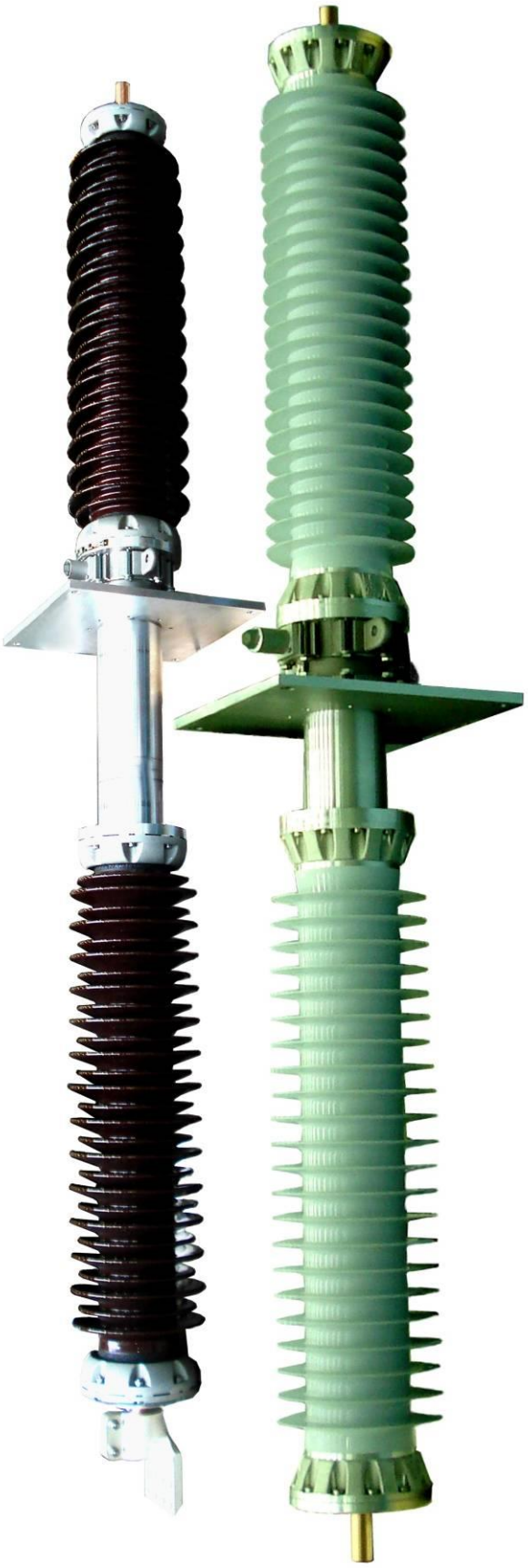


Wall Bushings
Type EW/SEW

Mounting
Operating
and
Maintenance Instructions

SAFETY INSTRUCTIONS

These instructions are valid for mounting, operation and maintenance of transformer bushings type EW/SEW.

Mounting, operation and maintenance involve following safety risks:

- Perilous, electrical voltages
- High voltage
- Moving machines
- Large weight
- Handling of moving masses
- Injuries caused by slipping, stumbling or falling

Especially rules and instructions for these topics have to be obeyed when handling such equipment. Disregarding of these instructions can induce severe injuries of persons, death, damages of products and materials or following industrial injury and/or consequential damages.

In addition to these rules national and international safety rules have to be obeyed.

In these instructions we have marked risks of injuries of persons and damage of material with following signs near the texts and mounting steps:

Personal injuries or fatal damages

Industrial injury and/or consequential damages

These operating and maintenance instructions are valid for bushings type EW.. and SEW.. For each bushing type these instructions are valid only together with the respective bushing specification, which contains all technical details and the dimension drawing. It is an integral part of these operating and maintenance instructions.

CONTENT

1 Description

1.1 Construction

	Design	Type	Fig.
A	Porcelain, double sided	EW f/f	4
B	Silicon, single sided	SEW f/i	3
C	Silicon, double sided	SEW f/f	2
		SEW f/i	2
D	Flat connection*	optional	1

*Standard version with circular connection (terminal bolts)

S = Silicon composite insulator
E = Epoxy resin impregnated active component
W = Wall bushing
Without "S" = Porcelain version
f = Outdoor
i = Indoor

Other variants could be available beyond this presentation; please refer to the bushing specification for the actual version.

