125 years

IZOLYATOR

Centuries-old traditions – state-of-the-art technologies

HIGH-VOLTAGE WALL BUSHINGS

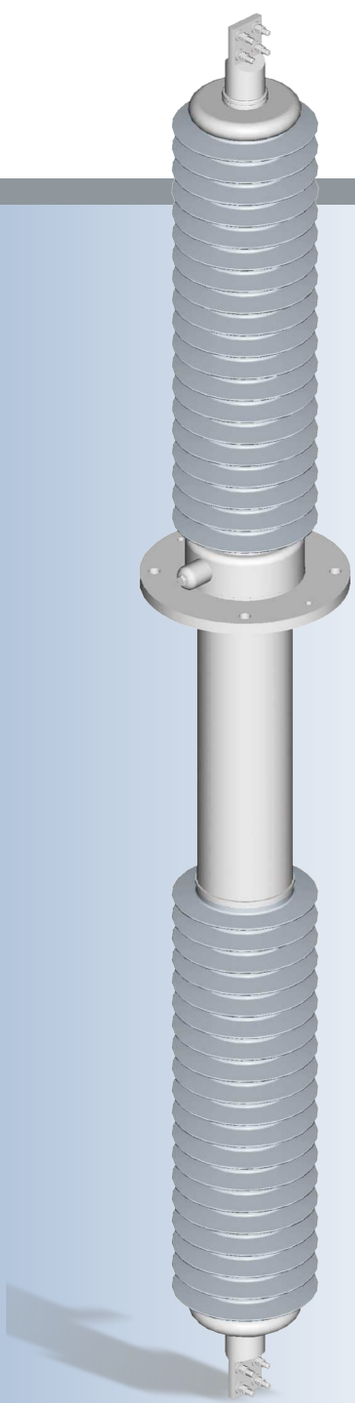
«AIR—AIR»

RIP-INSULATION

Voltage 72.5–252 kV

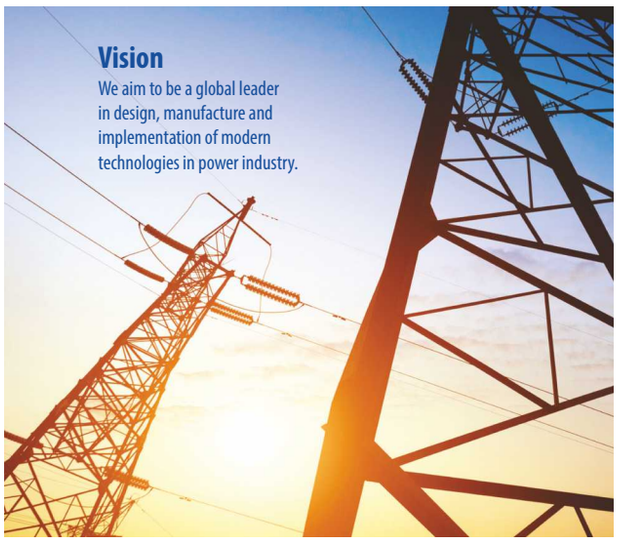
Rated current 2000–4000 A

WE CREATE THE FOUNDATION FOR A SUSTAINABLE POWER SUPPLY



2021 Edition

MISSION. VISION. SOCIAL RESPONSIBILITY



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

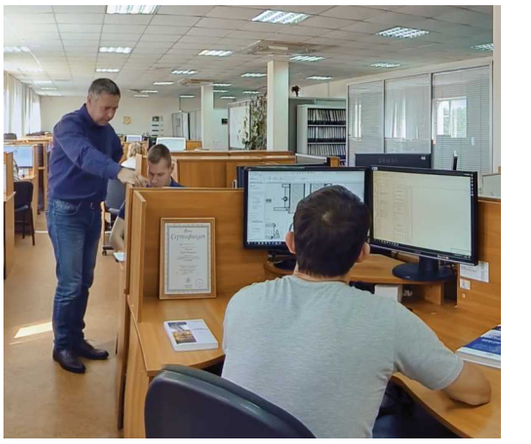
Vice-President of TRAVEK

Vice-President of AES RF

MANUFACTURING FACILITY

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 sleeves
- 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 240 to 3000 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

