

Typical arrangement; may differ from the actual transformer concerned.

## **OPERATING MANUAL**

### **SGB Cast Resin Transformers**

21.04.2023 EN (Rev. H)

IMPORTANT

READ CAREFULLY BEFORE USE

KEEP THE MANUAL FOR FUTURE REFERENCE





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Original in German

**Information about this operating manual**

## Table of contents

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Table of contents .....	3
1 Information about this operating manual .....	5
1.1 Important information about this manual .....	5
1.2 Availability of this manual .....	6
1.3 Conventions regarding instructions and other highlighted text .....	6
2 Safety .....	7
2.1 Intended use .....	7
2.2 Incorrect use .....	7
2.3 Modifications to the transformer .....	8
2.4 Warranty and liability .....	8
2.5 Disclaimer .....	8
2.6 Requirements regarding staff .....	9
2.7 Warning and safety provision system .....	10
2.8 Personal protection measures .....	11
2.9 Safety information for risk avoidance associated with the transformer's life cycle phases .....	11
2.9.1 General rules for each phase of the transformer's life cycle .....	11
2.9.2 Transport and installation .....	11
2.9.3 Commissioning .....	13
2.9.4 Operation .....	15
2.9.5 Maintenance .....	15
2.9.6 Decommissioning .....	18
3 Description of the transformer .....	19
4 Planning details .....	22
4.1 Conditions on site .....	22
4.2 Normative references for requirements regarding the site of installation .....	23
4.3 Important information to be complied with regarding transformer! .....	23
4.4 Electromagnetic behaviour / compatibility .....	25
4.5 Ventilation of the transformer rooms .....	25
4.6 Temperature monitoring .....	26
5 Packaging .....	27
6 Transport .....	28
6.1 Fastening the suspension gear and transport by means of a crane .....	28
6.1.1 Lifting the transformer .....	28
6.1.2 Lift transformer with enclosure .....	30
6.2 Transport on castors .....	33
6.2.1 Mounting the castors to the carriage .....	33
6.2.2 Rolling the transformer .....	34

6.3	Transport by means of a forklift truck.....	35
6.3.1	Tilt protection for forklift transport.....	37
6.4	Requirements imposed on transport vehicles and load securing .....	38
6.5	Checking the consignment before unloading.....	39
7	Storage .....	41
8	Installation.....	42
8.1	Position the transformer on its site of operation .....	42
8.2	Removal of packaging and transport safeguards .....	44
8.3	Secure positioning in the station .....	44
8.4	Mount parts which have been removed for transport.....	48
8.5	Mount enclosure.....	48
8.6	In case of possible soiling in the meantime between installation and commissioning .....	50
9	Commissioning .....	51
9.1	Preparations.....	52
9.2	Tightening torques .....	53
9.3	Voltage conversion.....	54
9.4	Phase terminals.....	56
9.5	Temperature monitoring.....	58
9.6	Fan.....	60
9.7	Minimum clearances around transformer .....	60
9.8	Checks before applying voltage.....	61
10	Operation .....	62
11	Maintenance .....	64
11.1	Cleaning.....	66
11.1.1	White rust (zinc corrosion).....	67
11.2	Temperature monitoring.....	68
11.3	Main terminals and bars.....	70
11.4	Windings .....	70
11.5	Other maintenance activities .....	70
11.6	Fan.....	72
11.7	Enclosure.....	73
11.8	Checks before applying voltage.....	73
12	Troubleshooting .....	74
13	Recycling of cast resin transformers.....	77
14	Index.....	78

# 1 INFORMATION ABOUT THIS OPERATING MANUAL

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## 1.1 Important information about this manual



Make sure that you read this operating manual carefully and understand it before you perform work on the transformer. SGB cannot be held liable for damage caused by non-compliance with the information provided in this manual.

This manual

- is an integral part of the documentation of a cast resin transformer.
- is intended for the plant designer, plant operating company, person in charge of the plant and for the qualified staff deployed for the task in question.
- contains important information regarding the safe and trouble-free operation of the transformer.
- only refers to the transformer and does not contain any information about particularities and dangers on site.
- uses the term "Cast resin transformer" for all dry-type transformers manufactured by SGB and applies equally to SGB transformers with non-encapsulated windings.
- is not intended for use on the US market in this version.

Comply with all specifications of this operating manual, the enclosed documentation of external manufacturers and the locally valid standards and regulations! This is a prerequisite for

- correct and appropriate operation of the transformer.
- proper storage, transport, installation, commissioning and decommissioning, maintenance and inspection of the transformer.
- avoidance of dangers and compliance with the required technical safety provisions.

## 1.2 Availability of this manual

Keep this manual so that it is available for reference.

This Operating Manual is part of the unit and must be passed on to the subsequent owner if the unit is sold.

## 1.3 Conventions regarding instructions and other highlighted text

In addition to the warnings and safety provisions described in *section 2*, which you have to comply with at all times, this manual contains other highlighted text:

- 1,2,3 ... or a, b, c,... Instructions involving a chronological sequence are identified by figures or letters. Comply with the specified sequence of operations.
- Enumerations which do not involve a chronological sequence are identified by indents. Such operations can be performed in any order.

*Keywords or supplementary information*

Keywords or supplementary information appear in italics in special areas.

### RECOMMENDATION

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Contains recommendations on how to improve the product or the workflow.

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## 2 SAFETY

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### 2.1 Intended use

The transformer must only be used to transform electrical AC voltage. In accordance with the underlying standards and regulations, the transformer must be operated within the scope of the electrical data specified in the data sheet, and within a self-contained electrical facility. A self-contained electrical facility is a "room or location" that is used exclusively for operation of electrical equipment, and that is kept under lock and key. Qualified electricians and people who have received electrical engineering training have access, however laypersons are only allowed access, if they are accompanied by qualified electricians or people who have received electro engineering training".

Intended use also includes

- Compliance with the operating manual.
- Operation within the capacity limits.
- Compliance with inspection and maintenance tasks.
- Compliance with the supplier documentation or separate documentation provided by third-party manufacturers of attachments and accessories.

A different use, or use that extends beyond the intended use described above, is considered non-intended use and can result in personal injury or material damage.

### 2.2 Incorrect use

Inappropriate use (meaning use OTHER than intended) includes but not limited to:

- Unauthorized design changes to the transformer
- Assembly of monitoring and protective equipment other than recommended or supplied with the unit
- Deactivating or bypassing safety equipment, and operation of the unit with faulty safety equipment
- Operation and maintenance of the transformer by non-qualified staff
- Inappropriate assembly, operation, maintenance or commissioning of the transformer
- Non-compliance with the instructions in the operating manual and the supplier documentation or the separate documentation of the external suppliers of attachments and accessories.

## 2.3 Modifications to the transformer

Any modifications to the transformer or to any other parts of the shipment that has not been previously agreed upon in writing by SGB will immediately void or restrict the warranty and liability.

## 2.4 Warranty and liability

The warranty period and the liability are specified in the contract. Deviations from the intended use described in this operating manual shall restrict or void the warranty and liability.

## 2.5 Disclaimer

The contents of this manual have been checked for matching the product described. Deviations nevertheless cannot be ruled out. Thus, SGB cannot guarantee full agreement with the product in question. This manual is subject to revision on a regular basis; thus, any necessary corrections will be reflected in subsequent versions.



## 2.6 Requirements regarding staff

The transformer may only be handled by personnel (=specialists) qualified for the task in question.

The term "specialists" or "qualified personnel" within the meaning of this manual shall refer to persons who due to their education, knowledge, experience and instructions from the person in control of work activity are able to recognize and avoid the hazards, which might emanate from their area of work.



### Note

Any person who is entrusted with working on the unit has the responsibility to read this manual thoroughly and understand it, particularly the "Safety" chapter.

The authorized personnel must:

- Utilize and be trained in the proper usage of required Personal Protection Equipment (PPE).
- be aware of the local safety-specific mounting / erection provisions and comply with these at all times.
- have been authorized and instructed by the appropriate person in charge to perform the work on the transformer.
- Ensure unauthorized persons are not present in the danger zone.

## 2.7 Warning and safety provision system

The warnings and safety provisions in this manual are to ensure your own safety, the safety of other persons and the prevention of damage to the transformer or the plant.

The information given always reflects the highest hazard level. This means that an instruction regarding personal injury may also include an instruction regarding material damage.

The warning information below is shown with a descending degree of hazard:

### **DANGER**

#### **Risk of fatal injuries!**

This symbol in conjunction with the signal word “DANGER” indicates a life-threatening situation that results directly in the death of or severe injury to the person.

### **WARNING**

#### **Risk of severe injuries!**

This symbol in conjunction with the signal word „WARNING“ indicates a dangerous situation that results in the death of or severe injury to the person.

### **CAUTION**

#### **Risk of minor to medium injuries!**

This symbol in conjunction with the signal word “CAUTION” indicates a potentially dangerous situation that may result in minor or medium injury to the person.

### **ATTENTION**

#### **Risk of damage to property!**

Describes a situation that could lead to property and/or environmental damage.

#### **Notice**

Describes malfunctions, application information, and provides useful information.

## 2.8 Personal protection measures

Use exclusively protective equipment which has been certified for the specific tasks by nationally recognized independent agencies.

Always wear safety shoes for the entire duration of the work!

Use additional protective equipment as required, according to local regulations and common sense.



## 2.9 Safety information for risk avoidance associated with the transformer's life cycle phases

### 2.9.1 General rules for each phase of the transformer's life cycle

All work shall be performed by authorized qualified Personnel only.  
Installation is only admissible within electrical operating areas.

#### - Applies in general for working at heights

- Do not rest ladders against the transformer.
- Only use suitable stepladders which are free from damage.
- Place stepladder only on solid, level ground and ensure a stable position.
- Secure stepladder against slipping or tipping over.
- When performing work, stand on the ladder with both feet on the rung.
- Protect against falling down.

### 2.9.2 Transport and installation

#### - Transport with a crane:

- Make sure that the transformer is transported exclusively in vertical position with the carriage aligned horizontally.
- Never step below suspended loads and never move suspended loads above persons.
- Only use:
  - the four lifting lugs provided to lift the unit.
  - all lifting lugs simultaneously.
  - load fastening equipment suitable for the transformer's weight.

- load fastening equipment and transport securing devices which have been certified for such tasks by nationally recognized independent agencies.
  - Never lift the transformer by the tie-down rings.
  - When lifting the transformer and enclosure using a lifting device, check the threaded connections on the lifting device and tighten these if necessary.
- **When mounting the castors or machine bases:**
- While mounting the castors, protect the transformer from tipping over. Support transformer on supports or squared timbers that are slightly taller than the castors or machine bases and capable of bearing the transformer's weight.
  - Mount the castors so that all 4 of them are aligned either longitudinally or transversely.
  - Secure the castors in the selected orientation.
- **When moving the transformer using its castors:**
- Do not move the transformer along curved routes but only straight in the direction of the castors.
  - When pulling, always use both towing eyelets located in the direction you want to pull the transformer.
  - Never use electrical components (windings, terminals, etc...) to pull on when moving the transformer.
- **Transport with a forklift truck:**
- Transport by forklift truck is only permitted for transformers with "forklift lifting" design.
  - Lift only permitted with correctly positioned tilt protection elements.
  - Only use forklift trucks that can carry the weight of the transformer.
  - Ensure that the center of gravity of the load is centered between the forks.
  - Always place the load on the forks to the stop and tilt the forks backward.
  - Always secure unstable loads that tend to tilt.
  - If necessary, use a slip-on shoe on the forks to hold and protect the load securely.
  - Never transport multiple loads.
  - Ensure that no one is in the danger zone.
  - Always drive with the load lowered.
  - Always drive with a load facing uphill. This applies to uphill and downhill.
  - Always adjust the driving speed so that the stopping distance in the event of an unexpected hazard or obstacle is as short as possible.

- Maintain a tilt angle of  $> 0^\circ$  and  $\leq 5^\circ$ .

- During installation:

- During positioning of the transformer, maintain the minimum air gaps of
  - the live conductors and the windings to grounded parts!
  - the conductors to the windings and other live parts of the transformer!
- Maintain these clearances even when the unit is installed in the enclosure.
- During routing of the cables, maintain the minimum air gaps of
  - the live conductors and the windings to grounded parts!
  - the conductors to the windings and other live parts of the transformer!
- Secure the transformer at the operating site so it cannot roll away. Use the locking devices, machine feet or transformer bearings (structure-borne noise dampening elements).
- When setting up an enclosure, contact washers SN 70093 must be used in place of flat washers on at least two screw connections on every connection of two metallic components with one another.
- Maintain a minimum clearance of 30 cm to the walls and ventilation openings of the enclosure.

### 2.9.3 Commissioning

- Before and during commissioning work, the following applies as a general rule:

For the entire duration of the work, observe the five safety rules, subsequently also called safety measures, in accordance with EN 50110-1 (section "Dead working") in the specified order!

The rules are:

1. Disconnect main and auxiliary circuits
2. Secure against re-connection
3. Verify that the installation is dead
4. Carry out earthing and short-circuiting
5. Cover or fence off adjacent live parts

- When completing commissioning work, comply with the following as a general rule:

- Cancel the condition established by applying the safety measures according to the applicable local requirements, or, if there are no such requirements, restore the previous condition by canceling the five previously performed safety measures in the inverse order.
- Before closing the plant / enclosure, verify that no persons / animals are in it.

- Make sure that no impurities and foreign matter (e. g. screws and bolts, tools, metal chips etc.) are left on any transformer surfaces.
- Make sure that all impurities and foreign matter (e. g. screws, tools, metal chips etc.) are eliminated from inside the enclosure and other plant components.
- Do not apply voltage to damaged transformers!
- Apply voltage only if you are authorized and have been commissioned to do so!
- Switch-on/switch-off operations in direct succession are not permitted. There must be a time window of at least one minute between switching operations.

#### - Changing voltage taps:

- Before voltage conversion, make sure that the surfaces of the transformer have cooled down to a temperature lower than 40°C.
- When tightening or releasing the threaded connections on the coupling rods, compensate the torque by holding them up by means of an open-end wrench size 20 or 21.

#### - Phase connection:

- In case of copper-aluminum connections, insert a copper-clad aluminum sheet in the contact area.
- Before screw-fastening the contact surfaces, polish them to make them bright.
- Make sure that no metal dust is left on any transformer surface after polishing.
- When connecting the components in question, make sure that the transformer terminals are not subject to mechanical stress.
- When tightening or releasing the threaded connections on the connection links, compensate the torque with an open-end wrench size 20 or 21.
- When routing the cables, comply with the specified minimum clearances between
  - the live conductors and the windings, and the earthed parts!
  - the conductors and the windings and other live parts of the transformer!

#### - Temperature monitoring:

- Do not replace thermistors with such that have temperature settings higher than specified by the factory.
- If a programmable temperature monitor is used: Do not set the nominal functioning temperatures of the devices higher than specified by the factory.

- Attach suitable surge protection devices as close as possible to the terminal strip of the transformer, in order to protect the electronics.