Porcelain housing

Silicon-composite housing with standard Sheds, optional with alternating shed

Bushing flange

Test tap

Square wall bracket plate

Wall penetration, metallic extension

Wall penetration, grounded insulator extension

Insulating body, indoor design

Flat connection (optional)

Bolt connection

Head armature

Fig.1

Fig.2 Fig.3 Fig.4

1.2 Design

Different versions are available depending on the application:

Type designation:	Media:	Cross-sectional view:
with porcelain:		
EW f/f	outdoor/outdoor	left top
EW f/i	outdoor/indoor	left top/right bottom
EW i/i	indoor/indoor	right bottom
with silicon composite insulator:		
SEW f/f	outdoor/indoor	right top/left bottom
SEW f/i	outdoor/indoor	right top/right bottom
SEW f/I	outdoor/indoor	right top/left bottom

The main insulation of the RIP-wall bushing S/EW... is an insulator (10). It is made of a special paper impregnated with epoxy resin under vacuum and coaxially configured control inserts (11) made of aluminium foil, which effectuates uniform voltage distribution on the insulator.
The electric conductor (1), generally a copper bolt, is permanently impregnated into this insulator, in various versions also pushed through as a bolt.

This insulator is integrated in an insulating housing (9) together with its electric conductor, depending on the version in a porcelain housing (8) (left, top half of the cutaway view) with cemented fittings (6,12) made from weather-resistant aluminium casting or a silicon composite insulator (9, 21) which together with the head (4) and flange fittings (13) creates an inseparable unit (right to half of the picture). At the same time, silicon shields and the fittings are vulcanized directly onto a glass-fibre reinforced epoxy resin pipe.
In versions for indoor operation or indoor operation on one side, no insulation housing is provided (20). The surface of the RIP insulator is then mirror-finish painted.

The gap between the insulator and the insulator housing is filled with a foamed polyurethane elastomer (7), which on its part creates an elastic connection of the components through adhesive bonding so non-destructive disassembly of this part is not feasible.

The square flange plate (17) of the bushing is bolted to the bottom flange (14) of the composite insulator, creating the actual bushing flange. This flange is provided with test tap (15) and ground drill holes (18) and, depending on the size and version, with hoisting facilities (16). In versions with insulator housings on both sides, the flange has a pipe-shaped extension (19) with a transition to the insulator, either as a flange for porcelain or, as shown, a vulcanized shoulder in silicon composite housings.

The bushing heads, depending on the insulator housing, are made either as bolted covers (5) for porcelain or as integrated end caps (4) for silicon. In both versions, the electric conductor is fed through, sealed with O-ring seals (3/23) and a stainless steel cover panel (2/24), to prevent electrolytic corrosion between the bolt and head material. All rings are made as O-ring seals.

