IZOLYATOR
group

RIN

NEW GENERATION HIGH-VOLTAGE BUSHINGS WITH RIN-INSULATION

FOR POWER TRANSFORMERS

2022

AIR
OIL

VOLTAGE
12-550 kV
RATED CURRENT
315-5000 A

Mission. Vision. Social responsibility

Mission

Participating in a stable and reliable energy supply, we help everyone to realize their potential.

Vision

We aim to be a global leader of the industry and help to fill the world with energy and light, creating a high-quality charge in various parts of the planet with smart and advanced solutions in the electric power industry.

Social responsibility

We build our social policy on the basis of a harmonious combination of the interests of the company owners, employees, the local community and society with strict observance of the laws of the Russian Federation.

The history of high-voltage bushings development in Russia is inseparably associated with Izolyator plant. In its century-long history, the plant has produced over 620 thousand high-voltage bushings, operating at the overwhelming majority of power facilities in Russia and neighboring countries as well as 30 more countries in the world.

One of the key events for Izolyator was receipt of the leading science and technology partner to the Russian National Committee (RNC) of the International Council on Large Electric Systems — CIGRE (Conseil International des Grands Réseaux Électriques) status. That is the largest international nongovernment and noncommercial organization in power industry.

Today Izolyator has become a research base for CIGRE National Study Committee D1 “Materials and Emerging Test Techniques”. Collaboration with RNC CIGRE allows us to bring Izolyator's work to a whole new level in the interests of all global market players and for Russia's energy system development in general.

All Izolyator's success became possible thanks to the well-coordinated work of our highly professional team and a strong support from our partners. We shall do our best to fulfill the obligations in high-voltage bushings production and after sales support of our customers.

Century-old traditions — state-of-the-art technologies — these words have become a motto for those employed at the plant, which is justly considered a global leader in development and production of high-voltage bushings.

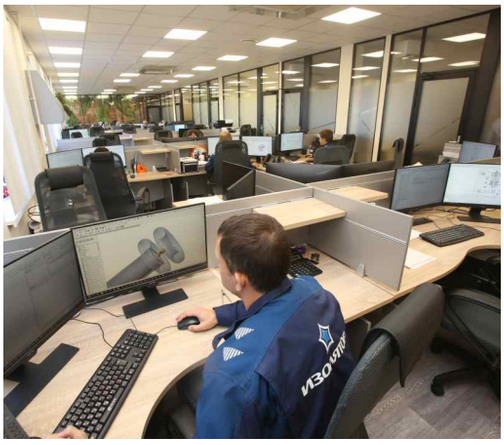
Dr. Alexander Slavinsky

Chief Executive Officer of Zavod Izolyator LLC
Chairman of Board of Massa Izolyator Mehru Pvt. Ltd.
Head of CIGRE National Study Committee D1
Vice-President of AES RF

Designing. Production. Maintenance

R&D Center

- creation of new designs of insulating equipment
- development of new production technologies
- carrying out research activities and prototyping
- serial products upgrades
- highly qualified technical service
- complex diagnostics
- warranty and post-warranty repair
- consulting technical services of customers



Production of Bushings

- the most technologically advanced production equipment from the top OEMs of the world
- patented production technology of RIP and RIN insulation
- patented technology of polymer external insulation making
- making of the internal insulation up to 12 m long and 750 mm in diameter

High-Voltage Cable Accessories Production

- proprietory design of stress cones and actuating bodies of cable accessories
- modern hi-tech equipment from the leading global OEMs
- complete cycle including production, testing, training in installation and maintenance of cable accessories
- manufacture of cable accessories for a wide range of copper and aluminum cables for 185 to 2500 mm^2 conductor cross-section

Test Center

- testing under alternating current up to 1200 kV
- testing under direct current up to ±1600 kV
- testing by full and chopped lightning impulse 1.2/50 μs
- testing by switching impulse 250/2500 μs
- testing of insulation materials and prototypes

Contents

High-voltage bushings with RIN-insulation for transformers

Izolyator manufactures high-voltage bushings with solid internal RIN-insulation in voltage range 12 to 550 kV and rated current 315 to 5000 A for transformers.

RIN-insulation (Resin Impregnated Nonwoven) is a polymer non-woven fabric, impregnated with epoxy-compound followed by curing.

RIN-insulation has been developed by the design office of Izolyator plant together with partners in order to increase the moisture resistance of the internal insulation of high-voltage bushings in difficult conditions or in violation of the rules for their operation and storage.

The main insulation is a polymer non-woven material that does not contain cellulose, as a result of which it has an extremely high hydrophobicity and resistance to atmospheric moisture, virtually eliminating moistening of the insulation.

Izolyator high-voltage bushings with RIN insulation are certified for compliance with the requirements of GOST R 55187-2012 and are certified by the Rosseti Group for use at the facilities of subsidiaries and affiliates.

RIN — a new generation HV insulation: more durable, lasts longer, easier to operate

Bushings with RIN-insulation, retaining all the advantages of RIP-insulated counterparts, have superior operational and technical characteristics.

High reliability, stable parameters and extended service life.

Low level of water absorption of the main insulation of the bushing, even with intense exposure to moisture. Low dielectric loss factor of main insulation: tanδ 0.20–0.25 %. Absence of partial discharges in the insulation at increased voltage up to the maximum operating voltage.

Operation at both extremely low and extremely high temperatures.

RIN insulation has a high thermal conductivity and low coefficient of thermal expansion, which leads to decreased mechanical stresses in the bushing's construction elements, ensuring high reliability and long service life over a very wide range of operating temperatures.

Shorter lead time of products delivery.

The use of synthetic cloth allows to abandon the thermal vacuum drying of the wound insulation, significantly reducing the production time of the bushing.

Transportation and storage of bushings without moisture protection measures.

The resistance to atmospheric moisture of the main insulation allows transporting and storing the bushing indefinitely in the standard original packaging.

The solid RIN insulation was developed by the Izolyator design office in cooperation with the National Research University 'Moscow Power Engineering Institute' in order to dramatically improve the technical and operational characteristics of high-voltage bushings by maximizing the moisture resistance of their internal insulation.

Izolyator high-voltage bushings with RIN insulation comply with the GOST R 55187-2012 requirements and are certified by the Rosseti Group of companies for use at facilities of its subsidiaries and affiliates.

RIN-insulation at the forefront of cutting-edge technologies

A high-temperature superconducting fault current-limiter, designed and manufactured by SuperOx, was put into commercial operation at the 220/20 kV Mnevniki substation of the United Energy Company in Moscow.

This unrivalled unit is equipped with 252 kV Air - Liquid Nitrogen high-voltage bushings with RIN-insulation, which were designed for the first time in the world and made by Izolyator specially for the project.

2019

2017

For the first time in Russia, high-voltage bushings, immersed into a cryostat with liquid nitrogen, were successfully tested at the Izolyator plant.
The specially designed 126 and 252 kV RIN bushings with capacitive regulation of the electric field withstood the temperature difference from - 200^0 C at the bottom part to +10^0 C at the top.

2020

Fot the first time in Russia 252 kV bushing with solid internal RIN insulation was installed for pilot operation in the Vladimir region.

The bushing is used to replace the OIP analogue on a 40 MVA transformer at the 220 kV Dalnyaya substation of the Main Power Systems of the Centre, a branch of the Federal Grid Company of the Unified Energy System.

Bushing assemble

Contact terminal is intended for connecting high potential to it, made of copper alloy (Fig.1)

Body contains the following bushing's elements:

- gas cushion compensates temperature-caused changes of liquid filler volume, being a free air volume;
- tightening device that ensures required mechanical strength and leaktightness of the bushing;
- oil gauge for control of liquid filler level (oil) in the bushing.

Filler, dry, liquid or gaseous, protects the bushing's internal space against moistening.

Porcelain external insulation ensures protection of the internal insulation from moistening and required arching distance and creepage distance along its outer surface.

Internal RIN-insulation (Resin Impregnated Nonwoven) is a polymer non-woven fabric, impregnated with epoxy-compound followed by curing.

Central tube is intended for winding internal insulation on.
The coupler is used for placing the measuring tap and mounting flange on.

Mounting flange is used for securing the bushing on the equipment.

Groundable liner — the last liner of the insulation core staying in permanent electric contact with the measuring tap.

Bottom shield equalizes external electric field in the bottom part of the bushing.

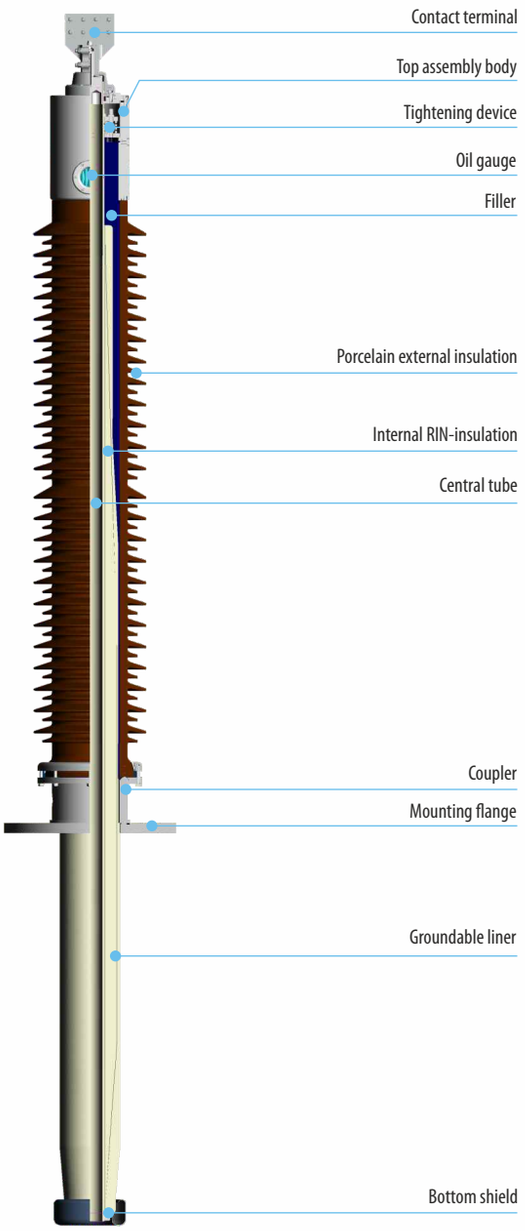


Fig. 1 Bushing with porcelain external insulation

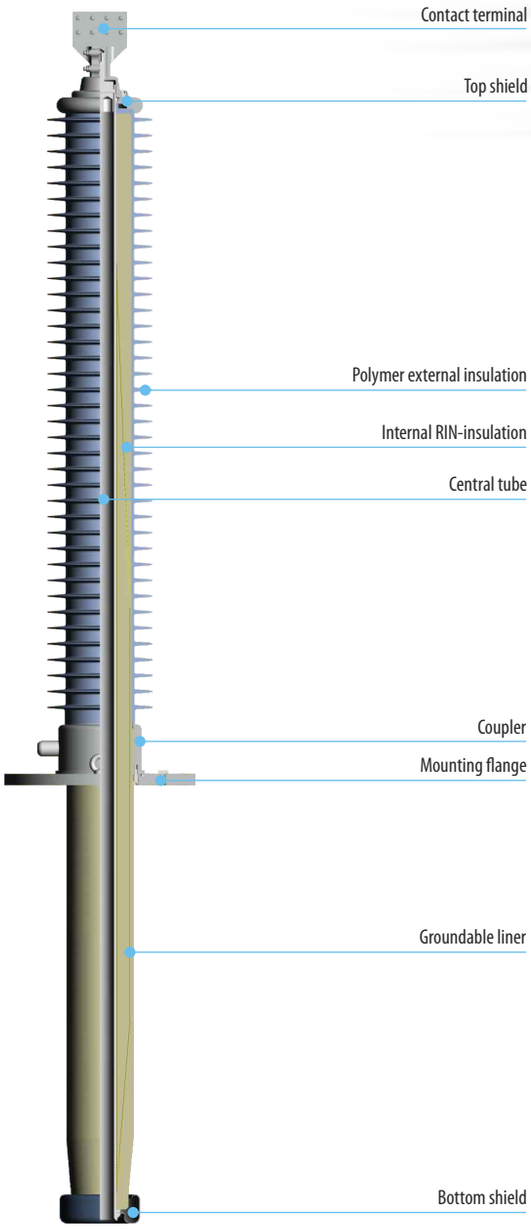


Fig. 2 Bushing with polymer external insulation

Top shield is used in designs of bushings with polymer external insulation for equalizing external electric field in the top part of the bushing (Fig. 2).

In bushings with porcelain housing the top shield function is performed by the body.

Polymer insulation is used on bushings with internal RIN-insulation as alternative to porcelain housing and performs the same functions (Fig. 2).

Bushings with polymer external insulation have the following advantages:

- absolutely dry, explosion and fire safe service-free design;
- stability of insulating properties throughout entire operation;
- high tracking resistance;
- hydrophobicity of external insulation that decreases flashover probability even on moistened dirty insulation surface;
- eslasticity of external insulation, decreasing damage risks at transportation and installation;
- absense of installation angle restrictions on equipment;
- seismic load withstand;
- minimal weight;
- ecological safety.

Assemblies and components of bushings

Solid internal RIN-insulation

The solid internal RIN-insulation (Fig. 3) is the main constructional part of a bushing. The main insulation is a polymer nonwoven material, which does not contain cellulose and therefore has extremely high hydrophobicity and resistance to atmosperic moisture, virtually eliminating moistening of the insulation. The insulation of the type does not require usage of transformer oil as insulation component making operation of bushings much more convenient.

Condenser liners are used to equalize the electric field and evenly distribute potential inside the insulation core. The nearest to the central tube liner is in electric contact with it and the last (groundable) liner is in permanent electric contact with the pin of the measuring tap. The materials used for making of the insulation core ensure required mechanical strength and crack resistance of the insulation. This fact is verified by mechanical, climatic and seismic tests and results of RIN bushings operation.

External insulation

External insulation covers the upper part of the insulation core, located outside a transformer or reactor, and is made of porcelain (Fig. 4) or silicone (Fig. 5).

The external insulation also protects the internal insulation against moinstening and provides the required length of external surface creepage path.