## 2.9.4 Operation

### - General instructions regarding operation:

- Operate the cast resin transformers exclusively in closed electrical operating areas.
- If voltage is applied to a transformer without enclosure or if the enclosure is considered as not closed "safe to touch", **never approach the windings or other conductive transformer components closer than 1.5 m!**
- Persons with pacemakers and/or other medical implants and aids must never approach more closely than is permitted by the limits specified for their devices or implants regarding electromagnetic interferences! **The following examples for field intensities only refer to the transformer and do not take the remaining part of the plant into account. At a distance of 2 m from a transformer of 50 Hz / 630 kVA / 20 kV-0.4 kV, 5  $\mu$ T can be measured. At a distance of 5 m from a transformer of 50 Hz / 3000 kVA / 20 kV-0.69 kV, there is a field intensity of 10  $\mu$ T.**
- Consider the applicable regulations for exposure to electric, magnetic and electromagnetic fields regarding transformer-near working.

### - Temperature monitoring:

- Only operate the transformer with the temperature monitoring device connected and functioning.

## 2.9.5 Maintenance

### - Before and during maintenance work, the following applies as a general rule:

For the entire duration of the work, observe the five safety rules, subsequently also called safety measures, in accordance with EN 50110-1 (section "Dead working") in the specified order!

The rules are:

1. Disconnect main and auxiliary circuits
  2. Secure against re-connection
  3. Verify that the installation is dead
  4. Carry out earthing and short-circuiting
  5. Cover or fence off adjacent live parts
- Before beginning the work, verify that the transformer surfaces have cooled down to below 40°C.

### - When completing maintenance work, comply with the following as a general rule:

- Cancel the condition established by applying the safety measures according to the applicable local requirements, or, if there are no such requirements, restore the previous condition by canceling the five previously performed safety measures in the inverse order.
- Before closing the plant / enclosure, verify that no persons / animals are in it.
- Make sure that no impurities and foreign matter (e. g. screws and bolts, tools, metal chips etc.) are left on any transformer surfaces.
- Make sure that all impurities and foreign matter (e. g. screws, tools, metal chips etc.) are eliminated from inside the enclosure and other plant components.
- Do not apply voltage to damaged transformers!
- Apply voltage only if you are authorized and have been commissioned to do so!
- Switch-on/switch-off operations in direct succession are not permitted. There must be a time window of at least one minute between switching operations.

- **Cleaning the transformer:**

- When cleaning the transformer,
  - do not use water
  - do not use metal brushes or wire wool
- Make sure that no impurities and foreign matter (e. g. screws and bolts, tools, metal chips etc.) are left on any transformer surfaces.
- Make sure that all impurities and foreign matter (e. g. screws, tools, metal chips etc.) are eliminated from inside the enclosure and other plant components.

- **To check the temperature sensors:**

- Use ohmmeters with a service voltage of  $\leq 2.5$  Volt!
- Attach suitable surge protection devices as close as possible to the terminal strip of the transformer, in order to protect the electronics.

- **If electrical terminals have been disconnected during maintenance:**

- In case of copper-aluminum connections, insert a copper-clad aluminum sheet in the contact area.
- Before screw-fastening the contact surfaces, polish them to make them bright.
- Make sure that no metal dust is left on any transformer surface after polishing.
- When connecting the components in question, make sure that the transformer terminals are not subject to mechanical stress.



- When tightening or releasing the threaded connections on the reconnection links, compensate the torque by holding them up by means of an open-end wrench size 20 or 21.
- When routing the cables, comply with the specified minimum clearance between
  - the live conductors and the windings, and the earthed parts!
  - the conductors and the windings and other live parts of the transformer!

- Maintenance of the fans:

- Wear protective gloves when working on rotor blades.
- Make sure that the fan is disconnected from the electrical circuit and protected against being switched on again.
- Do not switch on the fan before it has been installed correctly into the enclosure and tested.

- Maintenance of the enclosure:

- When finishing work, make sure that
  - all impurities and foreign matter (e. g. screws, tools, metal chips etc.) are eliminated from inside the enclosure and other plant components.
  - the equipotential bonding lines which have been removed for access are re-connected!
  - the transformer, fan and enclosure are dry.
  - air inlets outside of the enclosure are not blocked.
  - all warning labels are present and free from damage.

## 2.9.6 Decommissioning

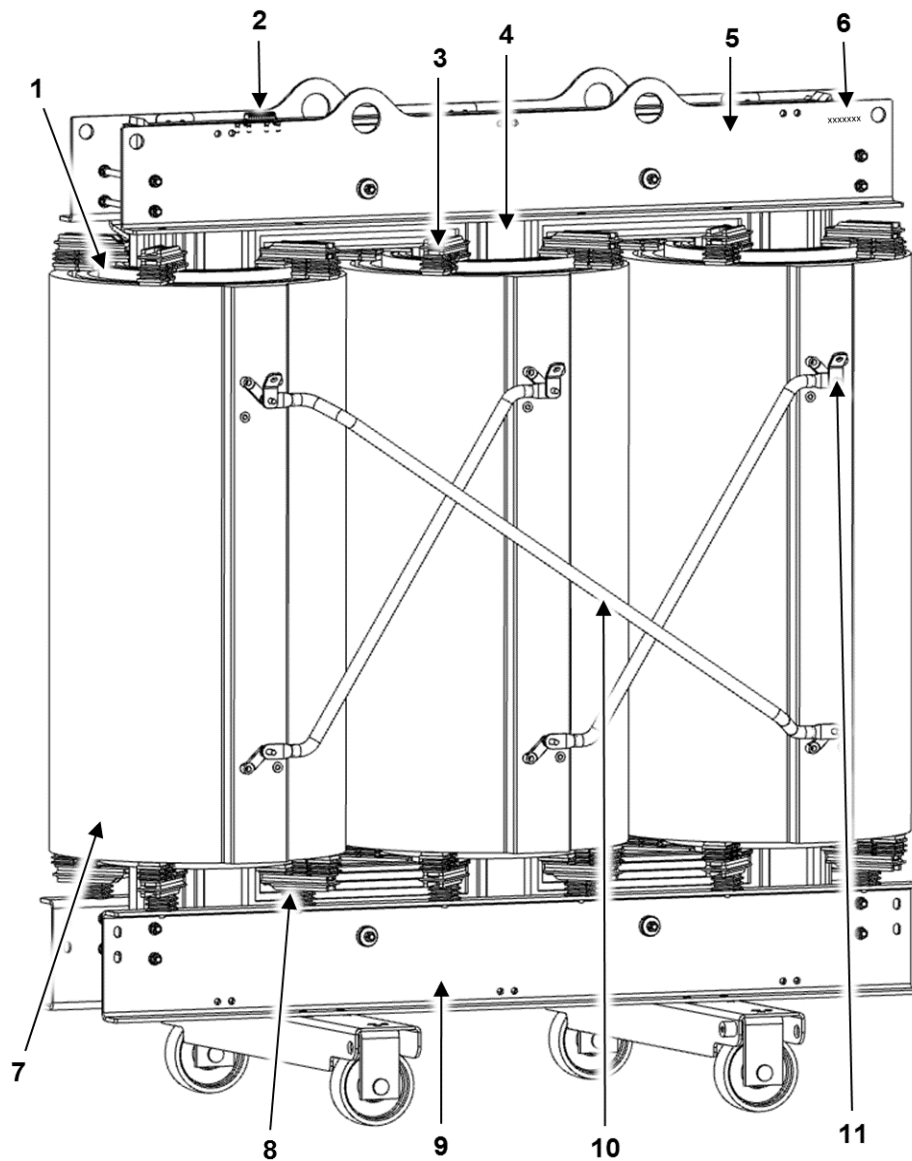
- In general:

For the entire duration of the work, observe the five safety rules, subsequently also called safety measures, in accordance with EN 50110-1 (section "Dead working") in the specified order!

The rules are:

1. Disconnect main and auxiliary circuits
  2. Secure against re-connection
  3. Verify that the installation is dead
  4. Carry out earthing and short-circuiting
  5. Cover or fence off adjacent live parts
- Before beginning the work, verify that the transformer surfaces have cooled down to below 40°C.
  - Observe the safety information in "Transport and installation".

### 3 DESCRIPTION OF THE TRANSFORMER

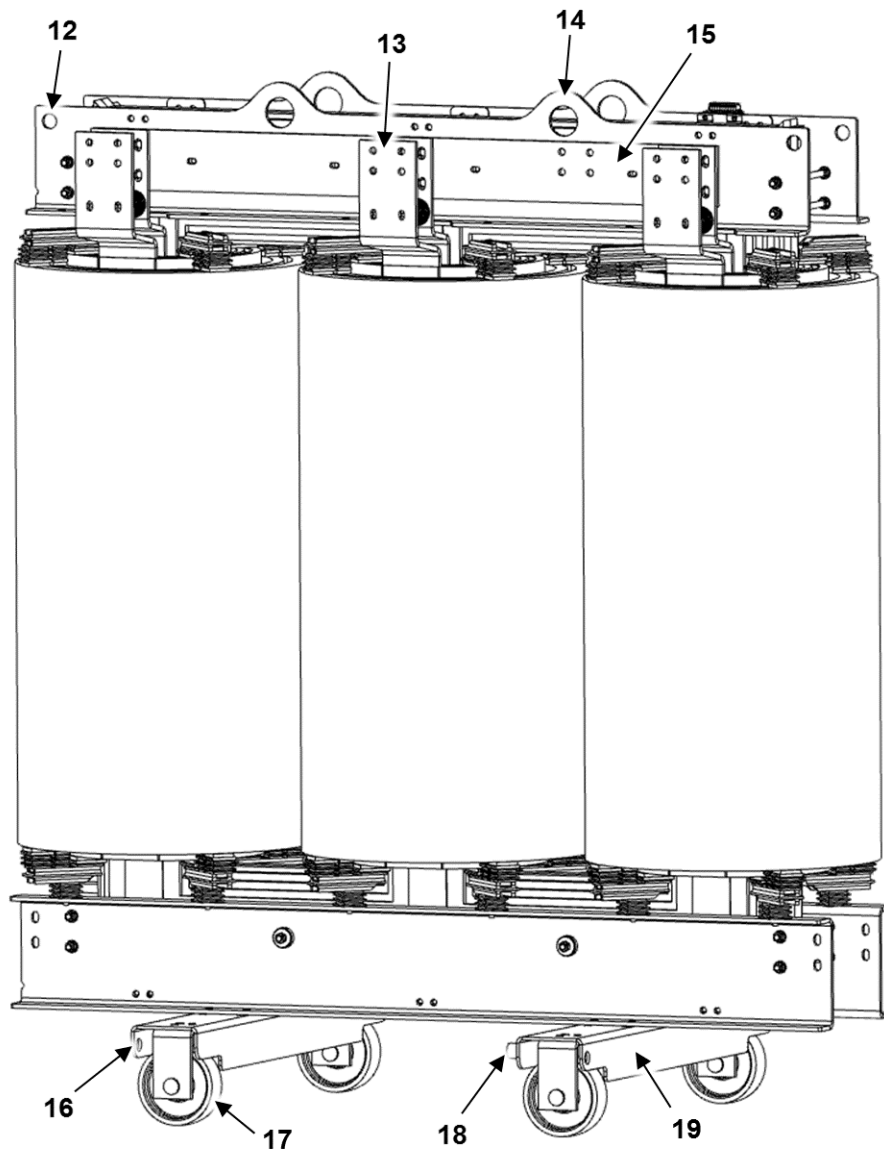


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Fig. 1: High-voltage side (HV) of a standard cast resin transformer (example)

1	Low-voltage winding	6	Transformer serial number
2	Terminal strip for connection of temperature monitoring device	7	High-voltage winding
3	Upper supporting blocks	8	Lower supporting blocks
4	Core	9	Lower steel clamps
5	Upper steel clamp	10	Circuit connection
		11	High-voltage terminal

#### Description of the transformer



000005

Fig. 2: Low-voltage side (LV) of a standard cast resin transformer (example)

12 Tie-down rings for transport	16 Towing eyelets for longitudinal and transverse movements
13 Low-voltage terminal	17 Castors, can be installed for moving in either longitudinal or transverse directions
14 Lifting lugs	18 Earth terminals
15 Neutral bar (N terminal)	19 Carriage

Transformers are used to transform AC voltages. According to international regulations (IEC 60076-11), cast resin transformers are classified as dry-type transformers. Air is used as coolant.

#### Description of the transformer

*Transformer standards*

In general, technical characteristics and the design are based on IEC 60076-11 or on EN 50588-1 and order-specifically according to the customer's specifications.

Moreover, as of 1 July 2015, transformers intended for operation in the European Union are subject, in addition to the above-mentioned standards, to Regulation 548/2014 of the EU Commission on the implementation of the Ecodesign Directive 2009/125/EC.

*Transformer design - concise description*

The transformer core consists of grain-oriented cold-rolled soft magnetic steel sheets which are insulated from each other. The individual laminations are shaped so as to ensure that their optimized geometrical arrangement (so-called step-lap) results in reduction of the no-load losses and the transformer noise.

The low-voltage windings are mostly designed as foil windings. Utilization of this winding type for the low-voltage windings enhances short-circuit strength.

A special characteristic of the cast resin transformers are the high-voltage windings which are completely encapsulated in cast resin under vacuum. This ensures, compared to conventional dry-type transformers, a high partial discharge, short-circuit and dielectric strength and a lower sensitivity to environmental stress, such as that caused by humidity and dust.

Further technical details are either visible, as cast resin transformers do not feature a tank, or specified in the following documents.

*These documents are located on the transformer.*

Nameplate, circuit plate, label showing terminal arrangement for connection of the temperature monitoring device, table of torque values for HV and LV terminals, jacking sketch with indication of specified angles, 1x label "Do not touch" with supplementary information indicating the minimum clearances from the HV windings, 1x SGB logo, 1x label "Warning, electric voltage", 2x label prohibiting transport by means of industrial trucks

*These documents can be requested again stating the transformer serial number.*

Dimension drawing with parts list, measuring and test records, manufacturer documents regarding the accessories provided by SGB.

**Description of the transformer**

## 4 PLANNING DETAILS

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Unless otherwise specified in the contract, SGB cast resin transformers comply with the following requirements acc. to IEC 60076-11 and IEC 60076-1:

- Climate class: C2
- Environmental class: E2
- Fire classification F1
- Short-circuit strength acc. to IEC 60076-5

### 4.1 Conditions on site

Unless otherwise stipulated in the contract, the transformers are required to satisfy the following conditions on site:

- The cooling air does not exceed the following temperatures:
  - + 40°C at any given time;
  - + 30°C in the monthly average of the hottest month of the year;
  - + 20°C in the annual average;
- and does not undercut the following temperatures:
  - 25°C in case of outdoor installation within a protective enclosure
  - 5°C in case of indoor transformers.
- The installation altitude is less than 1,000m above sea level.
- The site of installation is a closed electrical operating area.
- The site of installation complies with the national and local building code and fire regulations for transformer rooms. If there are no such regulations, refer to the directives in the IEC or DIN EN 61936-1 standards.
- The installation surface must be leveled, clean and designed to bear the transformer's weight.