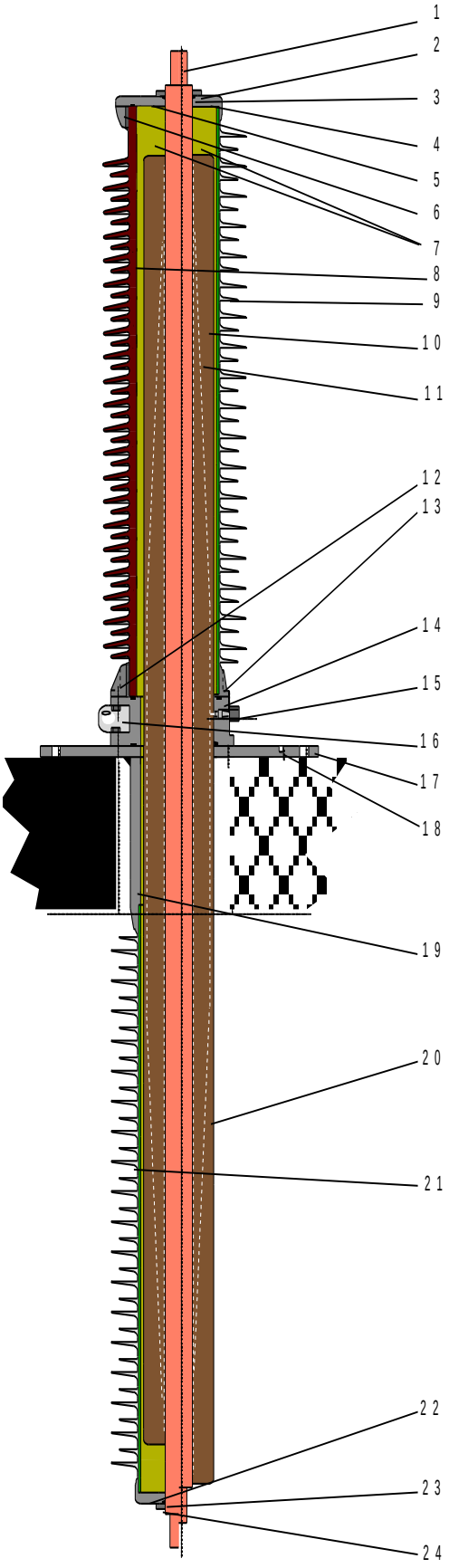


Fig.5

1.3 General operating conditions

Application:	Bushing for application as wall or ceiling bushing.
Classification:	Epoxy resin impregnated paper, capacitor control, Outdoor or indoor wall bushing
Ambient temperature:	Outdoor side and indoor side: - 30 to + 40°C ** compliant with Temperature Class 2 acc. IEC 60137
Installation height:	< 1000 m above sea level**
Rain level and humidity:	for outdoor side: 1-2 mm rain/min. vertical and horizontal compliant IEC 60060 - I
Pollution class:	Corresponding to the specific creepage distance*** acc. IEC 60815
Immersion medium:	Air
Corrosion protection:	All fittings and fastening devices made of corrosion resistant materials
Marking:	Acc. to IEC 60137
Packing:	Wooden crate, ventilated, bushing on foam pads, supported on head and flange, welded in plastic film with desiccant additive.

** Standard value, Deviations for special cases see related bushing specification
*** Standard min 25 mm/kV for heavily polluted environment, deviations see bushing specification

1.4 Mechanical stresses

Test bending load:	Standard compliant with IEC 60137 Table 1, Class II
Operating load:	50% of the value of the test bending load

* Standard value, Deviations in special cases see related bushing specification

2 Mounting

2.1 Status of dispatch

The bushing is shipped in a ventilated wooden crate. It is supported by styro-foam cushions, in porcelain models on porcelain, in silicon versions on the head and in the flange area and in versions for indoor use on the insulator itself. In addition, the flange in larger bushings is supported and fixated with cross beams.

The complete bushing is enveloped and welded in a plastic film with inlaid dehydrating bags (Fig.6).

This packing allows the bushings to be stored in roofed, rain protected rooms for 12 months.
If the bushing is packed in an aluminium laminated plastic instead of the plastic film, it can be stored under the same conditions for 24 months.

Fig. 6

2.2 Handling

To remove the bushing from its crate, in the porcelain versions one can use hoisting equipment with a hemp rope or plastic rope or belt, but bushings of this type for voltages >170 kV only on the flange and head at the intended hoisting points.
Lift bushings with silicon composite insulators solely on the flange and head to prevent damaging the silicon; setting down on the insulator leads to a permanent deformation of the shields.
Bushings for single or double sided indoor operation can be lifted on the insulator itself using upholstered ropes or belts.

After lifting out of the packing, lay the bushing on the flange and head on bearing supports. Remove the plastic film - do not use a knife as there is a danger that the shields could be damaged on silicon bushings.

With unprotected, indoor-side ends, the bushing can be handling outdoors for a short time during dry weather. Longer storage, e.g., during rain, is impermissible. The material RIP is hygroscopic and absorbs moisture on its surface, which influences the operating behaviour.

If bushings are found that clearly exhibit traces of interacting moisture on its indoor side, contact the manufacturer (discoloured paint coating, detachments, bubbles, cracks, etc.).

2.3 Lifting and installation

Use the lifting rings to lift. They are supplied either as detachable eye bolts on the flange and head or, depending on the version, as lifting rings that are cast directly to the flange.

Remove the detachable eye bolts after installation and seal the tapped holes through the plastic covers.

Lift using hoisting tackle (Fig. 7). To insert the wall mounting opening, the bushing generally has to be installed from the exterior wall side. To adapt the installation direction while doing so, it is recommended to attach a weight to the lighter bushing end for balance; under certain circumstances in bushings up to 170 kV rated voltage they can also be corrected manually from the installation scaffolding (see also Fig. 7).