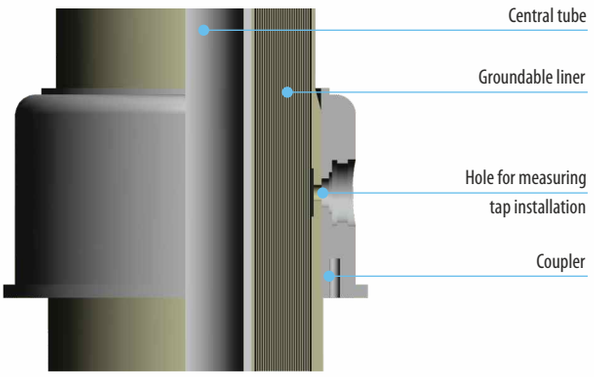


Fig. 3 Internal RIN-insulation

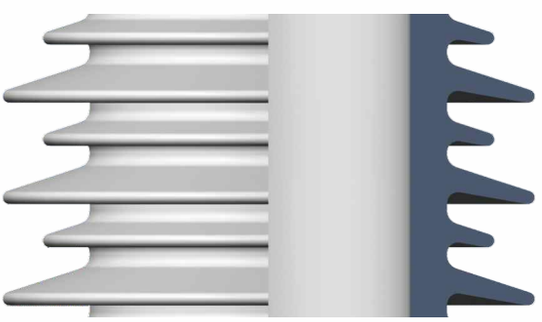


Fig. 4 Porcelain housing profile

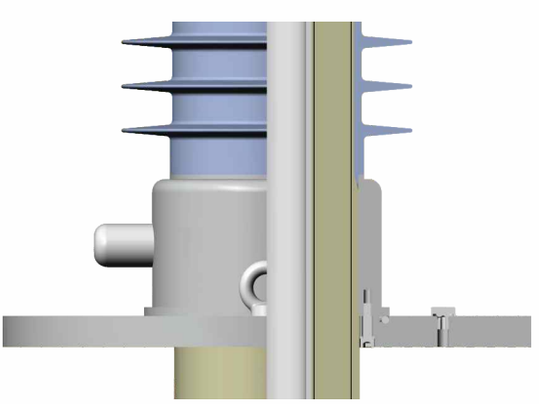


Fig. 5 Polymer insulation profile

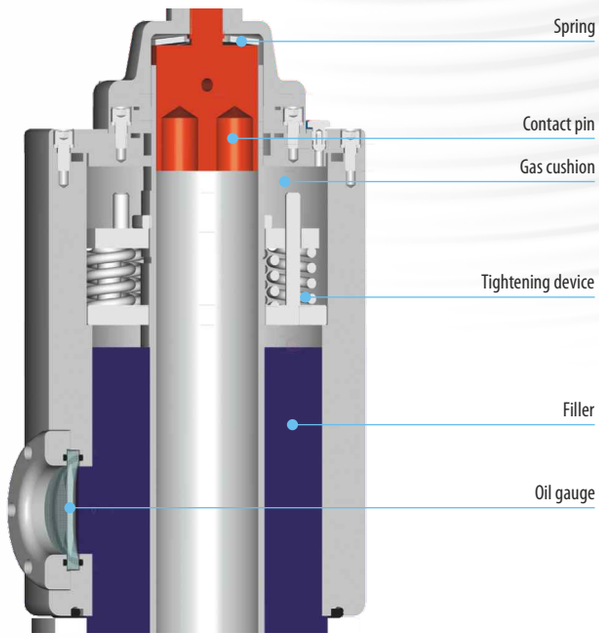


Fig. 6 Upper part of 252 kV bushings and higher with RIN-insulation and liquid filler

Fig. 7 Normal level of liquid filler

Fig. 8 Low level of liquid filler

Pressure compensator

Pressure compensator is intended for compensating volume changes of liquid filler caused by temperature variations. It is used only in the bushings with porcelain external insulation, filled with transformer oil. The compensator presents a gas cushion located in the upper part of the bushing (Fig. 6). For 252 kV and higher bushings, sufficient filler level is checked visually through the oil level indicator glass located in the bushing's upper body. The gas cushion volume is calculated so that the level of filler should be above the glass at all times (Fig. 7). When the level falls below the calculated value, vertical notch marks become visible on the glass (Fig. 8), a signal to contact Izolyator plant immediately. In the bushings with the voltage below 252 kV, the gas cushion is located in the upper part of the porcelain housing, and no direct control of the oil level is possible. As the bushing oil is not an insulating material, there is no need to control its condition in operation.

Tightening device

It is located inside the pressure compensator body and is used to compensate the difference between elongations of the central tube and external porcelain insulation caused by different thermal linear expansion coefficients.

Contact pin

In the upper part of the central tube of the bushing, there is a contact pin, which is intended for soldering-in transformer taps. During the installation of the bushing, the pin with soldered-in taps is drawn through the bushing's central tube and fixed in the upper part of the tube with a pin or a special nut.

Bottom part of the bushing

Bottom part of the bushing is made suitable for installing current transformers, which should be positioned within the grounded lining zone, and the distance from the bushing axis to the grounded parts of the transformer must be at least R.

Depending on the bushing type and rated voltage, its bottom part may be installed both without the shield (Fig. 9) and with the shield for electric field equalizing.

Shields may be installed either at Izolyator plant (Fig. 10) or at the installation site with the use of screws (Fig. 11) or a bayonet lock (Fig. 12) according to the operation manual supplied with each bushing.

In the standard design, up to 0.5 mm layer of electric insulating coating is applied on the shield using power paint. If necessary, bushings can be completed with up to 12 mm thick insulating paper covering. In this case, the shield is shipped inside a separate tank filled with transformer oil in the bushing packing.

Due to the fact that the structure of RIN-insulation does not contain cellulose, the insulation core is not subject to moistening and does not require special protective measures in case of long-term storage. In the standard factory packing, bushings can be stored indefinitely.

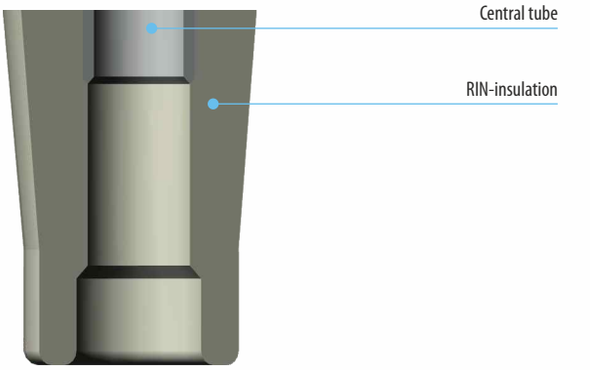


Fig. 9 Bottom part of a RIN bushing

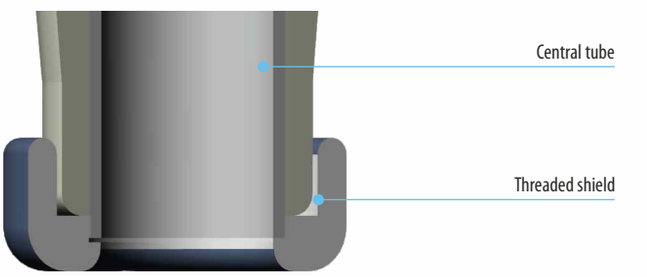


Fig. 10 Factory set shield

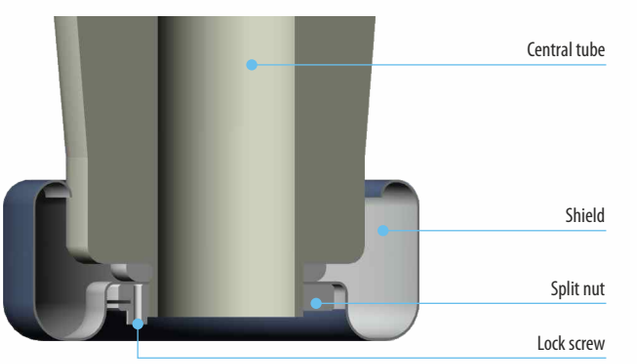


Fig.11 Shield secured with screws

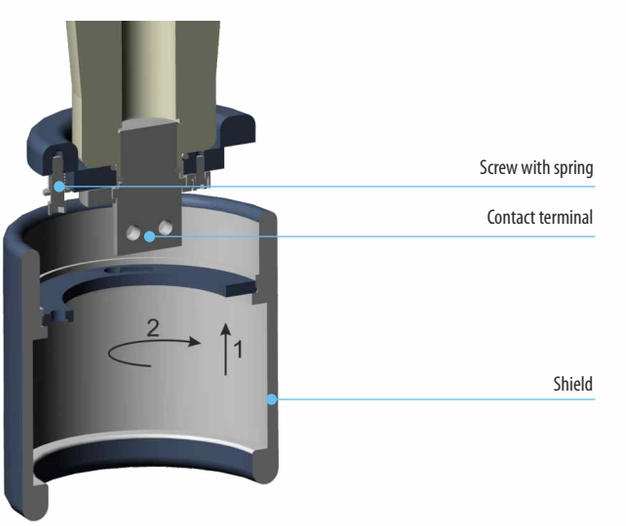


Fig.12 Shield secured with bayonet lock

Connection

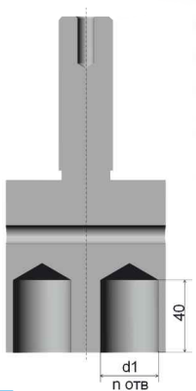


Fig.13 Contact pin

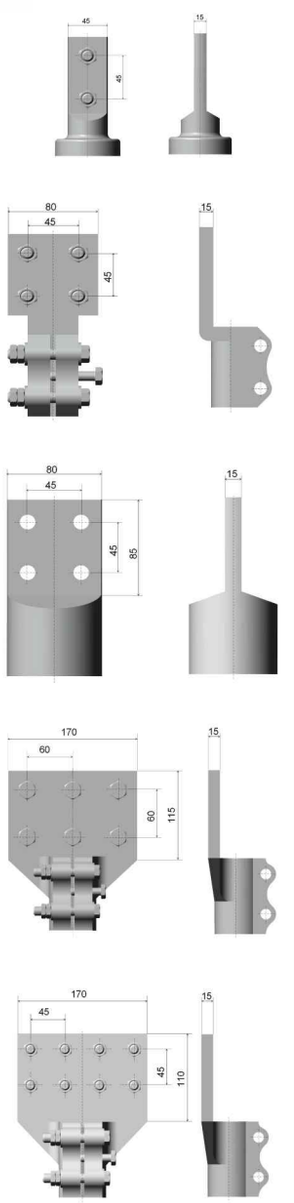


Fig.14 Contact terminals

Bushings differ by the type of connection to transformer or reactor winding as follows:

1. Draw-lead type bushings that have transformer tap lead as current-conducting element. The connection is performed by drawing a cable with soldered contact pin through the central tube of the bushing. The following cable cross-section values are recommended depending on the maximum transformer current (see table 1.)

Table 1

Rated current, A	Cable cross-section, mm²
400	1x150
500	1x185
630	1x300
800	1x300
1000	1x500
	2x300
	3x185
1250	3x240
1600	4x300
2000	4x400
2500	4x500
	7x240

Contact pin (Fig. 13) is supplied with the bushing and is soldered to the transformer tap lead at the installation site.

2. Non-draw lead type bushing with bottom connection that uses the central tube of the bushing as current-conducting element.

In this case, transformer tap lead is connected to the contat tip of the bottom part of the bushing executed as a flat or square contact terminal, smooth or threaded plug.

They put a contact terminal (Fig. 14) on the top contact pin for connection to the bus bar lead.

Measuring tap

Measuring tap from the last equalizing liner of the insulation core serves to control the condition of the internal insulation and must be grounded when measurements are not performed.

Figure 15 shows the measuring tap, made since 2014.

To unground the tap, it is necessary to unscrew the hood and take off the spring-loaded multicontact. After the measurements are made on a bushing, the multicontact is to be put back by placing the pin in the hole of the measuring tap body and setting the multicontact on the pin of the measuring tap.

The hood is used to seal the cavity of the measuring tap. It is required to screw on the hood by hand to pressing on the rubber O-ring on the measuring tap body.

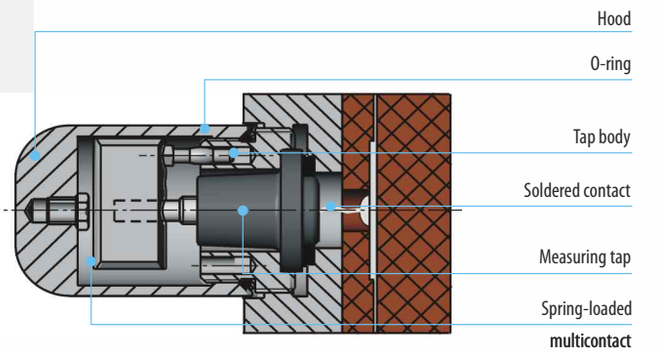


Fig.15 Measuring tap with grounded multicontact

Fig.16 Sensor for protection of the measuring tap

External diagnostic tools

External diagnostic tools connected to the measuring tap provide a possibility to monitor the condition of the bushing under operating voltage.

Herewith, for protection of the measuring tap against long-lasting occurence of unacceptably high voltage, a special sensor with protection against cable break (Fig. 16) shall be installed on the measuring tap. The cable is connected not to the measuring tap, but to the sensor contact.

The sensor is included in the delivery set of all bushings with voltage of 363 kV and higher. For bushings with lower voltage classes the sensor can be ordered optionally.

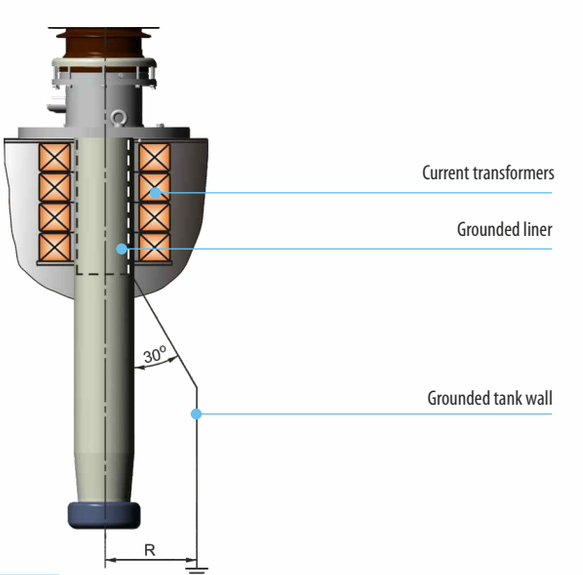


Fig.17 Installation diagram of current transformers

Production of bushings

Fig. 18 Highly automated machine for winding the main insulation of 252 - 1200 kV bushings

Fig. 19 Vacuum impregnation of main insulation

Fig. 20 Lathe turning of the insulation core

Making of internal insulation

The main insulation presents a core, which is formed by winding polymer non-woven material on the central tube (Fig. 18).