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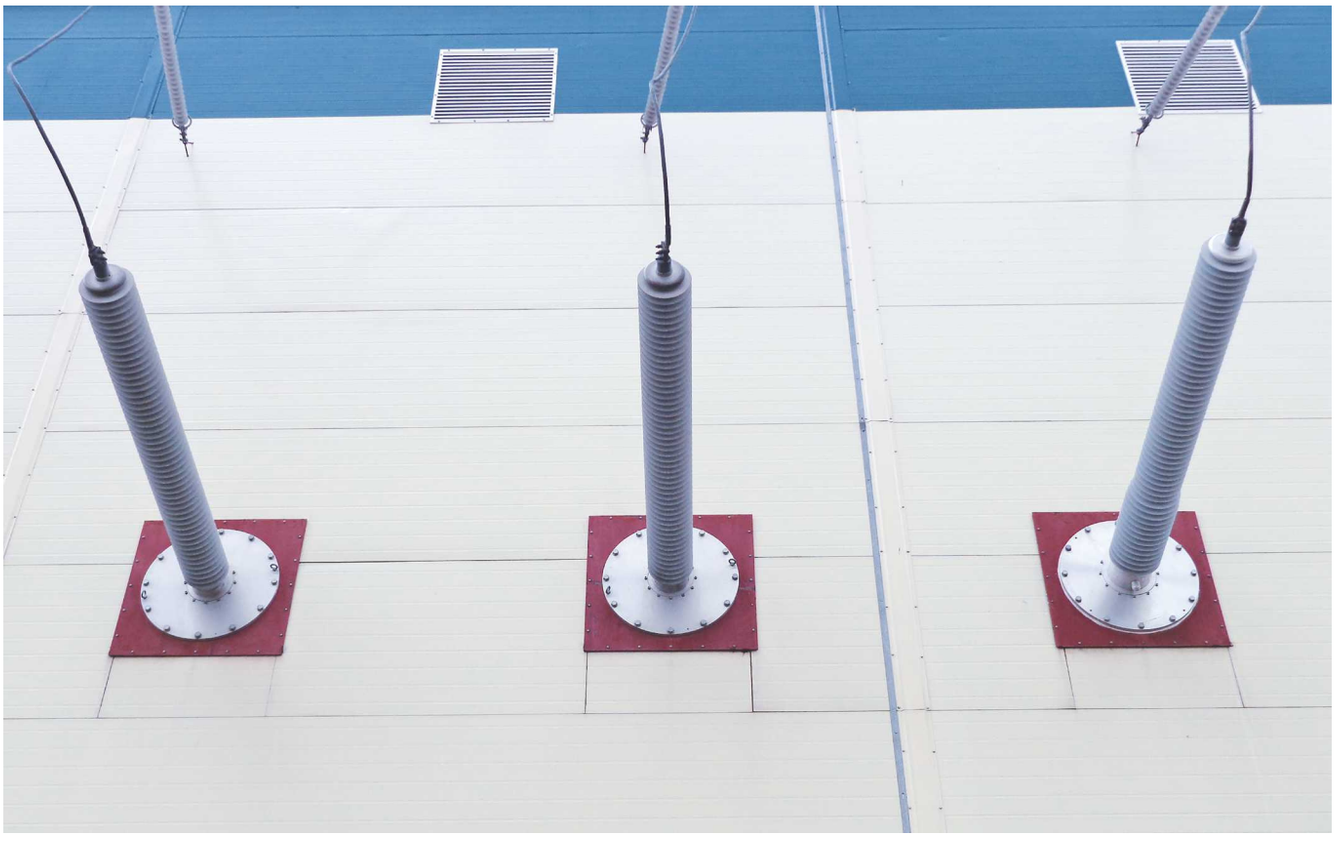


Wall Bushings

High-voltage wall bushings are designed for installation in walls and intermediate floor of switchgear buildings.

A high-voltage bushing is structurally independent product and represents a through insulator of complicated design with external and internal insulation intended for operation under most unfavorable environmental conditions. Dimension of the bushing is determined by switch gear voltage class.

Izolyator company produces wall bushings only with solid internal insulation of capacitor type according to RIP technology (Resin Impregnated Paper), being the most effective one.

Both polymer insulation or porcelain sheds can be used for external insulation.

In this case the space between the housing and internal insulation is filled with dry filling.

