM.** TU 3587-006-51172458-10

Optical cable for distribution of tube design, with a central strength member made of GRP rod, steel strand, or steel wire. It is possible to manufacture the cable with dry water-blocking elements. The cable is designed for laying in cable channels inside plastic pipes (the fire-retardant version is used for installation inside buildings and structures).



Trademark: **OKTTS.** TU 3587-006-51172458-10

Indoor optical cable with a central tube containing up to 48 optical fibers, with a wire strength member. The cable is designed for laying in cable channels inside plastic pipes (the fire-retardant version is used for installation inside buildings and structures).

#### Main characteristics

Parameters	OKTM	OKTTS
Number of optical fibers	4-288	2-48
Cable diameter	10.0-19.7 mm	from 6.7x7.7 mm
Allowable tensile force	1.0-3.5 kN	
Service temperature for the cable	from -40 to 70 °C	
Min. allowable temperature for laying	-10 °C	



Technical inspection at one of production lines

**1.4. AERIAL OPTICAL CABLES**



Trademark: **OKSD**. TU 3587-004-51172458-10

Optical cable, self-supporting, dielectric, of tube design, with a central strength member made of GRP rod, with an outer strength member made of aramid filament. The cable is designed for suspension on supports of aerial power and communication lines, of contact networks of railways. It received the Findings of the Attestation Commission of PAO Rosseti.



Trademarks: **OKSM, OKSMs**. TU 3587-007-51172458-10

Optical cable, self-supporting, dielectric, of tube design, with a central strength member mad of GRP rod, with an outer strength member made of glass or aramid filament. The cable is designed for suspension on supports of communication lines, of contact networks of railways, street lamp poles.



Trademarks: **OKSTS, OKSTSs**. TU 3587-007-51172458-10

Optical cable, suspension, self-supporting, dielectric, qith a central tube containing up to 48 optical fibers, with a strength member made of two GRP rod. An additional strength member made of aramid filament or glass filament is used for manufacturing cables with a tensile force from 3 kN and more. The cable is designed for suspension and service on supports of aerial communications lines, street lamps poles, contact network of urban transport, between buildings and structures.

**Main characteristics**

Parameters	OKSD	OKSM, OKSMs	OKSTS, OKSTSs
Number of optical fibers	4-288	4-288	2-48
Cable diameter	10.1-23.9 mm	10.0-19.5 mm	5.0-11.2 mm
Allowable tensile force	4.0-100.0 kN	3.0-50.0 kN	1.2-20.0 kN
Service temperature for the cable	from -60 to 70 °C	from -60 to 70 °C	from -60 to 70 °C
Min. allowable temperature for laying	-30 °C	-30 °C	-30 °C



Trademark: **OKPM**. TU 3587-007-51172458-10

Suspension optical cable of tube design, with a central strength member made of GRP rod, with an outer strength member made of GRP rod or steel wire. The cable is designed for suspension and service on supports of aerial communication lines, street lamps poles, contact network of urban transport, between buildings and structures.



Trademark: **OKPC**. TU 3587-007-51172458-10

Suspension optical cable with a central tube containing up to 48 optical fibers, with an outer strength member made of GRP rod, steel strand, or steel wire. The cable is designed for suspension and service on supports of aerial communication lines, poles of street lamps, contact network of urban transport, supports of radio transmitting network, between buildings and structures.

**Main characteristics**

Parameters	OKPM	OKPTS
Number of optical fibers	4-288	4-48
Size of the cable	from 9.7×20.7	from 6.8×13.0
Diameter of the outer strength member	4.2 mm	4.2 mm
Allowable tensile force	3.0-15.0 kN	
Service temperature of the cable	from -60 to 70 °C	
Min. allowable temperature for laying	-30 °C	



Trademark: **OKPP**. TU 3587-007-51172458-10

Suspension flat optical cable with a central tube containing up to 48 optical fibers, with a strength member made of two GRP rods. The cable is designed for suspension and service of supports of aerial communication lines, poles of street lamps, contact network of urban transport, supports of radio translation network, between buildings and structures. It is allowable to lay the cable indoor, in cable trays, cable channels, and along front sides of buildings.

**Main characteristics**

Parameters	OKPP
Number of optical fibers	2-48
Cable diameter	from 3.4×6.8 mm
Allowable tensile force	1.0-7.0 kN
Service temperature for the cable	from -60 to 70 °C
Min. allowable temperature for laying	-30 °C



Production shop of AO MKF



Armoring line

## 2. OPTICAL CABLES FOR LANS



Trademarks: **OKS, OKD**. TU 3587-008-51172458-12

Indoor optical cable consists of one or two optical fibers in tight buffer; a strength member of high-modulus filament is applied over it. The cable is designed for indoor installation, manufacturing of cords and pigtails and is laid in special ducts, boxes, inside buildings and structures.

### Main characteristics

Parameters	OKS	OKD
Number of optical fibers	1	2
Cable diameter	1.8-2.8 mm	
Size of the cable, width × height	1.8×3.6-2.8×5.6 mm	
Allowable tensile force	0.1 kN	
Service temperature for the cable	from -10 to 50 °C	
Min. allowable temperature for laying	-10 °C	

Trademark: **OKR**. TU 3587-008-51172458-12

Indoor optical cable, distribution, containing up to 12 optical fibers in tight buffer; a strength member – high-modulus filament is applied over it. Additional strength members – GRP rod, steel wire may be used in the cable. The cable is designed for indoor and outdoor installation and is laid in special ducts, boxes, inside and outside buildings and structures, including vertical installation.



Trademark: **OKR with microtubes**. TU 3587-008-51172458-12

Indoor optical cable for distribution containing up to 24 microtubes with optical fibers. A strength member made of high-modulus filament is applied over microtubes. Additional strength members – GRP, steel wire may be used in the cable. The cable is designed for indoor and outdoor installation and is laid in special ducts, boxes, outside and inside buildings, including vertical installation.

### Main characteristics

Parameters	OKR	OKR with microtubes
Number of optical fibers	2-12	4-288
Cable diameter	4.5-8.6 mm	4.0-13.7 mm
Allowable tensile force	0.5 kN	
Service temperature for the cable	from -40 to 50 °C	
Min. allowable temperature for laying	-10 °C	

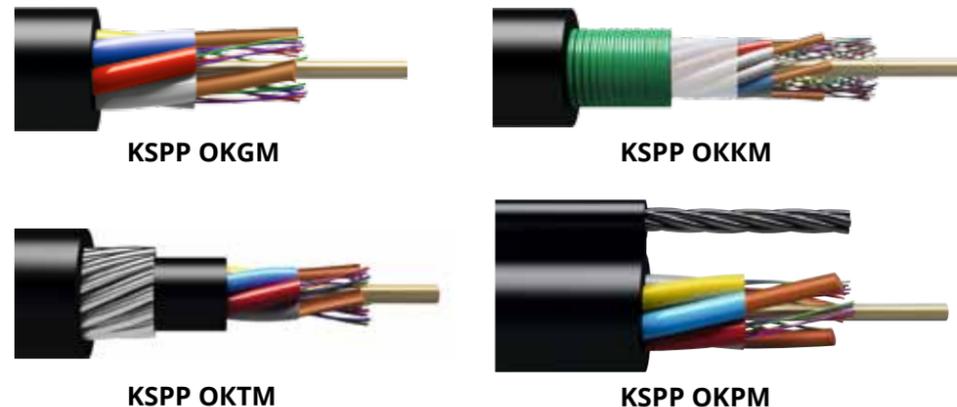


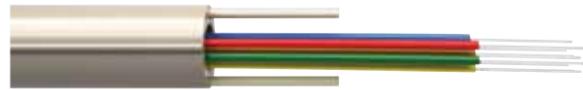
Optical fiber made by Fujikura Ltd. (Japan)

## 1.5. COMPOSITE OPTICAL CABLES

Designs of cables, types OKGM, OKKM, OKTM, OKPM and others can be manufactured with additional stranding elements – insulated copper conductors for connection to weak-current equipment. Number of cores can vary from 2 to 10; the cross-sectional area is subject of agreement with the customer.