The winding is divided into layers by conductive equalizing liners, which serve to optimize electric field distribution in radial and axial directions. It helps ensure the highest values of dielectric strength of both internal and external insulations and specifically along the open bottom part of the bushing located in the oil of transformer.

The wound insulation is impregnated with epoxy compound consisting of ingridients supplied by the world's best manufacturers (Fig. 19).

The subsequent solidification under pressure completely removes gaseous inclusions from the insulation. The epoxy compound formulation and technological parameters of RIN-insulation manufacturing process are intellectual property of Izolyator plant.

As the result, the insulation core forms a solid body, which undergoes mechanical processing (Fig. 20).

Assembly of bushings

After mechanical processing and external surface varnishing, a coupler is mounted on the insulation core by the press fit method.

Then, porcelain housing (Fig. 21) is mounted or polymer external insulation is applied on the insulation core.

Stable tightening of the gaskets is performed by a tightening spring assembly compensating temperature changes in the insulation core length and housing within the range -60^0 C to +60^0 C.

The space between the insulation core and the porcelain housing is filled with a dry or liquid filler for protection against moistening. Unigel compression gel is used as dry filler (Fig. 22), transformer oil — for liquid filler, which in this case is should be viewed as a cooling agent, not part of bushing insulation.

Leaktightness between the central tube and upper flange of the bushing is provided by a seal system. Such design provides reliable transformer leaktightness even in case of damage of the bushing's porcelain housing.

Polymer insulation is molded from elastic material based on original Wacker organosilicon compositions of RTV-2 type (Fig. 23).

Molding and polymerization take place directly on the insulation core according to "direct molding" technology in special forms developed at Izolyator.

Fig.21 550, 363 and 126 kV bushings with RIN-insulation on technological racks at the assembly shop

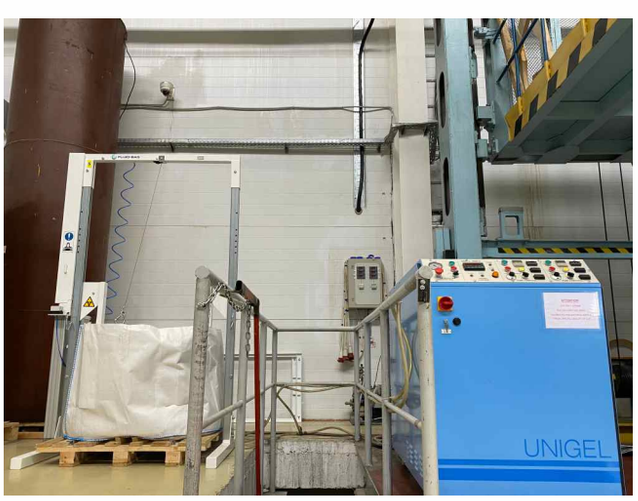


Fig.22 Unit for degassing and metering feed of compression gel

Fig.23 Automatic manufacturing of polymer external insulation

Testing

Fig.24 Electrical tests of a 550 kV RIN bushing at the test centre of Izolyator plant

Testing of bushings

Every new bushing type passes acceptance tests for compliance with GOST R 55187-2012 and IEC 60137 (Fig. 24 and 25).

Each mass-produced serial bushing undergoes acceptance tests for checking conformity thereof with appropriate type and manufacturing quality, including tests with measurement of partial discharge level and tg of the insulation according to the above mentioned documents.

Fig.25 Electrical tests of 126 kV bushings

Transportation and storage

Having passed the tests, the bushings are packed into wooden boxes, completed with mounting parts, spare parts, tools and accessories and documents according to design documentation (Fig. 26). The packaged bushing is stored in the finished goods warehouse.

The bushing is transported and stored in standard factory packing without any special measures to protect against moisture penetration. This is due to the absence of cellulose in the structure of RIN-insulation as the insulation core is not subject to moistening.

Thus, RIN-insulated bushings in their original packing can be stored indefinitely.

Fig.26 Packing bushings at Izolyator plant

Operation

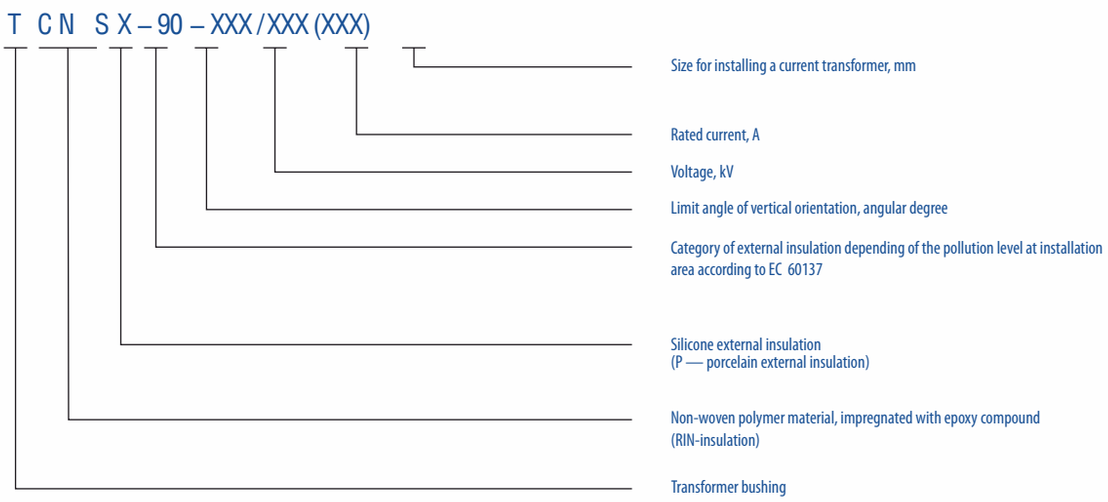
Transformer oil is used as filler in some RIN bushings and is not intended for active insulation. Therefore, periodic checks of oil condition are not required.

RIN bushings maintenance provides for merely periodic measurement of insulation tg, main insulation capacity C1 and insulation resistance of the measuring tap.

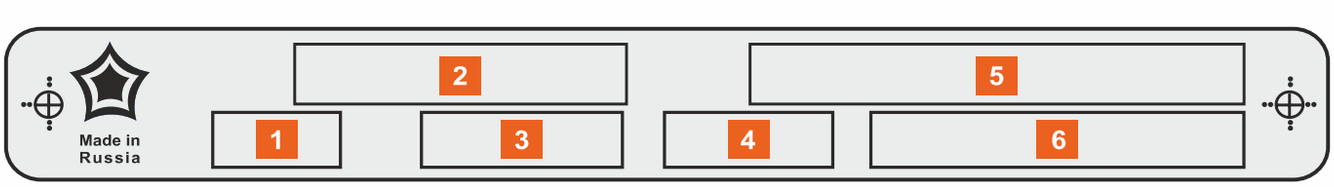
Interchangeability of bushings

Izolyator high-voltage bushings are installed both on new transformers and reactors and as replacement to spent bushings of obsolete design. For that reason, equivalence of the submerged bushings part and the length of the drawn lead as well as fitting dimensions of the mounting flange are observed. If necessary, these characteristics may be coordinated with the manufacturer of particular power equipment where the bushings need to be substituted.

Key to Bushing Designation Code



Izolyator nameplate on bushings



1. Bushing weight
2. Drawing number
3. Serial number
4. Production date
5. Bushing type
6. State technical standard number

IZOLYATOR
group

HIGH-VOLTAGE
BUSHINGS FROM
12 TO 1200 KV

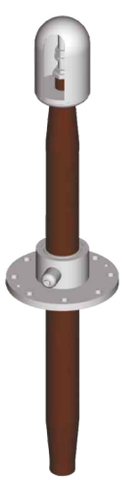
COMPLETE RANGE OF
BUSHINGS

Innovative products

Izolyator designs, makes, services and repairs high voltage bushings on alternating and direct currnent in the voltage range 12–1200 kV with Air — Oil, Oil — Oil, Air — Air, Air — SF6, SF6 — Oil, Air — Liquid nitrogen applications.

The solid internal insulation, which has a higher reliability and durability, is used in the majority of produced bushings.
There are bushings with two types of solid insulation: RIP and RIN. The RIN insulation possesses extremely high hydrophobicity and resistance to atmospheric moisture, virtually elmiminating any moistening of insulation. Porcelain sheds, polymer insulation directly applied on the internal insulation, composite housing with external silicone ribbing are used for external insulation.

Air–Oil bushings for oil switches
Voltage: 40.5–252 kV
Current: 1000–3150 A
Insulation: RIP or RIN



Oil–Oil bushings for cable connection of tranformers
Voltage: 72.5–550 kV
Current: 630–1000 A
Insulation: RIP or RIN

Oil–Oil bushings for cable connection of tranformers
Voltage: 72.5–550 kV
Current: 630–1000 A
Insulation: RIP or RIN

Air–Air wall bushings
Voltage: 72.5–252 kV
Current: 2000–4000 A

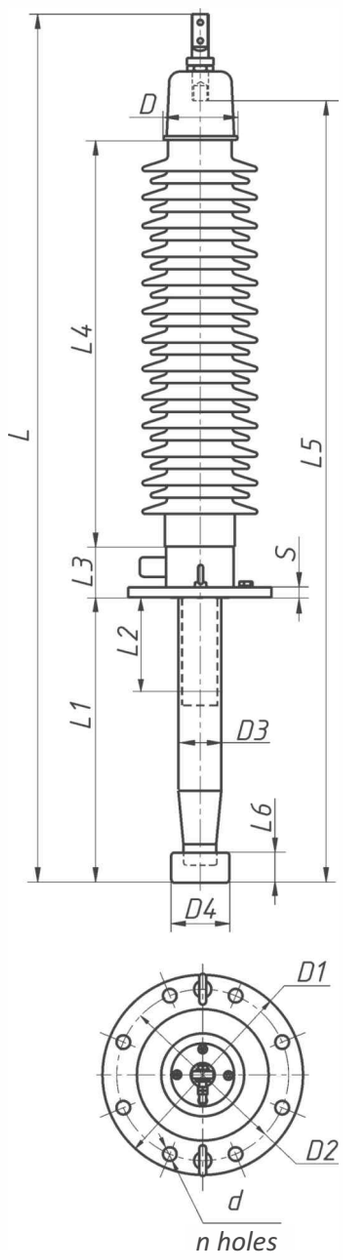
Air–Oil bushings for power transformers and shunt reactors
Voltage: 12–1200 kV
Current: 315–5000 A
Insulation: RIP or RIN (up to 550 kV)

Air–SF6 bushings for switchgear
Voltage: 252 kV
Current: 2000–3150 A

DC HV bushings
Voltage: ±126–800 kV
Current: 1800–5400 A

Air–Oil detachable bushings for power transformers
Voltage: 20–40.5 kV
Current: 6–20 kA

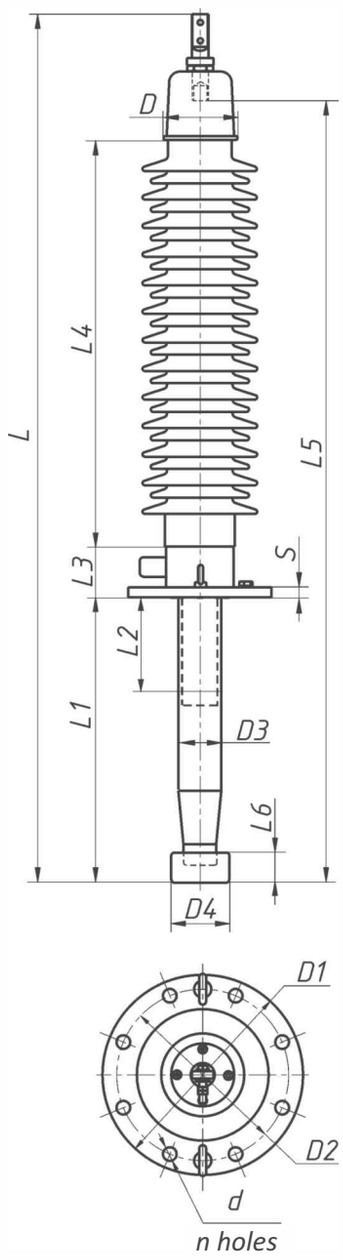
Specifications power transformer bushings with RIN-insulation



Bushing type	Drawing №	Type of internal insulation	Maximum operating voltage, effective value, kV	Phase-to-ground voltage, effective value, kV	Rated current, A	Test voltage, kV			Creepage distance, mm	Test cantilever load, N	Weight, kg	
						1 minute, 50 Hz, effective value	Switching impulse, 250/2500 μs	Lightning impulse full wave, 1.2/50 μs				
12 kV												
TCNSIV-90-12/1000 (0)	686381.279	RIN	12	7	1000	34	—	80	540	625	16,8	
TCNSIV-90-12/1000 (100)	686381.279-01	RIN	12	7	1000	34	—	80	540	625	18,8	
TCNSIV-90-12/1000 (200)	686381.279-02	RIN	12	7	1000	34	—	80	540	625	20,2	
TCNSIV-90-12/1000 (300)	686381.279-03	RIN	12	7	1000	34	—	80	540	625	21,5	
TCNSIV-90-12/1000 (400)	686381.279-04	RIN	12	7	1000	34	—	80	540	625	23,3	
TCNSIV-90-12/1000 (500)	686381.279-05	RIN	12	7	1000	34	—	80	540	625	24,5	
TCNSIV-90-12/1000 (600)	686381.279-06	RIN	12	7	1000	34	—	80	540	625	26,5	
TCNSIV-90-12/2500 (0)	686381.280	RIN	12	7	2500	34	—	80	540	1000	22,8	
TCNSIV-90-12/2500 (100)	686381.280-01	RIN	12	7	2500	34	—	80	540	1000	24,7	
TCNSIV-90-12/2500 (200)	686381.280-02	RIN	12	7	2500	34	—	80	540	1000	26,6	
TCNSIV-90-12/2500 (300)	686381.280-03	RIN	12	7	2500	34	—	80	540	1000	28,5	
TCNSIV-90-12/2500 (400)	686381.280-04	RIN	12	7	2500	34	—	80	540	1000	30,4	
TCNSIV-90-12/2500 (500)	686381.280-05	RIN	12	7	2500	34	—	80	540	1000	32,3	
TCNSIV-90-12/2500 (600)	686381.280-06	RIN	12	7	2500	34	—	80	540	1000	34,2	
24 kV												
ГТCNSIII-90-24/5000(0)	686381.274	RIN	24	15	5000	65	—	125	750	3150	85	
TCNSIII-90-24/5000(100)	686381.274-01	RIN	24	15	5000	65	—	125	750	3150	93	
TCNSIII-90-24/5000(200)	686381.274-02	RIN	24	15	5000	65	—	125	750	3150	101	
TCNSIII-90-24/5000(300)	686381.274-03	RIN	24	15	5000	65	—	125	750	3150	109	
TCNSIII-90-24/5000(400)	686381.274-04	RIN	24	15	5000	65	—	125	750	3150	117	

