SIEMENS energy

GEAFOL- / CARECO-
Cast-resin Transformer

Operating Instructions



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Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER
Indicates that death or severe personal injury will result if proper precautions are not taken.

⚠ WARNING
Indicates that death or severe personal injury may result if proper precautions are not taken

⚠ CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE!
indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING!

Siemens Energy products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens Energy. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the product described.

Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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1 General information and safety notes

1.1 General information

Note
Siemens Energy AG does not accept any liability for damage and failures that result from the non-observance of these operating instructions.

These operating instructions are part of the transformer delivery. Store the operating instructions near the transformer. Please read the operating instructions prior to handling the transformer and observe the information they contain. This is how you ensure safe and disturbance-free function.

Note
In addition to these operating instructions, special contractual agreements and technical documentation apply to a special transformer design and the associated supplementary equipment.

Please refer to the other operating instructions supplied with the product.

The described transformers correspond to the state-of-the-art at the time these operating instructions were printed.

Siemens Energy AG reserves the right to change individual components and accessory parts in the interest of further development. The changes serve to improve the performance and safety. The significant features are retained. The operating instructions are always being updated with new contents.

The latest versions of the operating instructions, the declaration of incorporation and the declarations of conformity are available in electronic form in the Online Support (https://www.siemens-energy.com/global/en/offerings/power-transmission/transformers/geafol-transformers.html#Downloads)

If you have any technical questions, please contact Technical Support (kirchheim-sck.energy@siemens-energy.com)

or the local contact addresses on the back of this manual.

1.2 Intended use

The transformers described in these operating instructions have been designed for stationary use in general engineering applications.

Unless otherwise agreed, the transformers have been designed for use in plants and equipment in industrial environments.

The transformers have been built based on state-of-the-art technology and are shipped in an operationally reliable condition. Changes made by users could affect this operational reliability and are forbidden.

The transformer have been designed solely for the application described in the IEC 60076-11. Do not operate the transformer outside the specified power limit. Other operating conditions must be contractually agreed.

1.3 Obligations of the user

The company operating the unit must ensure that all persons assigned to work on the transformer have read and understood these operating instructions and that they comply with them in all points in order to:

- Eliminate the risk to life and limb of users and others
- Ensure the operational safety of the transformer.
- Avoid disruptions and environmental damage through incorrect use.

Comply with the following safety instructions:

Shut down the transformer and disconnect the power before you carry out any work on them.

Make sure that the transformer cannot be turned on accidentally, e.g. lock the key-operated switch. Place a warning notice at the drive connection point which clearly indicates that work is in progress on the transformer.

Carry out all work with great care and with due regard to "safety".

For all work, carefully comply with the relevant regulations for work safety and environmental protection.

Comply with the instructions on the rating plates and warning plates attached to the transformer. The rating plates and warning plates must be always kept free from paint and dirt. Replace any missing rating or warning plates.

In the event of unexpected changes during operation, switch off the drive unit immediately.

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Take appropriate protective measures to prevent accidental contact.

Take appropriate protective measures to prevent accidental contact with parts and equipment that heat up to over +70 °C.

When removing protective equipment, keep fasteners in a safe place. Re-attach removed protective equipment before commissioning.

Do not place any objects on the transformer.

Do not carry out any welding work on the transformer. Do not use the transformer as a grounding point for welding work.

Carry out equipotential bonding in accordance with applicable regulations and directives by electrotechnology specialists.

Comply with the permissible tightening torque of the fastening bolts.

Replace damaged bolts with new bolts of the same type and strength class.

Siemens Energy AG accepts the warranty only for original spare parts.

The manufacturer who installs the transformer in a plant must include the regulations contained in the operating instructions in its own operating instructions.

Do not step on the transformer, the fans or the delta connection tubes

If you have any questions, please contact the manufacturer's factory (See back of these operating instructions).

1.4 The five safety rules

For your own personal safety and to prevent material damage when carrying out any work, always observe the safety-relevant instructions and the following five safety rules according to
EN 50110-1 Working in a voltage-free state. Apply the five safety rules in the sequence stated before starting work.

Five safety rules :

1. Disconnect. Also disconnect the auxiliary circuits, for example the anti-condensation heating

2. Secure against reconnection

3. Verify absence of operating voltage

4. Ground and short circuit

5. Cover or safeguard neighboring live parts

After the work has been completed, undo the measures taken in the reverse order.

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1.5 Particular types of hazards

⚠ DANGER!



High Voltage!
Do not approach the transformer or remove protective covers until the transformer is de-energized.

⚠ WARNING!



Extreme surface temperatures!

Hot surfaces over +55 °C pose a burn risk.
Measure the surface temperature before working on the transformer.
Do not touch the transformer as long as the surface temperature is not below +55°C.

⚠ WARNING!



Sharp edges and corners!
General risk of injury by sharp edges and corners.

⚠ WARNING!



Falling!
General risk of injury by falls.
Use only self-locking climbing assistance

⚠ WARNING!



Magnetic field!
The transformer generates a magnetic field.
People with pacemakers must stay at least 3 m away from the transformer

1.6 Occupational safety and protective equipment



Read operating instructions



Wear protecting gloves



Wear protecting glasses



Wear safety shoes



Secure the transformer against being switched on again during work!

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2 Scope

These operating instructions apply to cast-resin transformers in three-phase or single-phase design including all special transformers such as converter and starpoint transformers of the series

GEAFOL / GEAFOL Neo; Typ 4G... and
CARECO / CARECO Neo; Typ 4G...

Rating plate

On the transformer and the housing (if any) is a rating plate with the nominal values and define operating conditions.

3 Usage

Unless otherwise agreed, the transformers are designed in accordance with the applicable standards for the following cooling air values:

- 40° Celsius at any given time
- 30° Celsius monthly average of the hottest month
- 20° Celsius yearly average

GEAFOL-/CARECO-transformers intended for installation at altitudes over 1,000 m above sea level are identified as such on the rating plate, which cites the maximum permissible installation elevation.

3.1 Classification in accordance to IEC 60076-11

GEAFOL-/CARECO transformers fulfil the classes defined in EC 60076-11:

Environmental class

GEAFOL/CARECO: Standard E2 - Frequent condensation or light pollution or combination of both

GEAFOL NEO /CARECO NEO: Standard E3 -
Frequent condensation or heavy soiling, even both at the same time. (E3 for wind turbines on request.)