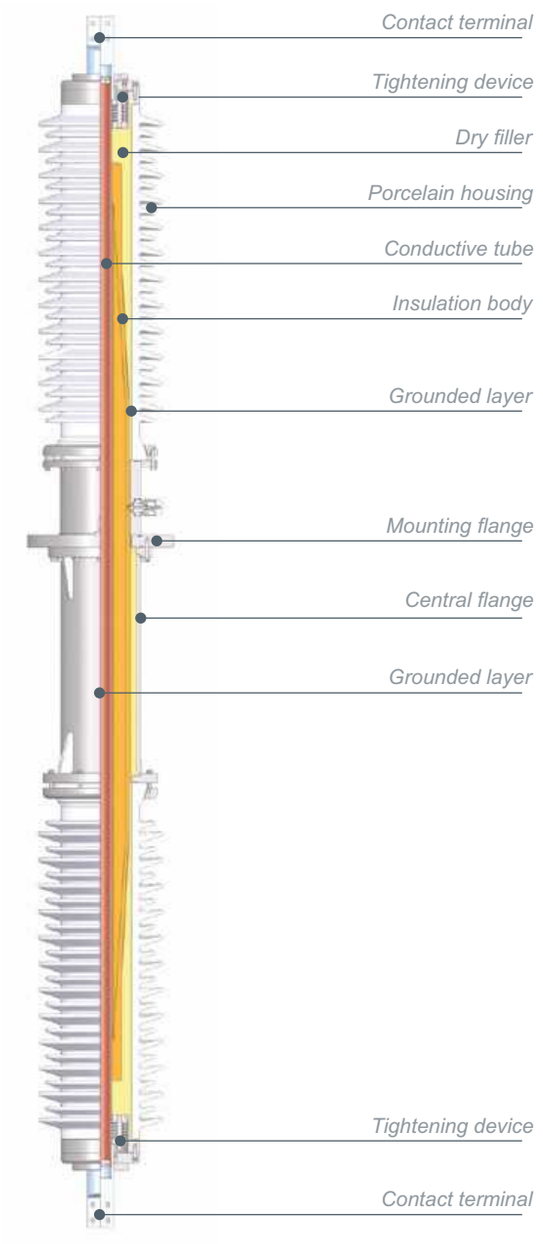


Fig. 1. Bushing with porcelain external insulation

Wall Bushing Design

Contact terminal is intended for connecting high potential to it; it is made from brass (Fig. 1).

Tightening assembly provides the required mechanical strength and leaktightness of the bushing.

Dry filler protects the internal space of the bushing against moistening.

Porcelain housing is an external insulation of the bushing, providing necessary arcing distance and creepage distance along its outer surface.

Insulation body is internal insulation of the bushing, equalizing electric field in radial and axial directions by placing condenser liners.

Central flange is intended for installation of the test tap and mounting flange of the bushing.

Mounting flange is intended for securing the bushing at the place of its installation and, in its turn, is secured by screws to the central flange of the bushing.

Grounded layer is last equalizing layer of insulation body, being in permanent electrical contact with test tap.

Shields are used in the design of bushings with polymeric external insulation and are intended for equalizing the external electric field in upper and lower parts of the bushing (Fig. 2). In bushings with porcelain housing the upper and lower flanges serve as shields. Polymeric insulation is used as an alternative to porcelain insulation and executes the same functions.

The bushings with polymeric external insulation have thefollowing advantages:

- absolutely dry explosion-proof and fire-proof maintenance-free design;
- stable insulation properties throughout the service life;
- high tracking resistance;
- hydrophobic behavior of external insulation, reducing risk of flashover, even in case of contaminated insulation moistening;
- polymer insulation elasticity, reducing the risk of damage during transportation and mounting;
- no limitation of the bushing vertical alignment angle;
- seismic load resistance;
- minimum weight;
- environmental safety.