To this effect, the transformer's center of gravity may be assumed to be in the horizontal plane in the center of the middle core column. In case of installation on castors, this would mean that each castor bears one-fourth of the transformer's weight.

Asymmetric supplementary attachments such as unilateral supports or earthing switches or fans mounted on one side only may shift the center of gravity relative to the longitudinal axis and must be taken into consideration.

#### *Installation surface*

Outline and foundation tolerances:

Tolerances must not be cumulated.

Outline tolerance is nominal.

- Mounting hole position  $\pm 1.5\text{mm}$
- Area must not be convex.
  - Mounting plane face flat within 2 mm per 1 m x 1 m
  - Mounting plane level in both directions within 1 mm/m (4'ARC)

- Maximum deviation from level 10 mm when the length of the foundation exceeds 10 m

## 4.2 Normative references for requirements regarding the site of installation

Requirements for the installation sites of transformers are provided in the following standards.

Please note that the list cited here is only an incomplete example for Germany and that some of the standards / regulations must be replaced or supplemented by locally valid standards / regulations.

- IEC 60076-11 (Dry transformers)
- IEC 60076-1 (Power transformers)
- Annex C of IEC 60076-11 - can be used for ventilation design
- DIN EN 50110-1 (Operation of electrical installations)
- DIN EN 61936-1 (Power installations exceeding 1 kV - Part 1: Common rules)
- DIN EN 50522 (Earthing of power installations exceeding 1 kV)
- DIN VDE 0141 (Earthing systems for power installations with rated voltages above 1 kV)
- DIN VDE 0100 (Low-voltage electrical installations)
- DIN VDE 0100-718 (Erection of low-voltage installations - Requirements for special installations or locations - Part 718: Installations for gathering of people)
- Elt Bau VO (Regulation on the construction of electrical service rooms)
- Arb. Stätt. VO (Regulations for the Workplace Ordinance)
- TA-Lärm (instructions for protection against acoustic pollution)

## 4.3 Important information to be complied with regarding transformer!

Please take the following into account:

- The SGB cast resin transformers are exclusively intended for operation in closed electrical operating areas.
- When installing the transformer in a transformer cell, comply with the mandatory structural condition of the room.
- Always comply with the minimum clearances between the earthed parts
  - and the live conductors and the windings!
  - the conductors and the windings and other live parts of the transformer!

These clearances are indicated in the "circle of protection" on the dimensional diagram of the transformer, in Chapter "*Installation section 8.1*" of this manual, or consult DIN EN 60076-3 for the clearances between blank parts.

**Whenever planning any work in the vicinity of the transformers, please note that the "circle of protection" does not specify the limits of the**

**danger zone within the meaning of DIN EN 50110-1, but defines only the distance required for operation free of disturbances.** In this context, the zone of danger and approach is specified in Annex A to the above-mentioned standard.

- Despite their cast resin insulation, the **windings** of the cast resin transformers are **not safe to touch**. This is a functional insulation. **This insulation does not offer protection against dangerous shock currents in case of contact or against flashover in case of approach.** Take protective measures to prevent persons from entering the danger zone of the windings! When planning and implementing the protective measures, treat **the windings as non-protected active parts!**
- The SGB dry-type transformers must **not be installed in potentially explosive atmospheres (EX)** without supplementary precautions!
- Take precautions to prevent the **transformer room from being flooded.**
- SGB cast-resin transformers feature the degree of protection **IP 00** and **are intended for indoor installation.**  
In case of **outdoor installation**, use an enclosure with the **minimum protection type IP23C.**

#### RECOMMENDATION

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Although the transformers normally comply with the requirements of climate class C2 and environmental class E2 acc. to IEC 60076-11, adverse weather conditions may cause formation of foreign matter on the windings. Thus, we recommend equipping the enclosure with an **anti-condensation heating in case of outdoor installation.**

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- If the transformer is operated in an enclosure in the vicinity of a wall and if the wall-facing enclosure side contains air vents: ensure a distance of at least **30 cm between the enclosure side and the building wall.**

#### RECOMMENDATION

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To improve ventilation and accessibility, we recommend increasing the distance to 40 cm.

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## 4.4 Electromagnetic behaviour / compatibility

Pursuant to IEC 60076-11 (sect. 4.3), transformers must be considered as passive elements regarding emission and immunity.

However, when designing electrical operating areas adjacent to areas accessible to the general public, it must be taken into consideration that persons with implants or pacemakers are subject to an increased risk when approaching such areas. The intensity of the magnetic field in the vicinity of the transformer depends on its power, voltages, short-circuit voltage and distance. At a distance of 5 m, a transformer featuring  $S=3$  MVA,  $uk=6\%$  HV=20kV, LV=690V will reach a magnetic field intensity of  $10\ \mu\text{T}$  at a power frequency of 50 Hz. These values apply exclusively to the transformer, not to influences by other components in the vicinity.

## 4.5 Ventilation of the transformer rooms

### ATTENTION

#### Crack formation on winding surfaces!

Cooling air that is blown directly onto windings can cause cracks in the resin coating of the windings, due to the extreme temperature differential.

- Do not blow cooling air directly onto hot windings.

Equip the installation room with **properly dimensioned ventilation**. When operating the transformer, losses occur in the form of heat, which must be dissipated. Total transformer losses are comprised of no-load losses and short-circuit losses at operating temperature. Operating temperature is the sum of the ambient temperature and the permissible temperature rise. Always provide the inlet opening of the supply air at the bottom, and with a maximum height up to the beginning of the HV winding. This promotes the chimney effect and circulation of the air flow in the duct between the windings.

The configuration of the cooling in a naturally ventilated room is described in IEC 60076-11 Annex C.

For **force-ventilated rooms**, the required air volume must be assumed as 3.2 cubic meters per kilowatt losses per minute.

**Consider the increased power dissipation during AF mode (forced cooling with air)!** The increased losses are disproportionate to the current and are included quadratically in the calculation. For example, in AF mode at 140% power, short-circuit losses increase by a factor of 1.96 and must be dissipated accordingly:

$$(140\% / 100)^2 = 1,96$$

## 4.6 Temperature monitoring

The temperature has a direct effect on the service life of the transformer. In order to prevent premature aging of the insulation and dangerous overheating, the transformer temperature must be monitored continuously during operation.

The SGB standard calls for monitoring of 2 nominal response temperatures (subsequently called NRT).

The warning NRT is the temperature at which the continuous rated power temperature has been reached. Any further increase in the load should be avoided due to a reduction in the transformer service life.

At the triggering NRT, the temperature limit for the insulation system has been exceeded. There is a risk that the dimensional stability of the insulation systems will be compromised. This operating state must be avoided for continuous operation and should be limited to emergencies. In all other situations we recommend shutting the transformer off if this temperature is reached.

The thermistors or PT100 resistors are placed in the low-voltage windings. The color of the connections indicates the NRT of the thermistors.

The terminal strip for connecting the thermistor strings to the tripping units is typically located on the upper steel clamp. The terminal assignment label is located in the immediate vicinity. For example:

Fig. 3

Example of terminal assignment for standard temperature monitoring version



Temperatures for warning (terminals 1 and 4) and tripping (terminals 5 and 8) can be monitored.

The tripping units, available separately, are intended for installation in the control panel.

Temperature monitoring isn't absolutely necessary on units designed solely for short-term operation of less than 10 minutes.

## 5 PACKAGING

### ATTENTION

#### Corrosion through condensation!

During longer storage in foil covers, condensation may occur. This causes zinc corrosion (white rust).

- Remove foil covers immediately after receiving the transformer.
- For longer storage periods pack the transformer into a wooden crate. Provide air circulation within the packaging or use silica gel in order to prevent condensation.
- Commission the transformer as quickly as possible, at least in no-load operation.

Cast resin transformers are not sensitive to natural air humidity.

Short transport on vehicles with tarpaulin normally does not require packaging.

For extended transport, foil covers, wooden crates or containers should be used.

This is stipulated in detail in the sales agreement between the customer and the manufacturer.

If foil packaging is required, proceed as follows:

- Arrange the foil cover so that the foil cannot slip during transport or storage!
- Cut the foil in the area of the lifting points and fasten it by means of adhesive tape in order to avoid having to provide additional cuts in the subsequent handling process.
- Remove foil covers immediately after receiving the transformer.
- For longer storage periods pack the transformer into a wooden crate.
- For longer storage in foil covers provide air circulation within the packaging or use silica gel in order to prevent condensation. Without these measures longer storage in foil covers is forbidden.

*Please contact us should you need advice regarding the selection of the packaging mode.*

## 6 TRANSPORT

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This section informs about loading and unloading, transport of the transformer using a truck and checks on receipt of the goods.

Unless otherwise stipulated, the provisions of the IEC 60076-11 and IEC 60076-1 standards apply.

### 6.1 Fastening the suspension gear and transport by means of a crane

#### 6.1.1 Lifting the transformer

##### **WARNING**

###### **Risk due to suspended load!**

The load is very heavy.

Non-compliance can result in death or serious injury!

- Never step under the suspended load!
- Never move the suspended load above people!

##### **WARNING**

###### **Risk of lifting equipment breaking!**

Non-compliance can result in death or serious injury!

Unsuitable lifting equipment may break.

Use 4-line lifting gear with lines of equal length which

- has been designed for the weight of the plant to be lifted.
- are not damaged.
- bears the label of a neutral test agency.

Secure the lifting gear to all four lifting lugs simultaneously.

Comply with the maximum allowed spreading angle of the lifting gear.

##### **WARNING**

###### **Risk of the tie-down rings getting torn out!**

Non-compliance can result in death or serious injury!

Tie-down rings are not provided for lifting the transformer and may tear.

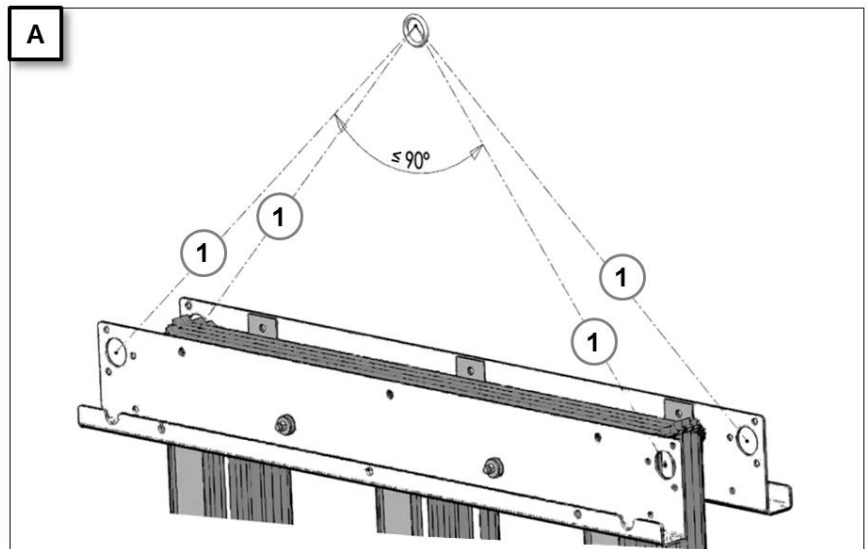
- Pay attention to the differing lifting lugs in case of various steel clamp designs.

Fasten the lifting gear to all four lifting lugs so that the **spreading angle of the lifting gear is maximum 90°!**

**Version A**

1 *Lifting lugs or tie-down rings*

✓ Lifting allowed



**Version B**

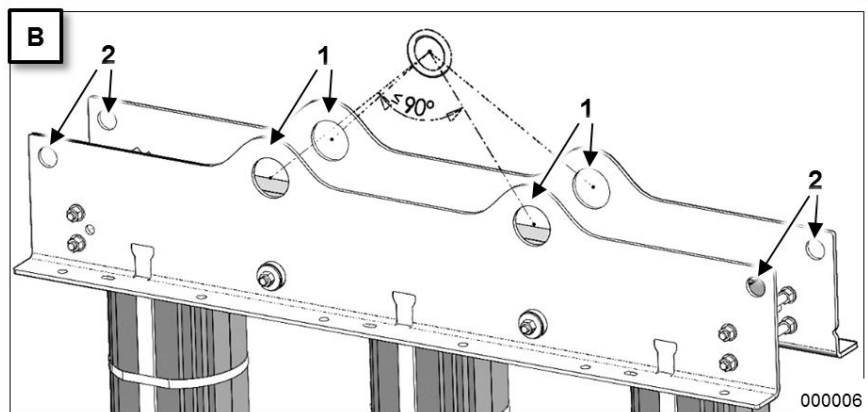
1 *Lifting lugs*

✓ Lifting allowed

2 *Tie-down rings*



Lifting prohibited



**Fig. 4: Different versions of lifting lugs**

In version A, the lifting lugs also serve as tie-down rings.

Version B has lugs that serve exclusively as tie-down rings (2). Lifting here is strictly forbidden!

Lift and move the load to its destination. Avoid jerky lifting and depositing!

### 6.1.2 Lift transformer with enclosure

## ⚠ WARNING

**Risk of falling! Risk of stumbling!**

Non-compliance can result in death or serious injury!

The enclosure top

- features hidden raised parts.
- may be slippery, e.g. due to moisture or contamination.

Use fall protection.

Check the stability where you set your foot before putting weight on it.

Walking on the roof of the enclosure is restricted with regard to mechanical strength. Only one person at a time, with a maximum weight of 90 kg, may walk on the roof to attach the lifting gear, or for execution of installation tasks on the transformer that has been de-energized and grounded.

1 Transformer lifting lugs connected to the enclosure

✓ Lifting allowed

2 Lifting lugs for enclosure ONLY

✗ Lifting of the transformer prohibited

3 Tie-down rings



Lifting prohibited

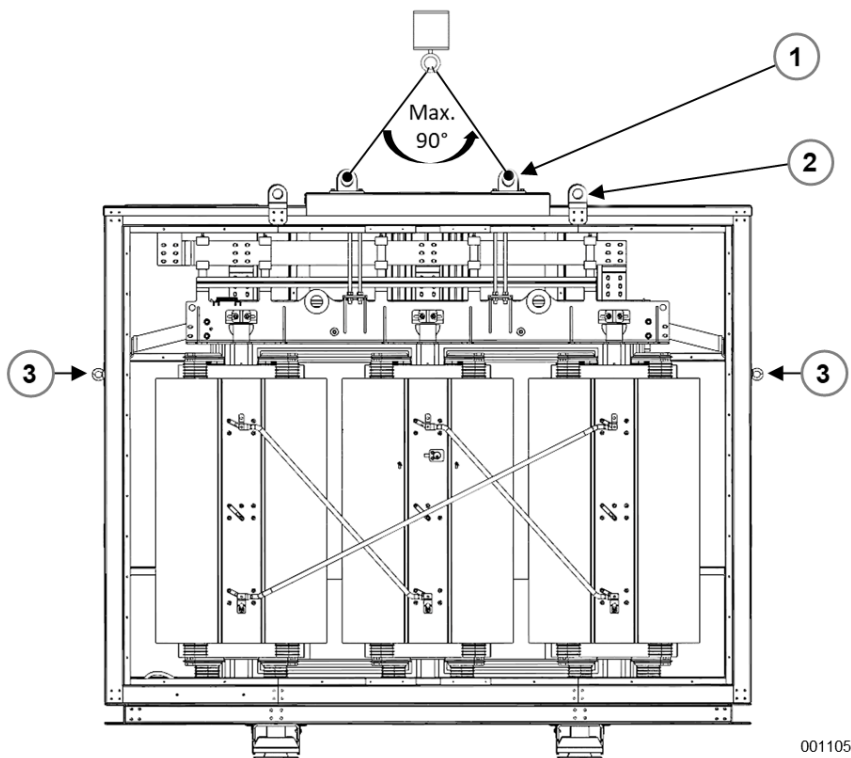


Fig. 5: Transformer with enclosure [example]

## DANGER

### Falling load!


Failure to comply will result in death or serious injury!