Fire behaviour class F1

The characteristics of the transformer limit the risk of fire.

Climatic class

The following climate classes are available for GEAFOL/CARECO transformers:

Climatic class	Temperature for	
	Transport and storage	Operation
C2*	to -25°C	to -25°C
C3**	to -40°C	to -25°C
C4	to -50°C	to -40°C

*) Standard for CARECO-transformers
**) Standard for GEAFOL-transformers
For lower ambient temperatures, external preheating equipment must be installed on site.

Corrosion protection

The corrosion protection is available in accordance to ISO 12944 based on the customer's specification in
C2H (e.g. interior, rural areas), or
C4H (e.g. industrial atmosphere. coastal), or
C5H (e.g. aggressive atmosphere, offshore) executed, or
CX (extreme) in agreement with customer.

Frequency of energization

The frequency of energization on is limited to max. 3 times a day, max. 50 times a year, unless otherwise agreed.

Load dump conditions for machine transformers

Max. Voltage rise at load dump 140% of Unenn for max. 5 seconds.

Operating conditions

The requirements at the installation site according to IEC 60076-11, chap. 4.2 must be observed, in particular with regard to grounding of transformers

- Protection of the transformer against overvoltages
- Load current harmonic content
- Symmetry of three-phase supply voltages
- Environmental conditions concerning biological environmental conditions, chemically active substances, mechanically active substances, mechanical conditions

Regenerative mode

CAUTION!
The transformer may only be used in regenerative mode (Step-up) with an appropriate protective device.

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4 Description



1 Low-voltage terminals
2 Lifting lugs
3 Lashing lugs
4 High-voltage terminals
5 Delta connection
6 Grounding screw
7 Lower core frame
8 Wheels, can be turned 90°
9 Pulling lugs
10 High-voltage tappings
11 (these may also be on the low-voltage terminal side)
12 Casted high-voltage winding
13 Connection for temperature monitoring system
14 Upper core frame
15 Low-voltage winding

Core

Only grain-oriented, cold-rolled sheets insulated on both sides are used for the iron core. The leg and yoke cross-sections are staggered with different lamination widths. The outer legs have miter joints. Legs and yokes are connected by 45° cuts, and the middle leg with a pointed miter joint at the yoke junction.

Windings

The high-voltage coils are made of aluminum or copper foils and high-quality insulating films. Each phase winding is formed from several separate coils connected in series; these are encapsulated in resin under vacuum. The winding ends and tappings are routed to threaded bushes and are encapsulated with the remainder of the winding. The low-voltage coils are made of aluminum/copper strips and resin-impregnated insulating film (prepreg).

Insulation

The insulation structure is dimensioned on the basis of the impulse voltage distribution. It ensures freedom from partial discharge up to twice the rated voltage, as well as thermal and mechanical strength.

Supports

A clamping arrangement designed specifically for the characteristics of the strip/foil windings and the flexible bracing of the coils ensure both high short-circuit strength and a very low noise level.

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5 Transport, goods receipt, storage

5.1 Unloading, lifting by crane

GEAFOL/CARECO transformers must be lifted by the lifting lugs provided on the upper core frames (Fig. 5.1). The transformer must be lifted and transported with four individual chain strands in the correct angle.
The instructions on the labbels at the lifting lugs must be observed (see Fig. 5.2, 5.3). If the transformer is delivered with the housing fully assembled, the relevant information on the housing must be observed

CAUTION!
Do not push or pull on the high-voltage windings or their connecting tubes.



Fig. 5-1: lifting lugs for crane hook with

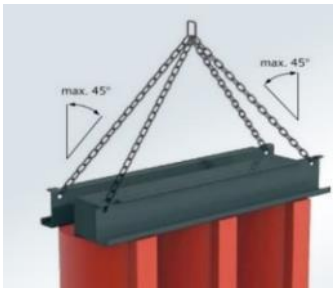


Fig. 5-2: Correct lifting of transformer

5.2 Transport by road and sea

The transformer is designed for accelerations of 10 m/s2 or 1.0 g in all directions during transport. For this purpose, the transformer must be fixed as described below.

To fix the transformer on the loading area, use an anti-slip mat or fix the transformer at the crossbar on the floor of the loading area. Tension belts must then be attached to the lashing eyes of the upper press frame from the inside (see Fig. 5-4).

The tensioning straps must not be in contact with the windings of the transformer or the rejections. When tightening the tensioning straps, make sure that the tension is applied evenly to the opposite tensioning straps.

CAUTION!
Pulling on the tensioning straps from one side can generate a permanent skewing of the transformer!



Fig. 5-3: Not correct lifting

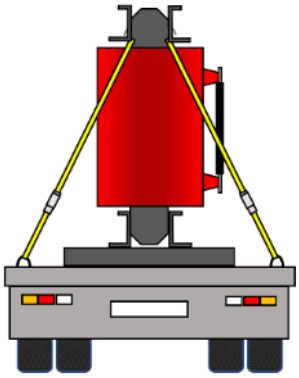


Fig. 5-4: Lashing the transformer to the loading area

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5.3 Unloading and lifting with forklift truck

When using a forklift truck, insert the forks into the transport bridges of the transformer.



NOTICE!
If signs prohibiting transport by forklift are attached near the bottom of the transformer, transport of the transformer by forklift is absolutely prohibited!

Forklift transports are only permitted if the transporter ensures that

- the transformer is moved horizontally (Fig. 5-5)
- the transformer is adequately secured against the risk of tipping and/or falling and
- damage to the iron core between the core frames and any attached accessories like fans or grounding switches is reliably prevented.

5.4 Moving, placement

If a transformer is moved on its transport wheels, the pulling lugs in the lower core frames are to be used as points of application (see figure 5.6).
The drawbar between the towing vehicle and the transformer must be mounted as horizontally as possible (see figure 5.7).

⚠ WARNING!
Do not pull the drawbar eyes jerkily or from above. (Danger of tipping over)

⚠ WARNING!
The centre of gravity of the transformer is in the upper half. Make sure that you transport the transformer horizontally.

⚠ WARNING!
Moving the transformer on the transport wheels is only permitted on a firm, level surface.

