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into top technology all round

GEAFOL / CARECO cast-resin transformers

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The safe technology

GEAFOL / CARECO cast-resin transformers

Wherever distribution transformers have to assure the utmost safety in areas frequented by people, GEAFOL / CARECO® cast-resin transformers are the ideal solution.

With GEAFOL / CARECO, the limitations of liquid-filled transformers are avoided, but the proven characteristics such as operating safety and service life are retained.

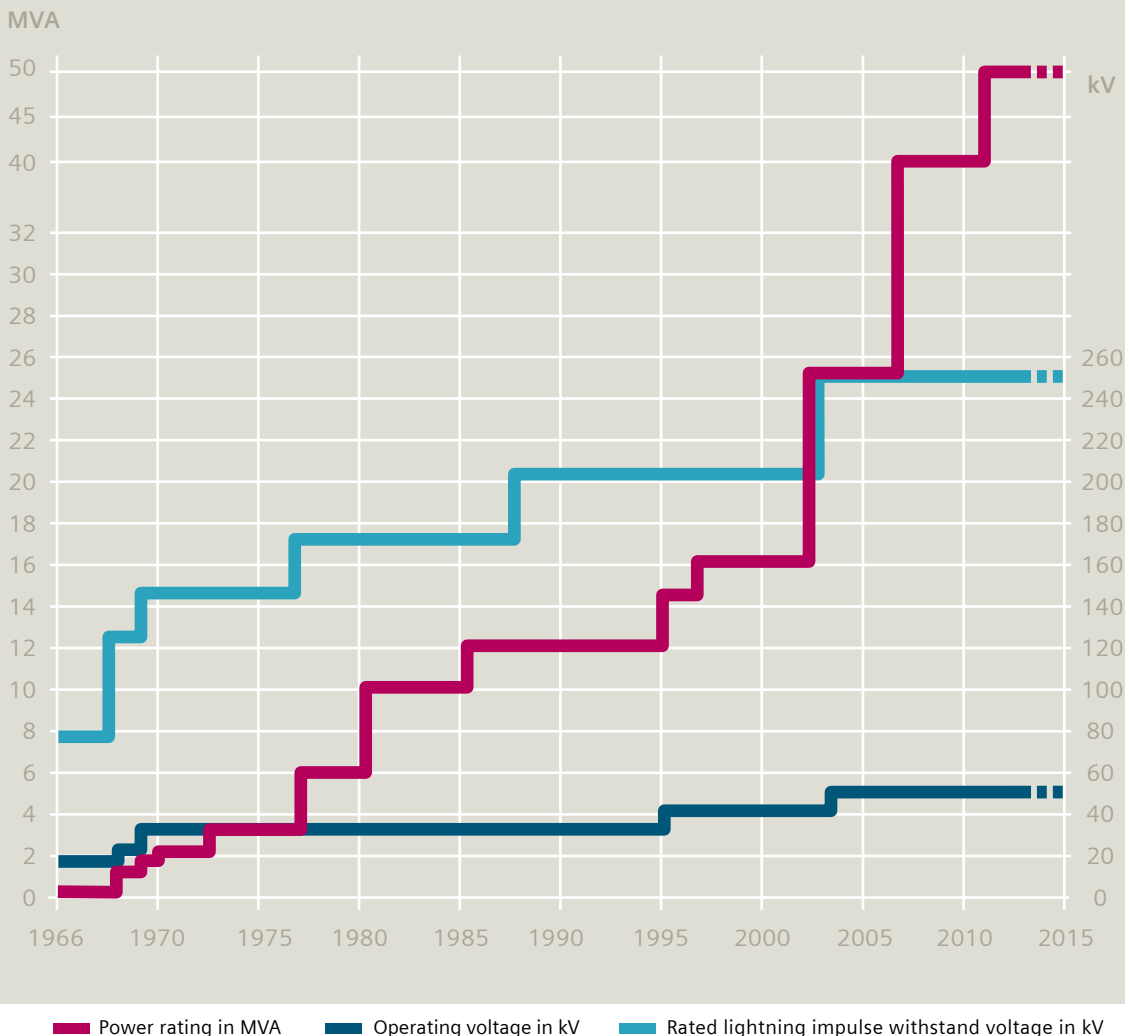
GEAFOL / CARECO cast-resin transformers comply with IEC 60076-11 or EN 60076-11 as well as VDE 0532-76-11. However, they can also be designed to meet special national regulations or customer wishes. We offer tailored solutions that meet all requirements when it comes to operating mode, low noise and loss levels, connection technology, type of cooling, as well as transport and installation.

