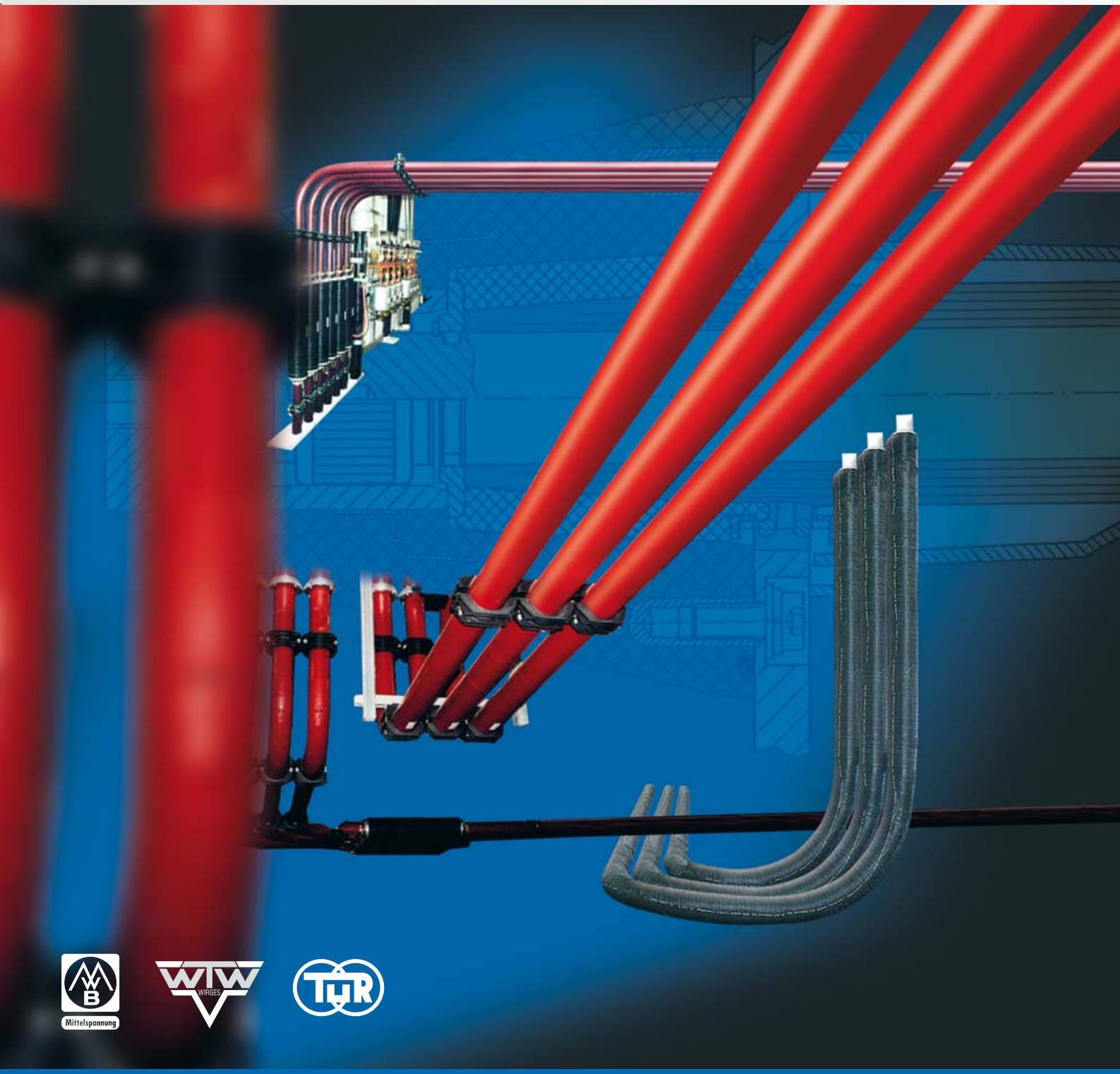
RITZ

Instrument Transformers

SIS Solid Insulation System



HAMBURG WIRGES KIRCHAICH DRESDEN MARCHTRENK KECSKEMÉT SHANGHAI

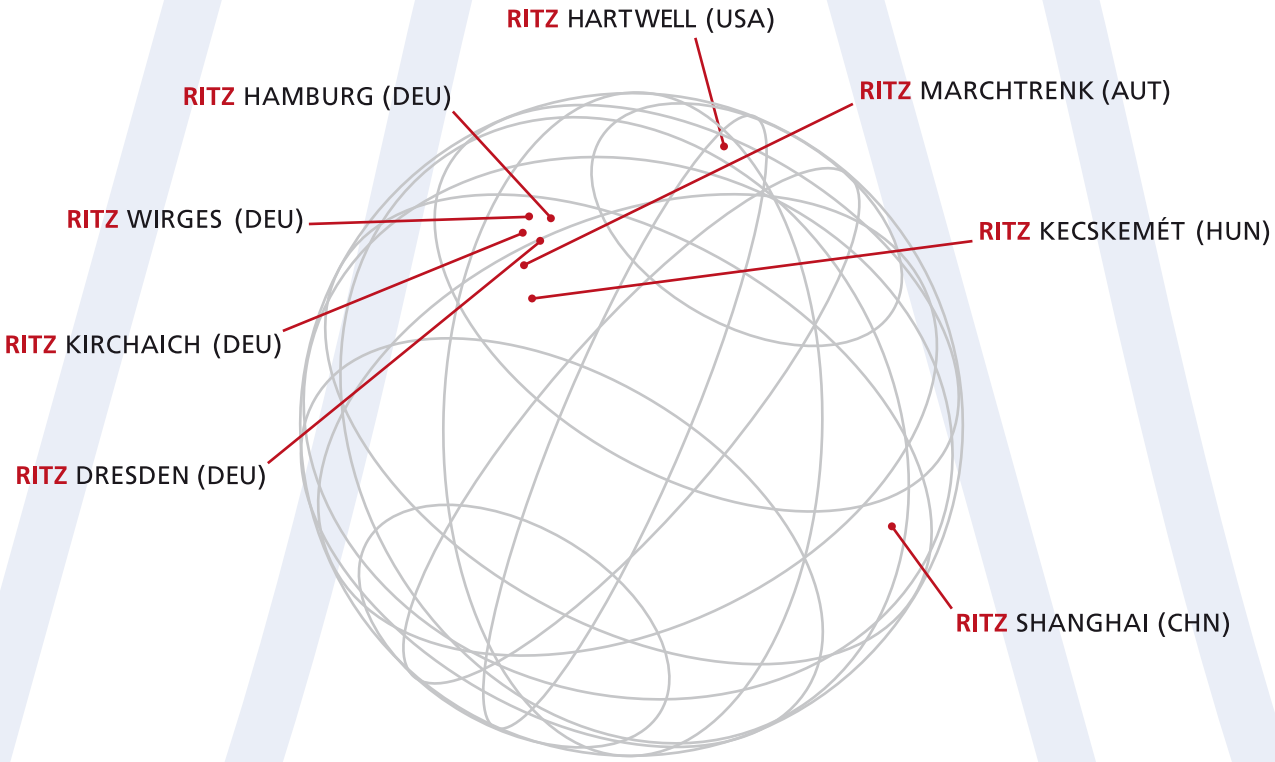
RITZ Instrument Transformers GmbH – Core competency

Under the trading name „RITZ Instrument Transformers GmbH" RITZ has been pooling its activities to gather new strengths since 01.08.2007.

The tradition and knowledge of the parent company „RITZ Messwandler Hamburg" and the subsidiary „RITZ Messwandler Dresden (TuR)" has been united with the companies "Wandler- und Transformatoren-Werk Wirges (WTW) and "Messwandlerbau Bamberg (MWB)" under this name. This merger unites a total of more than two hundred years of know-how in instrument transformers production.

In addition, RITZ has decided to concentrate on the core business of medium voltage and low voltage transformers in which the high voltage division is sold. The resources gained through this shall now be applied for additional innovations and quality standards in the medium and low voltage products. RITZ is therefore securing its position on the global market.

The overseas corporations of RITZ Instrument Transformer GmbH in Austria (Marchtrenk), Hungary (Kecskemét) and China (Shanghai) strengthen the company's position on the international market.