NOTICE:
Moving the transformer on the transport rollers is permitted up to max. 50 m

5.5 Unpacking, examination

GEAFOL-/CARECO-transformers should be unloaded and unpacked in a sheltered area and inspected immediately for trans-portation damage. Any visible damage must be noted in the transport papers and confirmed by the deliverer. The sender must be informed immediately so that a suitable claims settlement procedure can be initiated, if necessary with the participation of the transport insurance company.

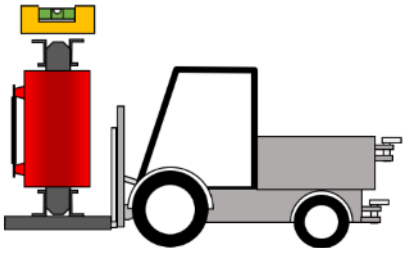


Fig. 5-5: Horizontal transportation of transformer by forklift



Fig. 5-6: Pulling lugs in lower core frame

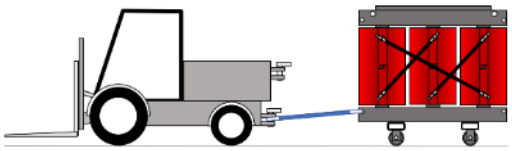


Fig. 5-7: Pulling of transformer with transport wheels

5.6 Storage

If the transformer is not commissioned immediately it must be stored in a sheltered area that is dry and protected from sunlight.
The transformer must be packed in a protective film when being transported on-site or being stored temporarily. This effectively prevents the ingress of dust and foreign matter. In order to prevent condensation from forming, an adequate quantity of desiccant agent (such as silica gel) must be enclosed in the packaging.

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5.7 Lifting the transformer on support plates during insertion (Optional)

For slight lifting of the transformer, support plates are optionally attached to the side of the base frame (See Fig 5-8)

⚠ DANGER!
Do not lift the transformer only at one support plate!

⚠ DANGER!
Do not work under transformer as long as lifting rams are under load!

The lifting is performed simultaneously on all support plates in small steps. The lifting jacks can be underlaid with hardwood to distribute the pressure on the base and reduce the lifting distance (See Fig 5-8). After lifting, the transformer frame is secured by a temporary stable sub-structure, e.g. with hardwood, and lowered onto it. This reduces risks due to failure of a lifting jack.

After the relevant measure has been carried out, e.g. installation of an insulating mat or removal of rollers, the temporary substructure must be removed and the lifting jacks lowered evenly.

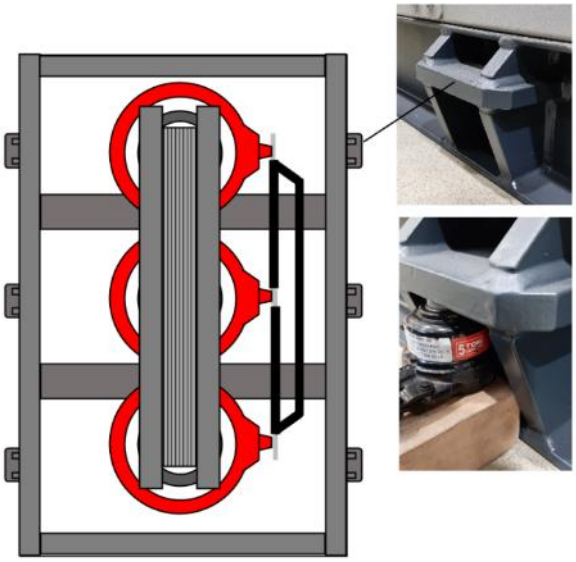


Fig 5-8: Lifting of transformer at support plates

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5.8 Data logger of vibrations (Optional)

At the customer's request or as specified by Siemens Energy, transformers are equipped with data logger sensors for continuous recording of vibrations. These sensors are activated
before transport. During the entire transport route, the data logger records the occurring shocks and vibrations. The
recorded data can be read out and transmitted wirelessly. Details can be found in the barcode on the product.

The data logger is located on the frame of the transformer (see Fig. 5-9)

In the event of transport damage, Siemens Energy can request the customer to transmit the data from the data logger.
customer.

The data logger can be sent back to Siemens Energy for reuse.
Siemens Energy for reuse (for address see
Back page of this manual)



Fig 5-9: Data logger of vibrations

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5.9 Covers on high-voltage tappings and tubes of delta connection

Transformers of the serie GEAFOL-/CARECO COMPACT for may have covers on the high voltage tappings and the tubes of the delta connection (See Figure 5.8) These covers are essential parts of the insulation system.
The transformer may only be operated if these covers are correctly installed.
Damaged covers must be replaced BEFORE switching on the transformer. A modification of the covers is not permitted !

⚠ WARNING!
Switching on the transformer with missing or damaged electrical insulation covers may destroy the transformer.



Figure 5-10: Covers on high-voltage tappings and tubes of delta connection

5.10 Disassembly of delta connections

⚠ WARNING!
Disassembly and fitting of the delta connections is the responsibility of the customer !

When installing the transformer in confined spaces, it may be necessary to dismantle the delta connections.
If there are covers at the ends of the switch tubes, open the cable ties with a spanner and carefully pull the cover off the screw connection.
Mark the screws and switch tubes with the relevant installation position BEFORE dismantling the switch tubes!

⚠ WARNING!
Tightening the screws of the delta connections with too low torque or mixing up the screws of can lead to serious damage to the transformer!

⚠ WARNING!
Incorrect assembly of the delta can cause a serious damage to the transformer when switching on.

CAUTION!
The screws for fixing the switch tubes may have different lengths. Mixing up the screws can result in the torque being achieved without the switch tubes being pressed against the contact surfaces.

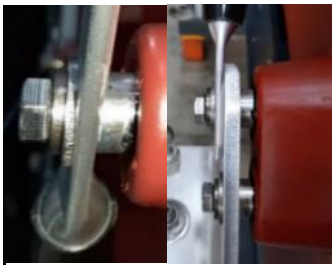


Figure 5-11: Position of the washers at the delta connection Anschluss



Figure 5-12: Detect the end position of the cover by feeling of the screw

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The arrangement of the switch tubes and washers is shown in Fig. 5-9. All six screws of the switch tubes must then be tightened with a torque wrench (torque for M10 with 45 Nm, for M12 with 75 Nm).
If there are covers on the switch tubes, push the cover onto the connection cone until the screw of the contact connection can be felt through the cover (see Fig. 5.10).
Position the clamp and tighten the hexagon of the clamp until the front edge of the white marking on the band is flush with the body of the clamp (See Figure 5.11)



Fig. 5-13 Position of color marking on clamp after tightening

5.11 Setting up

⚠ DANGER!
Cast-resin transformers are not safe to touch. The power must be shut off before work is performed on the transformers. Applicable regulations must be observed.