Trademarks: **KSPP OKGM, KSPP OKKM, KSPP OKTM, KSPP OKPM**  
TU 3587-011-51172458-14





Trademark: **OKV**. TU 3587-008-51172458-12

Indoor optical cable for distribution with free access to optical fibers containing up to 48 optical fibers in tight buffer loosely laid in polymer sheath. There are two sheathed strength members made of GRP rod. The cable is designed for indoor arrangement and is laid vertically in risers of building and structures.



Trademark: **OKV with microtubes**. TU 3587-008-51172458-12

Indoor optical cable for distribution with free access to fibers containing up to 24 microtubes with optical fiber. Microtubes are loosely laid in polymer sheath. There are two sheathed strength members made of GRP rod. The cable is designed for indoor arrangement and is laid vertically in risers of buildings and structures.

#### Main characteristics

Parameters	OKV	OKV with microtubes
Number of optical fibers	2-24	4-288
Cable diameter	6.0-10.5 mm	5.5-14.5 mm
Allowable tensile force	1.0 kN	
Service temperature for the cable	from -10 to 50 °C	
Min. allowable temperature for laying	-10 °C	



Production bays of AO MKF



Moskabel – Fujikura



Trademark: **OKDP**. TU 3587-009-51172458-13

Indoor optical cable; optical fibers are loosely laid in the center of the cable. There are two sheathed strength members (GRP rods or steel galvanized wires). The cable is designed for suspension on supports of aerial communication lines, poles of street lamps, contact network of urban transport, supports of radio transmitting network, for installation inside buildings and structures.



Trademark: **OKDP with an outer strength member**.

TU 3587-009-51172458-13

Optical cable with an outer strength member made of steel galvanized wire or GRP rod. Optical fibers are loosely laid in the center of the cable. There are two sheathed strength members (GRP rods or steel galvanized wires). The cable is designed for suspension on supports of aerial communication lines, poles for street lamp, contact network of urban transport, on supports of radio transmitting network, for installation inside buildings and structure.

#### Main characteristics

Parameters	OKDP	OKDP with an outer strength member
Number of optical fibers	1-4	1-4
Size of the cable	2.0x3.0 mm	2.0x5.0 mm
Allowable tensile force	0.22 kN	1.0 kN
Service temperature for outdoor laying	from -60 to 70 °C	
Min. allowable temperature for laying	-30 °C	



MOSKABELMET  
Group of Companies



**ELKAT LLC** – is the legal successor of a joint Russian-Finnish company to which MKM CJSC and Pysmian Finland Oy are parties.

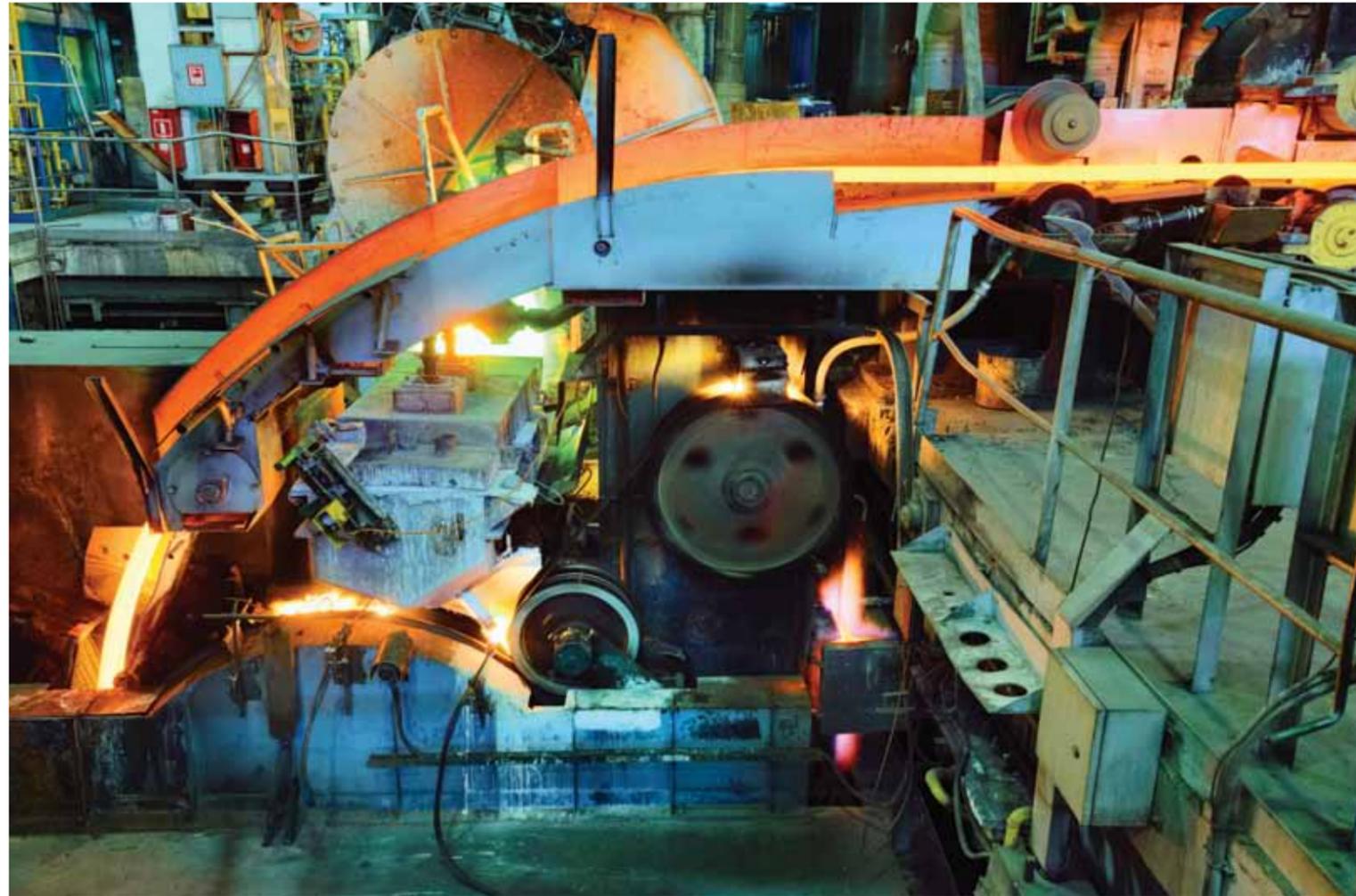
Since its foundation in 1988, the plant has produced more than 2,000,000 tons of rods. The production capacity of the enterprise is designed for 150 thousand tons of rod and 16 thousand tons of wire per year. Elkat was first in Russia to manufacture copper rod by the method of continuous casting and rolling.