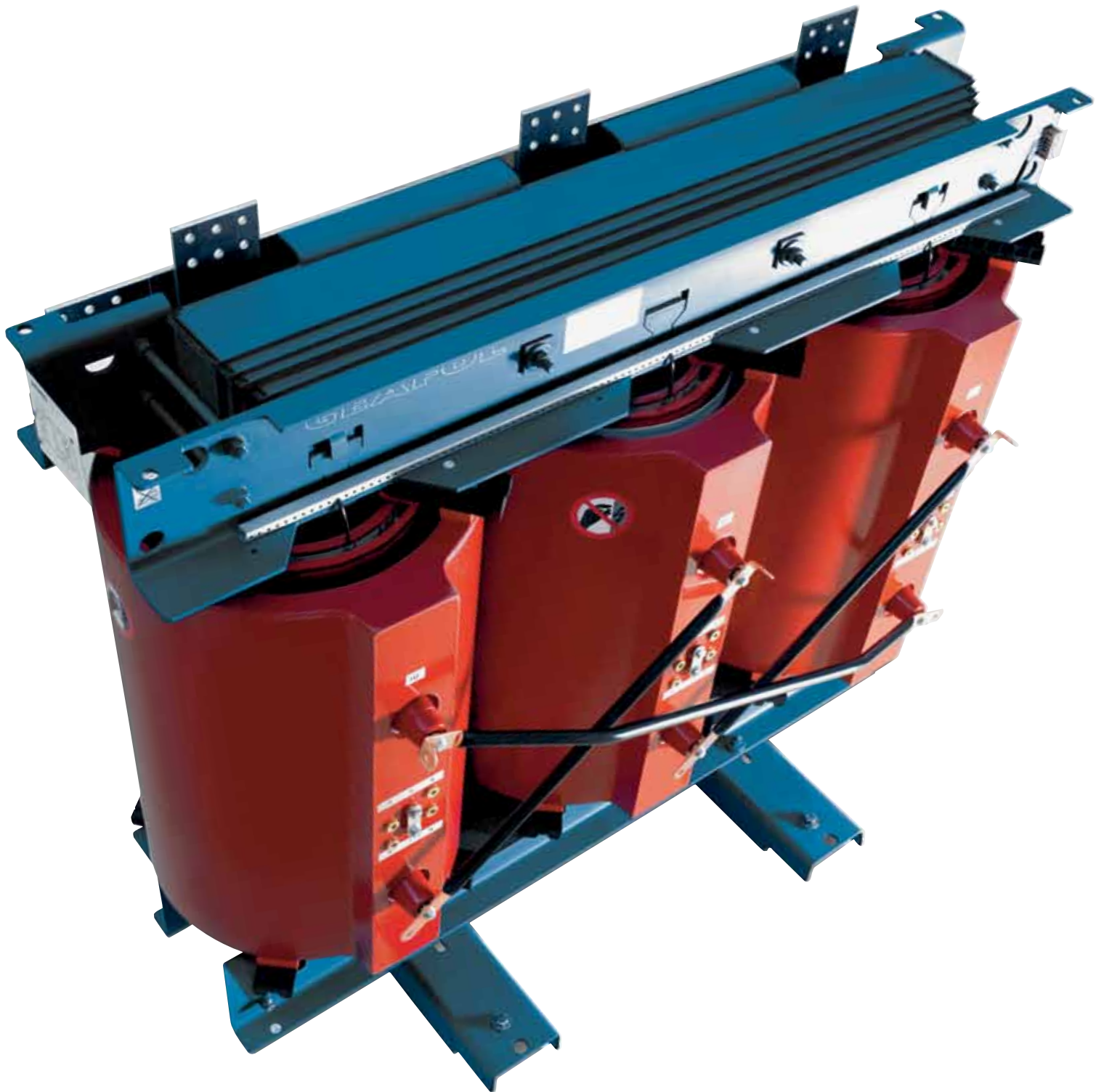
Safety proven 100,000 times over

There are good reasons why GEAFOL / CARECO cast-resin transformers are used wherever absolute safety is required. They can be found in high-rise buildings, hospitals, road and underground railway shafts, offshore installations, mines, wind turbines, nuclear power plants, and many other similar safety-critical environments. It is not surprising that the superior GEAFOL / CARECO technology is produced under license by many transformer manufacturers all over the world.

Over 100,000 GEAFOL / CARECO cast-resin transformers have proven themselves in power distribution all round the globe. The diagram below shows the power rating and voltage range developments achieved since 1966 as a result of continuous innovation.