The lifting lugs on the housing are not designed for the weight of the transformer.

If a transformer with an enclosure attached to the transformer's carriage is lifted by the enclosure's lifting lugs, the transformer will fall.

- To lift the transformer together with the enclosure, use the lifting lugs on the transformer.
- Only use the lifting lugs on the enclosure for lifting the enclosure roof.

To lift the transformer and enclosure together, use the lifting lugs on the transformer!

 The lifting points (2) on the enclosure roof that are not connected to the transformer must not be used, except when lifting off the roof.

Optionally available jack rings (1) on the enclosure roof, which are attached to the transformer by a lifting device and are suitable for lifting the transformer with the enclosure, are shown on the dimension drawing.

## WARNING

### Danger due to falling load!

Failure to comply with these instructions can result in death or serious injury!

The transformer with enclosure can fall down if the lifting device is attached incorrectly. Screw connections can come loose during transport.

- Before lifting the transformer, check whether the color marks on the lifting device screw connections are still intact.
- If the color marks are damaged, tighten the screw connections to the correct torque.
- If screw connections have come loose or parts of screw connections are missing, re-attach the screw connections using lock washers.

	M12		M16		M20	
	A2A <sup>1</sup>	A2 <sup>2</sup>	A2A <sup>1</sup>	A2 <sup>2</sup>	A2A <sup>1</sup>	A2 <sup>2</sup>
Tightening torque [Nm]	80	70	200	135	375	175

Table 1

<sup>1</sup>A2A-8.8

<sup>2</sup>A2-70



Color marks intact



Loose screw connection

Fig. 6: Lifting device for the transformer and enclosure

## ⚠ DANGER

### Risk of electric arc or electric shock!

Non-compliance will result in death or serious injury!

The plant may be damaged if it is lifted or set down abruptly.

- Avoid sudden lifting or lowering!
- Do not connect damaged transformers!
- When positioning the transformer, verify prior to commissioning that the minimum air gaps in the enclosure, which are required between live conductors and windings, and earthed components are complied with!

Lift and move the load to its destination. Avoid jerky lifting and depositing!



## 6.2 Transport on castors

### 6.2.1 Mounting the castors to the carriage

#### **⚠ WARNING**

##### **Do not tilt the transformer!**

The transformer is very heavy.

Failure to comply with these instructions can result in death or serious injury!

Secure the transformer against tipping when mounting the castors! Use squared timbers under the carriage for this purpose, which

- are slightly higher than the castors.
- can bear the weight of the transformer.

Enclosures mounted on the carriage should be supported on the carriage itself. The enclosure cannot bear the weight of the transformer.

The four castors have been designed for mounting in either the longitudinal or the transverse direction. Mounting in any other direction (e. g. diagonally) is prohibited and may result in an unsafe condition!

- 1 Index pin
- 2 Index bore-hole for rolling in longitudinal direction
- 3 Index bore-hole for rolling in transverse direction
- 4 Towing eyelet

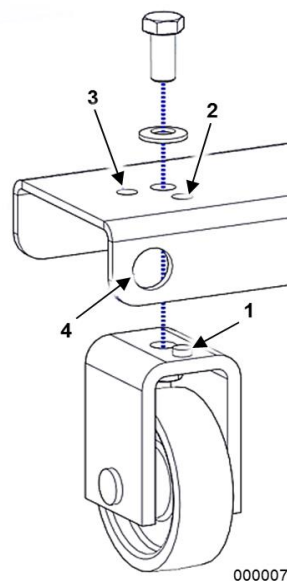


Fig. 7: Fastening the castors to the carriage

#### **Implementation:**

1. Lift the transformer so that the castors can be mounted below the carriage.
2. Protect the transformer against tipping over.

3. Mount the four castors as shown in the previous illustration, aligning them all in the same driving direction.
4. To this effect, position the index pin (1) in the required index bore-hole (2, 3).
5. Lock the connection by tightening the M16 hex. bolt! The tightening torque without lubricant is 135 Nm. Please note that in case of larger castors, another M16 bolt is used instead of the index pins. The same tightening torque applies to that bolt.
6. Remove the tilt protections and place the transformer on the floor.

### 6.2.2 Rolling the transformer

#### WARNING

**Severe injuries! Risk of tipping over the transformer.**

The transformer is very heavy.

Non-compliance may result in death or serious injury!

- Roll the transformer in the longitudinal or transverse directions only!
- Do not roll transformer on a curved path!

#### ATTENTION

**The transformer may be damaged!**

When rolling the transformer, please make sure that force is only transmitted to the carriage.

Pushing or pulling the transformer by grasping other parts of it will most probably cause damage to the unit.

The transformer features towing eyelets on the carriage (Refer to *Fig. 7*) and should be pulled only via these.

If pushing is required, please note that

- the force may only be transmitted to the carriage!
- when doing so, do not damage the corrosion protection (paint) and do not shift other parts!

Attach the load fastening equipment to the two towing eyelets according to your driving direction and pull the transformer to its site of installation. To change the driving direction, reposition the transformer by means of a crane or change the direction of the castors accordingly.

### 6.3 Transport by means of a forklift truck

#### **⚠ WARNING**

##### **Warning of the transformer tilting!**

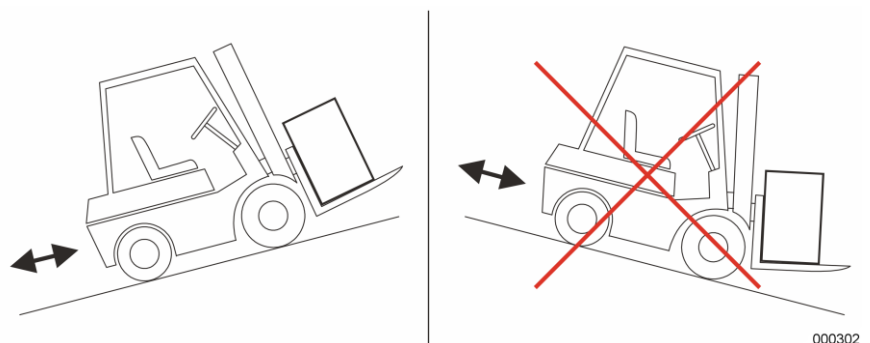
The transformer is very heavy.

Non-compliance can result in death or serious injury!

In case of inappropriate handling of forklift trucks, there is a risk of serious accidents and damage to plant components.

The following instructions must be observed on principle:

- Transport by forklift truck is only permitted for transformers with "forklift lifting" design.
- Lift only permitted with correctly positioned tilt protection elements.
- Only use forklift trucks that can carry the weight of the transformer.
- Ensure that the center of gravity of the load is centered between the forks.
- Always place the load on the forks to the stop and tilt the forks backward.
- Always secure unstable loads that tend to tilt.
- If necessary, use a slip-on shoe on the forks to hold and protect the load securely.
- Never transport multiple loads.
- Ensure that no one is in the danger zone.
- Always drive with the load lowered.
- Always drive with a load facing uphill. This applies to uphill and downhill.



**Fig. 8: Forklift truck on uphill / downhill gradients**

- Always adjust the driving speed so that the stopping distance in the event of an unexpected hazard or obstacle is as short as possible.
- Maintain a tilt angle of  $> 0^\circ$  and  $\leq 5^\circ$ .



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Fig. 9: Tilt angle for transporting with a forklift truck

### 6.3.1 Tilt protection for forklift transport

#### **⚠ WARNING**

##### **Warning – do not tilt the transformer!**

The transformer is very heavy.

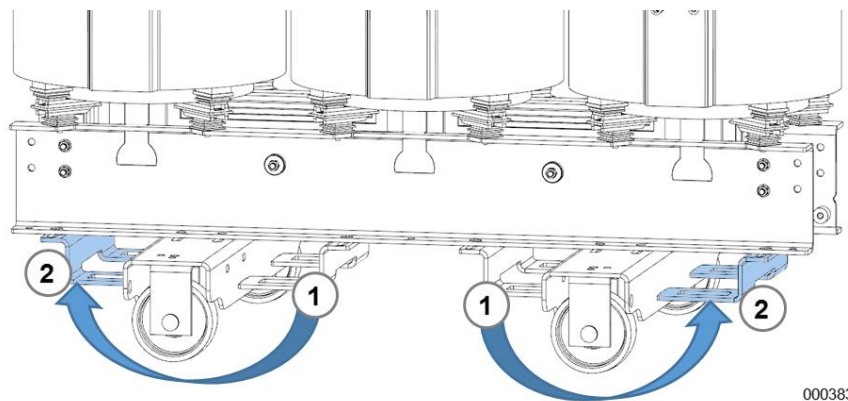
Failure to comply with these instructions can result in death or serious injury!

When lifting with a forklift under the bottom steel clamp, the transformer can tilt.

- Before lifting, check for correct positioning of the tilt protection elements at the attachment points of the forklift on the steel clamp.
- Never attach one tilt protection element on the inside, and the other tilt protection element on the outside. Always mount both tilt protection elements either inside or outside.
- If the tilt protection elements are incorrectly positioned, mount the steel profiles on the attachment points of the forklift. Ensure that the tightening torque is correct.

Steel supports are mounted on the steel clamp and carriage as tilt protection elements for forklift transport. The tilt protection elements can be mounted either on the inside or outside of the carriage as required. Never attach one tilt protection element on the inside, and the other tilt protection element on the outside!

- 1 Position, carriage inside
- 2 Position, carriage outside



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Fig. 10: Positions of the tilt protection elements

**Tightening torques for threaded fittings – tilt protection elements, strength class 8.8 and higher:**

Thread size	Tightening torque
M10	45 Nm
M12	80 Nm
M16	200 Nm

## 6.4 Requirements imposed on transport vehicles and load securing

Comply with the SGB GmbH Loading Instructions 02.04.90-03.002 when loading and securing the goods to be transported. You can request the current version of the Loading Instructions at any time.

If special transport conditions have not been agreed beforehand, **the transport vehicle for transformers ≤ 10 t weight, in addition to the statutory requirements, must also meet all five of the requirements** listed here:

- Air suspension
- Closed design (tarpaulin vehicle)
- Can be loaded from above (it must be possible to temporarily dismount the body and tarpaulin)
- For each transformer to be transported, carry at least four lashing straps (according to DIN EN 12195-2) and four non-slip mats at least 8 mm thick
- Have sufficient lashing lugs (at least four per transformer)

For transport, ensure that the values for accelerations of 1 G ( $\cong 10\text{m/s}^2$ ) specified in IEC 60076-11 are not exceeded, in all directions. Any higher loads must be communicated in the offer stage.

When selecting the transport vehicles and their number, ensure that the transformers are only loaded longitudinally to the direction of travel and only in one row. A transverse load or loading in several rows is not permitted for load-securing reasons and for insurance reasons.

Transport of the transformers by means of railway vehicles involves increased accelerations and - unless otherwise expressly stipulated - is not admissible due to the high risk of damage.

### ATTENTION

To tie down the transformer, **use all 4 tie-down rings** provided to this effect **simultaneously!**

Load securing directly via the yoke or other structural parts is inadmissible and is most likely to cause damage to the unit.

When loading the transformer onto the transport vehicle, secure it according to the instructions of the standard DIN EN 12195-1 or of regulations valid in your country.

## 6.5 Checking the consignment before unloading

**Inspect** the consignment for **completeness** against the delivery note.  
**Check** the consignment **visually before unloading** it.

▶ **Note**

If damage is noted on the transformer, enclosure or parts supplied in loose condition, or if the consignment is incomplete:

1. Do not unload.
2. Record the damage or any missing parts detected on the delivery note of the forwarding agent. Document the damage on the transformer (or accessories) and the nameplate with **photos**.
3. Contact **SGB GmbH** to coordinate the next steps. Ask for the **GTV-Service** (GTVS) department.

When visually inspecting the transformer, look for the following types of damage:

- Paint finish damage (e.g. flaking, deep scratches)
- Core damage, such as core tips that are severely bent and touch each other, or sheet metal layers that have fallen out (indicated by the absence of paint finish, or a differently colored paint finish).
- Insulation damage (e.g. flaking on the cast resin windings, dents on the circuit connectors).
- Slipping of the windings, indicated by extremely asymmetrical arrangement relative to the core, or tilted windings.

Pictures showing examples of damage:



Fig. 11:  
Inadmissible! Deformed insulation of a circuit connection



Fig. 12:  
Inadmissible! Surface chipping due to impact on circuit connection



Fig. 13:  
Inadmissible!  
Core tips of this yoke are seriously deformed and touch one another



Fig. 14:  
Ok  
Minor irregularities of surface and paint

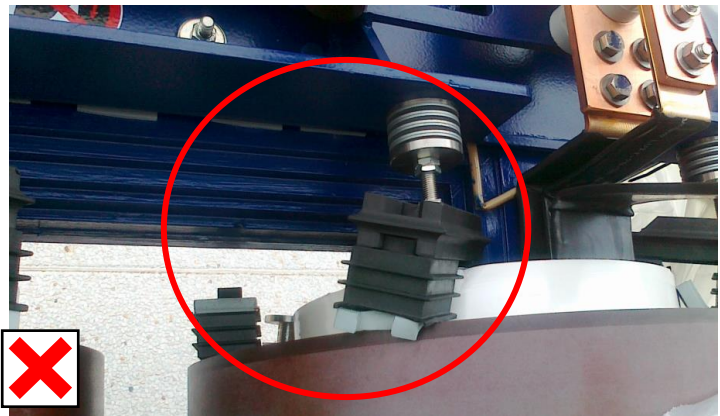


Fig. 15:  
Inadmissible!  
The windings have been shifted. Recognizable by torn-out supports.

If you have not detected any damage, then unload the transformer. Proceed as described under *section 6.1 Fastening the suspension gear and transport by means of a crane.*



## 7 STORAGE

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Unless otherwise stipulated, the provisions of the IEC 60076-11 and IEC 60076-1 standards apply.

### ATTENTION

#### Corrosion through condensation!

During longer storage in foil covers, condensation may occur. This causes zinc corrosion (white rust).

- Remove foil covers immediately after receiving the transformer.
- For longer storage periods pack the transformer into a wooden crate. Provide air circulation within the packaging or use silica gel in order to prevent condensation.
- Commission the transformer as quickly as possible, at least in no-load operation.