The enterprise is a manufacturer of products of such high quality that the leading enterprises of the cable industry from all regions of the country, from Kaliningrad to Kamchatka, purchase materials here.

The quality of the metal used meets the international standards which is monitored and confirmed by the independent Elkat Quality Laboratory which is the only copper cathode analyzer of the London Metal Exchange. All the copper-mining companies of Russia needing recognition at the international level are testing metal at the Elkat Quality Laboratory.

Elkat Limited Liability Company (Elkat LLC)

# Elkat



Production of Copper Rod at Southwire Unit

## EQUIPMENT

The enterprise is equipped with a continuous casting and rolling plant by Southwire (USA) which is the developer of the same technology of rod production. The production capacity is 150 thousand tons of rods per year.

The Company produces an oxygen-free copper rod at UPCAST (Finland) unit, a continuous casting line. The volume of production is 8 thousand tons of rods per year.

With the help of the Niehoff (Germany) drawing machine with combined annealing the Company annually produces 16,000 copper wires.

## RAW MATERIALS

Copper rod and wire are manufactured from copper cathodes of M00k grade (GOST 546-2001).



## KEY CLIENTS AND PARTNERS

Buyers of copper rod and wire of Elkat LLC are the largest cable plants: Estralin ZVK, Moscow; Rybinskelektrokabel, Yaroslavl Region, Rybinsk; Kamskiy Kabel, Perm and many others.

## QUALITY MANAGEMENT SYSTEM

Since 2001, the Company has been operating a quality management system. In 2016, TÜV Rheinland Cert GmbH, independent certification body, conducted a recertification audit of the quality management system for compliance with ISO 9001:2008 international standard. The inspection resulted in obtaining the certificate of conformity.

A «Quality Policy of the Enterprise» has been developed, a document confirming the commitment of management to the principles of quality management and being the basis for setting objectives in this area.

Keeping safety in production processes, Elkat LLC fulfils the requirements of the policy in the field of industrial safety in the operation of hazardous production facilities.

The enterprise includes the Elkat Laboratory which is accredited in accordance with the requirements of ISO/IEC 17025-2009 «General Requirements to the Competence of Testing and Calibration Laboratories».



Copper Quality Inspection

Since its foundation, Elkat has produced more than **2000 000** tons of rods

## PRODUCTS

Elkat LLC specializes in the production of copper rod and copper round electric wire: from the receipt of raw materials and materials to the warehouse to shipment of finished products to the consumer.

Manufacture of Oxygen-Free Rod on the UPCAST Unit



Copper Rod. Dimensions of the Coil 1,300 × 1,300 Mm

### 1. COPPER ROD

The copper rod is designed for the production of cable cores as well as electric products. The rod is produced by the method of continuous casting and rolling on the line of the American company Southwire from cathode copper of M00k grade (GOST 546-2001).

#### Key parameters

Parameters	Value	
Copper grade(GOST R 53803-2010)	KM M001	KM M0
Nominal diameter, mm	8, 10, 13, 18	8, 10, 13, 18
Deviations from nominal diameter, NMT, mm		
Diameter 8,10,13	±0.4	±0.4
Diameter 18	±0.6	±0.6
Surface oxidation, NMT, Å	1000	1000
Oxygen content, NMT, ppm	400	400
Specific electrical resistivity, NMT, Om m·10-6	0.01707	0.01718
Extension strain, NLT, %	35	35
One way torsion value before destruction, NLT	50	50

#### Packaging

Coils of copper rods, net weight of up to 5 tons, are supplied on wooden pallets with a size of 1,300 × 1,300 mm, fixed with steel bands (4 pcs.), and packed in a polyethylene bag.



Profile of Copper Rod

### 2. ROUND ELECTRIC COPPER WIRE

Round electric copper wire is intended for manufacturing wires and cables. The wire is produced on the two-way coarse drawing line MM-85 from Niehoff (Germany) from copper rod (GOST R53803-2010).

#### Key parameters

Parameters	Value
Nominal diameter of wire, mm	1.15-4.50
Specific electrical resistivity, Om m·10-6, NMT:	
MM wire brand	0.01724
MT wire brand	0.0177
Extension strain, %, NLT:	
MM wire brand	30
MT wire brand	
Deviations from nominal diameter, mm, NMT:	
1.15 to 2.95 mm inclusive	±0.02
over 2.95 to 3.81 mm inclusive	±0.03
over 3.81 to 4.50 mm inclusive	±0.04
Bends without destruction, NLT (for MT brand):	
with nominal diameter from 1.15 to 1.20 mm inclusive	7
over 1.2 to 2.6 inclusive	6
over 2.6 to 3.0 inclusive	7
over 3.0 to 4.0 inclusive	5
over 4.0 to 4.5 mm inclusive	4

#### Packaging

Reception of wire on the spooler is provided to obtain bundles of the following sizes:

- Height 740 mm
- Outer diameter 1200 mm
- Internal diameter 630 mm
- Maximum bundle weight of 3000 kg

The coil is tied with 8 plastic straps and attached to a wooden pallet (1150 × 1150 mm), packed in a polyethylene package.

### 3. OXYGEN-FREE COPPER ROD

Oxygen-free copper rod is designed for the production of wire, contact wires, bus bar and other electric products by cold deformation followed by annealing (coarse drawing machines and other drawing equipment) and rotational extrusion (Conform). Produced at the UPCAST (Finland) unit according to TU 1844-002-05829660-2014.

#### Key parameters

Parameters	Value
Nominal diameter of rod, mm	8, 10, 12.5, 16, 18, 20, 22
Surface oxidation, NMT, Å	100
Copper grade (GOST 859-2001)	M00b, M0b, M1b
Specific electrical resistivity in annealed condition, NMT, Om m 10-6 at 20 °C	0.01724
Extension strain, %, NLT:	30
Deviations from nominal diameter, mm, NMT:	
8 mm, 10 mm	±0.4
12.5 mm, 16 mm	±0.5
18 mm, 20 mm	±0.6
22 mm	±0.7

#### Упаковка

Coils of copper rods, net weight of up to 3 tons, are supplied on wooden pallets with a size of 1,500 × 1,300 mm, fixed with steel bands (4 pcs.), and packed in a polyethylene bag.



Profile of Round Copper Wire



**MOSKABELMET**  
Group of Companies

**MOSKABEL – TSVETMET LLC** has been established in 2003 on the basis of the shop for the production of non-ferrous rolled metal products of Moskabelmet.