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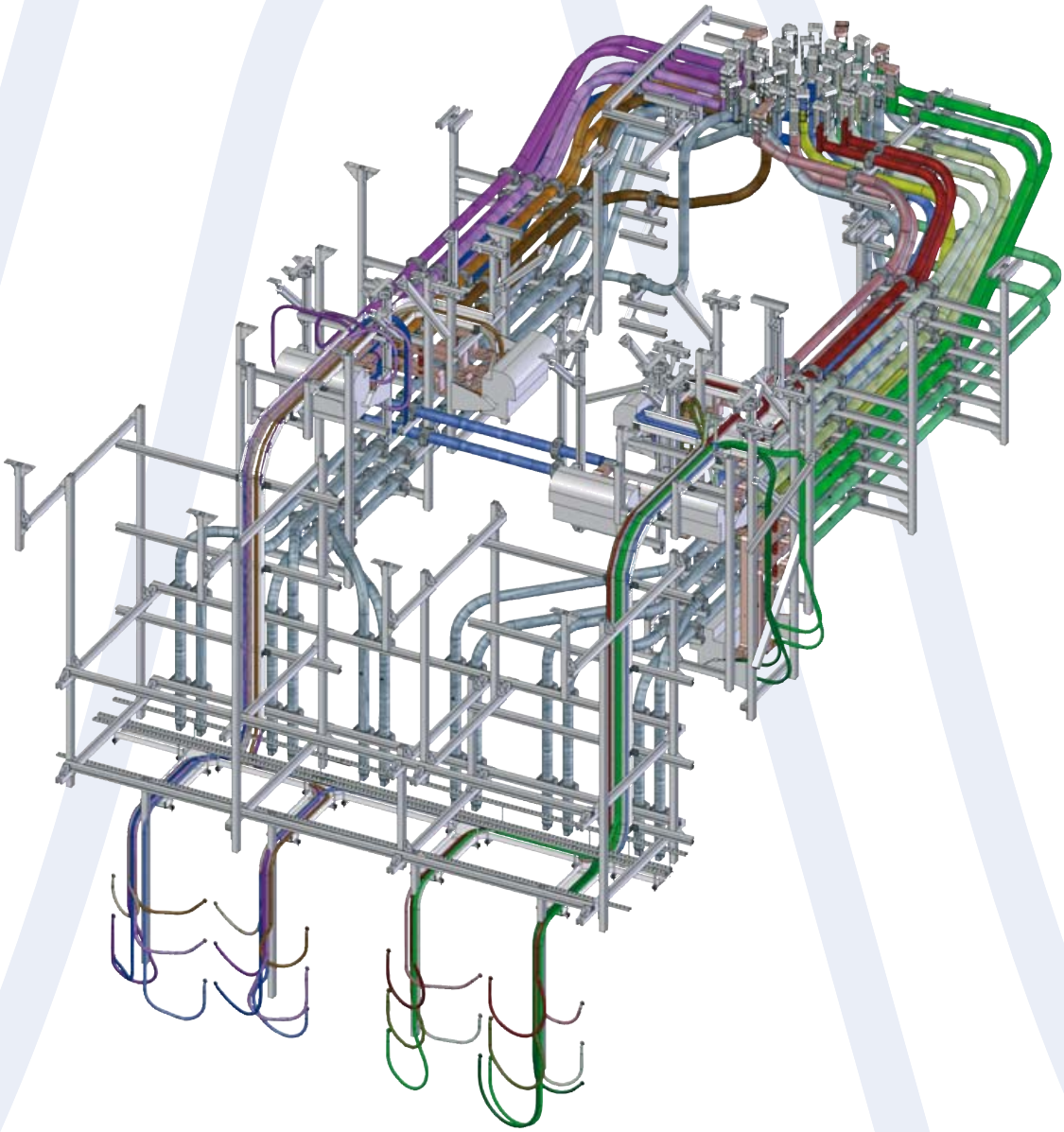


General

The equipment produced plays an important part in energy manufacture and energy distribution. Therefore, highest demands are made with respect to industrial safety.
By constantly supervising the manufacturing process as well as ongoing modifications to the materials used, the highest degree of safety is guaranteed. The available test equipment allows all of the type and routine tests necessary.

Before delivery each bus bar segment and connecting sleeve gets routine testing.

Especially for the transmission of higher currents, the solid bus bar insulation system is an alternative to parallel-connected cables and metal-enclosed bus bar connections. All requirements with respect to the protection of personnel and equipment are met. The following inherent benefits speak for the use of fully insulated bus bars:

Design

System Specific Benefits

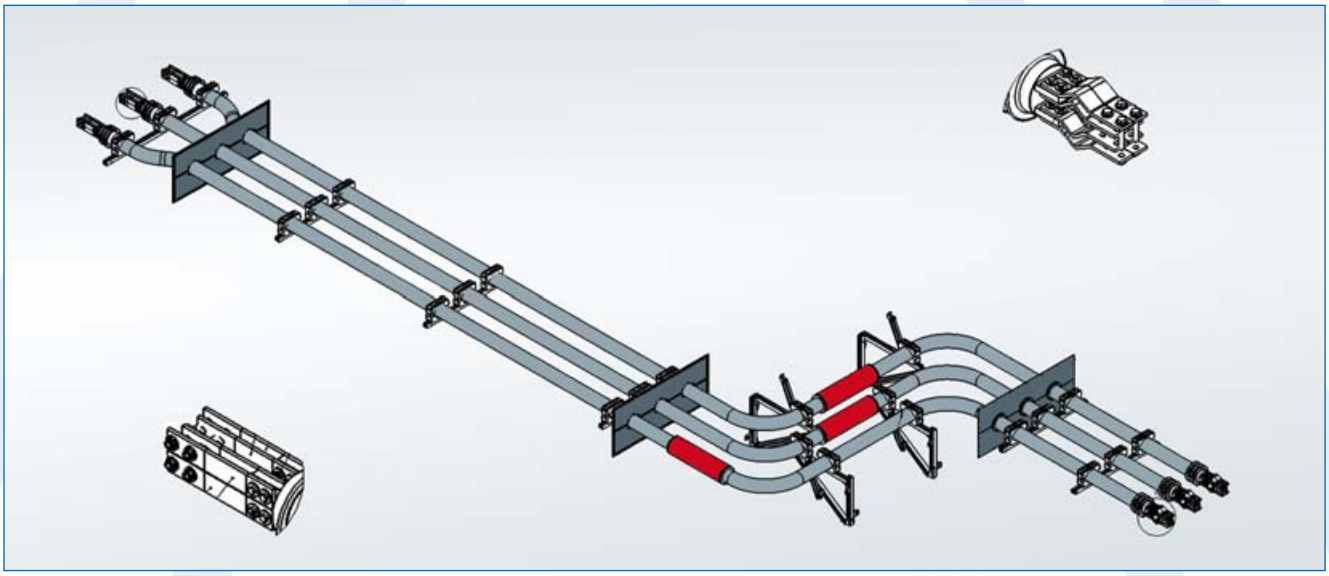
- Compact design
- Low space requirements
- Small bending radii
- 3-dimensional geometric shape is possible
- No maintenance