The transformer must be positioned on a stable, level surface.

GEAFOL-/CARECO-transformers should be installed only in a sheltered area or cell that is dry and protected from sunlight, where the degree of protection assured is at least IP 20. If appropriately coated with special paint and if an outdoor housing is used, they are also suitable for installation outdoors (minimum IP 23).

GEAFO/CARECOL transformers need an adequate supply of fresh air to dissipate the heat loss. Approximately 200 m3 of fresh air per hour and for each kW of heat loss is the recommended value; more information can be found in the GEAFOL Planning Guidelines.

5.12 Minimum clearances

Make sure that the clearances from the surface of the cast-resin coils to the walls, busbars, grounded parts, and other elements satisfy the applicable installation and safety regulations
(see Table 5-1 and Fig. 5-14).
For installation above 1000 m above sea level, the minimum distances according to Table 5-1 shall be increased by one percent for every 100 metres of altitude by which the installation altitude exceeds 1000 m.

Maximum voltage for equipment Um1)	Rated lightning impulse withstand voltage ULI1) (See type plate)	Minimum clearances (see Fig 5.10)			
[kV]	[kV]	a** [mm]	b** [mm]	c** [mm]	d***
12	75	120	*	55	
24	95	160	*	85	
24	125	220	*	105	
36	145	270	*	125	
36	170	320	*	170	
52	250	480	*	300	
72,5	325	630	*	450	

1) see IEC 60071

* If there are high-voltage tappings on this side, the value in column a applies to the clearance b; otherwise, the value in column c applies.
** Distance from blank, energized parts to walls or OS cables. For transformers with complete insulation at connection bars and switch tubes (bottom and top), the values of dimension c are to be used for the minimum distances of dimension a.
*** The distance d between the delta connections is defined constructively by the manufacturer

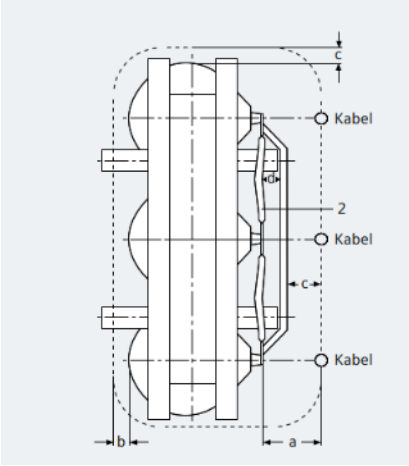


Fig. 5-14: Minimum clearances around GEAFOL cast-resin transformers with bare tappings and delta connection tubes

5.13 Ventilation of the transformer room

Every transformer has heat loss occurs during the operation. This heat must be dissipated from the transformer room.
A good cooling effect is achieved if the cooling air flows in at the bottom of the room and flows out at the top of the room
(see Fig. 5-15).
The cooling type is shown on the nameplate. The code of the cooling type is shown in Table 5-2.
Note:
A transformer designed up to a defined rated power with natural ventilation cooling, and for a higher rated power with forced cooling, is marked with ON/AF.

CAUTION!
Operate the transformer at least with the type of cooling specified on the nameplate.

Make sure that the ventilation ducts are not covered. If the supply air is heavily polluted, it must be filtered.

Make sure that there is no condensation above the transformer that steadily drips into the transformer.

If the transformer is regularly switched off for several days, make sure that no condensation occurs during this time.

This prompts the transformer to become dirty.
If the cooling effect is too low, a ventilation system can be retrofitted.

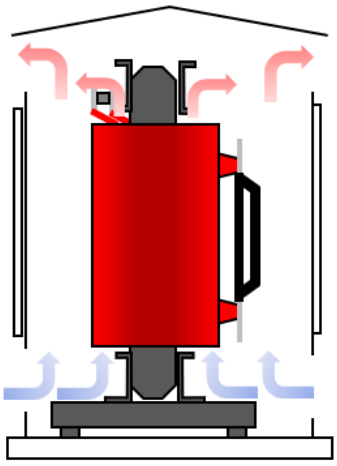


Fig. 5-15: Ventilation of transformer room

		Symbol
Cooling medium	Air	A
	Water	W
Type of circulation	Natural	N
	Forced	F

Table 5-2: Symbols of cooling method

The t
face.

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6 Connecting

CAUTION!
When connecting the transformer, do not climb onto the delta connection, overvoltage connections, busbars or insulators!

CAUTION!
Metallic objects in the coils can destroy the transformer!
The coils must be covered during connecting

6.1 Connection routing

GEAFOL/CARECO transformers allow many connection combinations, both from above and below.

When connecting cables are use, make sure that they feature adequate strain relief and are routed so that the voltage clearances are maintained in line with relevant regulations
(see Fig. 6.1, 6.2). The minimum clearances for cable connections shown in Table 5.1 must be observed.

6.2 Connection of high voltage

On the high-voltage side, the transformer is connected to the surfaces of the delta connecting tubes or the terminals provided on the casted delta connection bar, or to the cast-on post insulators on the high-voltage pottings (Y connection).

CAUTION!
For transformers with covers on the upper connections of the high voltage (see chap. 5.8), the HV must be connected always to the lower connections (see fig. 6.3).
Do not remove the covers !

6.3 A Connection of low voltage

On the low-voltage side, the transformer is connected to the aluminum terminals provided for this purpose. Here again it must be ensured when connecting cables, that they feature adequate strain relief to avoid undue mechanical stress at the terminals. The following guidelines must be observed when connecting the transformer terminals via expansion straps.

If the low-voltage connection is established with busbars, an expansion strap (flexible connection element) must be installed between the transformer and the busbars. This keeps mechanical stresses away from the transformer (see Fig. 6-4) and largely prevents transmission of structure-borne transformer noise. Detailed information on bolted busbar connections can be found in DIN 43673.