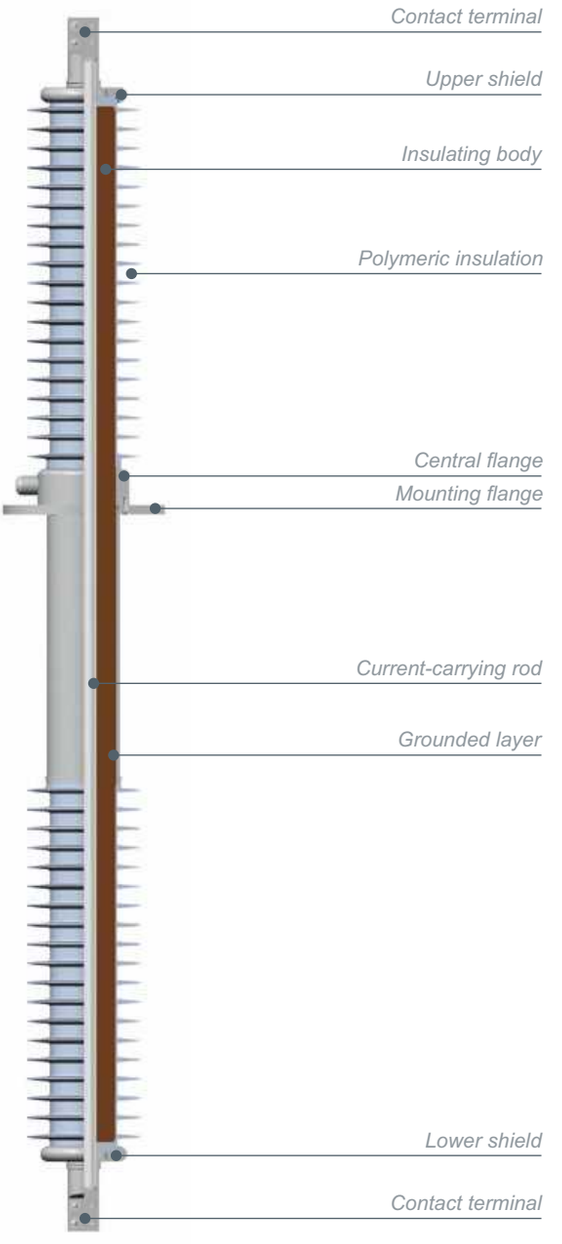


Fig. 2. Bushing with polymeric external insulation

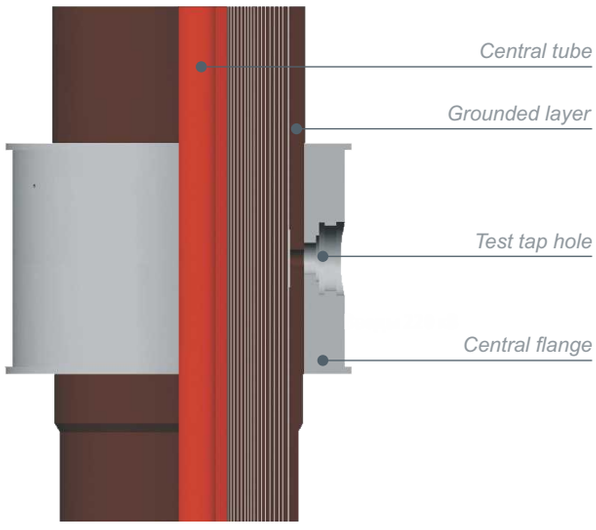


Fig. 3. Internal RIP-insulation

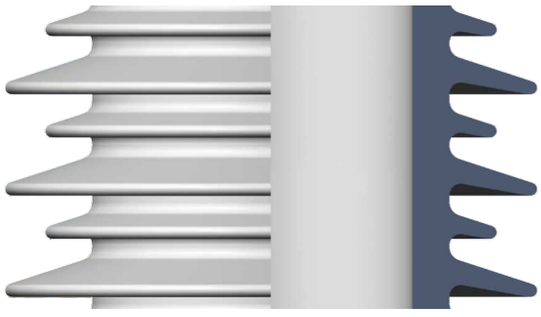


Fig. 4. Porcelain housing profile

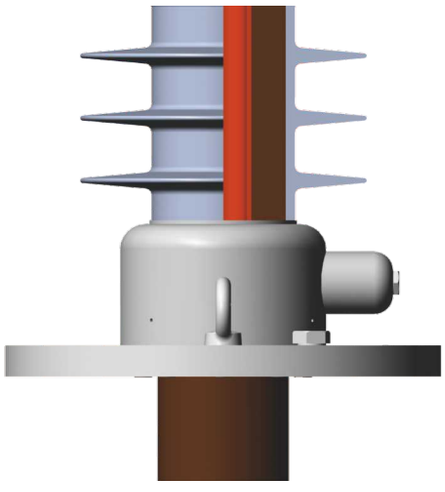


Fig. 5 Polymeric insulation profile

Wall Bushing Assemblies and Parts

Internal insulation

Internal solid RIP-insulation is the main structural part of the bushing (Fig. 3). It has high reliability and long service life due to low dielectric losses and low level of partial discharges inside the insulation, and its thermal strength. This insulation eliminates the use of transformer oil as an insulating component, thus substantially improving theserviceability of the bushings.