In any case, comply with the corresponding safety regulations when handling suspended loads!

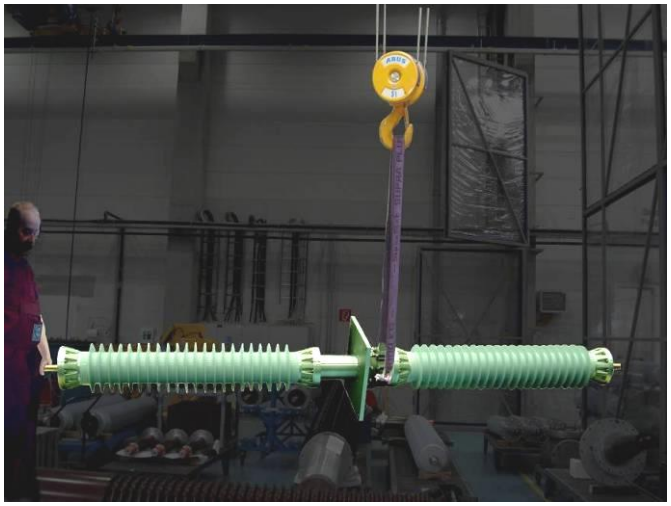


Fig. 7

For a vertical fitting position, always lift the bushing on the flange and the head with suitable means and secure against tipping away. Do not use the tapped hole in the face of the extern terminal bolt for lifting the entire bushing.

Bolt the bushing with its flange plate and correspondent to the anchor bolts provided in the wall. If stipulated by the construction site, seal the flange plate additionally against the penetration of moisture.

Ground on the M12 grounding screw in the flange plate.

The high-voltage side connections are made with the corresponding terminals. Perform normal contract preparation (cleaning, greasing, etc.).

Make sure no impermissibly high tensile or bending forces occur. The operating loads must not exceed 50% of the test loads, which are stated in the related bushing specification.

2.4 Putting into operation

Before putting into operation, check all threaded connections in the bushing flange plate and terminals for correct seating and torque. See table Fig.8 for the recommended values unless specifications have been defined by the plant contractor or building authorities.

Furthermore, visually inspect the insulator surfaces for integrity and cleanliness.

srew	torque (Nm)	torque (kpm)
M 4	1,1	0,11
M 5	2,2	0,22
M 6	4,0	0,40
M 8	10,0	1,0
MIO	19,0	1,9
M 12	33,0	3,3
M 14	52,0	5,2
M 16	80,0	8,0
M 18	1 10,0	11,0
M 20	160,0	16,0
M 22	210,0	21,0
M 24	255,0	25,5
M 27	370,0	37,0
M 30	510,0	51,0

The given values are reference values and refer to bolted joints with stainless steel screws. Applicable only for flange joints with metallic contact of the parts.

Fig. 8

2.5 Test tap

Check to see if the test tap screw cap - if provided see specification - is tight.

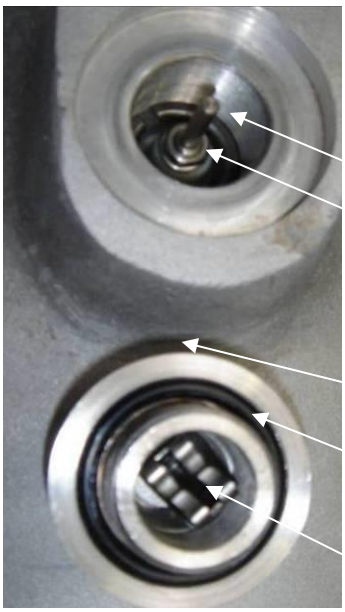
Test tap in the types EW… and SEW…:

Design A older model (Fig.9)
Design B later model (Fig.10)

With the test tap the last grading layer of the capacitor grading - insulated with a small bushing (1) - is led out. The removeable cap (2) has a contact sleeve or spring (3) in which the connecting pin (4) effectuates reliable grounding in the screwed-on state. The cap is provided with an O-ring sealing (5) to secure a moisture-free interior in the measuring connection.
This connection is always grounded during normal service conditions. The instrument lead line is connected to the pin for possible measurements on the bushings when the bushing is disconnected from the mains to determine the capacitance and dielectric loss factor.