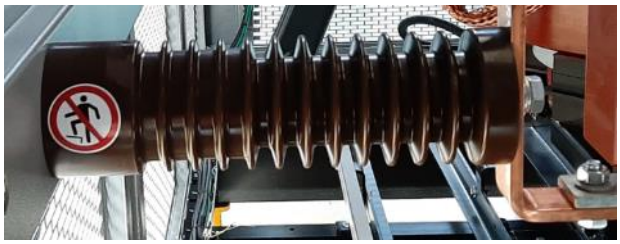


Bild 6-1: Nicht auf Schaltrohre, Stromschienen oder Isolatoren steigen!

.



Fig. 6-1: Example of connection

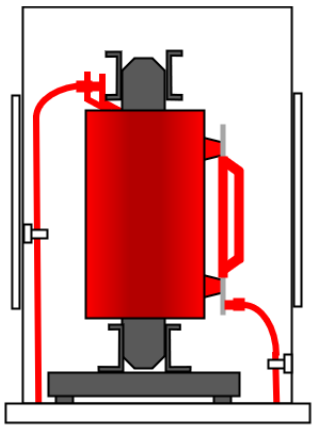


Fig 6-2: Connection CGEAFOL/CARRECO transformers from below

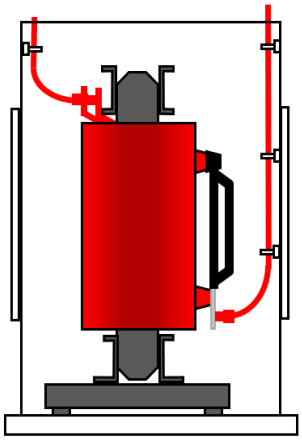


Fig 6-3: Connection GEAFOL/CARRCEO COMPACT from top (Standard design)

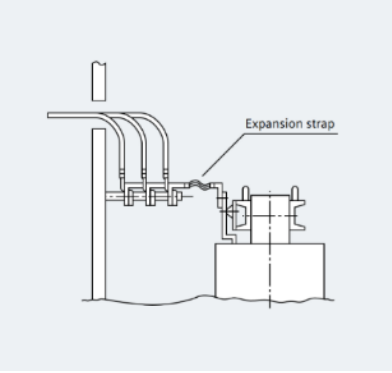


Fig. 6-4: Low-voltage end connection with expansion strapp

6.4 Surface preparation

Before making any bolted or terminal connections, it is necessary to remove the thin, invisible layer of oxide, which is a poor conductor of electricity, from the aluminum surface. Therefore, the contact surfaces to the customer connections must be made metallically bright. Every time a point of contact is opened, the aluminum contact surface must be subjected to the full preparation process again before it is bolted back together.
If the transformer is installed indoors in a room where condensation is expected, or where corrosive gases are present, and if the transformer will be connected to copper busbars, an aluminum sheet that is copper plated on one side (the product known by the trade name “Cupal”, for example), must be inserted between Cu-Al contact points.

The aluminum side is in contact with the aluminum terminal. All edges of this sheet must protrude several millimeters to ensure that any corrosion occurring in the transition area remains outside the contact zone. Corrosion can be avoided for the most part by applying a protective coating to the cut edges of this Cupal sheet.

Tin-plated terminals can be combined with bare aluminum, copper or silver-plated surfaces.

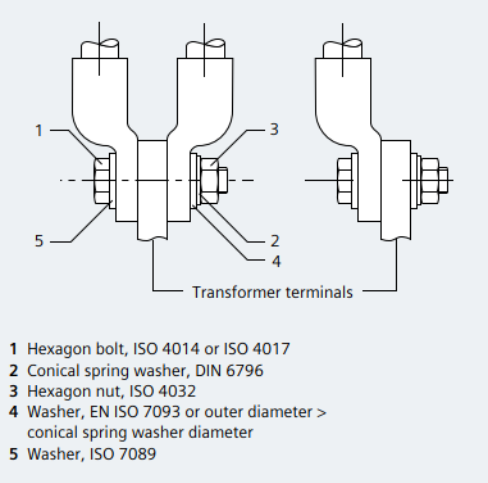


Fig. 6-5: Transformer connection with cable lug

6.5 Fastenings

Corrosion-proof parts must be used for bolted connections. Bolts in strength class 8.8 or 10.9 should be used. In order to transmit the bolting force to the largest possible contact surface, stiffened washers should be inserted under the bolt head and the nut. Spring elements are also necessary to resiliently accommodate heat-generated tension, to compensate for plastic deformation and maintain the required minimum contact pressure at all times.
Both conditions can be met by conical spring washers per DIN 6796, which are used in particular for conductor bar threaded fastenings.

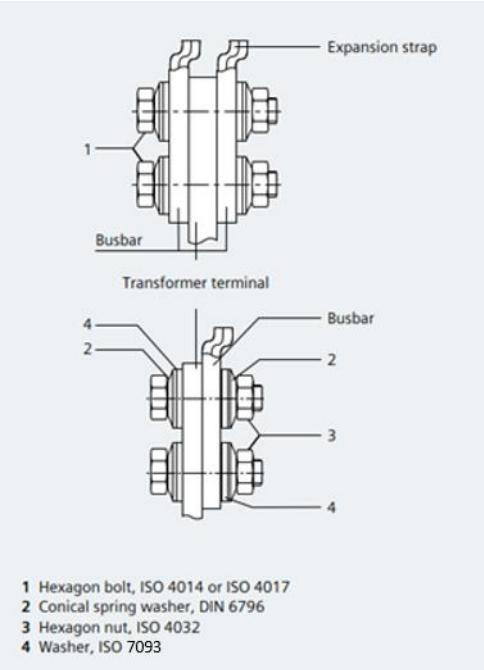


Fig. 6-6: Low voltage connection with expansion strap

6.6 Contact pressure

The bolts should be tightened with a torque wrench. This ensures that the bolt connections are made with adequate contact pressure.
To compensate for any settling in the joints, it’s advisable to retighten the bolts after a few hours. However, the torque then applied should not be greater than the torque applied in the initial installation.
For tightening the non-greased (dry) screw connections, we recommend using the tightening torques given in table 6-2

Bolt	Torque [Nm] dry
M 6	10
M 8	20
M 10	45
M 12	75
M 16	140

Table 6-1: Tightening torque values for the phase connections and tappings

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6.7 Grounding of transformers

Make sure that the necessary grounding connection is installed on accessories that are conected to the transformer after installation. Transformer housings must also be grounded in accordance with the known grounding specifications.
The grounding screws are located on the front sides of the lower press frame (see Fig. 6.7). A PE wiring must be connected here at one position. The dimensioning of the PE wiring is defined by specific regulations at the installation site.
For transformers with housing, corresponding grounding connections are located on the outside of the housing.