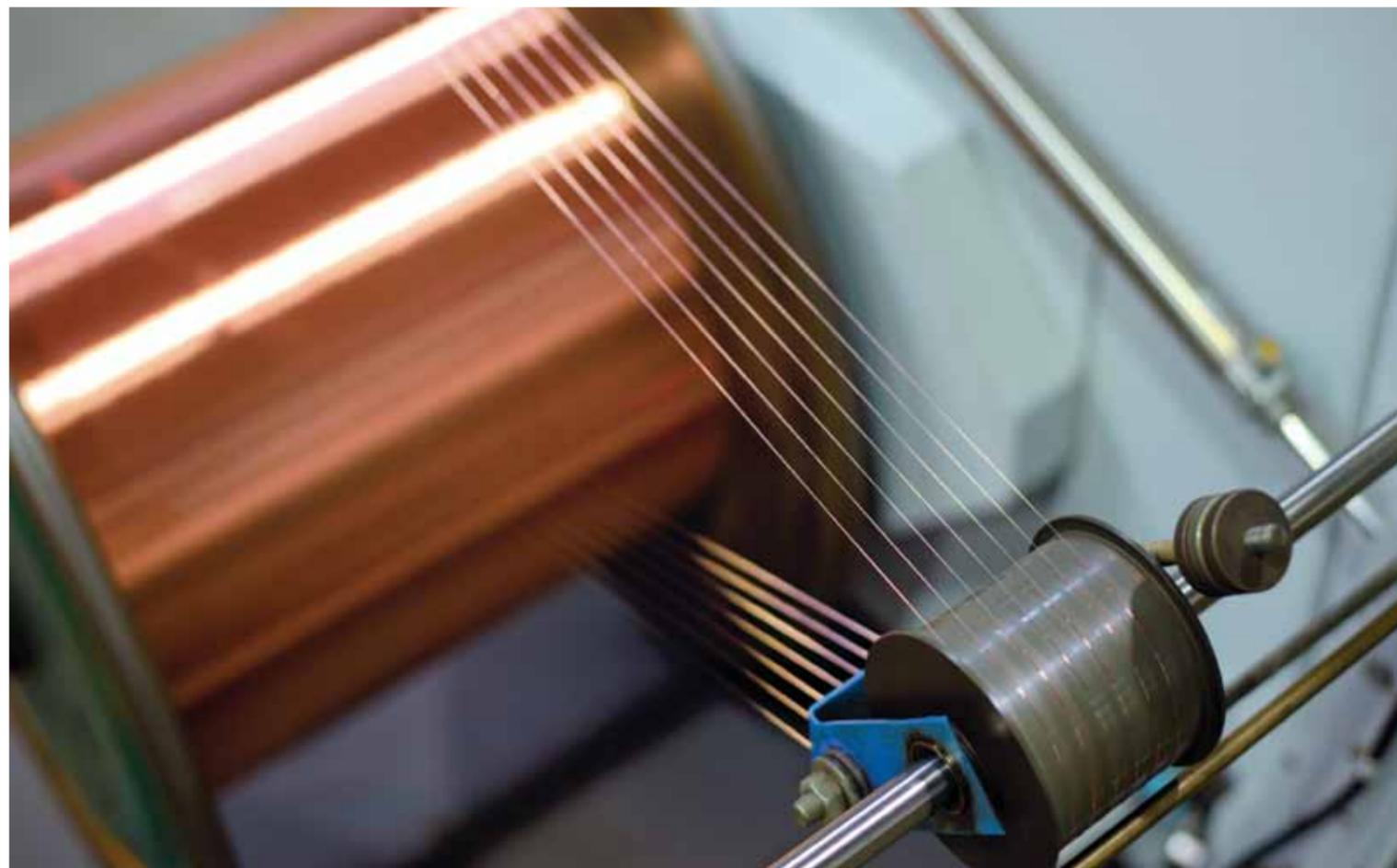
The enterprise produces dozens of wire and power core ranges and today it occupies the leading position in the market of non-ferrous rolled products due to the high quality of products which is confirmed by certificates of conformity for all types of products.

The plant does not stop there and constantly improves the production base by monitoring the emergence of new promising models of equipment offered by the world's leading manufacturers.

Moskabel – TsvetMet LLC is the only enterprise in Russia that thanks to MKD 18×800, the unique equipment, produces a hollow wire of the PA brand for transmission of electric power in air electric networks and for bus arrangement of open high voltage switchgears.

Moskabel-TsvetMet Limited Liability Company (Moskabel – TsvetMet LLC)

# Moskabel – TsvetMet



Technological Process of Manufacturing Copper Conductor on the Line of Multi-Thread Drawing and Twisting

## EQUIPMENT

Moskabel – TsvetMet has all the necessary technological equipment (drawing and twisting machines, furnaces for heat treatment of wire) for manufacturing products without which it is impossible to create wires, cables, electric motors and other types of electric products.

The enterprise uses the Buhler EWT 250-5 five-cage rolling mill for the production of flat copper wire of ПМТ and ПММ brands using cold rolling technology. Copper multi-wire conductor with a cross section

from 0.20 to 6.0 mm<sup>2</sup> is manufactured on the lines of multiple drawing using the most advanced Niehoff equipment of 2013.

## RAW MATERIALS

Materials for manufacturing products are supplied by the largest Russian producers of copper (Elkat LLC) and aluminium rod (UC «RUSAL»).

## KEY CLIENTS AND PARTNERS

Moskabel – TsvetMet LLC manufactures products that are used in such sectors as railway transport, automotive, electrical and food industries, electric networks, lighting equipment, tin-can manufacturing.

The constant customers of the enterprise are RZhD OJSC, Borets Manufacturing Company LLC, JSC Energokabel, Ruselprom – Resource LLC, PJSC Power Machines and other large companies and organizations.



## QUALITY MANAGEMENT SYSTEM

The company operates a quality management system that meets the requirements of GOST R ISO 9001-2015 which is also certified for compliance with the requirements of GOST RV 0015-002-2012 in the «Military Register» Voluntary Certification System.

The system of ecological management corresponds to GOST R ISO 14001-2007 (ISO 14001:2004).

Thanks to the unique **MKD 18×800** equipment the enterprise is the only company in Russia that produces a hollow wire of the PA brand

## PRODUCTS

The enterprise specializes in the production of copper and aluminium wire with round and flat sections, copper profile for collectors of electrical machines, flexible copper wires for the production of conductors of household and installation wires, for brushes of electrical machines, for the use in lightning protection systems, wires for the contact network of urban and railway transport, non-insulated wires for overhead power lines. These products are the basis for the production of products that consumers associate with the MKM quality mark.

### 1. WIRE

#### ROUND COPPER WIRE

TU 16-705.492-2005



There are the following brands of wire:

**MT** – hard copper wire,  
**MM** – soft copper wire.

Diameter of wire:

0.10 to 16.00 mm for MT wire,  
0.15 to 11.0 mm for MM wire.

Scope of application: The wire is designed for the manufacture of wires, cables and for other electrical purposes.

#### ROUND ALUMINIUM WIRE

TU 16.K71-088-90



There are the following brands of wire:

**AT** – hard aluminium,  
**AM** – soft aluminium,  
**APT** – semi-hard aluminium.

Wire dimensions under TU 16.K71-088-90

Scope of application: The wire is designed for the manufacture of wires, cables and for other electrical purposes.