The test tap is not self-grounding! For that reason, the cap must always be screwed on during operation! Operation with open test tap leads to destruction of the insulator of the small bushing (1) in the test tap with punch through to the interior of the bushing and subsequent breakdown!

As the bushing has been put through a workpiece test at HSP, the bushing is ready for operation after inspection or similar steps.



TEST TAP

DESIGN A

Connecting pin (4)

Bushing (1)

Cap (2)

Sealing (5)

Grounding spring made of non-corrosive steel (3)

Fig. 9

DESIGN B

Cap (2)

Contact sleeve (3)

Sealing (5)

Bushing (1)

Connecting pin (4)

Fig. 10

3 Maintenace

3.1 Recommended maintenance and checks

The bushing is maintenance free. Inspection and maintenance refers specifically to the insulator and its condition along with the condition of the fittings regarding corrosion. This type of inspection should be performed in annual intervals or in connection with possible plant maintenance.
We recommend electrical measurements on the bushing after the first 7-10 years of operation, then, depending on the measurement results, in intervals of 3 years or less (See 3.3).

3.2 Cleaning of insulator surface

The necessity of cleaning of porcelain surfaces and the methods used to this are assumed as a known fact.

The silicone compound insulator should not be cleaned regularly. Its good features regarding pollution are heavily influenced temporarily by cleaning, because on the surface there is a water-repellent coating which is removed by cleaning.

Cleaning is performed with cloths free of fluffs and soaked with cleaning liquid. As the sheds are flexible do not apply heavy force, but rub more frequently with less force.
Cleaning liquid: Wacker E10 from Wacker Chemie, lot size: 25 ltr. tanks, consumption 1 ltr. for approx. 3 – 5 m^2 of surface.

After cleaning the features return to their original condition after approx. 1-2 days.

An approximate statement about the condition of this so-called hydrophobicity is made by the HC-classification shown on the left hand side (Fig.11)). Class HC1 is the best, class HC6 the bad behaviour of the insulator surface.

For testing purposes during sufficiently spray an area of the size of hand with water from a spray bottle from a distance of approx. 30 cm wind still, dry weather and compare the image of the drops with the HC-table. In case of class HC 3 it can be assumed that the features are still sufficient for the location.

It is only a roughly comparing procedure the result of which is no guarantee for the operation behaviour.

In addition the insulator should be checked for possible discharge traces. Such traces must not occur, because they damage the surface of the insulator in this area regarding its hydrophobicity. In such a case the cause for the discharges has to be investigated.

Damages of the sheds or on the body, i.e. shearing's, cannot be repaired on site. In case of smaller faults repair in the factory may be possible und has to be agreed upon with the manufacturer beforehand.

Possible larger remainders of paint can be pulled off after they have hardened - do not use solvents!

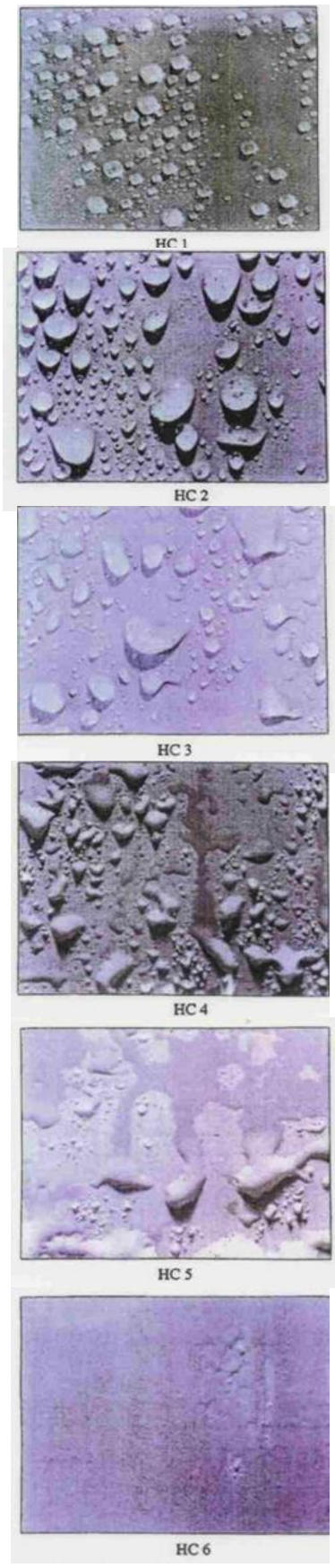


Fig. 11

3.3 Electrical measurements

The bushings are tested and attested as operationally qualified through the performed final factory tests.