The capacitor layers are arranged inside the insulating body for electric field equalization and even distribution of electric potential. The layer nearest to the central tube has an electric contact with it; the last (earthed) layer has permanent contact with the test tap pin. The earthed layer is manufactured from specially treated foil, making it possible to solder the test tap conductor directly to the plate, thereby nullifying the probability of loss of contact between the test tap conductor and the layer. The materials used for manufacturing of the insulating body provide the required mechanical strength and crack resistance of the insulation, which is confirmed by the mechanical, climatic and seismic tests as well as by long service life of the bushings with RIP-insulation.

External insulation

External insulation covers the upper and lower parts of the insulating body and is made of porcelain (Fig. 4) or polymer (Fig. 5).

External insulation protects internal insulation against moistening and provides the required creepage distance along the external surface.

Tightening spring-loaded assembly

It is intended to compensate the difference between elongations of the central tube and external porcelain insulation caused by different thermal linear expansion coefficients.
The tightening device creates a tightening force required for providing bushing leak-tightness at any ambient temperatures through generation of the required pressure onto the sealing washer between the compensator and porcelain housings.

Connection

The wall bushings are connected with the help of contact terminals located at both ends of the bushing (Fig. 6).

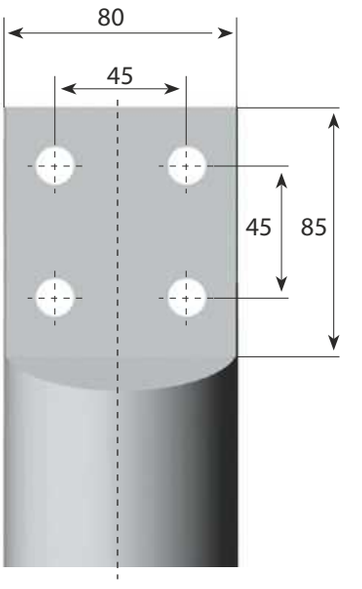


Fig. 6. Contact terminal

Test Tap

Test tap from the last equalizing layer of the insulating body serves for checking of internal insulation condition and must necessarily be grounded, when measurements are not performed.

The measuring tap design is shown on figure 7a. The grounding is done with a special springloaded multicontact offering a possibility of further visual and instrumental control of the grounding efficiency. In this case the hood serves only for sealing of the test tap cavity.

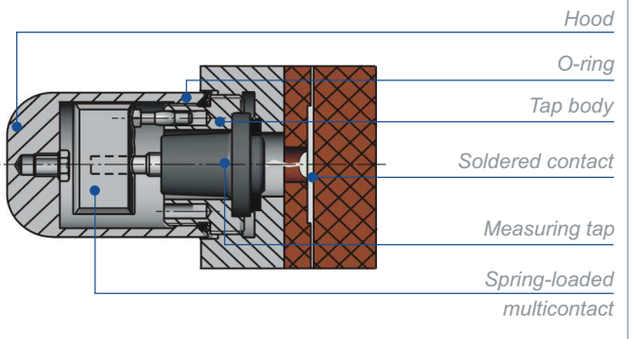


Fig. 7a. Measuring tap with grounded multicontact

Fig. 7b. Measuring tap with dismounted hood

Fig. 8. Shop area of 40.5-800 kV paper insulation winding at the Izolyator plant

Fig. 9. Hubers machine for vacuum impregnation of insulation at the Izolyator plant

Fig. 10. Lathe turning of 252 kV RIP-insulation at the Izolyator plant

Manufacturing of Wall Bushings

Fabrication of internal insulation

The main insulation represents a body formed by winding of high-quality dielectric crepe paper supplied by Weidmann on the central tube (Fig. 8).

The paper winding is divided into layers by conductive equalizing layers intended for optimal distribution of electric field in radial and axial directions. This provides the highest values of dielectric strength of both internal and external insulation.

The wound insulation undergoes thermal vacuum drying in order to eliminate residual moisture, and then is impregnated with epoxy compound consisting of ingredients supplied by the best world manufacturers (Fig. 9). Subsequent solidification under pressure completely removes gaseous inclusions from the insulation.

The epoxy compound formulation and technological parameters of RIP-insulation manufacturing process are intellectual property of Izolyator company.

As a result, the insulating body forms a solid core, which undergoes mechanical processing (Fig. 10).