Safety Benefits

- 100 % protection against contact
- Capacitive graded system
- Capable of withstanding high thermal and dynamic short circuit currents
- Safe to touch
- No short-circuits between phases due to full insulation
- Natural cooling due to effectual conductor design
- No toxic fumes in case of fire - self extinguishing
- High operational reliability due to factory routine test

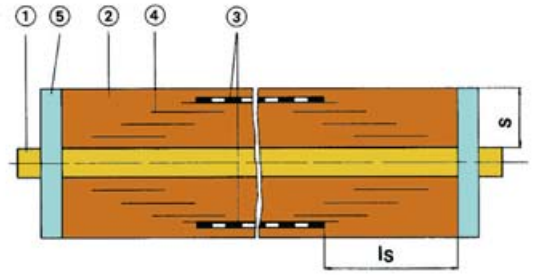
Construction and Installation Work

- Easy installation due to standardised installation and fixing parts
- Minimum project work for the user



Bus Bar Design Principle

The bus bar insulation is built up with Resin Impregnated Paper (RIP). Crepe paper is wound around the conductor (copper or aluminium) and impregnated under vacuum with epoxy resin.
This results in cavity free insulation which is free of partial discharge. To avoid partial discharge by delamination of the insulation from the conductor a conducting layer is wrapped around the conductor.
Layers of insulating crepe paper are built up on the high voltage layer according to the rated voltage. In these insulation layers of semi conducting paper, the capacitive grading at the ends of the bus bars are included. These are dimensioned to achieve an optimal distribution of the electrical field on the surface of the bus bar. These are dimensioned to reach an optimised electric field distribution on the surface of the bus bar. Thus a minimised grading length can be reached. Along the whole length of the bus bar, expect the grading area, an earth layer is wound on the insulating layers. This earth layer is built up by semi conducting paper, aluminium foil layers and axial copper strips to reach a high short circuit current capability. A connection device is soldered on the copper strips used as earthing point of the bus bar. As protection of the earth layers additional protecting layers are added. The whole bus bar is sealed vacuum tight with shrinking sleeve. After drying the insulation, the paper is impregnated with a low viscosity epoxy resin under vacuum conditions. The RITZ manufacturing technology permits to build a bus bar with any geometrical shape.



1. Conductor
2. Epoxy-impregnated paper wrapping
3. Earth layer
4. Capacitive grading
5. Metal ring

Bus bar design principle

U_{max}	min. length of grading (l_S)	Insulation wrapping (s)
12 kV	175 mm	10,0 mm
24 kV	215 mm	12,5 mm
36 kV	330 mm	17,5 mm

Production Process

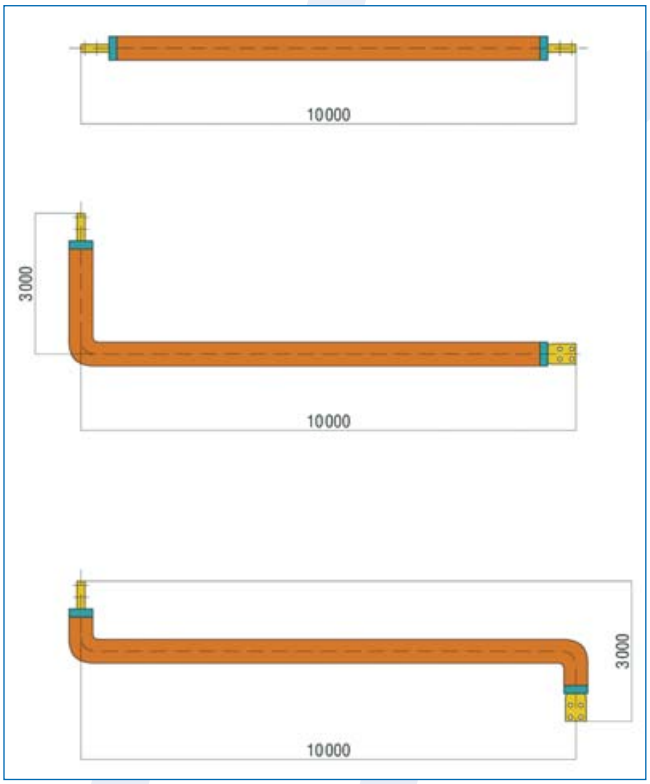
The bandaged conductor with paper insulation will be vacuum sealed with a shrink sleeve. A vacuum system will be connected through a hole in a ring at each end of the bus bar. The vacuum process dries the paper insulation. After the drying process one end will be connected to the resin tank. The other end still remains connected to the vacuum pump. Due to the depression the low viscose and slow hardening resin flows through the paper insulation. Based on this production technology any bus bar shape is possible. Impregnation by using fixed mould is not necessary. For special application requirements a stainless steel shell is available.