However, it is sensible, and is therefore recommended, to perform a so-called reference measurement onsite. That ensures that during later confirmatory measurements the measurement conditions are unchanged so comparable results can be attained.

Comparative data from the final factory measurement are available, but they can exhibit non-compliances in comparison to the installation location due to dispersion influences, which can falsify the results in the very small capacitance changes.
The bushing capacitance is measured as Main capacitance C1 and the dissipation factor tan delta. It is possible to measure the capacitance between the last control layer and the flange, but it does not provide any verification of the main insulation, indicating instead merely the state of the measuring connection area.

Example of mobile measuring equipment

Fig. 12

3.4 Electrical confirmation measurements

Confirmatory measurements on bushings require a good measure of experience with the measuring equipment, the measuring setup and the interpretation of the measurements.
That is due in part to the relatively small capacitance values, which are influence even just through the spatial influence of the environment. Likewise, the measurement of the dissipation factor can be influenced by moisture, weather, etc.

3.5 Measuring procedures

Mainly the measuring procedures differ by the coupling of the measuring signal. In case of so-called “not grounded” measurements the test voltage is applied to the conductor of the bushing and the measuring signal is taken at the test tap of the bushing.
The „grounded“ measuring procedure is applied, if the bushing which has to be measured does not have a test tap. This is not applicable for the bushings of the type range EW/SEW.
The devices required for the measurement are usually equipped specifically for the measurement of bushings. The measurement methods are described in comprehensive manuals
Recommendation: Measuring and tests only in dry ambient and dry insulator surface (influence of tan delta).

There are various measuring equipment manufacturers. Information can be obtained from the manufacturers in the Internet or through HSP (Fig.12).

3.6 Limits

For the measurement the influence of the ambient temperature has to be taken into consideration. In diagram shown on the left side for C and tan delta the variations through temperature is shown (Fig13).

For the material RIP, resin impregnated paper there are limit values for the deviation of the capacitance and the dielectric dissipation factor with relation to the “new value”.

This value is reliably deducted from the reference measurement described under 3.3.
In case the deviations are larger than mentioned in the table below, HSP has to be contacted in any case. When there are very large deviations the bushing have may have to be taken out of operation.

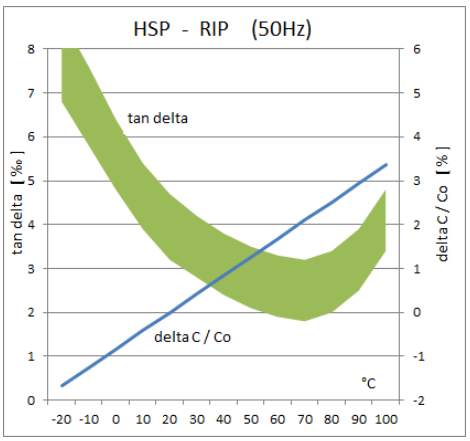


Fig. 13

4 Heating inspection with thermovision

If as a routine thermovision controls are carried out in the installations (Fig.15) following items must be taken into account for EW/SEW bushings:

An increase of temperature by up to 40 K can as a rule be detected at the external contact point, i.e. the lead clamp and is not unusual. Higher temperatures or excess temperatures during low load should lead to a check of the contacts.
Irregularities in the temperatures along the outdoor insulator length, though, may be caused by hotspots and have to be investigated more closely, if necessary contact manufacturer.

Voltage Level	C – Deviation
< 123 kV	10 %
≥ 123 kV	5 %
≥ 245 kV	3 %
≥ 420 kV	1 %
Orientation value tan delta	0.004 – 0.006

Fig.14

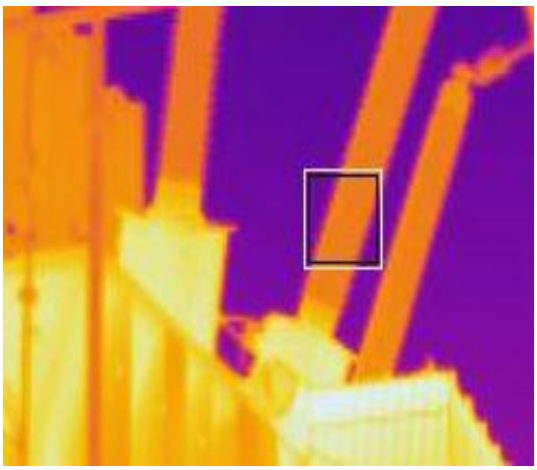


Fig.15

5 Possibilities of repair

Repair facilities are limited in the wall bushings, which except for the indoor versions are all equipped with dry packing, merely to the externally accessible parts because, for design reasons, it is not possible to dismantle the porcelain or the composite housing.