Fig. 6-7: Grounding connection

6.8 Temperature monitoring

The measuring sensors in the temperature monitoring system record the winding temperature. This acts as overload protection against excessive heat generation in the transformer windings.
The temperature monitoring system consists of PTC thermistors, according to DIN 44082 or resistance thermometers (PT100) in accordance with IEC 60751, and the associated monitoring devices.
The terminal box, the connection diagram of the temperature monitoring and the specification of the limit temperatures are located on the upper press frame as standard (Fig. 6-8).
The temperature values for the warning, alarm triggering or fan control functions must be set on the triggering device or monitoring system.



Fig. 6-8: Terminal box, connection diagram and limit temperatures on upper press frame (EXAMPLE)

6.9 Monitoring devices (Option)

For the activation of error messages on the basis of the sensor signals, different triggering devices are offered for GEAFOL/CARERCO transformers, depending on the type and number of sensors.
For transformers with housings as part of the scope of supply, the tripping devices are located in the control cabinet of the housing.
Information for connection and operation of the monitoring devices can be found in the respective operating instructions.
Test the function of the triggering devices during commissioning.



Fig. 6-9: Display of monitoring device (EXAMPLE)

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6.10 Siemens Sensformer® (Option)

The Sensformer is used for digital transmission of the measurement data in real time. By means of an app, an overview of the status of the individual transformers becomes possible. Likewise, a push message can be sent in the event of an error message.
The connection of the sensor transformer is located in the box on the front side of the upper press frame or in the control cabinet of the housing. I

nformation on connection and operation is available for you at https://www.siemens-energy.com/sensformer.



Fig. 6-10: Sensformer box

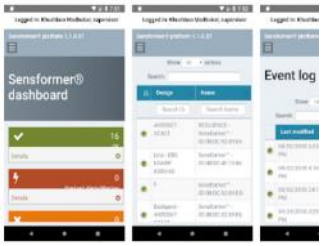


Fig. 6-11: Sensformer app

6.11 Fan (Option)

⚠ DANGER!
Disconnect the fans from the power supply before starting work on the transformer!

Caution!
Do not block the rotors of the fan while working on the transformer. This can lead to the damage of the fan.

NOTICE!
Do not step on fans or fan housing !

A control unit is required for temperature-dependent switching on of the fans (AN/AF operating mode). Switching on and off is carried out via an adjustable time or temperature in the monitoring unit.
Depending on the type, the fan is already connected to a monitoring device or is intended for the connection to a control device provided by the customer.
The connections of the fan are located on the fan motor of the individual fan on the bottom side of the transformer (Fig. 6.12) or below the middle fan.

- Pay attention to the correct voltage and frequency of the fan
- Connect the fan according to the operating instructions of the fan.
- During commissioning, check the function of all fans
- Ensure that the fans are rotating in the correct direction



Fig. 6-12: Power connection of fan

Notice:
On delivery, the default setting of the monitoring system types T154 and NT935 includes a functional test for fans. If run in the factory default setting, every 96 hours the fans will undergo a short test lasting 5 –10 minutes.

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6.12 Modification of high voltage tappings

By changing the position of the connecting brackets at the high-voltage coils, the voltage of the transformer can be changed according to the rating plate (Fig 6.13)
The numbering of the taps is explained on a label on the upper core frame of the transformer (Fig. 6.14)

⚠ WARNING!
The connecting brackets may only be reconnected when the device is deenergized.

CAUTION!
Operating the transformer with a voltage that does not correspond to the position of the switching jumpers on the top voltage taps may cause damage to the transformer.

NOTICE!
The change in voltage can destroy connected components. All connecting brackets at the HV windings must be fixed at the same voltage tapping.

NOTICE!
Different positions of the connecting brackets on the individual coils can destroy the transformer.
After reattaching, the screws of the connecting brackets must be tightened to the torque shown on the label (Fig. 6.14)


GEAFOL®

3 - Phasen - Transformator für		
Typ 4GB6244-3EY	F.-Nr.	
Bem.-Leistung		16
Verb. 5-6	10500 V	
Verb. 4-6	10250 V	
Bem.-Spg. 4-7	10000 V	
Verb. 3-7	9750 V	
Verb. 3-8	9500 V	

Fig. 6-13: Operating voltage on the rating plate depending on the position of the connecting brackets (SAMPLE)

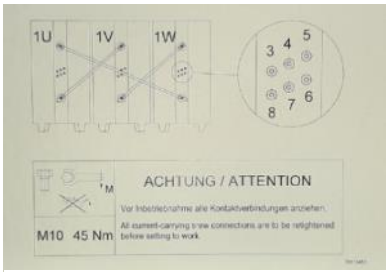


Fig. 6-14: Information label on the transformer regarding numbering and tightening torque of the taps (SAMPLE)

Cover on taps of connection bar

To remove the vacuum under the cover, press the silicone cap toward the inside with the fingers.

If there are covers on taps, these must be re-assembled after the intervention (Fig. 6.15).

Clean the sealing surfaces before reassembling.
Make sure that there is no consensual water in the Cover at assembly.

Turn the nuts onto the threaded pins by hand until the nut rests on the cover. Use a wrench and turn the nut 1 1/4 turn.



Fig. 6-15: Cover type A on taps of Connection bar

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7 Commissioning

The transformer must have been cleaned and it should not contain any foreign objects (see also Install, page 7).

- Compare the technical data on the rating plate attached to the transformer to the customer's requirements.
- Tighten all contact connections to the torque stated in Table 6.1.

NOTICE!
If the ambient conditions are outside the transformer specification (e.g. ambient temperature too low), the appropriate conditions must be established before switching on.