#### FLAT COPPER WIRE

GOST 434-78



There are the following brands of wire:

**PMM** – soft copper wire,  
**PMT** – hard copper wire.

Wire dimensions under GOST 434-78

Scope of application: The wire is designed for electrical products (electric machines, transformer plants, etc.).

#### FLAT ALUMINIUM WIRE

TU 16-705.451-87



There are the following brands of wire:

**PAT** – hard aluminium wire,  
**PAM** – soft aluminium wire.

Wire dimensions under TU 16-705.451-87

Scope of application: The wire is designed for the manufacture of winding wires and for other electrical purposes.



Installation of Payoff Reels with Wire in the Process of Manufacturing Wires for Brushes of Electrical Machines of PShch Brand

### 2. COPPER PROFILES

#### COPPER PROFILE FOR ROTORS, SUBMERSIBLE MOTORS

TU 1844-046-00219454-2000

TU ETT-05-04



Profiles are produced of copper of **M0** and **M1** grades. Profiles dimensions under TU.

Scope of application: Trapezoidal copper profile is used for the manufacture of rotors for submersible motors.

#### SHAPED COPPER WIRE OF PMTpr BRAND

TU 16-501.006-72



**PMTpr** – hard shaped copper wire.

Wire dimensions under TU.

Scope of application: The wire is designed for the manufacture of submersible motor.

**TRAPEZOIDAL COPPER PROFILE OF PKM BRAND**  
TU 16-501.033-87



The profile is of **PKM** brand.  
Accuracy of manufacture: **N** – normal; **E** – extended; **H** – high. Hardness grade: I, II, III.  
Profiles dimensions under TU 16-501.033-87  
Scope of application: Trapezoidal profiles are used for the manufacture of plates of collectors of electrical machines, electric operating mechanisms and electrical appliances.

**SHAPED ELECTRIC COPPER PROFILE OF PFE BRAND**  
TU 16-501.011-73



Profile of **PFE** brand.  
Profiles dimensions under TU 16-501.011-73  
Scope of application: Shaped electric profile is designed for the electric purposes.

**3. WIRES**

**NON-INSULATED WIRES FOR AIR TRANSMISSION LINES OF AC, A, M BRANDS**  
GOST 839-80



Possible constructions:  
**AC** – a wire consisting of a steel core and aluminium wires. Cross-section from 10/1.8 to 500/26 mm<sup>2</sup>.  
**A** – a wire consisting of several twisted aluminium wires. Cross-section from 16 to 500 mm<sup>2</sup>  
**M** – a wire consisting of one or more twisted copper wires. Cross-section from 16 to 400 mm<sup>2</sup>.  
Scope of application: Wires are used to transmit electric power in air electrical networks.

**PA BRAND WIRE**  
TU 16-505.397-72



Hollow wires of **PA** grade without supports. The wire consists of hard aluminium wires of shaped cross-section forming one batch and connected to each other in the lock without a supporting frame.  
Wire cross-section: 500 and 640 mm<sup>2</sup>.  
Scope of application: Hollow wires are used in aerial electric networks for transmission of electric power, buses of open distribution devices (substations and switching points) of high voltage.

**MГ BRAND WIRE**  
TU 16-705.466-87



Non-insulated flexible copper wires of **MГ** brand with cross-section from 10 to 120 mm<sup>2</sup>.  
Scope of application: Non-insulated flexible copper wires are used in electrical installations and devices.

**WIRES FOR BRUSHES OF ELECTRIC MACHINES OF PSHCH BRAND**  
TU 16-705.467-87



Cross-section from 0.30 to 10 mm<sup>2</sup>.  
Scope of application: Flexible wires of copper wires are designed for the production of brushes of electric machines.

**CONTACT WIRES OF COPPER AND ITS ALLOYS FOR ELECTRIFIED RAILWAYS**  
GOST R55647-2013



**MΦ** – shaped contact copper wire.  
**НлΦ** – shaped contact wire of low-alloyed copper.  
Cross-section: 85, 100 mm<sup>2</sup>.  
Scope of application: contact wires made of copper and its alloys are designed for the contact network of electrified railways.

**CONDUCTORS**  
GOST 22483-2012



Single-wire and multi-wire conductors made of copper and aluminium, flexible copper conductors.  
Design of **conductors** in accordance with GOST 22483-2012  
Scope of application: conductors are designed for fixed installation cable products.



Modern Line of Multi-Circular Drawing and Twisting for the Production of Copper Conductors