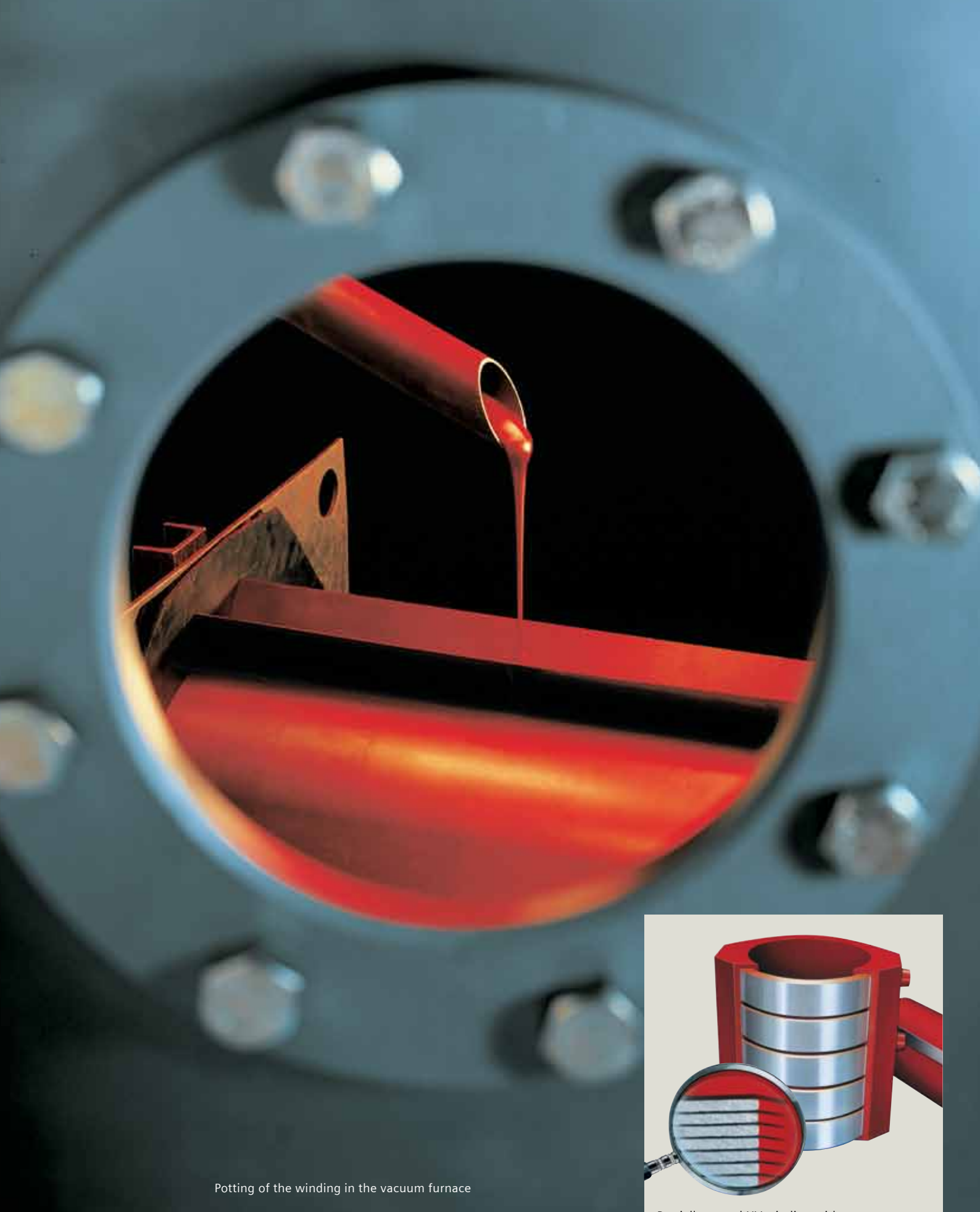
Development of voltage and power ratings



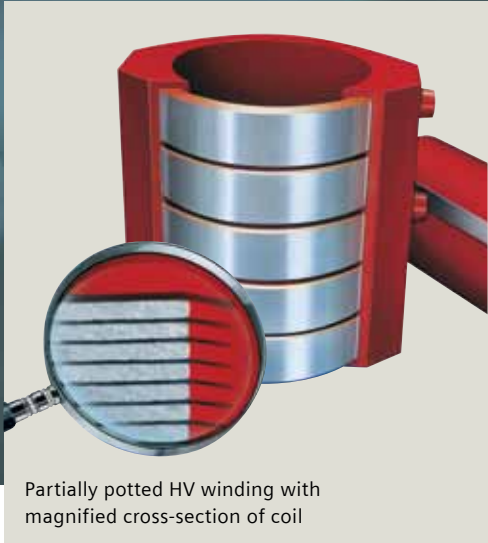


GEAFOL / CARECO transformers, with their environmentally sustainable technology and versatility, ensure efficient energy distribution at load centers.