### ATTENTION

Transformers and enclosures must **never be stored in rooms where salts, acids or bases are stored**, as this might result in deposits and damage to the transformer or the enclosure.

**Before storing** the transformers, **pack them** as described in *section 5*.

Comply with the storage instructions in the manufacturer's instructions for the attachments, e. g. fans.

Store the transformers in an **environment** where the following conditions are satisfied:

- **dry and weatherproof** (covered room with a max. relative humidity of 93%)
- non-corrosive and non-explosive atmosphere
- **ambient temperature higher than -25°C** (may differ subject to agreement)

## 8 INSTALLATION

The transformer must be installed at a location that corresponds to the descriptions in chapter *section 4*.

Depending on the transformer version, transport to the installation site occurs:

- with crane (see *section 6.1*)
- on rollers (see *section 6.2*)
- with forklift (see *section 6.3*)

### 8.1 Position the transformer on its site of operation

#### DANGER

**Risk of electric arc or electric shock.**

Non-compliance will result in death, serious injury or destruction of the plant!

When positioning the transformer, comply with the minimum clearance between

- the live conductors and the windings, and the earthed parts!
- the conductors and the windings and other live parts of the transformer!

*U<sub>m</sub> is the highest voltage for operating equipment*

*LI is the test level for full wave lightning impulse voltage*

Always **maintain** the **minimum clearance of**

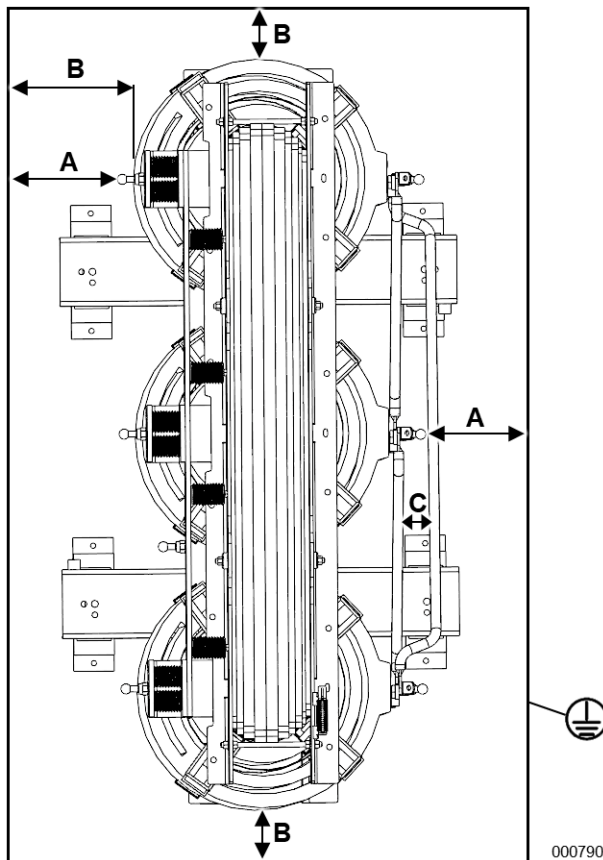
- the live conductors and the windings to grounded parts!
- the conductors to the windings and other live parts of the transformer!

Minimum clearances depend on the installation altitude above sea level and the U<sub>m</sub> / LI values of the respective winding.

Also maintain the minimum clearance when routing the cables.

Maintain the minimum clearance even when the unit is installed in an enclosure.

Minimum air gaps / minimum distances to grounded conductive parts:



$U_m/LI$ [kV]	A [mm]	B [mm]	C [mm]
1.1 / --	40	20	10
3.6 / 20	40	30	10
3.6 / 40	60	30	20
3.6 / 50	75	40	25
7.2 / 60	90	45	25
7.2 / 75	120	65	38
12 / 75	120	65	38
12 / 95	160	85	50
17.5 / 95	160	85	50
17.5 / 125	220	115	60
24 / 125	220	115	60
36 / 150	270	140	90
36 / 170	320	160	100
36 / 200	380	180	110
40.5 / 200	380	180	110

- A: Distance bare – bare  
 B: Distance bare – insulated  
 C: Distance insulated – insulated

Fig. 16: Schematic diagram of minimum air gaps relative to grounded conductive components

All values apply to installation altitudes  $\leq 1,000$  m above sea level!

- Do not underrange any of the specified minimum air gaps!
- If 2 values can be selected, then the value with the greater distance must always be selected!

The minimum air gaps are also specified in the dimension drawing as "clearance to ground".

When planning any tasks in the vicinity of the transformers, bear in mind that the "clearance to earth" does not prescribe the limits of the danger zone as defined by DIN EN 50110-1, but rather only the distance required for trouble-free operation. The danger zone and vicinity zone are specified in Annex A of the standard cited above.

## 8.2 Removal of packaging and transport safeguards

Remove existing packaging and transport safeguards, e.g. marked inclined supports. In this regard refer to the dimensional drawing of the transformer.

## 8.3 Secure positioning in the station

Ensure a stable stance in the station.  
To do this, lock the optional casters, if installed.  
When using bearing elements for structure-borne sound insulation, execute precise positioning.

### **WARNING**

**Severe injuries! Risk of tipping over the transformer.**

The transformer is extremely heavy. Non-compliance may result in death or serious injury!

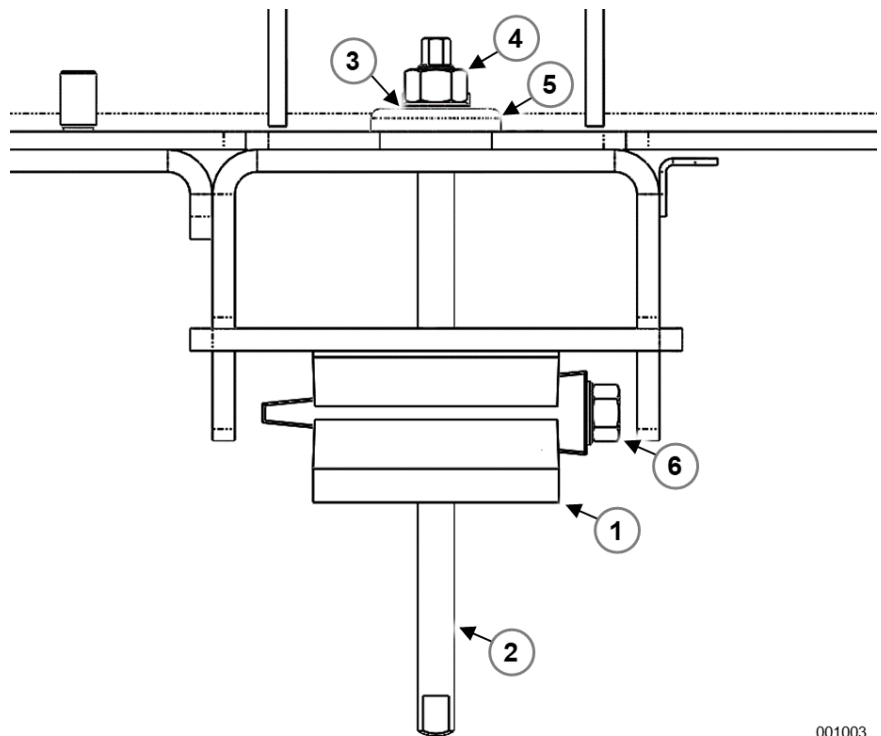
While mounting the machine bases, protect the transformer from tipping over! To this effect, place squared timbers below the running gear, these timbers

- being slightly higher than the machine bases and
- capable of bearing the weight of the transformer.

## Vibration damper

Vibration dampers are available with or without floor anchors.

- 1 Vibration damper
- 2 Stud bolt
- 3 Washer
- 4 Nut
- 5 RONKAP insulating washer
- 6 Leveling screw



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Fig. 17: Vibration damper with floor anchor

### ► Note

When using floor anchors and before installing the vibration damper, ask the adhesive manufacturer for the required drilling depth, the bearing diameter and the type of adhesive which is most suitable for the properties of the floor at the installation location!

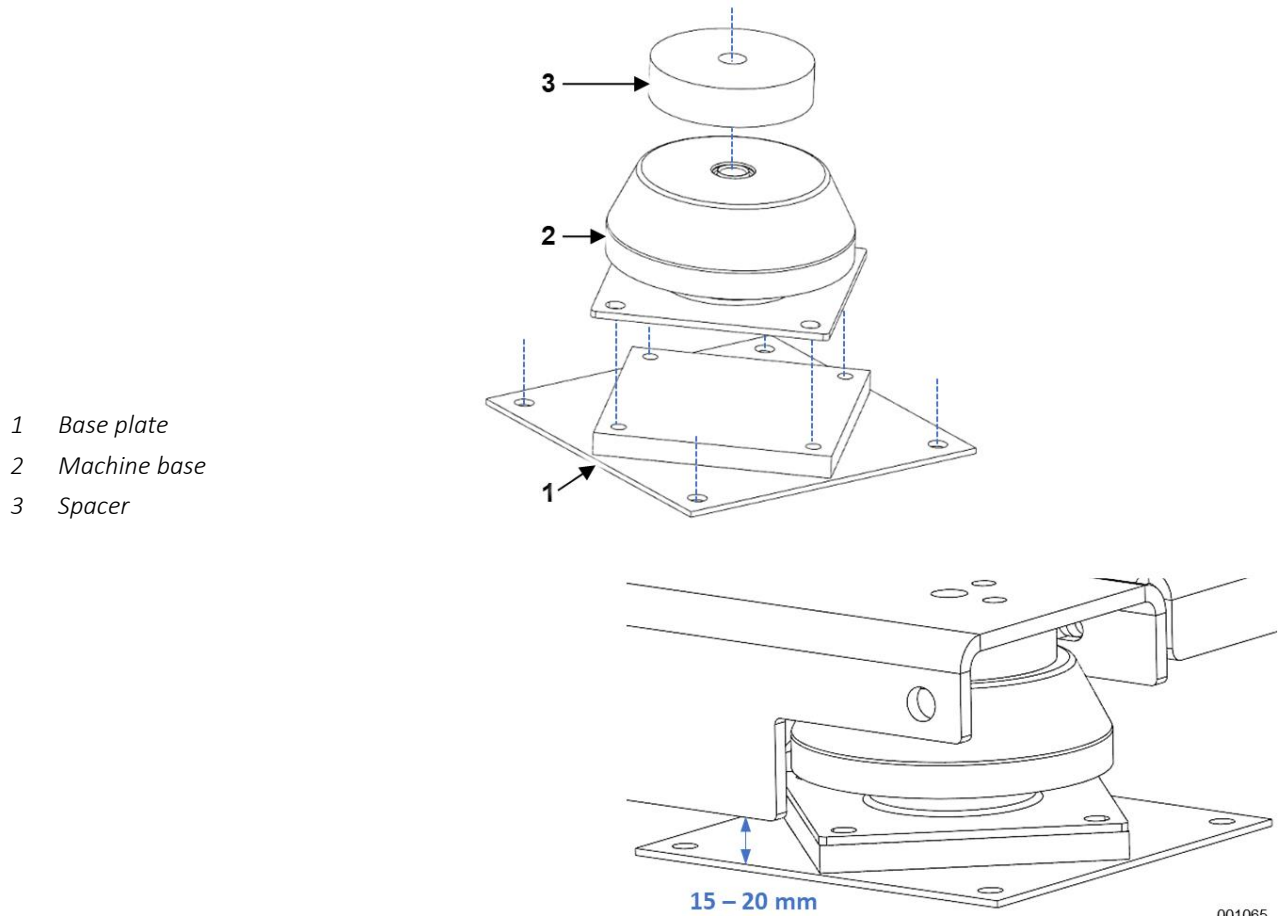
1. Lift the transformer so that the vibration dampers can be installed underneath the chassis.
2. Secure the transformer so it cannot tip over.
3. Attach the vibration dampers to the chassis with M16 screws and washers.
4. If anchoring to the floor, drill four holes in the respective locations. Please refer the transformer drawings for the exact spacing of the bearing points. Use the drilling depth and diameter values specified by the adhesive manufacturer.
5. Place the adhesive in the drilled bearing points.
6. Lift the transformer and position it in the desired location over the four prepared holes.

### ► Note

The height of the vibration dampers is easiest to adjust by adjusting them from top to bottom, and not the other way around. Ensure that the screw (6) is turned in all the way.

7. Fully extend the vibration damper.
8. Set the transformer down on the floor carefully and evenly.
9. Adjust the height of the vibration dampers with the screw (6) and a level until the transformer is leveled.
10. Tighten and secure the nuts (4) with a torque of **26 Nm**.
11. Mark the nut positions with a waterproof marker.

## Machine feet

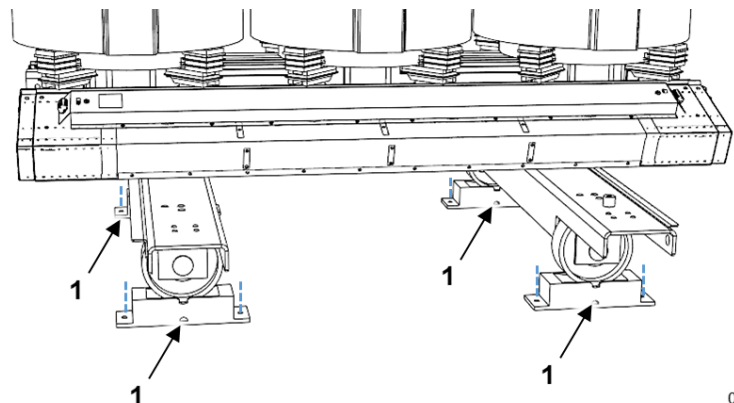


**Fig. 18: Machine base**

The machine feet must be attached to the floor. Maintain a distance of 15 – 20 mm between the bottom edge of the chassis and the parts attached to the floor (base plate, anchor bolts, etc.).

## Transformer bearings

### 1 Transformer bearings



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**Fig. 19: Transformer bearings**

The transformer bearings should be bolted securely to the base. Ensure that the rollers are at the lowest point of the channel.

If a screw connection isn't feasible, the bearings can also be guided by a U-shaped bracket in the crosswise direction in order to prevent sideways travel. Then the bearings must be secured to prevent travel in the lengthwise direction.

The bearings must not be welded on under any circumstances, otherwise the rubber-metal connection is damaged by the resulting heat.

## 8.4 Mount parts which have been removed for transport

Unpack all parts removed for transport such as connecting lugs, control boxes etc. and mount them.

Comply with the supplier documentation or the separate documentation of the external suppliers of attachments and accessories.

## 8.5 Mount enclosure

If an enclosure was included in the scope of delivery, set it up according to the included plans and **secure it** in case of floor installation **so it cannot move**.

Ensure that the minimum air gaps are maintained (*section 8.1*).