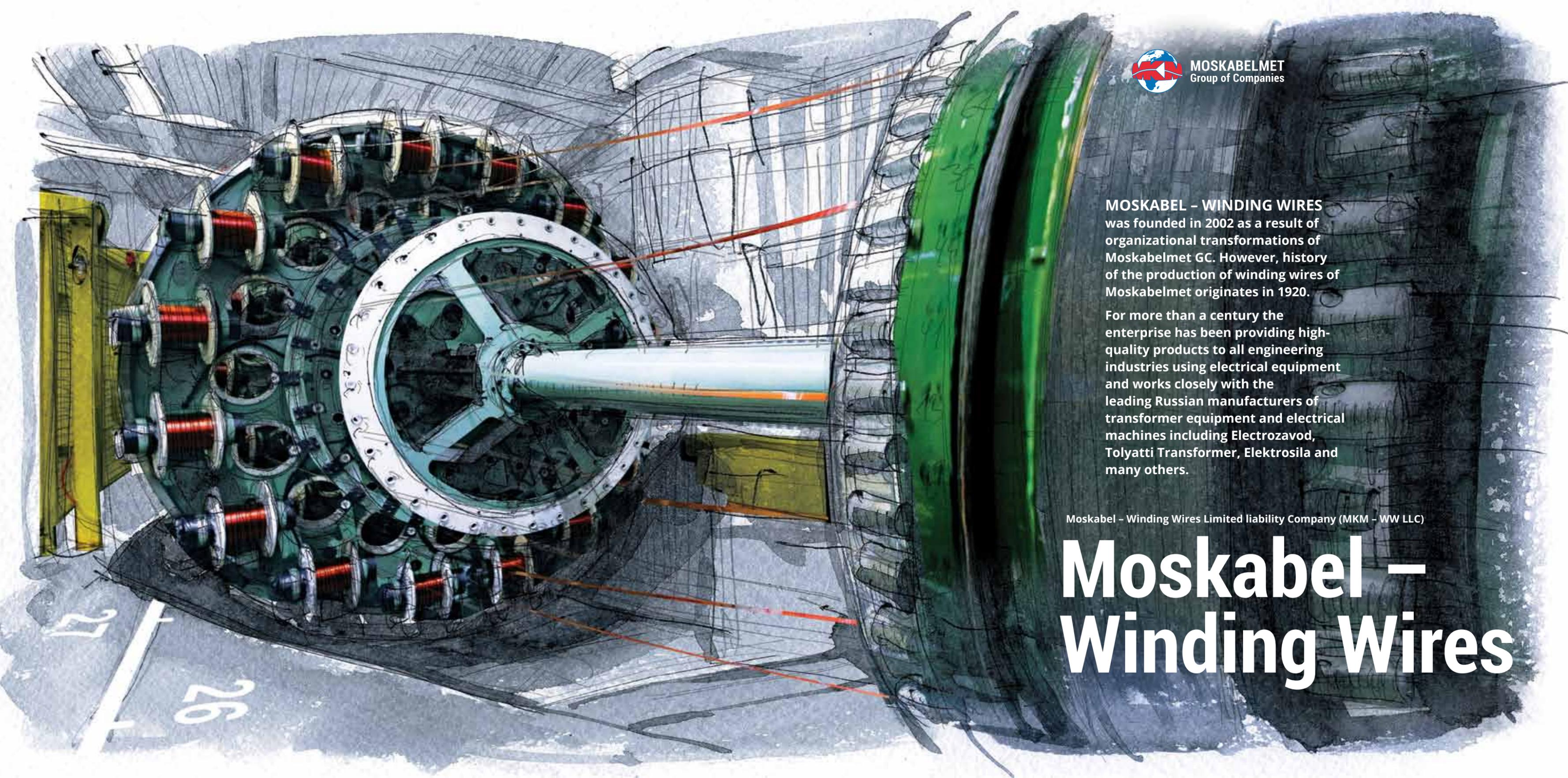
**MOSKABELMET**  
Group of Companies

**MOSKABEL – WINDING WIRES** was founded in 2002 as a result of organizational transformations of Moskabelmet GC. However, history of the production of winding wires of Moskabelmet originates in 1920.

For more than a century the enterprise has been providing high-quality products to all engineering industries using electrical equipment and works closely with the leading Russian manufacturers of transformer equipment and electrical machines including Electrozavod, Tolyatti Transformer, Elektrosila and many others.

Moskabel – Winding Wires Limited liability Company (MKM – WW LLC)

# Moskabel – Winding Wires





Production of Enamelled Wires

## KEY CLIENTS AND PARTNERS

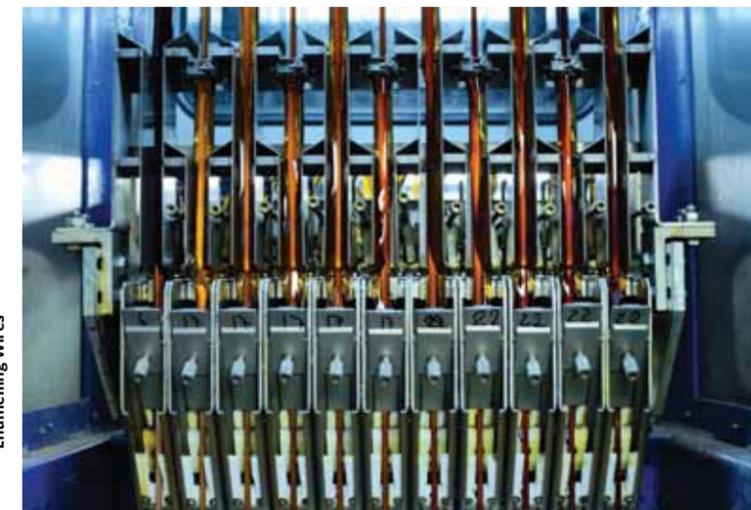
MKM – WW LLC successfully cooperates with the largest manufacturers. Partners of the company which have long ago established themselves in the market of transformer and electric machine building include (Electrozavod, Togliatti Transformer, UETM, Elektrosila, Ruselprom) and new companies established on the territory of Russia with the participation of foreign capital (Siemens Transformers, Power Machines – Toshiba, Siemens Electric Drive).

## QUALITY MANAGEMENT SYSTEM

The company operates a quality management system that meets the requirements of GOST R ISO 9001-2015 which is also certified for compliance with the requirements of GOST RV 0015-002-2012 in the «Military Register» Voluntary Certification System.

The system of ecological management corresponds to GOST R ISO 14001-2007 (ISO 14001:2004).

The enterprise is open to cooperation in the development and improvement of the designs of manufactured products.



Enamelling Wires



Production of CTC

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**Today, MKM – WW LLC is the only enterprise in the country that produces high-tech CTC. The plant is the largest manufacturer in Russia of virtually all types of winding wires that are used in the electrical industry.**

**Being a client-oriented company, MKM – WW LLC, by order of partners develops new types of winding wires. The products are manufactured according to TU and GOST and prove their reliability in different climatic zones of Russia, the CIS countries and the European Union where the enterprise is well known as a manufacturer of high-quality products.**

## EQUIPMENT

The enterprise has unique equipment designed according to the individual requirements of the plant. The Austrian equipment MAG and MALI which has no analogues in Russia is used to produce CTC.

Regular updating and modernization of the existing fleet of equipment is being conducted to maintain technological capabilities at the level of the world's leading manufacturers of winding wires.

## RAW MATERIALS

Insulating materials of the world's companies known on the market as reliable manufacturers and suppliers are used for the products. The necessary types of paper are purchased from Wiedmann, Munksjo, Krempel for CTC and paper-insulated wires. Iva and Elantas supply enamel for the production of enamelled wires and CTC.

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Enamelled Wire Production

### 7. ROUND WIRES WITH POLYIMID-FLUOROPLASTIC INSULATION

Round copper wires with polyimide-fluoroplastic insulation are used in windings of oil submersible motors.

Brands: **PPI-U, PPI-UM, PPI.** TU 16-705.159-80



#### Key parameters

Temperature Index	200 °C
Diameter of wire	1.00 to 10.00 mm
Breakdown voltage	12000 V

### 8. FLAT WIRES WITH POLYIMID-FLUOROPLASTIC INSULATION

Flat copper wires with polyimide-fluoroplastic insulation are used in windings of heavy duty electric motors.

Brands: **PPTPK-T, PPIPK-1, PPIPK-2.** TU 16.K71.202-93

Brands: **PPIPK-3, PPIP-T, PPIP-1, PPIP-2.** TU 16-705.035-82

Brands: **PPIPKS-1, PPIPKS-2.** TU 3592-101-59575813-2008



#### Key parameters

Temperature Index	200 °C
«a» conductor thickness	1.12 to 4.50 mm
«b» conductor width	3.35 to 14.00 mm
Breakdown voltage	1500 to 5000 V

### 9. WIRES WITH INSULATION FROM SYNTHETIC TAPES

Flat copper wires with aramid paper insulation are used in dry transformers and electric machines.

Brands: **PPA, APPA, PPA-1, PPA-2, PPTA-2.**

TU 3592-099-59575813-2005



#### Key parameters

Temperature Index	155, 220 °C
«a» conductor thickness	1.00 to 5.00 mm
«b» conductor width	4.00 to 16,00 mm
Breakdown voltage	700 to 5000 V

### 10. WIRES WITH INSULATION FROM MICA-CONTAINING TAPES

Flat copper wires with insulation from mica-containing tapes are used in high-voltage electrical machines.

Brands: **PPLS.** TU 3592-100-59575813-2013

Brands: **PPS, PPS-2.** Technical Specification



#### Key parameters

Temperature Index	155 °C
«a» conductor thickness	1.00 to 5.00 mm
«b» conductor width	4.00 to 16.00 mm
Breakdown voltage	2000 to 7500 V

### 11. ENAMELLED WIRE

Flat copper wires with enamel insulation are used in windings of electrical machines.