Outdoor Application

For outdoor applications the bus bar will be covered with a weatherproof stainless steel tube. To increase the creepage distance, the capactive grading of the bus bar insulation is covered on the outside by cast-on sheds.

Production Length

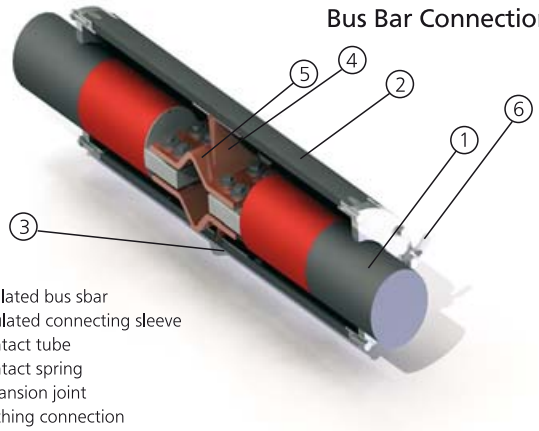
The length and geometric shape is limited by the size of the equipment (such as the kiln), the means of transportation and the local facilities (building construction).
RITZ manufactures different bus bar shapes and lengths as show in the picture below.



Multiple Bus Bar Connections

The length of the individual bus bars is limited by the manufacturing process, transportation and installation conditions. For complex installations the bus bars have to be connected. The connection is performed with flexible connectors between the bus bars to allow thermal expansion and to compensate for tolerances during installation. These joints are fully insulated by connection sleeves, which cover the capactive grading at the bus bar ends. These connecting sleeves are also fully insulated and guarantee absolute safety upon contact throughout the whole length of the bus bar installation. For voltages above 12 kV the sleeves are also capacitive gradings. The high voltage connection to the sleeve is realised by a contact spring installed on the flat connector of the bus bar. The connecting sleeves have protection class IP 45. Higher protection classes are available upon request.

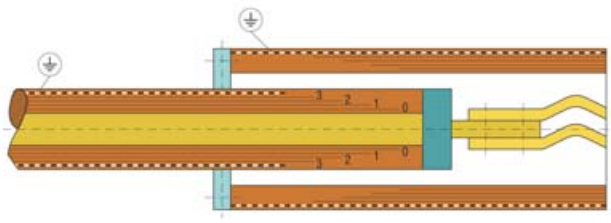
Bus Bar Connection



1. Insulated bus sbar
2. Insulated connecting sleeve
3. Contact tube
4. Contact spring
5. Expansion joint
6. Earthing connection

The drawing shows the insulated conductor and the insulated tube. The capacitive layer of the bus bar and connecting sleeve are laid in the opposite direction which guarantees a homogenous electrical field inside the connecting sleeve.

Capacitive grading bus bar - connecting sleeve



Bus Bar Connection

There are several variations of rigid or flexible connections between bus bar segments or between the bus bar and other equipment parts. The standard connection between the bus bars is a standardised flat terminal in accordance with the rated current.
For connecting the bus bar with other equipment parts the following options are available:

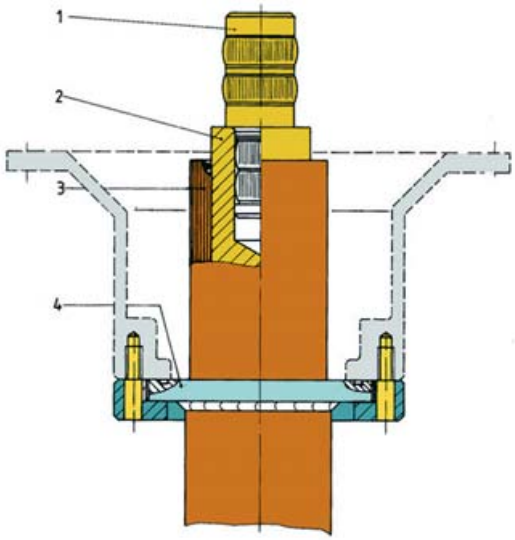
- Conductor end with flat terminal according to DIN 42 206.
- Conductor end with round bolt.
- According to customer's specification.
- If the insulated bus bar is to be connected gas-tight to an SF6-insulated switchgear, a metal flange is fitted at the earthed portion of the bus bar. Current connection can be done in an economical way by means of contact bolts or according to customer requirements.

Through the use of a fixed connection at both ends of the bus bar, a connecting sleeve should be attached to compensate for construction tolerances and thermal expansion of the bus bar during operation.