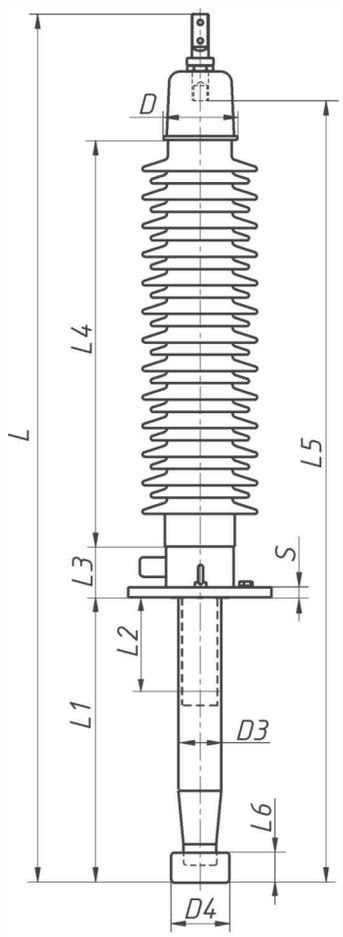
Table 2

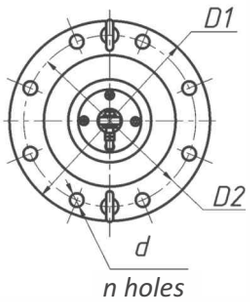
Fitting and connecting dimensions, mm																				
	L	L1	L2	L3	L4	L5	D	D3	D1	D2	d/n holes	S	L6	D4	d1/n1 holes	d2	d3	d4	I	R
	765	135	0	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	865	235	100	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	965	335	200	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1065	435	300	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1165	535	400	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1265	635	500	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1365	735	600	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	785	240	0	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	885	340	100	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	985	440	200	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1085	540	300	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1185	640	400	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1285	740	500	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1385	840	600	100	200	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	970	160	0	100	250	—	220	164	275	235	14/8	15	—	—	—	—	—	—	—	—
	1070	260	100	100	250	—	220	164	275	235	14/8	15	—	—	—	—	—	—	—	—
	1170	360	200	100	250	—	220	164	275	235	14/8	15	—	—	—	—	—	—	—	—
	1270	460	300	100	250	—	220	164	275	235	14/8	15	—	—	—	—	—	—	—	—
	1370	560	400	100	250	—	220	164	275	235	14/8	15	—	—	—	—	—	—	—	—



Bushing type	Drawing №	Type of internal insulation	Maximum operating voltage, effective value, kV	Phase-to-ground voltage, effective value, kV	Rated current, A	Test voltage, kV			Creepage distance, mm	Test cantilever load, N	Weight, kg	
						1 minute, 50 Hz, effective value	Switching impulse, 250/2500 µs	Lightning impulse full wave, 1.2/50 µs				
TCNSIII-90-24/5000(500)	686381.274-05	RIN	24	15	5000	65	—	125	750	3150	125	
TCNSIII-90-24/5000(600)	686381.274-06	RIN	24	15	5000	65	—	125	750	3150	133	
TCNSIII-90-24/1000(0)	686381.277	RIN	24	15	1000	65	—	125	680	625	18,3	
TCNSIII-90-24/1000(100)	686381.277-01	RIN	24	15	1000	65	—	125	680	625	20,5	
TCNSIII-90-24/1000(200)	686381.277-02	RIN	24	15	1000	65	—	125	680	625	21,8	
TCNSIII-90-24/1000(300)	686381.277-03	RIN	24	15	1000	65	—	125	680	625	23,2	
TCNSIII-90-24/1000(400)	686381.277-04	RIN	24	15	1000	65	—	125	680	625	25	
TCNSIII-90-24/1000(500)	686381.277-05	RIN	24	15	1000	65	—	125	680	625	26,2	
TCNSIII-90-24/1000(600)	686381.277-06	RIN	24	15	1000	65	—	125	680	625	28,2	
TCNSIII-90-24/2500(0)	686381.278	RIN	24	15	2500	65	—	125	680	1000	24,2	
TCNSIII-90-24/2500(100)	686381.278-01	RIN	24	15	2500	65	—	125	680	1000	26,1	
TCNSIII-90-24/2500(200)	686381.278-02	RIN	24	15	2500	65	—	125	680	1000	28	
TCNSIII-90-24/2500(300)	686381.278-03	RIN	24	15	2500	65	—	125	680	1000	29,9	
TCNSIII-90-24/2500(400)	686381.278-04	RIN	24	15	2500	65	—	125	680	1000	31,8	
TCNSIII-90-24/2500(500)	686381.278-05	RIN	24	15	2500	65	—	125	680	1000	32,7	
TCNSIII-90-24/2500(600)	686381.278-06	RIN	24	15	2500	65	—	125	680	1000	35,6	
TCNPIV-60-24/2000	686381.703	RIN	24	15	2000	65	—	125	840	1000	50	
40,5 kV												
TCNPIII-60-40,5/3500	686381.154	RIN	40,5	25	3500	95	—	190	1160	3150	95	
TCNSIII-90-40,5/1000(0)	686381.275	RIN	40,5	25	1000	110	—	200	1220	625	19,5	
TCNSIII-90-40,5/1000 (100)	686381.275-01	RIN	40,5	25	1000	110	—	200	1220	625	22,1	
TCNSIII-90-40,5/1000 (200)	686381.275-02	RIN	40,5	25	1000	110	—	200	1220	625	23,4	
TCNSIII-90-40,5/1000 (300)	686381.275-03	RIN	40,5	25	1000	110	—	200	1220	625	24,7	
TCNSIII-90-40,5/1000 (400)	686381.275-04	RIN	40,5	25	1000	110	—	200	1220	625	26	

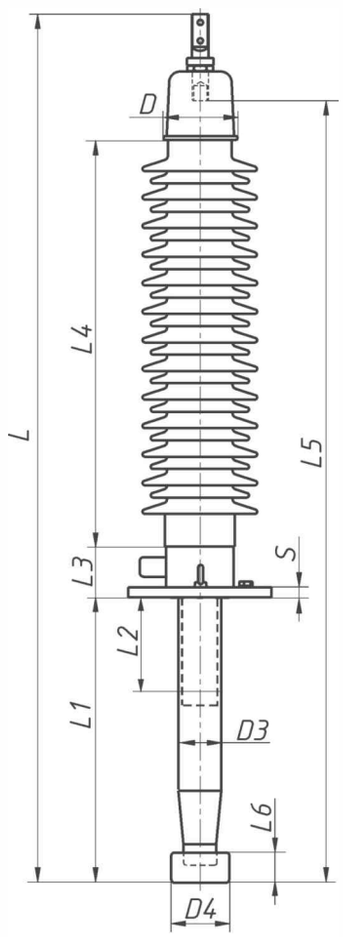
Fitting and connecting dimensions, mm																				
	L	L1	L2	L3	L4	L5	D	D3	D1	D2	d/n holes	S	L6	D4	d1/n1 holes	d2	d3	d4	I	R
	1470	660	500	100	250	—	220	164	275	235	14/8	15	—	—	—	—	—	—	—	—
	1570	760	600	100	250	—	220	164	275	235	14/8	15	—	—	—	—	—	—	—	—
	845	265	0	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	945	365	100	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1045	465	200	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1145	565	300	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1245	665	400	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1345	765	500	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1445	865	600	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	860	160	0	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	960	260	100	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1060	360	200	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1160	460	300	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1260	560	400	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1360	660	500	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1460	760	600	100	250	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	900	160	—	—	310	—	183	106	225	200	15/6	25	—	—	—	—	—	—	—	—
	1645	670	400	125	460	—	183	106	270	225	20/6	25	—	—	—	—	—	—	—	—
	1055	170	0	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1155	270	100	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1255	370	200	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1355	470	300	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1455	570	400	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—

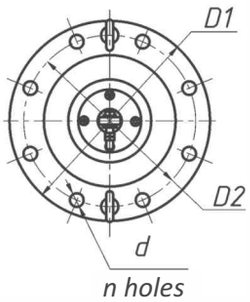




Bushing type	Drawing №	Type of internal insulation	Maximum operating voltage, effective value, kV	Phase-to-ground voltage, effective value, kV	Rated current, A	Test voltage, kV			Creepage distance, mm	Test cantilever load, N	Weight, kg	
						1 minute, 50 Hz, effective value	Switching impulse, 250/2500 µs	Lightning impulse full wave, 1.2/50 µs				
TCNSIII-90-40,5/1000 (500)	686381.275-05	RIN	40,5	25	1000	110	—	200	1220	625	27,3	
TCNSIII-90-40,5/1000 (600)	686381.275-06	RIN	40,5	25	1000	110	—	200	1220	625	28,6	
TCNPIV-60-40,5/1250	686381.168	RIN	40,5	24	1250	70	—	170	1290	1250	70	
TCNSIII-90-40,5/2500 (0)	686381.276	RIN	40,5	25	2500	110	—	200	1220	1000	27,8	
TCNSIII-90-40,5/2500 (100)	686381.276-01	RIN	40,5	25	2500	110	—	200	1220	1000	29,6	
TCNSIII-90-40,5/2500 (200)	686381.276-02	RIN	40,5	25	2500	110	—	200	1220	1000	31,4	
TCNSIII-90-40,5/2500 (300)	686381.276-03	RIN	40,5	25	2500	110	—	200	1220	1000	33,2	
TCNSIII-90-40,5/2500 (400)	686381.276-04	RIN	40,5	25	2500	110	—	200	1220	1000	35	
TCNSIII-90-40,5/2500 (500)	686381.276-05	RIN	40,5	25	2500	110	—	200	1220	1000	36,8	
TCNSIII-90-40,5/2500 (600)	686381.276-06	RIN	40,5	25	2500	110	—	200	1220	1000	38,6	
TCNSIV-90-40,5/800	686381.606	RIN	40,5	24	800	110	—	200	1160	1000	30	
TCNPIV-60-40,5/800	686381.706	RIN	40,5	25	800	110	—	200	1400	1250	30	
TCNPIV-60-40,5/800	686381.706-01	RIN	40,5	25	800	110	—	200	1400	1250	33	
52 kV												
TCNPIV-60-52/630	686381.167	RIN	52	30	630	995	—	250	1900	1600	60	
TCNPIV-60-52/630	686381.367	RIN	52	30	630	95	—	250	1900	1600	50	
TCNPIV-60-52/800	686381.167-01	RIN	52	30	800	100	—	250	1900	1250	48	
TCNPIV-60-52/800	686381.367-01	RIN	52	30	800	100	—	250	1900	1250	48	
TCNSIV-90-52/2000	686381.257	RIN	52	30	2000	70	—	170	1650	1250	50	
TCNPIV-60-52/800	686381.529-01	RIN	52	32	800	105	—	250	1820	1250	58	
TCNPIV-60-52/1250	686381.530	RIN	52	32	1250	95	—	250	1820	1250	80	
TCNPIV-60-52/1250	686381.701	RIN	52	32	1250	110	—		1650	1600	72	
TCNSIV-90-52/3150	686381.601	RIN	52	32	3150	105	—	305	2000	3150	80	
TCNSIV-90-52/2000	686381,614	RIN	52	32	2000	105	—	250	1650	2000	50	

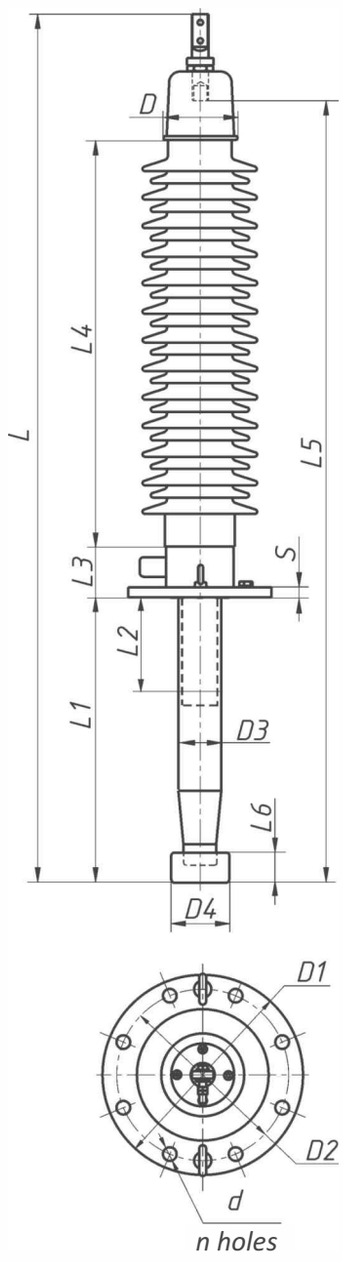
Fitting and connecting dimensions, mm																				
	L	L1	L2	L3	L4	L5	D	D3	D1	D2	d/n holes	S	L6	D4	d1/n1 holes	d2	d3	d4	I	R
	1555	670	500	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1655	770	600	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1480	470	300	125	460	—	183	106	290	250	15/8	25	—	—	—	—	—	—	—	80
	1065	170	0	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1165	270	100	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1265	370	200	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1365	470	300	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1465	570	400	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1565	670	500	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1665	770	600	100	450	—	128	78	225	180	14/6	15	—	—	—	—	—	—	—	—
	1230	490	300	105	450	1020	133	78	225	180	14/6	15	—	—	—	36	50	—	30	—
	1290	490	300	—	450	1080	160	78	225	180	14/6	15	—	—	—	36	50	—	30	90
	1490	690	500	—	450	1280	160	78	225	180	14/6	15	—	—	—	36	50	—	30	90
	1645	550	300	125	620	1365	186	106	290	250	15/8	25	—	—	—	36	50	80	30	80
	1635	550	300	125	620	1365	186	106	290	250	15/8	25	—	—	—	36	50	80	30	80
	1400	315	0	125	620	1130	186	106	290	250	15/8	25	—	—	—	36	50	80	30	80
	1400	315	0	125	620	1130	186	106	290	250	15/8	25	—	—	—	36	50	80	30	80
	1385	500	250	115	560	—	—	106	225	200	15/6	25	—	—	—	—	—	—	—	—
	1475	440	300	105	620	1200	186	106	225	185	15/6	20	—	—	30	36	50	80	30	120
	1520	440	300	105	620	—	183	100	225	185	16/6	20	—	—	30	56	62	100	40	—
	1530	470	300	—	620	—	183	106	225	200	15/6	25	—	—	—	—	—	—	—	—
	1505	475	200	225	550	—	210	108	335	290	15/12	25	—	—	—	—	—	—	—	250
	1370	430	260	—	550	—	148	106	240	200	22/6	25	—	—	—	—	—	—	—	—