Brands: **PEEIP-1-155, PEEIP-2-155** TU 16-705.414-86

Brands: **PETP-1-180, PETP-2-180** TU 3591-082-05758629

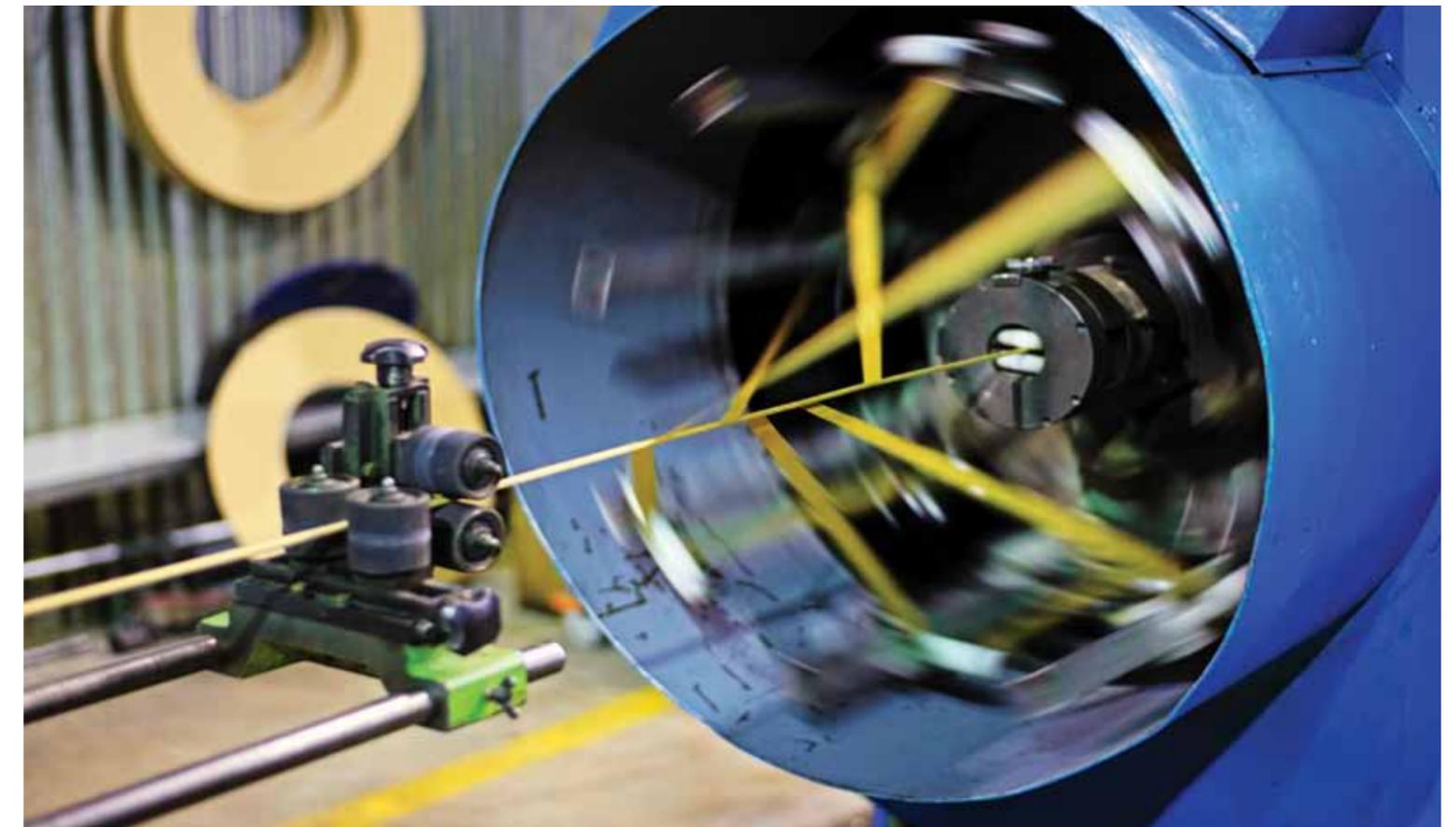
Brands: **PETPD-1-200, PETPD-2-200** TU 3591-081-05758629-01

Brand: **PETVP-S** 16-705.457-87



#### Key parameters

Temperature Index	130, 155, 180, 200 °C
«a» conductor thickness	0.80 to 5.60 mm
«b» conductor width	2.24 to 16.00 mm
Breakdown voltage	700 to 2000 V