Bushing Assembly

After machining of the external surface the central flange is mounted on the insulating body by press fit method.

Then the porcelain insulation (Fig. 11) is mounted or external polymer insulation is applied on the insulating body.

Porcelain insulation represents two housings, joints of each of them with the central flange on one side and with upper or lower flange of the bushing on the other side being sealed with special gaskets compatible with internal filler. Stable compression of the gaskets is performed by a tightening spring assembly, compensating temperature changes of length of the insulation body and of the housings within the range from -60°C to +60°C.

The space between the insulating body and porcelain housings is filled with dry filler for protection against moistening. The compression gel Unigel is used as filler (Fig. 12).

Polymeric insulation is molded from elastic material created on the basis of original Wacker organosilicon compositions of RTV-2 type.

Molding and polymerization take place directly on the insulation body according to "direct molding" technology in special molds developed in the Izolyator company (Fig. 13). Such technology eliminates the necessity for any filler and tightening spring assembly.

Fig. 11. 40.5-172 kV bushing assembly area at the Izolyator plant

Fig. 12. Unit for degassing and metering feed of compression gel at the Izolyator plant

Fig. 13. Direct molding of silicon rubber on solid RIP-insulation at the Izolyator plant

Fig. 14. Testing area for 252-1200 kV bushings at the Izolyator plant

Testing

Each new type of bushing undergoes the acceptance tests for compliance with all requirements of GOST P 55187-2012 and IEC standard 60137 (Fig. 14 and 15).

Each batch-produced bushing undergoes the acceptance tests for checking the conformity to its type and to the manufacturing quality, including tests with measurement of the partial discharge level and tgδ of the insulation according to the above mentioned documents.

Fig. 15. Electrical tests of 126 kV bushings at the Izolyator plant

Transportation and Storage

The bushings, which have passed tests, are packed into wooden packages, are completed with mounting parts, spare parts and documents according to design documentation (Fig. 16). A packed bushing is turned in for storage in the finished product storage area.

For the period of transportation and storage the external polymeric insulation is covered with polyethylene covers for protection against contamination. The bushings are carried in packages in the horizontal position by air, by rail or by roads with asphalt pavement or by dirt roads and by sea in holds in accordance with shipping rules applicable for a respective mode of transportation. It is allowed to carry the bushings in two tiers.

Packed bushings are stored in the indoor and outdoor storage areas in the horizontal position (two-tier storage is allowed) and unpacked bushings are stored in the vertical position on the special racks.

Fig. 16. Packing of bushings at the Izolyator plant

Operation

Maintenance of bushings with solid RIP-insulation provides for merely periodic measurement of insulation tgδ, main insulation capacity C1 and insulation resistance of the test tap.

Interchangeability of Bushings

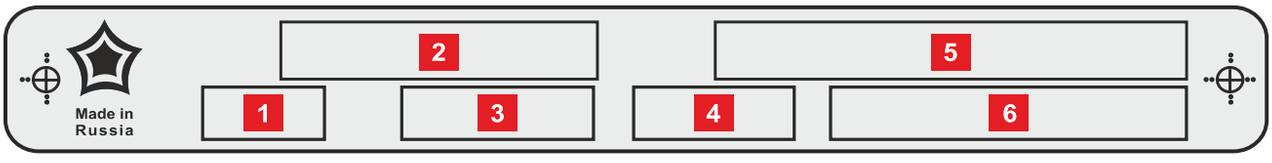
Wall bushings produced by the Izolyator company are installed on new switchgears as well as in substitution of spent bushings of obsolete design. Herewith, identical connecting dimensions of the mounting flange are observed.

Key to Bushing Designation Code

W C S X – 90 – 126 / 2000

- Rated current, A
- Maximum operating voltage, kV
- Limit angle of vertical oreintation, degree
- Category of external insulation depending on the pollution level at installation area according to GOST 9920-89 State technical standard
- Silicone (P — porcelain) external insulation
- Compound impregnation of crepe insulating paper (RIP insulation)
- Wall bushing