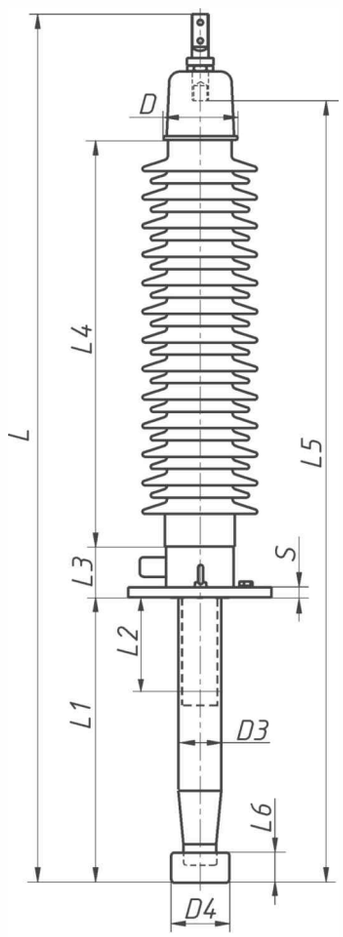
Bushing type	Drawing №	Type of internal insulation	Maximum operating voltage, effective value, kV	Phase-to-ground voltage, effective value, kV	Rated current, A	Test voltage, kV			Creepage distance, mm	Test cantilever load, N	Weight, kg	
						1 minute, 50 Hz, effective value	Switching impulse, 250/2500 µs	Lightning impulse full wave, 1.2/50 µs				
72,5 kV												
TCNPIII-60-72,5/630	686381.101	RIN	72,5	72,5	630	140	—	325	1810	1000	62	
TCNSIII-90-72,5/630	686381.201	RIN	72,5	44	630	140	—	325	1800	2000	29,5	
TCNPIII-60-72,5/2000	686381.102	RIN	72,5	44	2000	140	—	325	1810	3150	110	
TCNSIII-90-72,5/2000	686381.202	RIN	72,5	44	2000	140	—	325	1800	3150	83	
TCNPIII-90-72.5/2000	686381.302	RIN	72,5	44	2000	140	—	325	1810	3150	147,5	
TCNPIII-90-72.5/2000	686381.302-01	RIN	72,5	44	2000	140	—	325	1810	3150	119	
TCNPIV-60-72.5/1000	686381.529	RIN	72,5	44	1000	140	—	325	3150	1250	75	
TCNSIV-90-72.5/800	686381.611	RIN	72,5	44	800	155	—	325	2250	2000	100	
TCNSIV-90-72.5/2000	686381.619	RIN	72,5	44	2000	160	—	350	2250	31502	85	
100 kV												
TCNSIV-90-100/800	686381.607	RIN	100	60	800	185	—	450	3150	1250	37	
TCNSIV-90-100/800	686381.607-01	RIN	100	60	800	185	—	450	3150	1250	40	
TCNSIII-90-100/2500	686381.617	RIN	100	60	2500	185	—	450	2550	3150	50	
126 kV												
TCNPIII-60-126/800	686382.103	RIN	126	76	800	230	—	550	3150	1250	89	
TCNSIII-90-126/800	686382.203	RIN	126	76	800	230	—	550	3150	1250	42	
TCNPIII-60-126/800	686382.303	RIN	126	76	800	230	—	550	3150	1250	86	
TCNPIII-60-126/800	686382.103-01	RIN	126	76	800	230	—	550	3150	1250	87	
TCNSIII-90-126/800	686382.203-01	RIN	126	76	800	230	—	550	3150	1250	40	
TCNPIII-60-126/800	686382.303-01	RIN	126	76	800	230	—	550	3150	1250	85	
TCNPIII-60-126/800	686382.103-02	RIN	126	76	800	230	—	550	3150	1250	92	
TCNSIII-90-126/800	686382.203-02	RIN	126	76	800	230	—	550	3150	1250	44	
TCNPIII-60-126/800	686382.303-02	RIN	126	76	800	230	—	550	3150	1250	88	

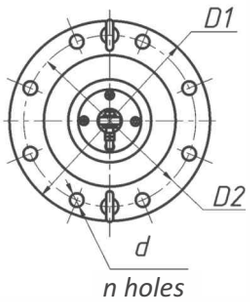
Fitting and connecting dimensions, mm																				
	L	L1	L2	L3	L4	L5	D	D3	D1	D2	d/n holes	S	L6	D4	d1/n1 holes	d2	d3	d4	I	R
	1360	315	1100	125	620	1130	186	106	350	300	20/8	25	—	—	30	36	50	80	30	120
	1235	315	100	125	607	970	148	106	350	300	20/8	25	—	—	30	36	50	80	30	120
	1980	785	500	125	620	1643	255	175	528	480	24/9	25	60	165	32/4	89	—	—	—	165
	1825	785	500	125	598	1470	220	175	528	480	24/9	25	60	165	32/4	89	—	—	—	165
	2090	785	500	140	710	1200	260	175	528	480	24/9	25	60	165	32/4	89	—	130	—	165
	1555	250	0	140	710	1200	260	175	335	290	15/12	25	60	165	32/4	89	—	130	—	165
	1890	475	300	105	1000	1650	186	106	225	185	15/6	20	—	—	30	36	50	80	30	120
	2130	695	300	225	1010	—	210	108	225	185	15/6	25	—	—	—	—	—	—	—	—
	1825	695	300	225	650	—	210	108	335	290	15/12	25	—	—	—	—	—	—	—	300
	1720	330	100	—	1055	1470	148	108	225	185	16/6	20	—	—	—	—	—	—	—	130
	1920	530	300	—	1055	1670	148	108	225	185	16/6	20	—	—	—	—	—	—	—	130
	1660	530	300	—	850	—	—	108	240	200	22/6	25	—	—	—	—	—	—	—	—
	2080	660	200	125	1000	1850	186	106	350	300	24/8	25	—	—	30	36	50	80	30	155
	2030	660	200	125	1055	1770	148	106	350	300	24/8	25	—	—	30	36	50	80	30	155
	2080	660	200	125	1000	1850	186	106	350	300	24/8	25	—	—	30	36	50	80	30	155
	2190	770	300	125	1000	1960	186	106	290	250	15/8	25	—	—	30	36	50	80	30	155
	2140	770	300	125	1055	1880	148	106	290	250	15/8	25	—	—	30	36	50	80	30	155
	2190	770	300	125	1000	1960	186	106	290	250	15/8	25	—	—	30	36	50	80	30	155
	2390	970	500	125	1000	2160	186	106	290	250	15/8	25	—	—	30	36	50	80	30	155
	2340	970	500	125	1055	2080	148	106	290	250	15/8	25	—	—	30	36	50	80	30	155
	2390	970	500	125	1000	2160	186	106	290	250	15/8	25	—	—	30	36	50	80	30	155



Bushing type	Drawing №	Type of internal insulation	Maximum operating voltage, effective value, kV	Phase-to-ground voltage, effective value, kV	Rated current, A	Test voltage, kV			Creepage distance, mm	Test cantilever load, N	Weight, kg	
						1 minute, 50 Hz, effective value	Switching impulse, 250/2500 μs	Lightning impulse full wave, 1.2/50 μs				
TCNPIII-60-126/800	686382.103-03	RIN	126	76	800	230	—	550	3150	1250	102	
TCNSIII-90-126/800	686382.203-03	RIN	126	76	800	230	—	550	3150	1250	55	
TCNPIII-60-126/800	686382.303-03	RIN	126	76	800	230	—	550	3150	1250	98	
TCNPIV-60-126/800	686382.103-04	RIN	126	76	800	230	—	550	3900	1250	112	
TCNPIV-60-126/800	686382.303-04	RIN	126	76	800	230	—	550	3900	1250	100	
TCNPIV-60-126/800	686382.103-06	RIN	126	76	800	230	—	550	3900	1250	115	
TCNPIII-60-126/800	686382.103-07	RIN	126	76	800	230	—	550	3900	1250	96	
TCNPIV-60-126/800	686382.103-08	RIN	126	76	800	230	—	550	3900	1250	130	
TCNSIII-90-126/800	686382.203-05	RIN	126	76	800	230	—	550	3150	1250	41	
TCNSIII-90-126/800	686382.203-06	RIN	126	76	800	230	—	550	3150	1250	39	
TCNSIV-90-126/800	686382.203-07	RIN	126	76	800	230	—	550	3900	1250	48	
TCNPIV-60-126/800	686382.303-05	RIN	126	76	800	230	—	550	3900	1250	98	
TCNPIV-60-126/800	686382.303-06	RIN	126	76	800	230	—	550	3900	1250	110	
TCNPIV-60-126/2000	686382.107-03	RIN	126	76	2000	230	—	550	3900	1250	130	
TCNSIII-90-126/800	686382.248	RIN	126	76	800	230	—	550	3150	3150	40	
TCNSIV-90-126/1250	686382.208	RIN	126	76	1250	230	—	550	3900	2500	100	
TCNPIII-60-126/2000	686382.104	RIN	126	76	2000	230	—	550	3150	4000	155	
TCNSIII-90-126/2000	686382.204	RIN	126	76	2000	230	—	550	3150	4000	85	
TCNPIII-60-126/2000	686382.104-01	RIN	126	76	2000	230	—	550	3150	4000	165	
TCNSIII-90-126/2000	686382.204-01	RIN	126	76	2000	230	—	550	3150	4000	92	
TCNPIV-60-126/2000	686382.104-02	RIN	126	76	2000	230	—	550	3900	4000	200	
TCNSIV-90-126/2000	686382.204-02	RIN	126	76	2000	230	—	550	3900	4000	94	
TCNPIV-60-126/2000	686382.104-03	RIN	126	76	2000	230	—	550	3900	4000	205	
TCNSIV-90-126/2000	686382.204-03	RIN	126	76	2000	230	—	550	3900	4000	100	

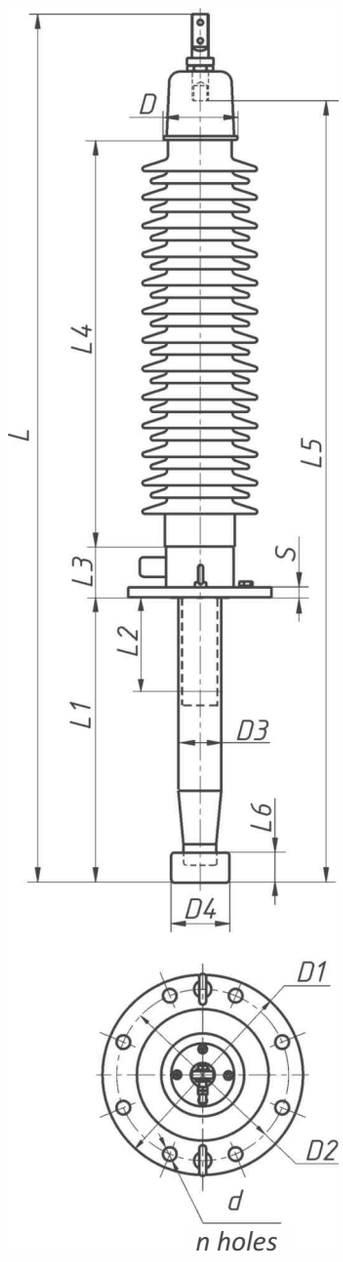
Fitting and connecting dimensions, mm																			
	L	L1	L2	L3	L4	L5	D	D3	D1	D2	d/n holes	S	L6	D4	d1/n1 holes	d2	d3	d4	I	R
	2390	970	200	125	1000	2160	186	106	535	480	24/9	25	—	—	30	36	50	80	30	155
	2340	970	200	125	1055	2080	148	106	535	480	24/9	25	—	—	30	36	50	80	30	155
	2390	970	200	125	1000	2160	186	106	535	480	24/9	25	—	—	30	36	50	80	30	155
	2390	770	300	125	1200	2160	186	106	290	250	15/8	25	—	—	30	36	50	80	30	155
	2390	770	300	125	1200	2160	186	106	290	250	15/8	25	—	—	30	36	50	80	30	155
	2590	970	500	125	1200	2360	186	106	290	250	15/8	25	—	—	30	36	50	80	30	155
	2310	890	500	125	1000	2080	186	106	490	445	20/12	25	—	—	30	36	50	80	30	155
	2680	1070	700	125	1200	2460	186	106	290	250	15/8	25	—	—	30	36	50	80	30	155
	1980	610	300	125	1055	1715	148	106	290	250	15/8	25	—	—	30	36	50	80	30	155
	1845	475	170	125	1055	1630	148	106	290	250	15/8	25	—	—	30	36	50	80	30	155
	2280	660	200	125	1305	2020	148	106	350	300	15/8	25	—	—	30	36	50	80	30	155
	2280	660	200	125	1200	2050	186	106	350	300	24/8	25	—	—	30	36	50	80	30	155
	2280	970	500	125	1200	2360	186	106	290	250	18/8	25	—	—	30	36	50	80	30	155
	2570	985	500	125	1200	—	186	105	290	250	—	25	210	190	—	—	—	—	—	250
	2175	805	400	125	1055	1915	148	106	400	350	24/6	25	60	120	30	36	60		—	155
	2540	840	400	125	1300	2300	220	175	400	350	24/6	25	—	—	46	56	70	130	30	170
	2275	720	400	125	960	1920	260	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2210	720	400	125	1045	1890	220	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2575	1020	400	125	960	2220	260	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2510	1020	400	125	1045	2190	220	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2620	720	400	125	1305	2265	260	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2460	720	400	125	1295	2140	220	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2920	1020	400	125	1305	2565	260	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2760	1020	400	125	1295	2440	220	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200