As this operating and maintenance regulation for the S/EW... type series is applicable, during repairs the various sectional drawings and parts lists for the explanation of the individual installation steps are required. In concrete cases, both can be requested from HSP by stating the serial number of the bushing and they will be sent immediately. Example of a sectional drawing and a parts list (Fig. 16).

Furthermore, depending on the repair requirements, corresponding brief instructions can be given.

As disassembly is not possible, the repair measures are limited to the external damage on the porcelain or silicon sheds, which are feasible for small damages by applying special measures based on the instructions or by being performed by HSP.

In case of internal breakdowns, access to the internal components is only possible by destroying the porcelain or the composite insulator. In that case, return to the manufacturer is recommended as it has access to suitable means and measures along with professional examination methods.

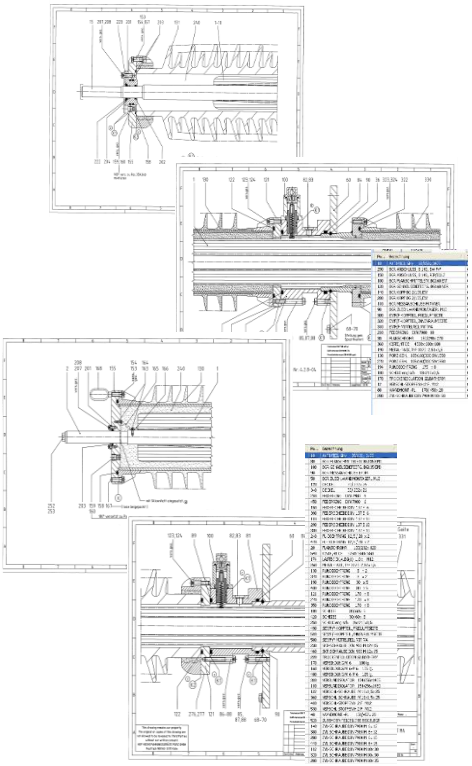


Fig.16

6 Storage

The bushing can be stored in its original packing for up to 12 months in rain protected rooms. If it is packed in aluminium laminated foil, the storage time is up to 24 months.

Long-term storage, for example as replacement bushings, is possible for the versions for outdoors, i.e. two sided outdoor version, in the original packing if it is stored against decomposition and humidity penetration in a protected storage site.

If storage in dry interior rooms is not possible, bushings for indoor operation, one or both sided, must be given a metallic protective vessel for long-term storage. Store a sufficient quantity of desiccant bags in the protective vessel and open the packaging in intervals of 2-3 years and replace the desiccant bags.

If water or moisture is found, the bushings must be dried depending on the condition (in a heating furnace at approx. 100°C for several hours) and then encased again in the protective vessel as described.

Before using after long storage periods, measure the capacitance and the tan delta to secure operational reliability.

Fig.17

7 Disposal after the end of operation

The bushing does not contain any liquids, the parts are neither toxic, self-inflamable nor physically burdening. All parts can be disposed of as industrial waste

The following components, depending on the version:

- Silicon elastomers
- Porcelain
- Portland cement
- Glass-fibre reinforced epoxy resin
- Polyurethane elastomer (dry filling)
- Epoxy resin impregnated special paper with aluminium foil as inserts
- Central pipe and fittings made of aluminium alloys
- Rope or conductor made of E-Cu
- Mounting elements, measuring connection, screws, etc. are made of stainless steel, aluminium alloy or brass

As the insulator in the composite housing is not connected removable from the dry filling, it is recommended to multiply disconnect the bushing above and below the flange, likewise on the head and the composite housing area for better disposal. Porcelain housings have to be destroyed (Caution: Danger of chipping!)