Production of Paper-Insulated Wires



MOSKABELMET  
Group of Companies



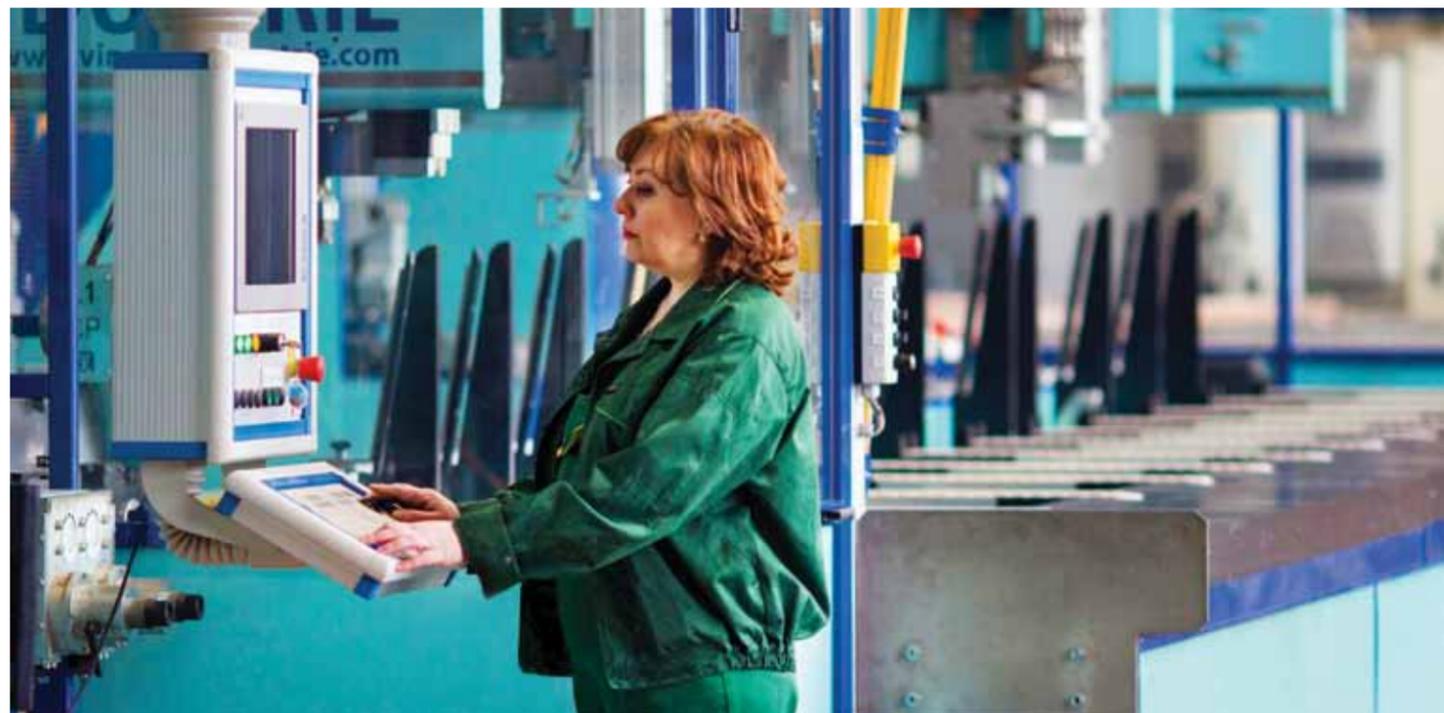
VERZ

**VOROTYNSKY ENERGOREMONTNYI ZAVOD LLC** has been repairing, modernizing and servicing electric machines of all types for more than 55 years. Many years of accumulated experience eloquently confirm the figures: since 1961 the enterprise has rendered more than 10,000 services, has repaired more than 570,000 electric motors, 90,000 generators, and 120,000 transformers.

The plant has a license to carry out works and manufacture equipment for nuclear power plants and has received a unique right to take part in equipping the world's first Floating Nuclear Thermal Power Plant (FNPP). A number of other large and ambitious projects that were successfully implemented are behind the company. Modernization of electric machines on the sea ice-resistant fixed platform «Prirazlomnaya» was carried out, emergency repair of the electric drive of the test stand for NPO Energomash named after Academician V.P. Glushko was carried out, works were carried out at the mining metallurgical plant «Norilsk Nickel».

Vorotynsky Energoremontnyi Zavod LLC (VERZ LLC)

# VERZ



Automated Line for the Production of Windings for Electrical Machines



The Process of Laying the Armature Winding

60

**VERZ LLC is part of the international association Interelectromash due to which it widely cooperates with manufacturers and scientific and technical enterprises of Russia and Europe in the entire electrical engineering industry.**

**The plant is a certified partner of two of the largest European manufacturers – Siemens and ABB which gives customers the right to repair while maintaining the warranty from the manufacturer.**

## EQUIPMENT

The production is equipped with a unique automated line designed specifically for the enterprise. The line includes the equipment of the French company Vincent Industries and the Swiss company Micamation. The unit produces bar windings of turbogenerators and hydrogenerators stator of any complexity from wire and copper tube with various geometries (3D transposition up to 720° including frontal parts, with rod length up to 8 meters).

The service center of VERZ LLC is equipped with devices by means of which the state of the electric machine is evaluated by non-destructive testing methods.

The PD-Analyzer HF/UHF for measuring the level of partial discharges in the insulation and the Baker test complex for checking the strength of the interturn isolation allow the engineers of VERZ LLC to predict the resource capabilities of electric machines.

The enterprise is equipped with large lathes capable of processing products with a diameter of more than 1 meter and weighing up to 10 tons.

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Since 1961, the Company has successfully repaired more than **570 000** electric motors, **90 000** generators, **120 000** transformers

## RAW MATERIALS

VERZ LLC uses only certified materials and components. Insulation materials of the latest generation from Vonroll Isola, Isovolt, Elinar, Dielectric are used in the manufacture of stator windings for electric machines up to 300 MW which guarantees reliability of the winding.

Due to the fact that the plant is included in the Moskabelmet GC we use wires of our own production from high-quality electoral copper from Moskabel-Obmotochnyi Provoz LLC which allows to shorten the delivery time, reduce the money invested by customers and guarantee the quality of the products (each drum passes the acceptance tests of the technical control department).

## KEY CLIENTS AND PARTNERS

VERZ LLC is the official certified partner for repair and maintenance of electric motors and generators of Siemens and ABB, General Electric, Baldor, WEG, Franklin Electric.

Committed partners of VERZ LLC include the Russian leaders in the nuclear, oil, energy, gas, mining and metallurgical industries, industrial giant enterprises, manufacturers of electrical machines, representatives of other spheres. These are such companies as Gazprom, Sibur, Transneft, Rosneft, Lukoil, Rosatom, Atlas Copco, VNIIEM, and Moscow Metro.

## QUALITY MANAGEMENT SYSTEM

VERZ LLC acknowledges the quality management system conformance to ISO 9001 quality standard on a timely basis. The enterprise is a self-regulatory organization member and a member of Interelectromash International Business Association. The company holds OHSAS 18001 and ISO 14001 (EMS) certificates.



Milling Parts

## PRODUCTS

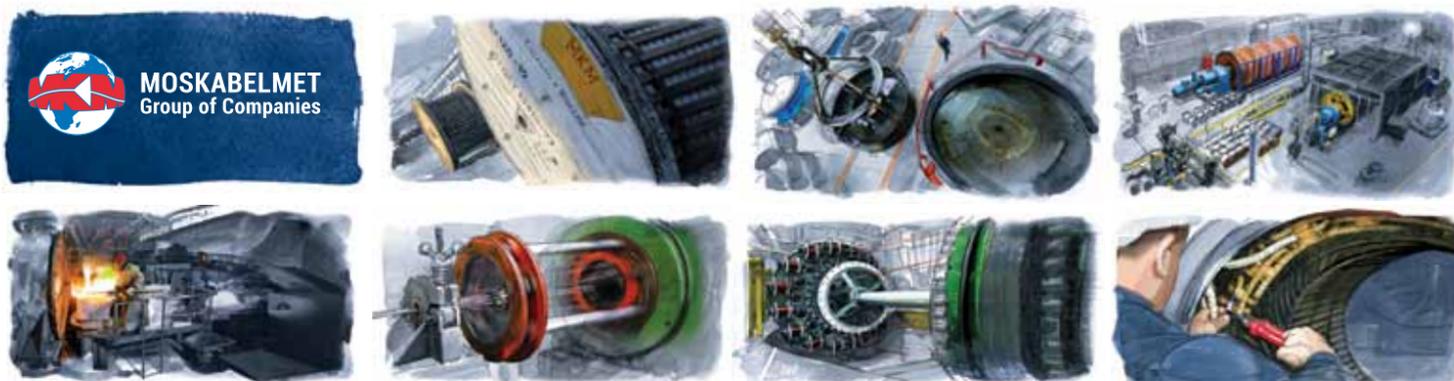
VERZ LLC performs a complex of services for professional diagnostics, repair, and modernization of electric machines.

Service maintenance and repair are carried out not only on its production base, but also on the customer's site, at the place of operation. Field work on diagnostics of electric machines is carried out with the help of its own mobile laboratory registered in Rostekhnadzor.

VERZ LLC holds the leading positions in the production of core windings of turbo generators and hydro generators of up to 300 MW. The work is carried out in record time (up to 40 days) thanks to its own automated line.

The Company provides a wide range of services for machining of parts for individual orders. Quality control of the performed works is carried out by modern methods of ultrasonic, capillary and radiographic fault detection.

VERZ LLC delivers new electric motors of Ruselprom-Electromash, ABB, Siemens, etc. to replace the old ones at special prices.



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