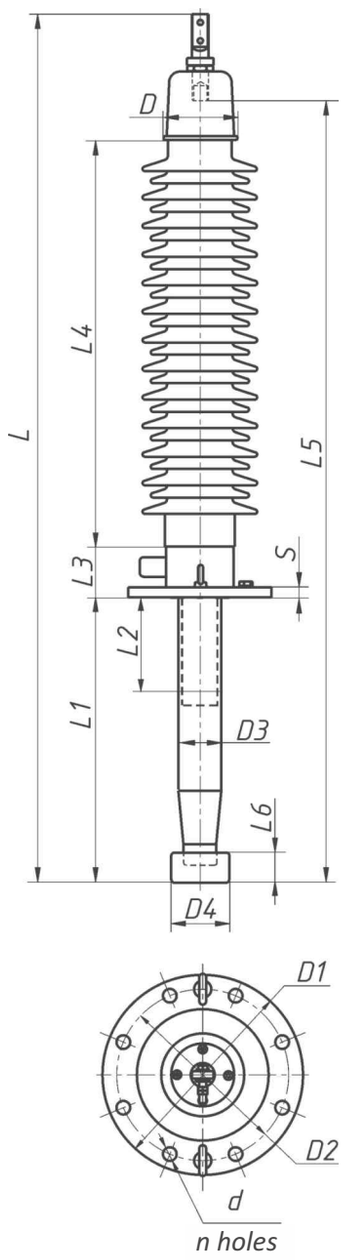
Bushing type	Drawing №	Type of internal insulation	Maximum operating voltage, effective value, kV	Phase-to-ground voltage, effective value, kV	Rated current, A	Test voltage, kV			Creepage distance, mm	Test cantilever load, N	Weight, kg
						1 minute, 50 Hz, effective value	Switching impulse, 250/2500 µs	Lightning impulse full wave, 1.2/50 µs			
TCNPIV-60-126/2000	686382.104-04	RIN	126	76	2000	230	—	550	3900	4000	202
TCNSIV-90-126/2000	686382.204-04	RIN	126	76	2000	230	—	550	3900	4000	95
TCNPIII-60-126/2000	686382.104-05	RIN	126	76	2000	230	—	550	3150	4000	172
TCNPIII-60-126/2000	686382.104-06	RIN	126	76	2000	230	—	550	3150	4000	182
TCNPIII-60-126/2000	686382.106	RIN	126	76	2000	230	—	550	3150	4000	143
TCNPIII-60-126/2000	686382.150	RIN	126	76	2000	230	—	550	3150	2500	170
TCNPIII-60-126/2000	686382.107	RIN	126	76	2000	230	—	550	3150	1600	125
TCNSIII-90-126/2500	686382.207	RIN	126	76	2500	230	—	550	3150	4000	75
TCNPIII-60-126/2000	686382.107-01	RIN	126	76	2000	230	—	550	3150	1600	130
TCNSIII-90-126/2500	686382.207-01	RIN	126	76	2500	230	—	550	3150	4000	78
TCNPIII-60-126/2000	686382.304	RIN	126	76	2000	230	—	550	3150	4000	152
TCNPIII-60-126/2000	686382.304-01	RIN	126	76	2000	230	—	550	3150	4000	162
TCNPIV-60-126/2000	686382.304-02	RIN	126	76	2000	230	—	550	3900	4000	196
TCNPIV-60-126/2000	686382.304-03	RIN	126	76	2000	230	—	550	3900	4000	201
TCNPIV-60-126/2000	686382.304-04	RIN	126	76	2000	230	—	550	3900	4000	198
TCNPIII-60-126/2000	686382.304-05	RIN	126	76	2000	230	—	550	3150	4000	169
TCNPIII-60-126/2000	686382.304-06	RIN	126	76	2000	230	—	550	3150	4000	179
TCNPIV-90-126/2000	686382.702	RIN	126	76	2000	230	—	550	3900	4000	110
TCNSII-90-126/800	686382.610	RIN	126	76	800	230	—	550	3000	1250	35
TCNSIV-90-126/800	686382.616	RIN	126	76	800	255/230	—	550	3900	3150	44
TCNSIV-90-126/800	686382.616-01	RIN	126	76	800	255/230	—	550	3900	3150	50
TCNSIV-90-126/800	686382.616-02	RIN	126	76	800	255/230	—	550	3900	3150	57
TCNPIV-90-126/800	686382.708	RIN	126	76	800	265	—	550	3900	3150	99
TCNPIV-90-126/800	686382.708-01	RIN	126	76	800	265	—	550	3900	3150	102

Fitting and connecting dimensions, mm																				
	L	L1	L2	L3	L4	L5	D	D3	D1	D2	d/n holes	S	L6	D4	d1/n1 holes	d2	d3	d4	I	R
	2670	770	400	125	1305	2315	260	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2510	770	400	125	1295	2190	220	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2575	1020	400	125	960	2220	260	175	528	480	24/9	25	60	165	32/4	89	—	—	—	200
	2575	1020	400	125	960	2220	260	175	690	650	24/12	25	60	165	32/4	89	—	—	—	200
	2155	620	300	125	960	1820	260	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2680	1130	810	145	960	2365	260	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2422	925	300	125	1000	—	186	106	290	250	15/8	25	210	190	—	—	—	—	—	250
	2360	925	300	125	1055	—	148	106	290	250	15/8	25	210	190	—	—	—	—	—	250
	2515	1020	500	125	1000	—	186	106	290	250	15/8	25	210	190	—	—	—	—	—	250
	2455	1020	500	125	1055	—	148	106	290	250	15/8	25	210	190	—	—	—	—	—	250
	2275	720	400	137	960	1920	260	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2575	1020	400	137	960	2220	260	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2620	720	400	137	1305	2265	260	175	420	380	22/12	25	60	165	32/4	89	—	—	—	200
	2920	1020	400	137	1305	2565	260	175	420	380	22/13	25	60	165	32/5	89	—	—	—	200
	2670	770	400	137	1305	2315	260	175	420	380	22/14	25	60	165	32/6	89	—	—	—	200
	2575	1020	400	137	960	2220	260	175	480	480	24/9	25	60	165	32/7	89	—	—	—	200
	2575	1020	400	137	960	2220	260	175	650	650	24/12	25	60	165	32/4	89	—	—	—	200
	2250	390	60	—	1100	—	222	106	330	302	14/8	25	—	—	14/2	—	—	—	—	—
	1630	310	30	—	1005	1415	148	108	290	250	15/8	25	—	—	—	37	50	80	30	—
	1950	310	30	—	1305	1580	148	108	290	250	16/8	25	—	—	—	37	50	80	30	145
	2250	610	300	—	1305	1880	148	108	290	250	16/8	25	—	—	—	37	50	80	30	145
	2450	810	500	—	1305	2080	148	108	290	250	16/8	25	—	—	—	37	50	80	30	145
	2190	660	200	—	1100	1850	222	108	350	300	24/8	25	—	—	—	36	50	80	30	155
	2300	770	300	—	1100	1960	222	108	290	250	15/8	25	—	—	—	36	50	80	30	155



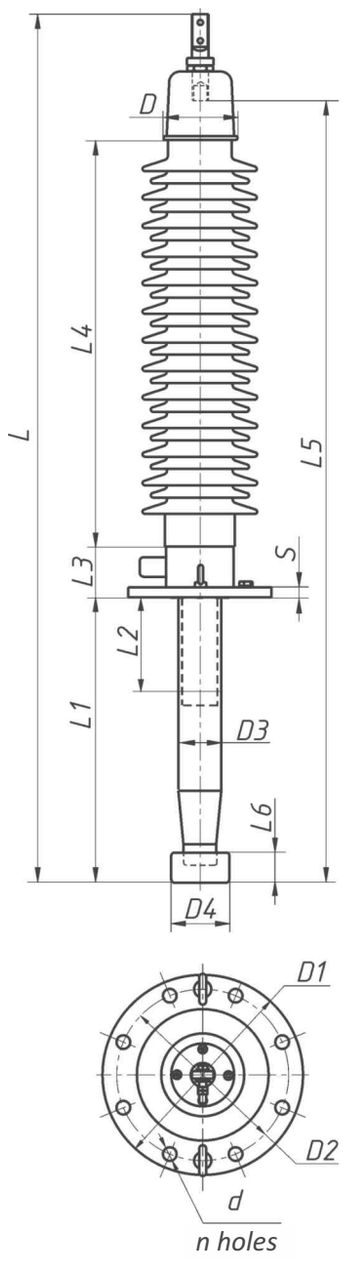
Bushing type	Drawing №	Type of internal insulation	Maximum operating voltage, effective value, kV	Phase-to-ground voltage, effective value, kV	Rated current, A	Test voltage, kV			Creepage distance, mm	Test cantilever load, N	Weight, kg	
						1 minute, 50 Hz, effective value	Switching impulse, 250/2500 µs	Lightning impulse full wave, 1.2/50 µs				
TCNPIV-90-126/800	686382.708-02	RIN	126	76	800	265	—	550	3390	3150	104	
TCNPIV-90-126/800	686382.708-03	RIN	126	76	800	265	—	550	3900	3150	115	
TCNPIV-90-126/800	686382.708-04	RIN	126	76	800	265	—	550	3900	3150	113	
TCNPIV-90-126/800	686382.708-05	RIN	126	76	800	265	—	550	3900	3150	105	
TCNPIV-90-126/800	686382.708-06	RIN	126	76	800	265	—	550	3900	3150	104	
TCNPIV-90-126/800	686382.708-07	RIN	126	76	800	265	—	550	3900	3150	96	
TCNPIV-60-126/1600	686382.715	RIN	126	76	1600	230	—	550	3900	4000	134	
145 kV												
TCNPIV-60-145/630	686382.166	RIN	145	84	630	275	—	650	4495	3150	190	
172 kV												
TCNPIII-60-172/800	686382.109	RIN	172	100	800	275	—	650	3900	1250	190	
TCNPIII-60-172/800	686382.109-01	RIN	172	104	800	275	—	650	3900	1250	195	
TCNSIII-90-172/800	686382.209	RIN	172	104	800	275	—	650	4250	4000	100	
TCNPIII-60-172/1000	686382.111	RIN	172	104	1000	275	—	650	4250	4000	240	
TCNSIII-90-172/1000	686382.211	RIN	172	104	1000	275	—	650	4250	4000	124	
TCNPIII-60-172/1000	686382.111-01	RIN	172	104	1000	275	—	650	4250	4000	230	
TCNSIII-90-172/1000	686352.211-01	RIN	172	104	1000	275	—	650	4250	4000	115	
TCNPIII-60-172/1000	686382.112	RIN	172	104	1000	275	—	650	4250	4000	220	
TCNPIII-60-172/2000	686382.110	RIN	172	104	2000	275	—	650	4320	5000	280	
TCNSIII-90-172/2000	686382.210	RIN	172	104	2000	275	—	650	4250	5000	160	
TCNPIII-60-172/1250	686382.710	RIN	172	104	1250	275	—	650	4250	4000	250	
TCNSIV-90-172/800	686382.604	RIN	172	104	2000	305	—	650	5800	4000	130	
TCNSIV-90-172/800	686382.608	RIN	172	104	800	355	—	750	5350	4000	120	
TCNSIV-90-172/800	686382.608-01	RIN	172	104	800	355	—	750	5350	4000	130	

Fitting and connecting dimensions, mm																				
	L	L1	L2	L3	L4	L5	D	D3	D1	D2	d/n holes	S	L6	D4	d1/n1 holes	d2	d3	d4	I	R
	2500	970	500	—	1100	2160	222	108	290	250	15/8	25	—	—	—	36	50	80	30	155
	2500	970	200	—	1100	2160	222	108	535	480	24/9	25	—	—	—	36	50	80	30	155
	2430	890	500	—	1100	2210	222	108	490	445	20/12	25	—	—	—	36	50	80	30	155
	2600	1070	700	—	1100	1390	222	108	290	250	15/8	25	—	—	—	36	50	80	30	155
	2500	970	600	—	1100	2290	222	108	290	250	15/8	25	—	—	—	36	50	80	30	155
	1840	310	30	—	1100	1630	222	108	290	250	15/8	25	—	—	—	36	50	80	30	155
	2190	660	300	125	1100	—	222	108	335	290	16/12	25	—	—	—	—	—	—	—	—
	2640	800	300	125	1380	2385	260	175	350	310	16/12	25	—	—	5	56	70	130	30	180
	2695	850	300	125	1363	2435	260	175	350	310	22/12	25	—	—	30	56	70	130	30	180
	2695	850	400	125	1363	2435	260	175	400	350	24/6	25	—	—	30	56	70	130	30	180
	2575	850	300	125	1400	2265	220	175	350	310	22/12	25	—	—	30	56	70	130	30	180
	2920	1075	300	125	1380	2670	260	175	670	620	24/9	25	—	—	19/4	56	70	130	40	180
	2870	1075	300	125	1400	2670	220	168	670	620	24/9	25	—	—	19/4	56	70	130	40	180
	2920	1075	450	125	1380	2670	260	175	530	480	24/9	25	—	—	19/4	56	70	130	40	180
	2870	1075	450	125	1400	2670	220	175	530	480	24/9	25	—	—	19/4	56	70	130	40	180
	3030	1180	300	125	1325	2770	260	175	670	620	24/9	25	—	—	28/3	56	85	130	40	180
	3125	1000	500	125	1475	2765	300	210	420	380	22/12	25	60	165	32/4	89	—	—	—	230
	2960	1000	500	125	1450	2460	270	210	420	380	22/12	25	60	165	32/4	89	—	—	—	230
	2725	820	500	—	1380	2405	225	175	420	380	22/12	25	—	—	—	69	—	—	—	195
	2885	800	300	—	1540	—	196	150	355	290	15/12	25	160	165	—	—	—	—	—	250
	2680	520	100	—	1800	2440	170	175	335	290	16/12	25	—	—	—	—	—	—	—	225
	2880	720	300	—	1800	2640	170	175	335	290	16/12	25	—	—	—	—	—	—	—	225