**⚠ DANGER**

**Danger due to electric shock!**

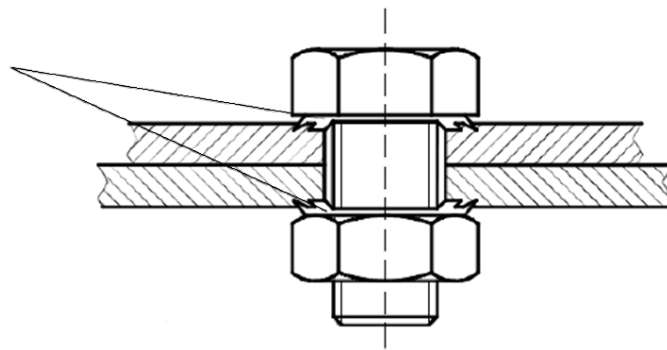
Failure to comply will result in death or serious injury!

If there is a faulty connection of the enclosure components the enclosure will not be correctly grounded and it will not be safe to touch. If it is touched, shock currents or electric flash-overs at approach can occur.

- For each connection of two metallic components contact washers SN 70093 must be used on at least two screw connections.

The contact between individual sheet metal components must be established via a toothed contact washer. To do this, at each connection of two metallic components, on at least two screw connections replace the flat washers with toothed contact washers SN 70093.

*Mount the contact washers in such a manner that the teeth penetrate the part that must be bolted and generate a metallic contact.*



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Fig. 20: Screw connection with contact washer SN 70093

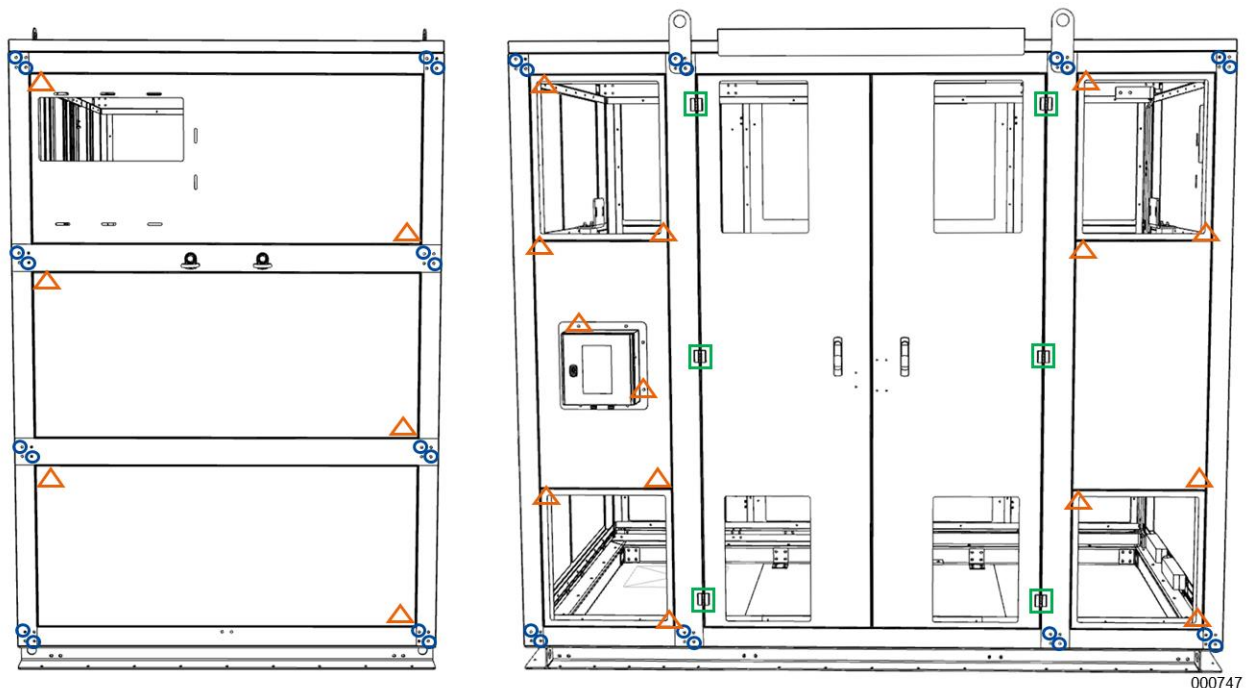


Fig. 21: Toothed contact washers SN 70093 [Example]

- At each connection of two components of the frame, on at least two screw connections replace the flat washers with toothed contact washers SN 70093
- △ At each connection of a ventilation cassette, sheet metal element, base plate, possible accessories (e.g. control cabinet) with the frame, place at least at two screw connections toothed contact washers SN 70093
- Doors grounded with grounding hinge with contact washer

If the enclosure is installed near a wall and has ventilation openings on the side facing the wall:  
Ensure that the clearance between the **side of the enclosure and the wall** is at least 30 cm .

#### RECOMMENDATION

To improve ventilation and accessibility, increasing the clearance to 40 cm is recommended.

## 8.6 In case of possible soiling in the meantime between installation and commissioning

If a **risk of soiling** exists in the period between installation and commissioning, e. g. due to dust from the construction site, **protect the transformer** as described in *section 5 Packaging*.

## 9 COMMISSIONING

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Switch-on/switch-off operations in direct succession are not permitted. There must be a time window of at least one minute between switching operations.

Every switching operation involves a risk of damage, therefore the recommended number of 24 switching operations per year according to IEC 60076-11 should not be exceeded.

The following safety notices apply for the **entire duration** of the work:

### **DANGER**

#### **Risk of electric shock!**

Non-compliance will result in death or serious injury!

Apply the five safety measures according to EN 50110-1 for the entire duration of the work, in the specified sequence (section "Working in the zero voltage state)!

The rules are:

1. De-energize main and auxiliary circuits
2. Lock out to prevent switching on
3. Verify zero voltage
4. Ground and short-circuit
5. Cover or block off adjacent live components

After completing the work:

Reverse the state established by applying the safety measures according to applicable local regulations or, if there are none, reverse the five safety measures listed above in the opposite sequence.

Only perform switching on if you are authorized to do so!

---

## WARNING

### Flashover due to foreign matter!

Non-compliance can result in death or serious injury.

Foreign matter on transformer surfaces during energizing cause damage to windings, flashover and fire.

- Make sure that there are no impurities and foreign matter on any transformer surfaces.
- Remove metal dust and other dust which might be on any transformer surfaces.
- When working, do not place tools, screws and metal parts on the transformer.
- Make sure that no impurities and foreign matter are left in the enclosure and on other plant components.

## CAUTION

### Risk of burns when touching hot surfaces!

Non-compliance may result in injury.

Before starting to work, make sure that the transformer's surfaces have cooled down to a temperature below 40°C, in order to avoid burns caused by unintentional contact!

## 9.1 Preparations

1. Set up the transformer as described under *section 8*.
2. Connect the transformer's earth terminal to the earthing system and verify the connection.
3. Check the transformer for impurities and foreign matter (e. g. screws, tools, metal chips, etc.) on all transformer surfaces, also on and between the windings, in the cooling ducts and between windings and core. If necessary, clean once more and remove foreign matter. There must not be any other adhesive labels on the HV windings, except the tapping and phase designations.
4. Check the windings and the upper supporting blocks for tightness. The rubber bases must be slightly compressed and the supporting blocks must fit tightly. If necessary, increase the pressure of the upper supporting blocks by tightening the adjusting nut.

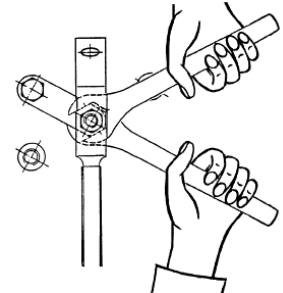
## 9.2 Tightening torques

### ATTENTION

#### Damage to high-voltage windings!

When tightening or releasing the threaded connections on the reconnection links, compensate the torque with an open-jaw wrench as shown in the drawing on the right.

This avoids damage to the windings.



Screw connection	Materials	Thread sizes – tightening torques with specification of lubricants [in Nm]									
		M8		M10		M12		M16		M20	
		A2A <sup>1</sup>	A2 <sup>2</sup>	A2A	A2	A2A	A2	A2A	A2	A2A	A2
Terminal rail / connection	Copper / copper Copper/Al <sup>3</sup> Al/Al	-	-	40	40	70	70	140	140	280	280
HV switchover lugs / encapsulated bushings	Copper / Al / brass	10	10	20	20	35	35	-	-	-	-
Surge arrestor		Depending on the manufacturer of the surge arrestor									
Fixed ball point diameter 20/25/30	Fixed ball point / copper / Al	-	-	-	-	80	70	-	-	-	-
Fan holder	Steel/steel	-	-	-	-	80	70	-	-	-	-
Steel with steel	Steel/steel	25	20	50	40	80	70	200	135	375	175
With wedge-lock washer	Steel/steel	-	-	50	40	70	45	175	105	340	175
Earthing lug	Cable lug/steel	20	20	50	40	80	70	-	-	-	-
Polyamide screws		5				-	-	-	-	-	-

Table 2 – Tightening torques

<sup>1</sup>A2A-8.8

<sup>2</sup>A2-70

<sup>3</sup>Use copper-plated aluminum sheet metal

Check all electrical screw connections; correct the torque if necessary. Ensure that the cable connections do not transfer any mechanical forces to the transformer connections.

### 9.3 Voltage conversion

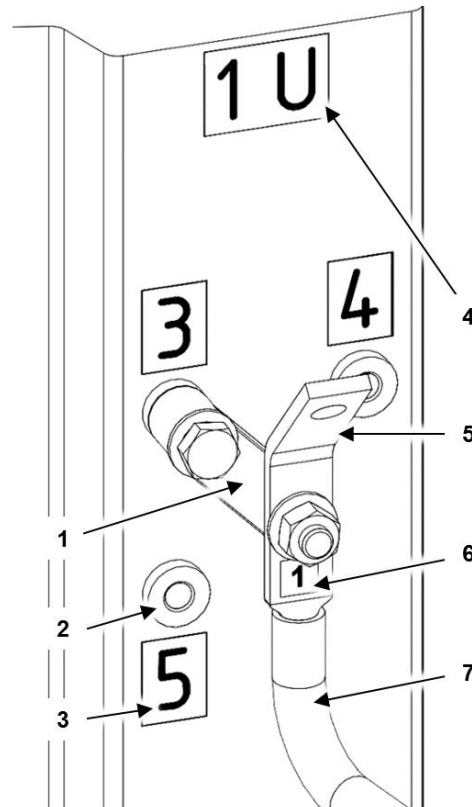
Unless otherwise stipulated, SGB cast-resin transformers are equipped with reconnection links to permit voltage conversion.

Voltage conversion is effected at zero voltage by connecting the reconnection link to an appropriate tapping (voltage tap) on the winding.

The circuit plate shows the possible voltages and the switching combinations pertaining to them. The circuit plate is located at the upper yoke of the transformer on the side where the reconnection links are provided.

To adjust the required voltage, the reconnection links on the circuit connections must be connected to the appropriately numbered voltage tapings, as specified on the circuit plate.

- 1 Reconnection link
- 2 Voltage tap
- 3 Number plate of the tap
- 4 Designation of the high-voltage terminal
- 5 High voltage terminal
- 6 Number plate of the circuit connection
- 7 Circuit connection



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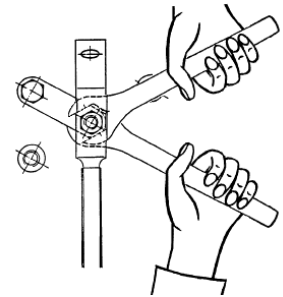
Fig. 22: Establishing a HV circuit connection

## ATTENTION

### Damage to high-voltage windings!

When tightening or releasing the threaded connections on the reconnection links, compensate the torque with an open-jaw wrench as shown in the drawing on the right.

This avoids damage to the windings.



For voltage conversion, proceed as follows:

Switch the changeover lugs one at a time, leaving the position of the circuit connections unchanged!

1. Loosen the screw connection for the changeover lug circuit connector. (1, 7).
2. Unscrew the mounting screw from the tapping/connecting socket (2).
3. The pivot point of the changeover lug circuit connection (1, 7) must not be located above a free tapping/connecting socket.
4. Polish the contact surfaces metallically bright to remove the invisible oxide layer which is a poor electrical conductor. Make sure that no metal dust is left on any transformer surface.
5. Slide the changeover lug over the newly selected connecting socket (2) and tighten it with the screw you removed earlier. Please note that for aluminum-copper connections, a washer made of copper-plated aluminum sheeting is enclosed between the respective contact surfaces! The copper-clad side must be in contact with the copper connection.
6. Retighten the changeover lug circuit connector screwing to the required torque (see *section 9.2*).

### Note

If the unused voltage taps are shielded through cover bushings, remove them for voltage changeover and attach them on the voltage tap that has become free.

## 9.4 Phase terminals

### DANGER

**Risk of electric arc or electric shock.**

Non-compliance will result in death, serious injury or destruction of the plant!

When routing the cables, comply with the specified minimum clearances between

- the live conductors and the windings, and the earthed parts!
- the conductors and the windings, and other live parts of the transformer!

Refer to section 8.1, page 42.

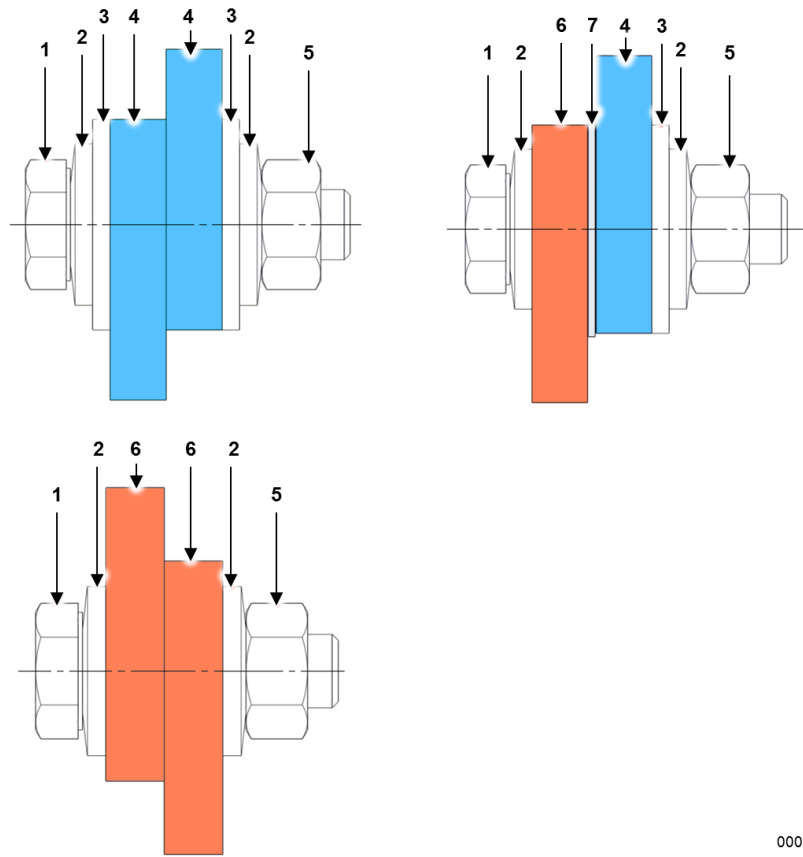
Connect the **phase terminals according to the circuit plate**. Here, the electrical terminals of the transformer may be made of aluminum or of copper.