When larger transformers are switched on, in single cases visible sparks may occur on the outside (especially in the area of the core and the clamped parts), but these will soon subside.
This effect occurs for reasons of physics and has no influence on operating safety; it is not a defect.

CAUTION !
Due to the low attenuation, it may take the switch-on currents of GEAFOL cast-resin transformers some time to decay. Refer to the test report for the exact values. This must be considered when selecting fuses and/ or relay times.

ATTENTION!
The level and decay time must be taken into account when selecting the fuses and/or relay times.

If protection settings are incorrect, the transformer will be switched off during the transient response of the current. This will lead to high excess voltages in the transformer windings, where they may cause damage in single cases.

8 Inspection and cleaning

GEAFOL/CARECO transformers are practically maintenance-free. If they are operated in very dusty installations, for instance in rolling mills, we recommend cleaning several times a year. Typically once every year, the contact bolts, warning functions, and the operation of any attached fans should be checked.
The transformer must be switched off on all sides before starting maintenance work. All terminals must be short-circuited and grounded. The safety regulations must be observed.

⚠ DANGER!
Check that the transformer is de-energized before approaching the transformer or you do not remove protective covers. Secure the transformer against unauthorised switching on.

CAUTION!
Dust and dirt are the main causes of transformer overheating and electrical short circuits. Dust deposits lead to higher operating temperatures.

CAUTION!
Make sure that used tools and cleaning equipment are completely removed from the transformer again after the inspection.

CAUTION!
Do not use cleaning equipment with metal brushes. Loose metal wires can cause severe damage to the transformer. Do not use sharp-edged tools!

⚠ DANGER!
Do not switch on transformer until it is completely dry!

CAUTION!
The tightening torques on current-carrying components may be considerably lower than for steel parts according to table 6.1. Please observe the corresponding markings on the
components.

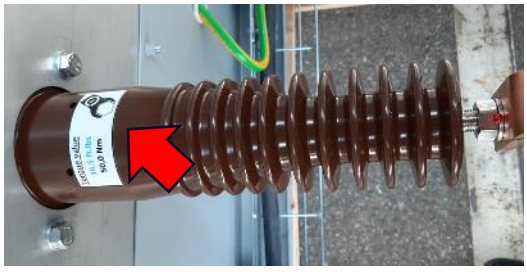


Fig. 8-1: Specification of the torque of a component

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Overview inspection activities

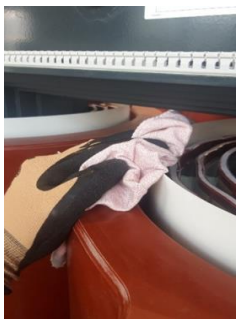
Remedy	Time interval (recommendation)	Description of the activity
Visual check	Commissioning 1x per year	• Check for soiling, damage, soot deposits, infestation by animals • Checking that the current-carrying connections are free of corrosion
Cleaning the transformer	Commissioning 1x per year/ In case of increased pollution several times a year	• Vacuuming of loose particles and dirt in the cooling channels of the upper and lower voltage coils with a hoover. Compressed air can also be used. • Cleaning or hoover the auxiliary equipment such as fans, surge arresters, connection terminals and the mounting substructure. • Rub down the dirty surfaces of the transformer with a cloth soaked in a commercially available surfactant-based cleaner. Then wipe with a dry. • Cleaning of auxiliary equipment such as fans, surge arresters, terminals and the baseframe. • Cleaning the floor and the wall around the transformer  Fig. 8.2: Blow out cooling channels  Fig. 8.3: Blow off upper yoke  Fig. 8.4: Cleaning upper voltage coil
Screw connections of all electrical connections and earthing at the transformer	Every 2 years /	• Check the torque of the screw connections of all electrical terminals, the high-voltage tappings, and the connections from one system to another in the case of double-tier transformer. Values of the torques see chap. 6, table 6.1. • Note: When using mechanical torque wrenches, make sure that the tension discs and spring washers are not pressed flat during repeated tightening over the years. From the 6rd year, reduce the tightening torque by 5 Nm compared to the specification.
Screw connections for electrical customer connection	To be defined by customer	• The responsibility for the connections made by the customer lies with the customer.
Control of the warning functions	Commissioning 1x per year and after error messages	• Visually check the clamp connections/ Retighten the screw terminals on the transformer and in the control cabinet on the housing (if present) • Carry out the function check according to the specifications in the operating instructions of the sensor/evaluation unit.
Fan check (if available)	Commissioning 1x per year	• Check attached fans for their function, cleanliness and operating properties in accordance with the specific operating instructions

Table 8-1

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9 Faults, causes and remedies

⚠ DANGER!
Check that the transformer is de-energized before approaching the transformer or you do not remove protective covers. Secure the transformer against unauthorized switching on.

NOTICE!
Only qualified personnel may repair faults on the transformer.

In the event of faults that cannot be rectified by the customer himself, a service center of Siemens AG must be informed.

Please state the factory number when making enquiries. The factory number is indicated on the rating plate.

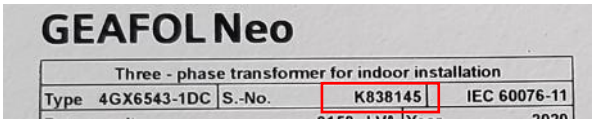


Fig.. 9.1: factory number on the rating plate

Product Support cast-resin transformers:

Telefon: +49 7021 9954 134
E-mail: kirchheim-sck.energy@siemens-energy.com
Webseite: siemens-energy.com/geafol

ATTENTION!
Return transports of transformers to Siemens Energy must
be carried out in accordance with chapter 5!