GEAFOL / CARECO transformers cover an output range from 100 kVA to approx. 20 MVA with operating voltages up to 35 kV.



Potting of the winding in the vacuum furnace



Partially potted HV winding with magnified cross-section of coil

The perfect technology

GEAFOL / CARECO cast-resin transformers

The GEAFOL / CARECO principle has succeeded in producing transformers with excellent electrical, mechanical and thermal characteristics, which have also proved to be particularly compatible with the environment.

Maintenance-free – environmentally friendly – rugged: The insulation

GEAFOL / CARECO transformers are insulated with an epoxy resin/quartz powder mixture. This is an environmentally friendly material that makes the windings maintenance-free, moisture-resistant, tropicalized, flame-retardant and self-extinguishing. This eliminates the need for additional flame-retardant chemicals, such as aluminum oxide trihydrate, which can negatively affect mechanical properties as well as aging. Even when the insulation is exposed to arcing, no toxic gases are generated. The windings are clamped between resilient spacers that provide effective vibration insulation both from the iron core and mutually between windings. The result: GEAFOL / CARECO transformers are as quiet as oil-immersed types.

Electrically safe: The aluminum/copper foil winding

The coils of the high-voltage windings are made of aluminum/copper foil. Why foil windings? Because foil windings combine a simple winding technique with a high degree of electrical safety. The insulation is subjected to less electrical stress than in other types of windings. In a conventional round-wire winding, the interturn voltages can add up to twice the interlayer voltage, while in a foil winding it never exceeds the plain voltage per turn because each layer consists of only one winding turn. The result: High power frequency and impulse voltage withstand capability.

Why aluminum is recommended? The thermal expansion coefficients of aluminum and the used cast resin are so similar that thermal stresses due to load changes are kept to a minimum.

No gas inclusions: The epoxy resin casting process

The high voltage windings are potted with epoxy resin under vacuum at a high temperature. This procedure prevents undesirable gas inclusions. The quality of the potting combined with the electrical advantages of the foil winding plays a decisive role in providing freedom from partial discharges (up to twice the rated voltage). The low-voltage strip winding is also of aluminum/copper. The width of the aluminum/copper strip is equal to the length of the coil. This considerably reduces axial short-circuit forces in the transformer. The conductor strip and the insulation material are bonded together by heating and thus form a compact unit with sufficient strength to withstand radial forces reliably, for example in the case of short circuits.

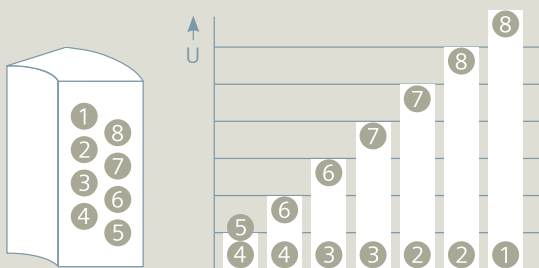
Universal: The application areas

Dry-type transformers must be marked with proven environmental, climate and fire resistance ratings. Our GEAFOL / CARECO cast-resin transformers are suitable for universal use and satisfy the requirements of the highest defined classes, as proven in comprehensive testing:

- Environmental class E2
- Climate category C2*
- Fire resistance class F1

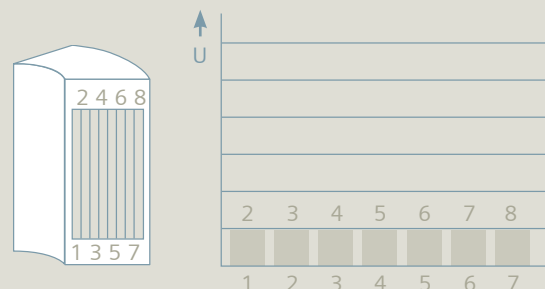
* For outdoor installation, IP 23 degree of protection must be maintained.