- Route the cables so that the **transformer terminals** are not subjected to mechanical stress.
- To avoid corrosion in the transition area, **insert a copper-plated aluminum sheet between the copper/aluminum contact surfaces**, ensuring that the copper-plated side rests against the copper terminal.
- Polish the **contact surfaces** metallicity bright to **remove the oxide layer** which is a poor electrical conductor. Repeat this procedure every time after the contact is opened, making sure that no metal dust is left on any transformer surface.
- On the aluminum side of the link, a washer acc. to ISO 7093 must be inserted additionally in the threaded connection.

The general design of threaded connections of electrical connections is shown in following figure:



- 1 Bolt ISO 4014 / 4017
- 2 Spring washer DIN 6796 / ISO 10670
- 3 Washer ISO 7093
- 4 Aluminum bar (shown in blue)
- 5 Nut ISO 4032
- 6 Copper bar (shown in brown)
- 7 Copper-plated aluminum sheet



000178

Fig. 23: General design of threaded connections of electrical connections (sectional view)

## 9.5 Temperature monitoring

### WARNING

#### Fire hazard!

Non-compliance may result in death or serious injury!  
If this instruction is disregarded, the transformer may be overloaded and the insulation system will age prematurely.

Do not replace the thermistors with others of a higher nominal response temperature!

### WARNING

#### Warning – electric shock!

Failure to comply with these instructions can result in death or serious injury!

If there is a fault, high voltage can be applied on temperature sensors, e.g. if there is a surge voltage event with voltage amplitudes outside of the specified insulation level.

- Provide suitable surge protection devices (e.g. surge arrestors, high voltage fuses, etc.) as close as possible to the terminal strip of the transformer. Comply with the appropriate requirements specified by the manufacturer of the protective device.

#### Connect the **temperature monitoring sensors** to the appropriate **inputs of the temperature monitoring device**.

Check the function of the sensors by interrupting the sensor circuits for PTC strings or by reading the current temperature values for other sensor types.

Program the temperature monitoring device for the nominal functioning temperatures. Consult SGB GmbH for the values for warning and tripping in case of utilization of a temperature monitoring device which does not comprise PTC sensors. This step is not necessary for temperature monitoring devices which use PTC thermistors.

*Fiber optic cable (FOC)*

### ATTENTION

#### Damage to the fiber optic sensor!

The measuring probes and extension cables are made of fragile glass material.

Accordingly, please observe these rules:

Route the fiber optical cables to the control cabinet. Leave enough slack on the cable to avoid pulling forces that could damage the cable. Observe the following rules when installing the fiber optic sensors:

- Do not twist or entangle the fiber optic cable, particularly when unwinding and rewinding.
- The measuring probe is located at the end of the FOC. It is very sensitive and must be protected from mechanical damage during placement and routing.
- Do not bend the final 20 to 30 mm of the probe near the tip or expose it to adhesive.
- Do not drag or lay the fiber optic cable over sharp-edged objects.
- Do not apply any pressure to the fiber optic cable, especially not to the tip of the probe.
- When connecting or disconnecting a probe, always use the metal part of the connector, rather than the soft black tube.
- Long-term minimum bending radius of approx. 8 mm. This is the minimum radius that must be maintained before the fiber optic cable may break in a certain position after many months or years.
- Minimum bending radius to avoid light wave interference of approx. 130 to 150 mm. Avoid a large number of bends smaller than 130 mm. The fiber optic sensors are rolled onto special carrier plates, thus ensuring an optimum bending radius of the fiber optics.
- Instructions for configuring the evaluation unit are available from the sales or service department of SGB GmbH. The compatibility of the FOC sensors with evaluation units other than those recommended by SGB GmbH cannot be guaranteed.
- If the customer extends the fiber optic sensor already installed, always use sensors that are compatible (in terms of connections, wavelength, etc.).

The signal transmissivity of the fiber optic cable is measured before delivery of the transformer to ensure that the sensors are faultless.

## 9.6 Fan

### WARNING

#### Severe injuries!

Failure to comply with these instructions can result in death or serious injury!

Long hair, garments that hang down, and jewelry can get caught and pulled in to the fan. Hands will be severely injured.

- Ensure that the fan is disconnected from the power circuit and protected against accidental start-up.
- Do not switch on the fan, until after it has been correctly installed in the enclosure and has been tested.
- Wear protective gloves for tasks on rotor blades.
- When performing tasks on rotating parts, do not wear loose-fitting clothing or jewelry.
- Protect long hair with a hood.

If fans are present:

- Observe the supplier documentation of the external manufacturer for the fan.
- Check the mechanical installation (e. g. does the propeller rotate without touching the enclosure? Are the tightening torques of the screws OK?).
- Check the correct sense of rotation of the fans.
- Check the control for proper working order.

## 9.7 Minimum clearances around transformer

### DANGER

#### Risk of electric arc or electric shock.

Non-compliance will result in death, serious injury or destruction of the plant!

When positioning the transformer, comply with the minimum clearance between

- the live conductors and the windings, and the earthed parts!
- the conductors and the windings and other live parts of the transformer!

Check the minimum clearances between conductors and earth, between winding surfaces and earth and between conductors with different voltages. Correct if necessary!

For minimum clearances for installation altitudes  $\leq 1,000$  m above sea level, see the Table in *section 8.1*.

Also maintain the minimum clearance when routing the cables.

## 9.8 Checks before applying voltage

Before switching on, ensure that the following conditions are met:

- There must be no contaminants or foreign objects (e.g. bolts, tools, metal chips, etc.) on any of the transformer surfaces, for example, on and between the windings, in the cooling channels, or between windings and core.
- The transformer must be dry and free of conductive substances (e.g. moisture, dust, etc.).
- There must be no contaminants or foreign objects in the enclosure or on other system components.
- The cooling air temperature must be within the agreed limits (standard -25 °C to +40 °C).
- The windings must be symmetrically aligned and firmly clamped in on the core. The support blocks must be firmly seated and their rubber elements must be slightly compressed.
- The torque of the electrical bolted connections must have been checked (see *section 9.2 Tightening torques*).
- The core must not be damaged and must not have shifted (for example, damage indicated by protruding sheet metal layers, core tips without paint that touch each other, asymmetries).
- Windings must not be damaged (indicated by chipping or cracks).
- All minimum air gaps must have been complied with in accordance with the rated voltage. (see *section 8.1 Position the transformer on its site of operation* ).
- There must be no personnel or animals in the transformer room.
- Transformer room and/or enclosure must be securely locked (condition: access/opening must only be possible with key or tool).
- Other, locally valid safety regulations must have been complied with.

## 10 OPERATION

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Operate the cast resin transformers exclusively in closed electrical operating areas!

Unless different customer specifications have been stipulated, cast resin transformers are subject to the general operating conditions acc. to IEC 60076-11.

### DANGER

#### Risk of electric arc or electric shock!

Non-compliance will result in death or serious injury!

Despite their cast resin insulation, the **windings** are **not safe to touch**. This is exclusively a functional insulation. This insulation does not protect against dangerous shock currents in case of contact or against flashover in case of approach.

- Never approach the windings or other conductive transformer components to less than 1.5 m!
- Transformer must be operated in a closed electrical operating area.

### DANGER

#### Danger due to electromagnetic disturbances affecting pacemakers!

Non-compliance will result in death or serious injury!

Electromagnetic radiation disturbs pacemakers or other medical implants and aids.

- Never approach more closely than is permitted by the limits specified for their devices or implants regarding electromagnetic interferences!
- Take the applicable provisions regarding loads imposed by electrical, magnetic and electromagnetic fields into account when working in the proximity of the transformer.

### WARNING

#### Fire hazard!

Non-compliance can result in death or serious injury!

Overheating causes the transformer to burn.

- Only operate the transformer with a connected and functioning temperature monitoring device!
- Temperature sensors must be serviced on a regular basis. Max. maintenance interval: 1 year.
- Thermistors must not be replaced by such with a higher nominal functioning temperature.

### 1. Temperature monitoring device

The transformer temperature during operation directly affects its service life.

Only operate the transformer with a connected and functioning temperature monitoring device!

This prevents premature aging of the insulation system and helps to detect malfunctions immediately and defects due to excessive temperatures. The functioning of the temperature monitoring device has been described in *section 4.6* connection of the sensors in *section 11.2*.

### 2. Overload capacity

Compared to oil transformers, cast resin transformers feature a different heat capacity, temperature of the insulation system and heating time constant which determine the overload capacity depending on the preload, coolant temperature and duration. Due to the various design and implementation options, there are no generally applicable load guidelines. They must be calculated individually and may be requested if required.

## 11 MAINTENANCE

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The following safety notices apply for the **entire duration** of the work:

### **DANGER**

#### **Risk of electric shock!**

Non-compliance will result in death or serious injury!

Apply the five safety measures according to EN 50110-1 for the entire duration of the work, in the specified sequence (section “Working in the zero voltage state)!)

The rules are:

1. De-energize main and auxiliary circuits
2. Lock out to prevent switching on
3. Verify zero voltage
4. Ground and short-circuit
5. Cover or block off adjacent live components

After completing the work:

Reverse the state established by applying the safety measures according to applicable local regulations or, if there are none, reverse the five safety measures listed above in the opposite sequence.

Only perform switching on if you are authorized to do so!

---

### **WARNING**

#### **Flashover due to foreign matter!**

Non-compliance can result in death or serious injury.

Foreign matter on transformer surfaces during energizing cause damage to windings, flashover and fire.

- Make sure that there are no impurities and foreign matter on any transformer surfaces.
  - Remove metal dust and other dust which might be on any transformer surfaces.
  - When working, do not place tools, screws and metal parts on the transformer.
  - Make sure that no impurities and foreign matter are left in the enclosure and on other plant components.
-



## ⚠ CAUTION

### Risk of burns when touching hot surfaces!

Non-compliance may result in injury.

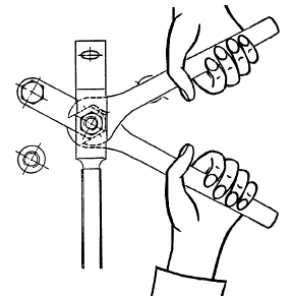
Before starting to work, make sure that the transformer's surfaces have cooled down to a temperature below 40°C, in order to avoid burns caused by unintentional contact!

## ATTENTION

### Damage to high-voltage windings!

When tightening or releasing the threaded connections on the reconnection links, compensate the torque with an open-jaw wrench as shown in the drawing on the right.

This avoids damage to the windings.



## RECOMMENDATION

Switch the transformer OFF at least 3 or 4 hours before commencing work. Leave the fans running (if applicable). Do not turn off the fans until just before commencing work. This will reduce the waiting times for cooling down on site. Depending on the load involved, longer cooling periods may have to be observed.

## Maintenance intervals

Perform transformer maintenance at intervals to be defined by yourself. We recommend an **initial inspection after max. 6 months**.

The inspection intervals depend on the transformer's degree of contamination. In case of minor impurities, the interval to the next check can be extended. If serious contamination is detected, reduce the intervals accordingly. The maintenance interval must **not exceed one year**.

Regarding all attachments and accessories, comply with the supplier documentation of the external supplier.

## 11.1 Cleaning

### ATTENTION

#### Transformer damage at switch-on!

Use the following for cleaning

- Soft brushes, cloths, sponges, rags.
- Do not use water.
- Do not use metal brushes or steel wool.

Determine the degree of contamination of the windings and clean the windings.

Ensure that the windings and the cooling channels have clean surfaces. **Clean the cooling channels and spaces between the windings** with special care. When using liquid cleaners, let the transformer **dry completely** (approx. 1 hour).

#### Degrees of transformer contamination:

Degree	Indicated by	Cleaning recommendations
Light	Light deposits of dry dust on the transformer	Clean the transformer with dry cloths and soft brushes. If necessary, compressed air can also be used to remove dust at places that are difficult to access.
Medium	Moist or salt-laden dust deposits on the transformer	Remove the deposits with soft brushes, sponges and cloths. Contact SGB GmbH if special cleaners are required.
Heavy	Indications as described for medium degree of contamination, however with traces of creep current and clear traces of partial discharge	If there is heavy contamination contact SGB GmbH for the subsequent procedure.

The filter mats must be checked each quarter for an IP5X enclosure. Replace the filter mats every 6 months.

The SGB service organization will be pleased to advise you with regard to cleaning concepts for SGB cast resin transformers.

Contact: [gt-service@sgb-smit.group](mailto:gt-service@sgb-smit.group)

### 11.1.1.1 White rust (zinc corrosion)

Zinc corrosion or white rust is a white, voluminous coating that can occur due to presence of water on the surface over a longer period of time during storage or transport. In the majority of cases, formation of white rust is merely a visual impairment of the zinc coating.

#### 1 White rust



Fig 24: White rust

If there are **low levels of white rust**, removal of the thin, whitish coating is not absolutely necessary.

**Light white rust** can be removed with the aid of a non-metallic sponge and cleaning agents that contain acetone.

If there are high levels of **white rust**, any repair measures to be carried out must be made dependent on the extent of the damage. If measurement of the remaining thickness of the zinc coating shows that the minimum values required by standard DIN EN ISO 1461 have been met, then it suffices to carefully remove the whitish coating. If the standard-conformant layer thicknesses are below the standard, an additional, professional repair of the corrosion protection must occur locally.

## 11.2 Temperature monitoring

### WARNING

#### Fire hazard!

Non-compliance may result in death or serious injury!  
If this instruction is disregarded, the transformer may be overloaded and the insulation system will age prematurely.

Do not replace the thermistors with others of a higher nominal response temperature!

### WARNING

#### Warning – electric shock!

Failure to comply with these instructions can result in death or serious injury!

If there is a fault, high voltage can be applied on temperature sensors, e.g. if there is a surge voltage event with voltage amplitudes outside of the specified insulation level.

- Provide suitable surge protection devices (e.g. surge arrestors, high voltage fuses, etc.) as close as possible to the terminal strip of the transformer. Comply with the appropriate requirements specified by the manufacturer of the protective device.

### ATTENTION

#### Damage to temperature sensors!

Use ohmmeters with a service voltage of  $\leq 2.5$  Volt!  
Otherwise, the sensors might be damaged!

**Measure the resistance of the temperature sensors** and compare the values with the information on the routine inspection certificate.

**Measure the PT100 twice**, always against the common white conductor. **Resistance of the PT100 at an ambient temperature of 20 °C is approx. 110 ohm.**

**Measure the PTCs together as a 3-strand chain** (sensor conductors of the same color) for a tripping temperature. The resistance of an intact chain **at 20 °C ambient temperature is between 60 and 750 ohm.**

*Fiber optic cable (FOC)*

If the optical signal is weak (e.g. less than 50%) or you have no signal at all, first clean the connectors of the probes and the meter. Cloths moistened with isopropyl alcohol or cleaning cotton swabs can be used for cleaning.

**Cleaning the probe connection:** Wipe the end of the ST connector with a moistened cloth in a circular motion for a few seconds.