Earthing

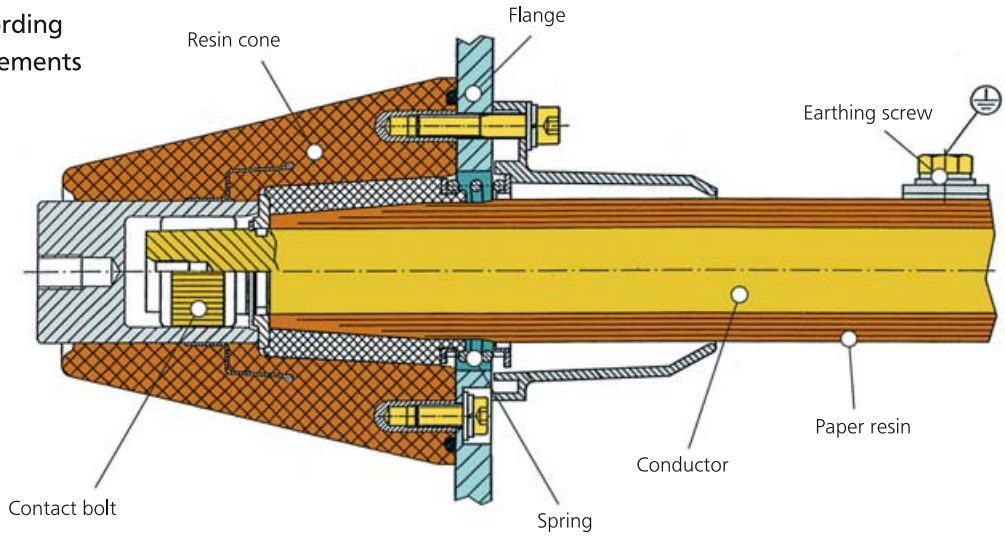
A separate earthing connection dimensioned in accordance with the required short circuit current generally has to be installed parallel to the bus bar system. Every single bus bar, connection sleeve and metallic fixation material has to be earthed on this earthing connection. If a bus bar or a connecting sleeve is not earthed correctly these elements will be destroyed after a certain amount of time.

Connection of bus bar to a GIS



1. Contact bolt
2. Conductor
3. Insulation
4. Metal flange

Special design according to customer requirements



Bus Bar Fixing

For installation of the bus bar system a flexible mounting system is used. Adjustments can easily be done at site. The bus bar fixing elements include aluminium C-profiles, angles, T-screws and fixing clamps. The fixing elements are adjustable with respect to each other and adjustable in all directions therefore allowing compensation for building tolerances. The fixing clamps include fixed bearings and slide bearings, allowing the bus bar to move axially within the fixing clamps in case of thermal expansion. In the first instance, the capability of the equipment to withstand a short-circuit, must be considered for the bus bar fixing. Another criterion is the natural frequency of the bus bar.

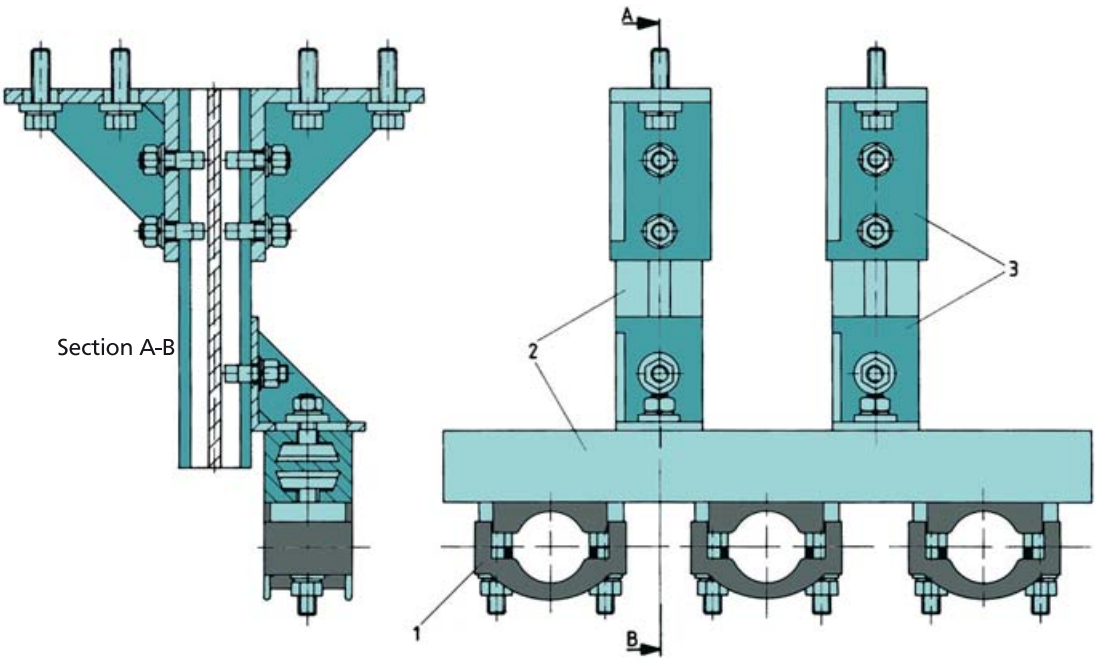
The distance between fixing points must be chosen to avoid resonance with respect to the power frequency of the system and its harmonics. The distance between the fixing points of the bus bar is individually calculated for each order.