Standard spare parts

Part designation	Siemens Energy Kirchheim Material-No.
Temperature sensor PT100	4170004730
Tripping device MSF 220 K (PTC)	4170010437
PTC resistor 120° (Fan on)	4102642197
PTC resistor 140° (Warning winding)	4102642213
PTC resistor 160° (Alarm fault winding)	4103946662
PTC resistor 170° (Alarm Core)	4170020002
Monitoring device T119 (3xPTC)	4106894836
Monitoring device T154 (4xPT100)	4170010212
Monitoring device NT538 AD(8xPT100)	4170036322
Monitoring device NT935 AD (4xPT100)	4170195860
Fan switching device VRT600	4170033802
COMPACT delta connection insulating cap	4170258641
Pipe clamp cover COMPACT	4170261722

Table 9-1

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Potential faults

Faults	Potential causes	Test steps / Remedy
Transformer too hot, Warning / alarm message from the temperature sensors of coils	Permanent overload	Check load / load distribution, reduce load if necessary
	Screw connections on live parts untighten	Tighten Screw connections on energized terminals, torque values see chap. 6, table 6.2
	Bad ventilation, ambient temperature too high	Check the ventilation ducts on the housing, fan and cooler, replace defective component if necessary
	Sensor defect	Check the function of the relevant sensor, if necessary, replace the sensor
Transformer too hot, Warning / alarm message from the temperature sensors of core	Permanent overvoltage	Check voltage, reduce voltage if necessary Check the position of the high voltage tappings (see chapter 6.11)
Short circuit (triggering a monitoring unit)	Inrush current too high	Adjust inrush current
	Dirt	Clean the transformer, see chap. 8.
	Humidity too high	Check ventilation, remove water, clear water drainage,
Traces of soot on the transformer (Tracking)	Dirt	Clean the transformer, see chap. 8, check ventilation
	Screw connections on live parts untighten	Check screw connections, see chap. 8.
Crack / chipped material on high voltage coil mit soot	Short circuit in coil	Call customer service - Do not switch the transformer on again!
Smell	Evaporation after commissioning	No action - the odor disappears after a few hours
	Dirt in the coils or on the core	Clean the transformer, see chap. 8.
Unusual noises	High voltage too high	Check voltages, if necessary reduce the voltage
	Vibration of the housing,	Tigthen of loose components, attach vibration damper if necessary

Table 9-2

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10 Recycling and disposal

GEAFOL/CARECO- transformers have advantages at the end of their life cycle: Without risk to the environment, 94 percent of the material can be recycled.
Protecting the environment and conserving its resources are high priority corporate goals for us. A worldwide environmental management system in accordance with ISO 14001 ensures compliance with the law and sets high standards. Environmentally friendly design, technical safety and health protection are fixed for our products. Please observe country-specific laws for the disposal.

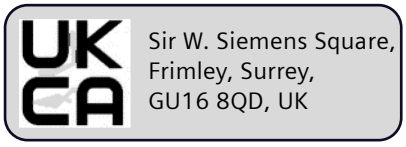
Recyclable materials in components

Separate the components for recycling according to the following categories:

- Electronic scrap, e.g. sensors
- Ferrous scrap (transformer core, press frame)
- Aluminum (winding upper and lower voltage coil, busbar)
- Non-ferrous metals, copper, brass (power lines, leads)
- Insulating materials (winding of upper and undervoltage coil)

11 Relevant standards

No.	Heading
IEC 60076-11	Power transformers Part 11: Dry-type transformer
IEC 60076-1	Power transformers Part 1: General
IEC 60076-2	Power transformers Part 2: Temperature rise for liquid-immersed transformers
IEC 60076-3	Power transformers Part 3: Insulation levels, dielectric tests and external clearances in air
IEC 60076-5	Power transformers Part 5: Ability to withstand short circuit
IEC 60076-10	Power transformers Part 10: Determination of sound levels
IEC 60076-12	Power transformers Part 12: Loading guide for dry-type power transformers
IEC 60076-16	Power transformers Part 16: Transformers for wind turbines applications
IEC 61936-1	Power installations exceeding 1 kV a.c. – Part 1: Common rules
EN 50708-2-1	Power transformers - Additional European requirements: Part 2-1 Medium power transformer - General requirements
EN 50708-3-1	Power transformers - Additional European requirements: Part 2-1 Large power transformer - General requirements
IEC 60721-3-4	Classification of environmental conditions - Part 3-4: Classification of groups of environmental parameters and their severities
IEEE Std. C57.12.01	Standard General Requirements for Dry-Type Distribution and Power Transformers
IEEE Std. C57.12.91	Standard Test Code for Dry-Type Distribution and Power Transformers



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12 EC declaration of conformity

SIEMENS energy

EG Konformitätserklärung/
EC Declaration of Conformity

Produktbezeichnung: *Product identification:*	GEAFOL / GEAFOL Neo; Typ 4G... CARECO / CARECO Neo; Typ 4G...
Hersteller: *Manufacturer*	Siemens Energy Global GmbH & Co. KG
Anschrift: *Address*	Hegelstrasse 20, 73230 Kirchheim unter Teck, Germany

Das oben beschriebene Produkt ist konform mit den Vorschriften folgender Europäischer Verordnung:

The product described above is in conformity with the provisions of the following European Regulation:

EU 548/2014	Mitteilung der Kommission im Rahmen der Umsetzung der Verordnung (EU) Nr. 548/2014 der Kommission zur Umsetzung der Richtlinie 2009/125/EG des Europäischen Parlaments und des Rates hinsichtlich Kleinleistungs-, Mittelleistungs- und Großleistungstransformatoren. *Commission communication in the framework of the implementation of Commission Regulation (EU) No 548/2014 on implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to small, medium and large power transformers.*
EU 2019/1783	Verordnung zur Änderung der Verordnung (EU) Nr. 548/2014 der Kommission zur Umsetzung der Richtlinie 2009/125/EG des Europäischen Parlaments und des Rates hinsichtlich Kleinleistungs-, Mittelleistungs- und Großleistungstransformatoren *Commission Regulation amending Regulation (EU) No 548/2014 on implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to small, medium and large power transformers*

Die Konformität mit der Richtlinie wird nachgewiesen durch die Einhaltung der folgenden Normen:

Conformity to the directives is assured through the application of the following standards:

Referenznummer *Reference number*	Ausgabedatum *Edition*	Referenznummer *Reference number*	Ausgabedatum *Edition*
EN 50708-2-1	2020-05	EN IEC 60076-11	2018-08
EN 50708-3-1	2020-05		

Unterzeichnet für und im Namen von:/ *Signed for and on behalf of:*
Siemens Energy Global GmbH & Co. KG

Kirchheim unter Teck, 19.11.2020
Ort / *place* Datum der Ausstellung/ *Date of issue*

i.V.
Christian Müller
Name / *name* Unterschrift / *signature*

Head of Factory Kirchheim unter Teck
Funktion / *function*

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Funktion / *function*

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