**Cleaning the instrument connector:** Instrument connectors are prone to soiling. It is advisable to always leave the caps provided on both ends of the feed-through. Cloths moistened with isopropyl alcohol or cleaning cotton swabs are needed. Once the swab is slightly moistened, rotate it inside the connector feed-through for a few seconds. If it comes out soiled, repeat the procedure. The cleanliness of the connector can be confirmed by reading the % power level. A clean connector should have an optical performance of 100%.

## 11.3 Main terminals and bars

### DANGER

#### Risk of electric arc or electric shock.

Non-compliance will result in death, serious injury or destruction of the plant!

When routing the cables, comply with the specified minimum clearances between

- the live conductors and the windings, and the earthed parts!
- the conductors and the windings, and other live parts of the transformer!

Refer to section 8.1, page 42.

- If electrical terminals have been disconnected during maintenance work, polish the contact surfaces to a bright surface finish before reconnecting them, making sure that no metal dust is left on any transformer surface.
- Check existing insulations for damage.
- Make sure that the cable terminals do not transfer any mechanical forces to the transformer terminals.
- Make sure that the bending radii specified for the conductor cross section are not exceeded.
- Check all the threaded electrical connections for tightness and, if necessary, correct the torques as described in *section 9.2*.

## 11.4 Windings

- Check that the windings on all legs of the transformer core are arranged symmetrically.
- Check the windings for tight fit. Retighten the clamping devices as required. The rubber elements between the windings and the clamping devices must be slightly compressed.
- In case of vibration-proof models with clamping devices, the preload must be checked and, if necessary, readjusted. The appropriate values are available from the SGB Service. Subsequently, the clamping devices must be secured again using a locking compound.
- Make sure there are no impurities and foreign matter (e. g. screws, tools, metal chips, etc.) on all transformer surfaces, also on and between the windings, in the cooling ducts and between windings and core. If necessary, clean once more and remove foreign matter.

## 11.5 Other maintenance activities

- Check the safety clearances from earthed conductive components. For the clearances, refer to the warning on the transformer, the Table in

section 8.1 or the protective circle on the dimension drawing of the transformer.

- Check that all labels, plates and warning information are located on the transformer and that there are no other adhesive labels on the HV windings, except the tapping and phase designations.

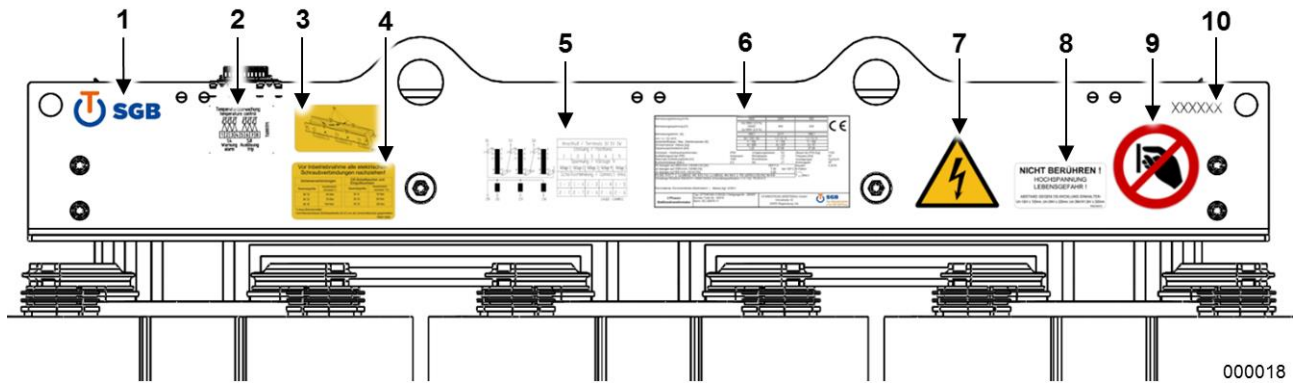


Fig. 25: Labels for upper steel clamp, HV side (example)

- |   |                                     |
|---|-------------------------------------|
| 1 Company logo                          | 6 Nameplate                         |
| 2 Terminal assignment                   | 7 Warning sign "danger voltage"     |
| 3 Instruction sign – lifting lugs       | 8 Supplementary sign "Do not touch" |
| 4 Instruction sign "Tightening torques" | 9 Prohibition sign "Do not touch"   |
| 5 Vector plate                          | 10 Transformer serial number        |

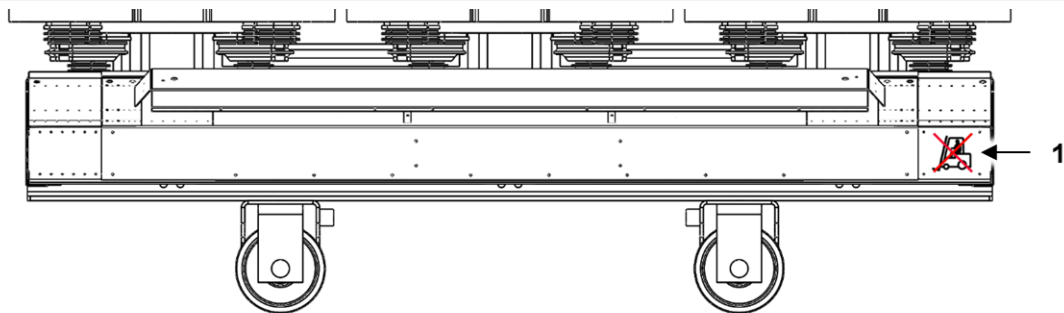


Fig. 26: Label, lower steel clamp

- |   |
|---|
| 1 Prohibition sign "Forklift truck" (not applicable for transformers with forklift brackets!) |
|---|

## 11.6 Fan

### **WARNING**

#### **Severe injuries!**

Failure to comply with these instructions can result in death or serious injury!

Long hair, garments that hang down, and jewelry can get caught and pulled in to the fan. Hands will be severely injured.

- Ensure that the fan is disconnected from the power circuit and protected against accidental start-up.
- Do not switch on the fan, until after it has been correctly installed in the enclosure and has been tested.
- Wear protective gloves for tasks on rotor blades.
- When performing tasks on rotating parts, do not wear loose-fitting clothing or jewelry.
- Protect long hair with a hood.

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This part applies only if the fans have been supplied by SGB. Otherwise, use the maintenance instructions of your fan manufacturer!

- Clean the air ducts using a dry rag!
- Check that
  - the fans are mounted securely and the mounting screws are properly tightened. Re-tighten as required!
  - no lubricant is leaking from bearings or motors. In this case, replace the fans!
  - the fan blades - especially welds - are not cracked. Replace the fans in case of damage!



## 11.7 Enclosure

This part is only to be used if the enclosure was supplied by SGB. If not, use the maintenance instructions of your enclosure supplier!

- Check the enclosure for damage that could affect personal safety or the function of the transformer. Replace any damaged parts.
- Clean the transformer housing inside, the supports and the air inlets. For enclosures with a protection class greater than IP5X, any filter mats present must be cleaned and replaced at least every 6 months.
- Check to ensure the supports and feed-throughs have no cracks on the surfaces. Replace any items as required.
- Remove all contaminants and foreign bodies (e.g. screws, tools, metal chips, etc.) from the enclosure and other system components.
- Reconnect the equipotential bonding conductors that were dismantled for access.
- Make sure that the transformer, fan and enclosure are dry.
- Make sure that no persons or animals are inside the enclosure and lock it.
- Make sure that the air inlets outside the enclosure are not blocked (minimum distance 300 mm).
- Make sure that all warning labels are present and undamaged. Signs for "Warning of dangerous electrical voltage" (DIN 4844-2 or DIN EN ISO 7010) must be present on all enclosure sides with access panels.

Check the positioning of the transformer in the enclosure for the minimum clearances between

- the live conductors and the windings to grounded parts.
- the conductors to the windings and other live parts of the transformer.

Refer to section 8.1, page 42.

## 11.8 Checks before applying voltage

Refer to *section 9.8*.

## 12 TROUBLESHOOTING

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Responding to early signs of trouble may minimize damage and increased costs. In many cases, the problem can be determined and eliminated quickly, and the transformer recommissioned in a short time.

### DANGER

**Risk of electrical shock!**

**Fire hazard!**

Non-compliance will result in death, serious injury or destruction of the plant!

If one of the symptoms listed below is detected, shut down the transformer immediately!

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### DANGER

**Risk of electrical shock!**

**Fire hazard!**

Non-compliance will result in death, serious injury or destruction of the plant!

If the problem cannot be eliminated, you are not allowed to recommission the transformer!

- Contact the manufacturer immediately to this effect. Further investigations may require disassembly of the transformer (disassembly of winding, core).
  - This work may only be performed by representatives of SGB or by an authorized repair workshop.
-

<b>Fault symptom</b>	<b>Possible causes</b>
<b>Electrical circuit</b>	
<i>Overheating, temperature warning</i>	<ul style="list-style-type: none"> <li>– Permanent overloads</li> <li>– External transformer connection incorrect</li> <li>– Poor, insufficient cooling air circulation</li> <li>– Excessive ambient temperature (max. admissible temperature 40°C, daily mean temp. of 30°C)</li> <li>– Damaged fans, wrong direction of rotation, improperly sized for application</li> <li>– Load with high harmonic content</li> <li>– Load unbalanced</li> </ul>
<i>Reduced no-load voltage</i>	<ul style="list-style-type: none"> <li>– Turn-to-turn fault</li> <li>– Reconnection link for HV tapping loose, not tightened</li> </ul>
<i>Excessive secondary voltage</i>	<ul style="list-style-type: none"> <li>– Excessive input voltage</li> <li>– HV taps incorrectly set</li> </ul>
<i>Unbalanced secondary voltage; deviation between phases</i>	<ul style="list-style-type: none"> <li>– Overload</li> <li>– HV taps not set to same voltage on all phases</li> <li>– Neutral terminal not grounded</li> </ul>
<i>Insulation faults, insulation resistances insufficient</i>	<ul style="list-style-type: none"> <li>– Perpetual overload</li> <li>– Dirt deposited on windings/in cooling ducts</li> <li>– Mechanical damage caused during handling (transport/installation)</li> <li>– Overvoltage due to lightning or switching operation</li> <li>– Humidity</li> <li>– Condensation</li> </ul>
<i>Switches or fuses tripped</i>	<ul style="list-style-type: none"> <li>– Short-circuit</li> <li>– Overload</li> </ul>
<i>Cables overheating</i>	<ul style="list-style-type: none"> <li>– Poor, insufficient screw connections</li> <li>– Incorrect conductor cross section, insufficient for load</li> <li>– Wrong bundling and/or laying/routing of cables</li> </ul>
<i>Flashover - high voltage to earth</i>	<ul style="list-style-type: none"> <li>– High static charge</li> <li>– Overvoltage within the grid</li> <li>– Insufficient voltage clearance to adjoining parts</li> </ul>
<b>Magnetic circuit</b>	
<i>Vibrations, loud operating noise</i>	<ul style="list-style-type: none"> <li>– Excessive input voltage and/or under-frequency condition</li> <li>– Core clamping loose (incorrect, rough handling during transport and installation)</li> <li>– HV taps incorrectly set</li> </ul>
<i>Overheating</i>	<ul style="list-style-type: none"> <li>– Excessive input voltage and/or insufficient system frequency</li> <li>– Load with high harmonic content</li> <li>– Load unbalanced</li> <li>– Serious contamination on the core</li> </ul>
<i>High excitation current</i>	<ul style="list-style-type: none"> <li>– Frequency too low</li> <li>– Input voltage too high</li> </ul>
<i>Switches or fuses</i>	<ul style="list-style-type: none"> <li>– Inrush</li> <li>– Turn-to-turn fault, short-circuit between strands</li> </ul>
<b>Dielectric circuit (isolation)</b>	

Fault symptom	Possible causes
<i>Smoke</i>	Insulation fault
<i>Burnt insulation</i>	<ul style="list-style-type: none"> <li>– Lightning overvoltage</li> <li>– Switching/line fault</li> <li>– Damaged connector sockets, taps or surge arresters</li> <li>– Major quantities of dirt and/or dust deposited on or clinging to winding surfaces /in cooling ducts</li> </ul>
<i>Overheating</i>	<ul style="list-style-type: none"> <li>– Clogged ventilation ducts</li> <li>– Insufficient ventilation</li> </ul>
<i>Switches or fuses tripped</i>	<ul style="list-style-type: none"> <li>– Insulation fault</li> </ul>

## 13 RECYCLING OF CAST RESIN TRANSFORMERS

According to the currently valid legal provisions, cast resin transformers do not contain any parts that are toxic waste.

Most of the transformer parts (approx. 95%) can be recycled.

Transformer parts	Disposal / recycling
Laminations, steel structures and carriage	Scrap iron
LV windings	Copper or aluminum scrap
HV windings (shredded)	Copper or aluminum scrap, epoxy resin / glass fiber components in domestic waste
Small parts: post insulators, supporting blocks, spacers etc.	In domestic waste

SGB offers free disposal / recycling of cast resin transformers manufactured by SGB. Upon prior clarification / by appointment, the units must be delivered to SGB by the customer.

## 14 INDEX

<b>C</b>		Overload capacity.....64
carriage .....	33	
Checking consignment .....	39	
Checks before applying voltage .....	62, 74	
Commissioning.....	52	
Conditions on site .....	22	
Crane.....	11, 28, 40	
<b>D</b>		<b>P</b>
Degrees of contamination.....	67	Pacemaker.....
Description .....	19	Packaging.....
Distances .....	43	Phase connection .....
<b>E</b>		Phase terminal: .....
Electrical shock .....	75	Planning details .....
Electric arc.....	42, 57, 61, 63, 71	Positioning.....
Electric shock .....	42, 52, 57, 61, 63, 65, 71, 75	Protection measures .....
Electromagnetic behavior .....	25	
Electromagnetic disturbance .....	63	<b>R</b>
Enclosure.....	17, 74	Rail transport.....
<b>F</b>		Recycling.....
Fan.....	61, 73	Road transport =< 10 t .....
Fans .....	17	Rolling the transformer .....
Forklift truck.....	12	
Fork-lift truck.....	35	<b>S</b>
<b>I</b>		Safety.....
Installation .....	42	Intended use.....
<b>L</b>		Liability .....
Load securing .....	38	Warranty .....
<b>M</b>		Safety information.....
Machine base.....	44	Commissioning .....
Maintenance .....	65	Decommissioning .....
Minimum air gaps .....	43, 48	Installation.....
Minimum clearance .....	61	Maintenance .....
<b>N</b>		Operation .....
Normative references .....	23	Risk avoidance .....
<b>O</b>		Transport .....
Operation.....	15, 63	Staff .....
		Storage .....
		Suspension gear .....
		<b>T</b>
		Temperature monitoring.....
		Tightening torques .....
		Transformer bearings .....
		Transport .....
		Troubleshooting .....
		<b>V</b>
		Ventilation.....
		Vibration damper .....

Voltage conversion.....	54	Working at heights .....	11
Voltage taps change .....	14	<b>Z</b>	
<b>W</b>		Zinc corrosion .....	68
White rust .....	68		