Izolyator Nameplate on Bushings

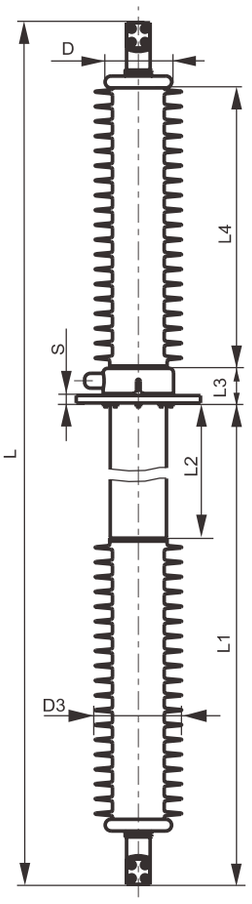


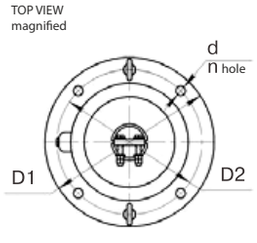
1. Bushing weight
2. Drawing number
3. Serial number
4. Production date
5. Bushing type
6. State technical standard number

Specifications of Wall Bushings with RIP-insulation

Bushing type	Drawing No.	Maximum operating voltage, effective value,kV	Phase-to-ground voltage, effective value, kV	Rated current,A	Test voltage, kV		Creepage dictance, mm	Test cantilever load, N	Weight, kg
					1 minute, 50 Hz, effective value	Lightning impulse full wave, 1.2/50 ms			
72.5 kV									
WCSIV-90-73/4000	686351.251	73	42	4000	140	350	2395/910	4000	160
126 kV									
WCSII-90-126/2000	686352.234	126	73	2000	230	550	2500	4000	144
WCSIII-90-126/2000	686352.234-03	126	73	2000	230	550	3150	4000	150
WCSIV-90-126/2000	686352.234-04	126	73	2000	230	550	3900	4000	153
WCSIII-90-126/2000	686352.234-01	126	73	2000	230	550	3150	4000	155
WCSIII-90-126/2000	686352.234-02	126	73	2000	230	550	3150	4000	160
WCSIV-90-126/2000	686352.234-05	126	73	2000	230	550	3900	4000	185
WCSIV-90-126/2000	686352.234-06	126	73	2000	230	550	3900	4000	170
WCPIII-90-126/2000	686352.386	126	73	2000	230	550	3150	4000	360
WCPIII-90-126/2000	686352.386-01	126	73	2000	230	550	3150	4000	367
WCPIV-90-126/2000	686352.386-02	126	73	2000	230	550	3900/1900	4000	355
WCPIV-90-126/2001	686352.386-03	126	73	2000	230	550	3900/1900	4000	360
172 kV									
WCSIII-90-172/2000	686352.291	172	104	2000	275	650	4250/4250	4000	187
WCSII-90-172/4000	686352.252	172	104	4000	230	550	3600/970	4000	230
WCSIII-90-172/4000	686352.298	172	104	4000	325	750	4770/4470	5000	370
252 kV									
WCSIII-90-252/2000	686353.235	252	153	2000	460	1050	6300	5000	370
WCSIV-90-252/2000	686353.235-01	252	153	2000	460	1050	7900	5000	395
WCSIII-90-252/2000	686353.235-03	252	153	2000	460	1050	7900	5000	383
WCPIII-90-252/2000	686353.335	252	153	2000	460	1050	7900	5000	720
WCPIII-90-252/2000	686353.709	252	153	2000	460	1050	7840/6920	4000	550

Mounting and connecting dimensions, mm										
L	L1	L2	L3	L4	D	D1	D2	D3	d/n hole	S
2145	1050	230	125	795	225	400	360	292	15/8	25
2950	1655	485	125	945	225	420	360	292	24/4	25
3150	1760	485	125	1045	225	420	360	292	24/4	25
3300	1655	485	125	1295	225	420	360	292	24/4	25
3350	1950	685	125	1045	225	420	360	292	24/4	25
3500	2150	835	125	1045	225	420	360	292	24/4	25
3820	2180	650	125	1295	225	420	360	292	24/4	25
3570	1930	650	125	1295	225	420	360	292	24/4	25
3490	1960	680	250	1030	225	420	360	365/290	24/4	25
3490	1960	680	250	1030	225	510	450	365/365	24/4	25
3660	1780	510	250	1380	225	420	420	365/290	24/5	25
3765	1885	615	250	1380	225	360	360	365/290	24/6	25
3740	1945	280	185	1450	225	450	400	292	16/8	25
3335	1825	650	185	1200	225	400	360	292	15/8	25
4725	2745	1005	185	1600	225	450	400	330/292	18/4	35
5815	3245	870	185	2155	225	890	840	330/292	22/12	35
6315	3245	870	185	2655	225	890	840	330/292	22/12	35
6060	3285	700	185	2466	225	890	840	330/294	22/12	35
5540	3080	870	185	1960	225	890	840	360	22/12	35
5880	2800	400	350	2475	225	500	450x450	350	22/4	35





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**
fax: **+7 (495) 727-27-66**
e-mail: **mosizolyator@mosizolyator.ru**

Terms and Acronyms

Autotransformer — a transformer in which two or more windings share a common part (GOST 30830-2002).