A respective calculation tool is available, which includes:

- Bus bar diameter
- Phase distance
- Mass of the busbar
- Bending strength

Fixing Clamp

The fixing clamps are differentiated between slide bearing and fixed bearing clamps. The use of fixed or slide bearing clamps is determined by the fixing points given by the calculation tool. The construction of a slide bearing clamp is designed with a rubber washer and a metal washer is used for the fixed bearing clamp.



Bus Bssar fixing

1. Plastic fixing clamps
2. Aluminium double-C-profile
3. Aluminium fixing angles

Dimensioning | Conductor Material

The bus bar conductors are dimensioned according to DIN 43670/671. The following criteria are taken into consideration:

- Thermal conductivity of the insulation
- Heat transmission beween the insulation and ambient air (through convection and radiation)
- Natural cooling
- Skin effect

The bus bars are dimensioned for an ambient temperature of 35°C with a maximum temperature increase of 50°C in the conductor. Accordingly, the maximum temperature of the conductor is 85°C under natural cooling conditions. Deviations from the above dimensioning criteria shall be specified and can be considered when the design calculation is made. The conductor material can be copper (E-Cu) or aluminium (E-Al-MgSi 0,5).

Dimensions for conductor material E-Al-MgSi 0,5					
$U_{(max)}$ / I_N	12–24 kV ø Conductor (mm)	12 kV ø Bus Bar (mm)	17,5–24 kV ø Bus Bar (mm)	36 kV ø Conductor (mm)	36 kV ø Bus Bar (mm)
1250 A	40	65	70	40	80
1600 A	50	75	80	50	90
2000 A	60	85	90	70/15	110
2500 A	80/15	105	110	80/15	120
3150 A	100/15	125	130	100/15	140
4000 A	120/15	145	150	130/15	170
5000 A	150/15	175	180	160/15	200
6500 A	200/15	225	230		

Dimensions for conductor material E-Cu					
$U_{(max)}$ / I_N	12–24 kV ø Conductor (mm)	12 kV ø Bus Bar (mm)	17,5–24 kV ø Bus Bar (mm)	36 kV ø Conductor (mm)	36 kV ø Bus Bar (mm)
1250 A	33	57	62	33	72
1600 A	40	65	70	50	90
2000 A	50	75	80	60	100
2500 A	70/10	95	100	70/10	110
3150 A	90/10	115	120	90/10	130
4000 A	110/10	135	140	110/10	150
5000 A	140/10	165	170	140/10	180
6500 A	180/10	205	210	190/10	230

Other voltages and currents on request.

Quality

Before use in production, the material is subjected to the following tests:
a) Conductor material:
- Measurement of specific resistance

b)Insulating paper:
- Verification of purity
- Tearing strength test

c) Impregnating resin:
- Measurement of viscosity
- Measurement of viscosity increase (with temperature as parameter)
- Measurement of gelation time

The impregnating process is checked by the following measurements:
- Conditioning (degassing) of the resin compound
- Temperature in vacuum kiln
- Continuous evacuation controls
- Gelation temperature and time
- Post-curing temperature and time

In the development stages, general investigations were made and the following was determined:
- Temperature of deflection under load (Martens method)
- Flexural strength
- Deflection
- Impact strength
- Module of elasticity
- Co-efficiency of thermal expansion
- Thermal conductivity

A differential thermal analysis (DTA) and life test was also performed.