Bushing type	Drawing №	Type of internal insulation	Maximum operating voltage, effective value, kV	Phase-to-ground voltage, effective value, kV	Rated current, A	Test voltage, kV			Creepage distance, mm	Test cantilever load, N	Weight, kg	
						1 minute, 50 Hz, effective value	Switching impulse, 250/2500 µs	Lightning impulse full wave, 1.2/50 µs				
TCNSIII-90-172/800	686382.615	RIN	172	104	800	355/325	—	750	4800	4000	115	
TCNSIII-90-172/800	686382.615-01	RIN	172	104	800	355/325	—	750	4800	4000	128	
TCNSIII-90-172/800	686382.615-02	RIN	172	104	800	355/325	—	750	4800	4000	137	
TCNSIV-90-172/2500	686382.630	RIN	172	104	2500	355/325	—	750	5350	5000	140	
TCNSIV-90-172/2500	686382.630-01	RIN	172	104	2500	355/326	—	750	5350	5000	155	
TCNSIV-90-172/2500	686382.630-02	RIN	172	104	2500	355/327	—	750	5350	5000	165	
252 kV												
TCNSIV-90-252/800	686383.249	RIN	252	153	800	460	—	1050	7900	4000	282	
TCNPIII-60-252/1000	686383.115	RIN	252	153	1000	460	—	1050	6300	1600	292	
TCNSIII-90-252/1000	686383.215	RIN	252	153	1000	460	850	1050	6300	4000	170	
TCNSIII-90-252/1000	686383.215-01	RIN	252	153	1000	460	850	1050	7200	4000	205	
TCNPIII-60-252/1000	686383.115-01	RIN	252	153	1000	460	—	1050	6300	1600	300	
TCNPIII-60-252/1000	686383.115-02	RIN	252	153	1000	460	—	1050	6300	1600	296	
TCNSIV-90-252/1600	686383.223	RIN	252	153	1600	460	—	1050	7900	4000	190	
TCNPIII-60-252/2000	686383.114	RIN	252	153	2000	460	—	1050	6300	5000	455	
TCNPIII-60-252/2000	686383.314	RIN	252	153	2000	460	—	1050	6300	4000	435	
TCNSIII-90-252/2000	686383.214	RIN	252	153	2000	460	—	1050	6300	5000	270	
TCNPIV-60-252/2000	686383.114-01	RIN	252	153	2000	460	—	1050	7900	5000	500	
TCNPIV-60-252/2000	686383.314-01	RIN	252	153	2000	460	—	1050	7900	5000	480	
TCNPIII-60-252/2000	686383.114-02	RIN	252	153	2000	460	—	1050	6300	5000	434	
TCNPIII-60-252/2000	686383.314-02	RIN	252	153	2000	460	—	1050	6300	5000	415	
TCNPIII-60-252/2000	686383.113	RIN	252	153	2000	460	—	1050	6300	4000	400	
TCNSIII-90-252/2000	686383.213	RIN	252	153	2000	460	—	1050	6300	5000	230	
TCNSIV-90-252/2000	686383.213-02	RIN	252	153	2000	460	—	1050	7900	5000	255	

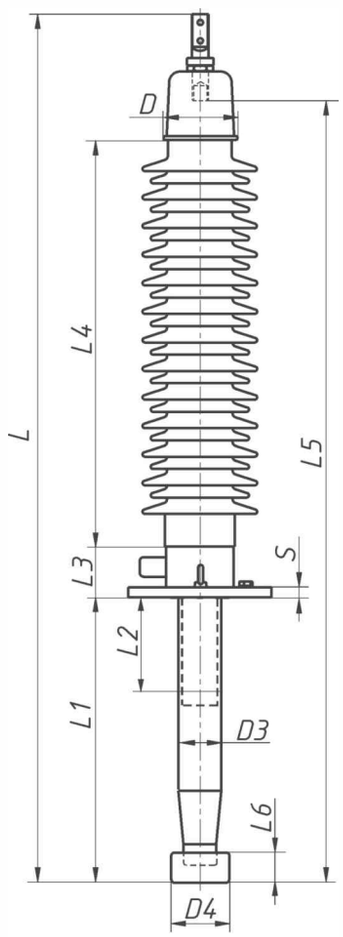
Fitting and connecting dimensions, mm																				
	L	L1	L2	L3	L4	L5	D	D3	D1	D2	d/n holes	S	L6	D4	d1/n1 holes	d2	d3	d4	I	R
	2380	420	30	—	1600	2140	170	165	290	250	16/8	25	—	—	—	56	70	107	40	255
	2680	720	300	—	1600	2440	170	165	290	250	16/8	25	—	—	—	56	70	107	40	255
	2880	920	500	—	1600	2640	170	165	290	250	16/8	25	—	—	—	56	70	107	40	255
	2720	545	0	—	1800	—	170	175	335	290	20/12	25	—	—	—	—	—	—	—	255
	3020	845	300	—	1800	—	170	175	335	290	20/12	25	—	—	—	—	—	—	—	255
	3220	1045	500	—	1800	—	170	175	335	290	20/12	25	—	—	—	—	—	—	—	255
	4990	1880	1045	125	2600	4690	270	210	550	500	24/12	35	120	251	30	89	—	—	—	325
	3805	1025	400	185	1960	3490	238	175	450	400	22/12	25	60	165	30	56	—	—	—	330
	3685	1025	400	185	2150	3685	230	210	450	400	22/12	30	60	165	30	56	—	—	—	325
	3935	1025	400	185	2400	1025	230	210	450	400	22/12	30	60	165	—	56	—	—	—	325
	4105	1325	700	185	1960	3790	238	175	450	400	22/12	25	60	165	30	56	—	—	—	330
	3905	1125	500	185	1960	3590	238	175	450	400	22/12	25	60	165	30	56	—	—	—	330
	4880	1880	750	125	2605	4650	220	175	550	500	24/12	25	60	165	46	56	—	—	—	300
	4800	1905	1140	195	2025	4470	276	210	760	720	24/16	35	90	251	32/4	89	—	—	—	325
	4515	1905	1140	195	2025	4185	276	210	760	720	24/16	35	90	250	32/4	98	—	—	—	325
	4530	1905	1140	205	2100	4025	270	210	760	720	24/16	35	91	251	32/4	89	—	—	—	325
	5175	1905	1140	195	2400	4845	276	210	760	720	24/16	35	90	251	32/4	89	—	—	—	325
	4890	1905	1140	195	2400	4560	276	210	760	720	24/16	35	90	251	32/5	89	—	—	—	325
	4585	1690	900	195	2025	4255	276	210	760	720	24/16	35	90	251	32/6	89	—	—	—	325
	4300	1690	900	205	2025	3970	265	210	760	720	24/16	35	90	251	32/7	89	—	—	—	325
	4275	1380	600	195	2025	3945	276	210	600	560	24/16	35	90	251	32/4	89	—	—	—	325
	4005	1380	600	195	2100	3500	270	210	600	560	24/16	35	90	251	32/4	89	—	—	—	325
	4505	1380	700	195	2600	4000	270	210	600	560	24/16	35	90	251	32/4	89	—	—	—	325

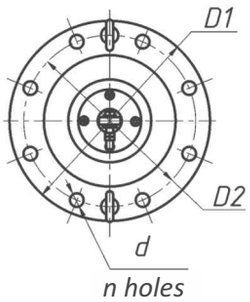


Bushing type	Drawing №	Type of internal insulation	Maximum operating voltage, effective value, kV	Phase-to-ground voltage, effective value, kV	Rated current, A	Test voltage, kV			Creepage distance, mm	Test cantilever load, N	Weight, kg	
						1 minute, 50 Hz, effective value	Switching impulse, 250/2500 μs	Lightning impulse full wave, 1.2/50 μs				
TCNPIII-60-252/2000	686383.313	RIN	252	153	2000	460	—	1050	6300	4000	380	
TCNPIII-60-252/2000	686383.113-01	RIN	252	153	2000	460	—	1050	6300	4000	427	
TCNSIII-90-252/2000	686383.213-01	RIN	252	153	2000	460	—	1050	6300	5000	250	
TCNPIII-60-252/2000	686383.313-01	RIN	252	153	2000	460	—	1050	6300	4000	402	
TCNPIII-60-252/2000	686383.113-02	RIN	252	153	2000	460	—	1050	6300	4000	384	
TCNPIII-60-252/2000	686383.313-02	RIN	252	153	2000	460	—	1050	6300	4000	384	
TCNPIII-60-252/2000	686383.113-03	RIN	252	153	2000	460	—	1050	6300	4000	397	
TCNPIII-60-252/2000	686383.313-03	RIN	252	153	2000	460	—	1050	6300	4000	397	
TCNPIII-60-252/2000	686383.116	RIN	252	153	2000	460	—	1050	6300	2500	370	
TCNSIII-90-252/2000	686383.216	RIN	252	153	2000	460	—	1050	6300	5000	190	
TCNPIII-60-252/2000	686383.117	RIN	252	153	2000	460	—	1050	6300	5000	390	
TCNPIII-60-252/2000	686383.118	RIN	252	153	2000	460	—	1050	6300	4000	320	
TCNPIII-60-252/2000	686383.119	RIN	252	153	2000	460	—	1050	6300	4000	310	
TCNPIII-60-252/2000	686383.119-01	RIN	252	153	2000	460	—	1050	6300	4000	315	
TCNPIV-60-252/2000	686383.119-02	RIN	252	153	2000	460	—	1050	7900	4000	365	
TCNPIII-60-252/2000	686383.119-03	RIN	252	153	2000	460	—	1050	6300	4000	320	
TCNPIII-60-252/2000	686383.122	RIN	252	153	2000	460	—	1050	6300	4000	375	
TCNPIV-60-252/2000	686383.121	RIN	252	153	2000	460	—	1050	7900	5000	450	
TCNPIV-60-252/2000	686383.121-01	RIN	252	153	2000	460	—	1050	7900	5000	450	
TCNPIII-60-252/2000	686383.164	RIN	252	153	2000	460	—	1050	6300	4000	310	
TCNPIII-60-252/2000	686383.164-01	RIN	252	153	2000	460	—	1050	6300	4000	315	
TCNPIV-60-252/2000	686383.164-02	RIN	252	153	2000	460	—	1050	7900	4000	365	
TCNPIII-60-252/2000	686383.164-03	RIN	252	153	2000	460	—	1050	6300	4000	320	
TCNPIII-60-252/3150	686383.153	RIN	252	153	3150	425	—	950	6300	4000	490	

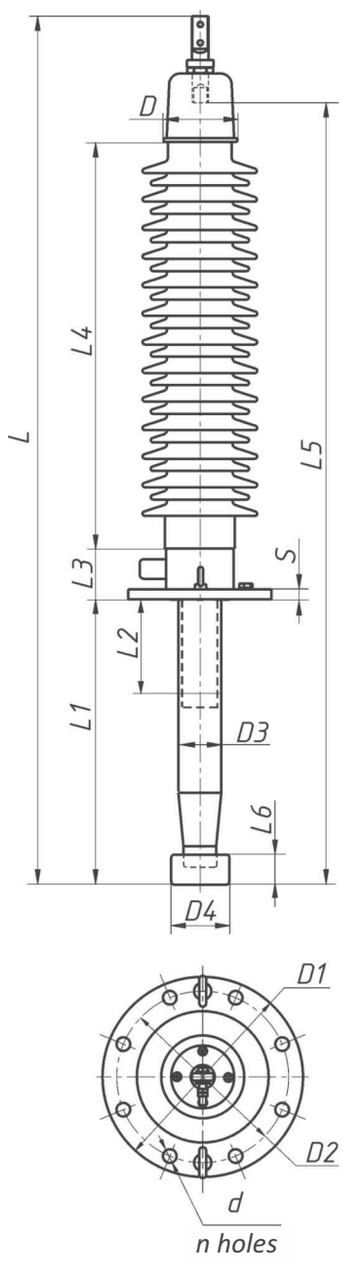
Fitting and connecting dimensions, mm																			
	L	L1	L2	L3	L4	L5	D	D3	D1	D2	d/n holes	S	L6	D4	d1/n1 holes	d2	d3	d4	I	R
	3990	1380	710	205	2025	3670	265	210	600	560	24/16	35	90	251	32/4	589	—	—	—	325
	4275	1380	600	195	2025	3765	276	210	760	720	24/16	35	90	251	32/4	89	—	—	—	325
	4005	1380	600	195	2100	3500	270	210	760	720	24/16	35	90	251	32/4	89	—	—	—	325
	3990	1380	710	205	2025	3490	265	210	760	720	24/16	35	90	251	32/4	89	—	—	—	325
	3990	1380	710	195	2025	3390	265	210	600	560	24/16	35	90	251	32/4	89	—	—	—	325
	3990	1380	710	205	2025	3390	265	210	600	560	24/16	35	90	251	32/4	89	—	—	—	325
	3990	1380	710	195	2025	3390	265	210	760	720	24/16	35	90	251	32/4	89	—	—	—	235
	3990	1380	710	205	2025	3390	265	210	760	720	24/16	35	90	251	32/4	89	—	—	—	235
	4155	1535	600	195	1960	—	238	175	670	620	24/16	35	70	175	—	—	—	—	—	330
	4025	1535	600	195	2145	—	238	175	670	620	24/16	35	70	175	—	—	—	—	—	330
	3965	1070	400	195	2025	3625	276	210	600	560	24/16	35	90	251	32/4	89	—	—	—	325
	3845	1225	300	195	1960	—	238	175	450	400	22/12	35	230	239	—	—	—	—	—	350
	3760	1030	300	195	1960	—	238	175	450	400	22/12	25	230	240	—	—	—	—	—	350
	3860	1130	400	195	1960	—	238	175	450	400	22/12	25	230	240	—	—	—	—	—	350
	4260	1130	400	195	2360	—	238	175	450	400	22/12	25	230	240	—	—	—	—	—	350
	3960	1230	500	195	1960	—	238	175	450	400	22/12	25	230	240	—	—	—	—	—	350
	3765	870	200	195	2025	3425	276	210	600	560	24/16	35	90	251	32/4	89	—	—	—	325
	4730	1460	600	195	2400	4390	276	210	600	560	24/16	35	90	251	32/4	89	—	—	—	325
	4730	1460	600	195	2400	4390	276	210	600	560	24/16	35	90	251	32/4	89	—	—	—	325
	3655	1030	300	195	1960	—	238	175	450	400	22/12	25	230	240	—	—	—	—	—	350
	3755	1130	400	195	1960	—	238	175	450	400	22/12	25	230	240	—	—	—	—	—	350
	4155	1130	400	195	2360	—	238	175	450	400	22/12	25	230	240	—	—	—	—	—	350
	3855	1230	500	195	1960	—	238	175	450	400	22/12	25	230	240	—	—	—	—	—	350
	4330	1380	710	195	2025	—	276	210	400	350	22/8	35	230	240	—	—	—	—	—	370