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 an fastening part (flange or fixing) which is an integral part of the bushing attaching it to the barrier.

GOST 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 the 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 the 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 rated voltage up to 550 kV inclusive, and not over 0,4 T for bushings with rated voltage 787 kV. The upper part of the bushing 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 and current into other, one or several, systems of alternative voltage and current, usually of different values at the same frequency, for the purpose of transfer of power (GOST 30830-2002).

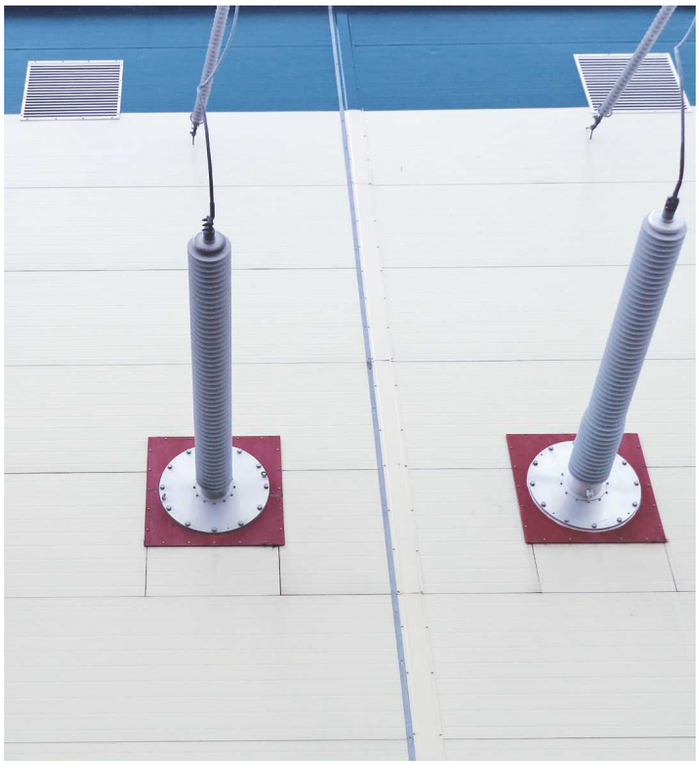
Dielectric loss tangent (tanδ, tgδ) is the ratio of active component of insulation leakage current to its reactive component. If alternating voltage is applied, this value is an important characteristic of the insulation of high-voltage transformers and bushings.

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 ends 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).

RIP — Resin Impregnated Paper. A type of solid internal insulation of high-voltage bushings.

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



Izolyator 220 kV wall bushings in a switchgear at oil refinery

Izolyator 330 kV bushings in a Main Power Transmission Lines transformer

Izolyator 110 kV bushings in an oil switch of Interregional Distribution Grid Company

220 kV bushings in a transformer at HPP

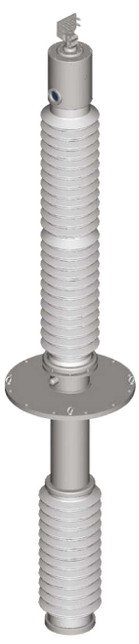
INNOVATIVE PRODUCTS

HIGH-VOLTAGE
BUSHINGS FROM
10 TO 1500 kV

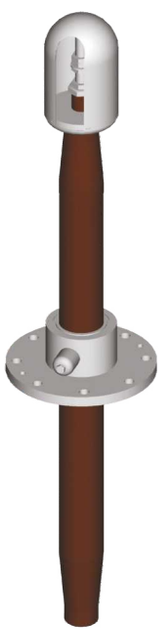
COMPLETE RANGE OF
BUSHINGS

Izolyator designs, makes, services and repairs high voltage bushings on alternating and direct currnent in the voltage range 10–1500 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

SF6–Oil bushings for gas insulated switchgears
Voltage:
126–550 kV
Current:
800–3150 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

125 years

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