Tests

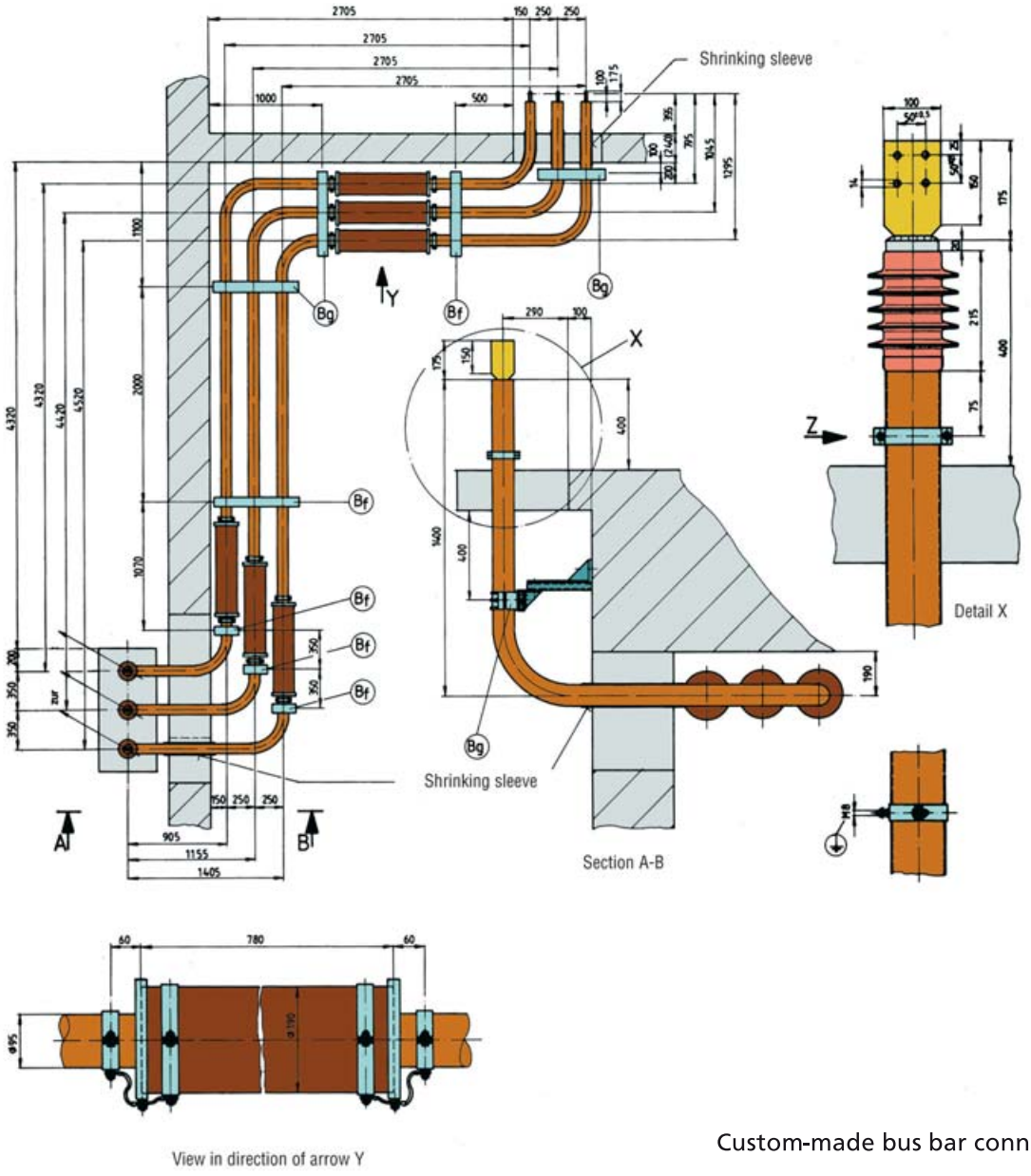
Each bus bar and each connection sleeve is subjected to an electrical routine test, namely:
- One-minute power frequency test, 50 Hz according to current standards (IEC, VDE, etc.)
- Measurement of partial discharges
- Measurement of capacitance and loss factors
- Visual inspection

The following type tests have been made:
- Power-frequency test and measurement of partial discharges
- Impulse voltage test
- Power-frequency test and measurement of partial discharges(rep.)
- Temperature rise test
- Temperature cycle test
- Power-frequency test and measurement of partial discharges (rep.)
- Life test

Ordering Information

Customers are kindly requested to supply the following information in their orders to enable quick processing in the factory:

- Rated voltage
- Rated current
- Short-circuit currents
- Frequency
- Max. ambient temperature
- Possible restriction for max. bus bar length (local facility - building construction)
- Distance between phases
- Definition of bus bar terminals
- Available earthing facilities
- Possible fixing method (wall or ceiling)



Custom-made bus bar connection

We look forward to our cooperation with you.

RITZ Product Overview

Medium Voltage Instrument Transformers

- 3 kV up to 52 kV
- Indoor and Outdoor
- Metal Clad Design
- Metalized Design
- Sensor Types

Low Voltage Instrument Transformers up to 1,2 kV in a Plastic Housing or Cast Resin Insulated

- Wound Primary C. T.
- Summation C. T.
- Window Type C. T.
- Multi-Range C. T.
- C. T. for Measuring Purpose
- Voltage Transformer
- Auxiliary C. T.
- C. T. for Switch Fuses
- Tube Type C. T.
- Split-Core C. T.
- 3-Phase C. T.
- C. T. for Bill / Tariff Metering
- Window Type C. T. for High Current
- Split Core Types for Earth fault Protection
- Laboratory Current and Voltage Transformers
- Damping Inductance Devices against Ferroresonance

Cast Resin Power Transformers

- up to 36 kV and 20 MVA

Applications

- Power Distribution
- Rectifier Drives
- Generator Excitation
- Transmitter Systems
- Earthing Systems
- Traction Supply Systems
- Oil Platforms / Vessels
- Injection Systems
- Laboratory Systems

Electronic Instrument Transformers and Sensor

Voltage-Sensoric

- Voltage up to 90 kV
- Accuracy of 0,2 %
- Frequency from 0 to 10 kHz

Current-Sensoric

- Current up to 24000 A
- Accuracy of 0,01 %
- Frequency from 0 to 10 kHz

Applications

- Power Engineering
- Rail Transportation Power Supply
- Electrochemistry
- Environment Engineering
- Research
- Grid Analyses
- Protection Technology
- Switchgear Systems
- Automobile Industry

Customised Cast Resin Parts

- Development and formulation of casting resin moulding materials for electrical applications in low and medium voltage ranges and for electronics.
- Design and production of cast resin form parts e.g. special bushings and fuse housings etc.

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