Fitting and connecting dimensions, mm																				
	L	L1	L2	L3	L4	L5	D	D3	D1	D2	d/n holes	S	L6	D4	d1/n1 holes	d2	d3	d4	I	R
	4025	1535	600	130	2145	—	225	175	670	620	24/16	25	70	175	—	—	—	—	—	—
	3680	1070	400	195	2025	3215	265	208	600	560	24/16	35	91	251	32/4	89	—	—	—	370
	4055	1070	400	195	2400	3590	265	208	600	560	24/16	35	91	251	32/4	89	—	—	—	370
	4040	1430	760	195	2025	3715	265	208	450	400	22/12	35	120	168	20/4	89	—	—	—	350
	4005	1161	300	—	2200	—	292	175	450	400	20/12	25	255	230	—	—	—	—	—	175
	3915	1130	300	—	2200	—	292	175	450	400	20/12	22	100	200	—	—	—	—	—	370
	4705	1060	300	—	3000	—	292	175	450	400	20/12	25	255	239	—	—	—	—	—	390
	3495	685	30	—	2200	3150	292	175	450	400	22/12	25	—	—	—	56	80	119	50	300
	3795	985	300	—	2200	3450	292	175	450	400	22/12	25	—	—	—	56	80	119	50	300
	3995	1185	500	—	2200	3650	292	175	450	400	22/12	25	—	—	—	56	80	119	50	300
	3935	1025	400	335	2220	3490	292	175	450	400	22/12	25	60	165	30	56	—	—	—	302
	4265	1380	710	—	2360	3945+40	225	175	760	720	24/16	25	100	200	—	—	—	—	—	250
	4020	1145	500	—	1990	3590	296	260	450	400	22/12	36	—	—	30/2	89	120	180	200	—
	3825	1110	300	—	2360	—	225	175	450	400	22/12	25	255	—	—	—	—	—	—	350
	4325	1205	400	220	2520	—	—	260	560	500	23/12	35	245	240	—	—	—	—	—	—
	5815	2160	600	205	2770	5220	296	260	818	770	24/16	35	90	251	30/2	69	—	—	—	380
	5673	2160	600	205	2970	5220	270	260	818	770	24/16	35	90	251	30/2	89	—	—	—	380
	5450	1490	600	205	3070	5150	296	260	500	450	24/12	35	90	251	30/2	69	—	—	—	380
	5000	1490	600	220	2965	4550	270	260	450	400	22/12	35	90	251	30/2	89	—	—	—	380
	4685	1155	300	205	2770	—	296	260	450	400	22/12	35	230	239	—	—	—	—	—	400
	4885	1355	500	205	2770	—	296	260	450	400	22/12	35	230	239	—	—	—	—	—	400
	5290	1620	600	205	2770	4970	296	260	600	560	24/16	35	90	251	32/2	89	—	—	—	380





Bushing type	Drawing №	Type of internal insulation	Maximum operating voltage, effective value, kV	Phase-to-ground voltage, effective value, kV	Rated current, A	Test voltage, kV			Creepage distance, mm	Test cantilever load, N	Weight, kg	
						1 minute, 50 Hz, effective value	Switching impulse, 250/2500 µs	Lightning impulse full wave, 1.2/50 µs				
TTCNSIII-90-252/2000	686383.216	RIN	252	153	2000	460	—	1050	6300	5000	190	
TCNPIII-60-252/2000	686383.317	RIN	252	153	2000	460	—	1050	6300	4000	395	
TCNPIV-60-252/2000	686383.317-01	RIN	252	153	2000	460	—	1050	7900	4000	420	
TCNPIII-60-252/1600	686383.317-02	RIN	252	153	2000	460	—	1050	6300	4000	390	
TCNSIV-90-252/2000	686383.602	RIN	252	153	2000	505	850	1050	8400	5000	240	
TCNSIV-90-252/1250	686383.605	RIN	252	153	1250	505	850	1050	8400	4000	230	
TCNSIV-90-252/1250	686383.612	RIN	252	153	1250	505	850	1050	11000	4000	280	
TCNSIV-90-252/800	686383.613	RIN	252	153	800	505/460	750	1050	7900	4000	200	
TCNSIV-90-252/800	686383.613-01	RIN	252	153	800	505/460	750	1050	7900	4000	217	
TCNSIV-90-252/800	686383.613-02	RIN	252	153	800	505/460	750	1050	7900	4000	217	
TCNSIV-90-252/1000	686383.629	RIN	252	153	1000	460	850	1050	8400	4000	198	
TCNPIII-60-252/800	686383.707-01	RIN	252	153	800	460	—	1050	7900	4000	350	
TCNPIII-60-252/800	686383.199	RIN	252	153	800	460	—	1050	6300	4000	420	
TCNPIV-60-252/2000	686383.714	RIN	252	153	2000	460	—	1050	7900	5000	370	
300 kV												
TCNSIII-90-300/3150	686383.618	RIN	300	220	3150	520	960	1175	7500	500	400	
363 kV												
TTCNPIII-60-363/1000	686384.171	RIN	363	220	1000	510	950	1175	9050	2500	650	
TCNSIII-90-363/1000	686384.224	RIN	363	220	1000	510	950	1175	9050	2500	960	
TCNPIV-60-363/1000	686384.171-01	RIN	363	220	1000	510	950	1175	11200	2500	550	
TCNSIII-90-363/1000	686383.224-01	RIN	363	220	1000	510	950	1175	9050	2500	320	
TCNPIII-60-363/1250	686384.147	RIN	363	220	1250	510	950	1175	9050	2500	600	
TCNPIII-60-363/1250	686384.147-01	RIN	363	220	1250	510	950	1175	9050	2500	612	
TCNPIII-60-363/2500	686384.125	RIN	363	220	2500	510	950	1175	8000	3150	620	



Bushing type	Drawing №	Type of internal insulation	Maximum operating voltage, effective value, kV	Phase-to-ground voltage, effective value, kV	Rated current, A	Test voltage, kV			Creepage distance, mm	Test cantilever load, N	Weight, kg	
						1 minute, 50 Hz, effective value	Switching impulse, 250/2500 μs	Lightning impulse full wave, 1.2/50 μs				
TCNSIII-90-363/2500	686384.225	RIN	363	220	2500	510	950	1175	9000	3150	300	
TCNPIII-60-363/2500	686384.325	RIN	363	220	2500	510	950	1175	9050	5000	600	
TCNSIV-90-363/1000	686384.271	RIN	363	220	1000	510	950	1175	11300	5000	505	
TCNPIV-60-363/1000	686384.371-03	RIN	363	220	1000	560	950	1175	11200	4000	660	
420 kV												
TCNSIV-90-420/1250	686384.603	RIN	420	255	1250	695	1050	1425	14740	4000	650	
TCNSIV-90-420/3000	686384.622	RIN	420	255	3000	750	1175	1425	14975	5000	810	
550 kV												
TCNPIII-60-550/800	686385.128	RIN	550	334	800	680	1230	1550	13150	4000	1200	
TCNPIII-60-550/1250	686385.128-01	RIN	550	334	1250	680	1175	1550	13150	4000	1200	
TCNPIII-60-550/1250	686385.146	RIN	550	334	1250	680	1230	1550	15125	4000	1200	
TCNPIII-60-550/1250	686385.146-01	RIN	550	334	1250	680	1230	1550	15125	4000	1180	
TCNPIII-60-550/1600	686385.146-02	RIN	550	334	1600	680	1230	1550	15125	4000	1200	
TCNPIII-60-550/1600	686385.173	RIN	550	334	1600	680	1230	1550	13150	4000	1350	
TCNPIII-60-550/630	686385.173-01	RIN	550	334	1600	680	1230	1550	13150	4000	1406	
TCNPIII-60-550/2500	686385.172	RIN	550	334	2500	680	1230	1550	13150	2500	1230	
TCNPIII-60-550/2500	686385.172-01	RIN	550	334	2500	680	1230	1550	13150	2500	1230	
TCNPIV-60-550/2500	686385.372	RIN	550	334	2500	680	1230	1550	16300	5000	1231	
TCNPIV-60-550/2500	686385.372-01	RIN	550	334	2500	680	1230	1550	16300	5000	1226	
TCNPIV-60-550/2500	686385.372-02	RIN	550	334	2500	680	1230	1675	16300	5000	1142	
TCNSIII-90-550/2500	686385.627	RIN	550	334	2500	695	1230	1550	16100	5000	720	

Fitting and connecting dimensions, mm																			
	L	L1	L2	L3	L4	L5	D	D3	D1	D2	d/n holes	S	L6	D4	d1/n1 holes	d2	d3	d4	I	R
	5140	1615	600	220	2970	4820	270	260	670	560	24/16	35	90	250	32/4	89	—	—	—	380
	5000	1620	600	205	2770	4680	295	260	600	560	24/16	35	90	250	32/4	89	—	—	—	—
	5940	2160	610	220	3000	5220	350	260	818	770	24/16	35	90	251	30/2	69	—	—	—	—
	5835	2160	1400	205	3070	5220	295	260	818	770	24/16	35	90	251	30/2	69	—	—	—	—
	6055	1640	400	—	3745	—	410	320	720	660	24/12	35	245	275	—	—	—	—	—	515
	6010	1505	500	—	3865	—	410	320	480	430	20/8	25	250	280	—	—	—	—	—	555
	6462	1790	600	237	3670	—	296	320	720	660	24/12	36	330	296	—	—	—	—	—	520
	6580	1790	600	237	3670	—	296	320	720	660	24/12	36	350	310	—	—	—	—	—	520
	7515	2080	900	237	4240	6980	296	320	720	660	24/12	36	190	290	20/4	69	—	—	—	520
	7215	1780	600	237	4240	6680	296	320	720	660	24/12	36	190	290	20/4	69	—	—	—	520
	7515	2080	900	237	4240	6980	296	320	720	660	24/12	36	190	290	24/4	69	—	—	—	520
	7665	2750	1000	237	3955	—	296	320	1200	1130	24/16	36	285	490	—	—	—	—	—	—
	8665	3850	2000	237	3670	—	296	320	1200	1130	24/16	36	285	490	—	—	—	—	—	—
	7470	2600	1000	237	3670	6520	296	320	1200	1130	24/16	36	175	282	28/4	89	—	—	—	520
	7540	2670	1000	237	3670	6520	296	320	1200	1130	24/16	36	280	400	28/4	89	—	—	—	520
	7505	2600	1000	237	4240	6520	295	320	1200	1130	24/16	36	175	282	32/4	89	—	—	—	520
	7505	2600	1000	237	4240	6520	295	320	1200	1130	24/16	36	280	400	32/4	89	—	—	—	520
	7480	2600	1000	237	4240	6970	295	320	720	660	24/16	36	175	282	32/4	89	—	—	—	520
	7475	2600	10000	237	4095	6520	410	320	1200	1130	24/16	36	332	332	28/4	89	—	—	—	520

FAQ

What is the lead time for delivery of your products?
The lead time depends on the voltage class of the ordered bushings. For example, 126 kV serial bushings are delivered in 45 days, 252 kV — in 60 days, etc.

What waranty period is set for the bushings produced by you?
The warranty period is subject to agreement with the customer, and is determined in course of signing the purchase and sale contract.

What should be done if an obsolete bushing needs replacement?
Please get in touch with our aftersales department SVN-Service, or with sales department — contact details are listed on our website www.mosizolyator.com, or use our corporate number +7 (495) 727 3311, or email address mosizolyator@mosizolyator.ru

Why bushings with internal RIN-insulation are better than their RIP-insulated predecessors?
Bushings with RIN-insulation, keeping all the properties of their analogs with RIP-insulation, have the following advantages due to new materials and technologies:

- higher reliability and stability of parameters;
- increased service life;
- operation both at extremely low and at extremely high temperatures;
- transportation and storage of bushings without moisture protection measures;
- shortened delivery time of products.

Is moisture protection required for the bottom part of the bushing with RIN insulation during long-term storage?
No, no protective measures are required. This is due to the absence of cellulose in the structure of the RIN-insulation, as a result of which the insulation core is not subject to moistening.
Therefore, a RIN bushing can be stored in factory packing indefinitely.

What are the advantages of the bushings with polymer external insulation as compared to porcelain insulation?
The key advantages of bushings with polymer external insulation:

- fire safety and explosion safety of bushings due to oil-free design;
- tracking erosion resistance;
- high pollution resistance due to high hydrophobic properties of polymers;
- dielectric stregth of contaminated insulation 15-20% higher than that of porcelain insulators;
- high shock resistance and seismic resistance due to elasticity of the material;
- no limitations in regard to bushing installation angle;
- less weight.

How to clean the polymer external insulation?
The polymer external insulation should be cleaned using soft cloth soaked in white spirit or acetone; do not use abrasive cleaning agents. For detailed information, please get in touch with Izolyator, and appropriate instructions will be sent to you in case of necessity.

If you have other questions, or need more detailed information, please visit our website www.mosizolyator.com or contact Izolyator directly:
phone: **+7 (495) 727-33-11**
e-mail: **mosizolyator@mosizolyator.ru**

Terms and Acronyms

Bushing — a device used for passing one or several live conductors through a barrier (e.g. wall, transformer tank, reactor tank, etc.) and insulating the conductors from the barrier. The bushing is furnished with a fastening part (flange or fixing), which is an integral part of the bushing attaching it to the barrier.

GOST R 55187-2012 — Russian technical standard for bushings.

Dielectric losses — energy dissipated in electric insulating material under the impact of electric field.

Creepage distance — the shortest distance on the surface of external insulation between two conducting zones. Creepage distance is selected pursuant to GOST 9920-89, it depends upon the contamination of the environment where the bushing operation is planned and is designated by digits from I to IV. The higher level of contamination of the environment, the higher the category of external insulation of the bushing should be selected. For our bushings, the minimal category of external insulation is category III.

IEC 60137:2017 — International standard for bushings.

Main capacitance of he bushing C1 — capacitance between the high-voltage central conductor and the measuring tap of the bushing.

Acceptance tests are performed for each bushing at release from the plant.

Development acceptance tests are performed for each new bushing type during launch of mass production.

Shunt reactor — reactor, connected in parallel, intended for compensation of capacitive current (GOST 18624-73)

Reactor bushing — a bushing which bottom part is inside the reactor tank, in transformer oil, in alternating magnetic field with induction not over 0.35 T for bushings with voltage up to 550 kV inclusive and not over 0.4 T for bushings with voltage 800 kV. The upper part of bushings is in the open air.

Power transformer — a static device having two or more windings, designed for transformation (by means of electromagnetic induction) of one or several systems of alternating voltage or current to one or several other systems of alernating voltage and current, usually of different values at the same frequency, for the purpose of transfer of power (GOST 30830-2002).

Dielectric loss tangent (tg) is the ratio of active component of insulation leakage current to its reactive component. If alternating voltage is applied, this value is an important characteristic of the insulation of high-voltage transformers and bushings.

Transformer bushing — a bushing, which bottom part is inside the transformer tank, in transformer oil, while the upper part is in the open air. In addition, the conductor either may be a part of the bushing (bottom connection type bushing) or may be drawn through the central tube of the bushing (draw-lead type bushing). The bushing for cable connection of transformers is a bushing with both end designed for submerging into insulating medium other than ambient air (e.g. oil or gas). The insulating medium may be homogeneous (oil - oil, gas - gas) or heterogeneous (oil - gas).

RIN (Resin Impregnated Nonwoven) — a polymer nonwoven fabric, impregnated with epoxy compound followed by curing. A type of internal insulation of high-voltage bushings.

RIP (Resin Impregnated Paper) — crape paper, impregnated with epoxy compound with subsequent curing. A type of internal insulation of high-voltage bushings.

RTV-2 (Room Temperature Vulcanization) — a polymer compound solidified at room temperature.

IZOLYATOR
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