Voltage stress



Round-wire winding

The interturn voltages can add up to twice the interlayer voltage



Foil winding

The interlayer voltage is equal to the interturn voltage

The flexible technology

GEAFOL / CARECO cast-resin transformers

50 % performance reserves – with radial-flow fans

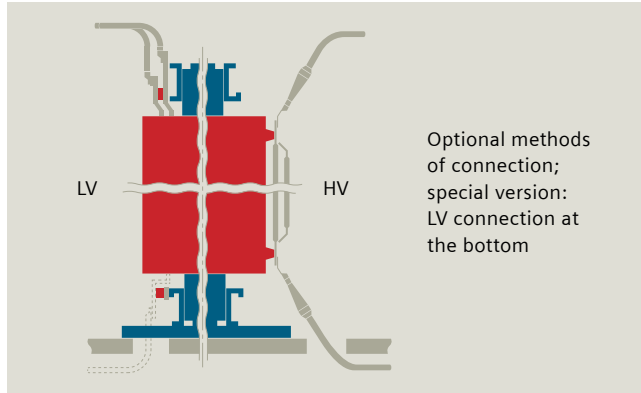
Radial-flow fans with temperature-dependent control can be installed to provide capacity reserves and to cover peak load periods. In this way, the transformer output can be raised by up to 50 %. To simplify installation and connection, the transformer is optionally available with connection on either the HV or LV side, top or bottom (note: LV connections are usually located on top, if fans are installed). Plug connections are also available.

Uncomplicated: Planning with maximum freedom

Planning with GEAFOL / CARECO does away with the limitations imposed by conventional transformer technology. Since these transformers can be installed without difficulty at load centers, optimum supply system concepts are possible. No special safety features are required (such as coolant-collecting troughs). Since the GEAFOL / CARECO transformers often need less space than liquid-filled and gas-insulated transformers, a higher output can be accommodated in the same area. The modular design of the transformer is another economical feature. Windings, for instance, can be mounted and replaced on the spot.

CO₂ balance

State-of-the-art transformers reduce the CO₂ balance because of their high efficiency and low transport losses. Thanks to environmentally friendly product design and the resulting reduction in materials and final weight, CO₂ is reduced during the manufacturing process as well.



Economical: No maintenance, no maintenance costs

GEAFOL / CARECO transformers are practically maintenance-free. Once connected, in most cases they can be left to get on with their job. If the advantages of GEAFOL / CARECO transformers are taken into consideration as early as at the planning stage, the overall costs of a power supply system can often be considerably reduced.

Disposal

GEAFOL / CARECO transformers are long-lasting investment goods with an economic lifetime of 30 or more years. Yet despite that, the time will come when the product will need to be replaced and disposed of. GEAFOL / CARECO cast-resin transformers have a high recycling rate. On average, only 4 % of the material is used thermally, 2 % of the material can be disposed of in the landfill, and a full 94 % of the material can reenter the raw material cycle and be reused. It is conceivable that this material will be used again in your facility as a new transformer.

Radial-flow fans increase performance by up to 50 %



GEAFOL / CARECO standard protective casings, e.g. to IP 20 degree of protection; optionally, modified housing designs are possible





GEAFOL / CARECO – Transformer technology at a glance:

- 1** Three-limb core made of grain-oriented, low-loss electrolaminations insulated on both sides
- 2** LV winding made of aluminum strip; turns firmly glued together by means of insulating sheet wrapper material (prepreg)
- 3** HV winding consisting of vacuum-potted single foil-type aluminum coils; see also page 4
- 4** LV terminals
- 5** Delta connection tubes with HV terminals
- 6** Coil support system to insulate core and windings from mechanical vibrations, resulting in low noise emissions as well

as allowing free expansion of the components in case of temperature fluctuations

- 7** Clamping frame and truck
Rollers can be turned around for lengthwise or sidewise travel
- 8** Insulation: Mixture of epoxy resin and quartz powder makes the transformer nearly maintenance-free, moisture-proof, tropicalized, flame-resistant and self-extinguishing (aluminum oxide trihydrate not necessary)
- 9** HV tapping links $\pm 2 \times 2,5\%$ (on the HV terminal side) permitting adjustment to system conditions; can be reconnected in de-energized state

Temperature monitoring by PTC thermistor sensors in the LV winding (on request PT 100)

Paint finish on steel parts
Thick-layer coating, RAL 5009, on request: Two-component varnish or galvanizing (for particularly aggressive environments)

Modular design e.g., windings can be individually mounted and replaced on site

Ambient class E2

Climatic category C2

(if the transformer is installed outdoors, degree of protection IP 23 must be assured)

Fire resistance class F1

Selection of ordering data for Standard 10kV/11kV

A. Electrical data

Rated Power	Winding Material	Rated primary voltage	Tapping of HV	Rated secondary voltage	Vector group	No-load Loss	On-load Loss 120°C	Short Circuit Impedance	Noise (Lpa-1)	No-load Current
kVA		kV		kV		kW	kW	%	dB	%
100	Copper or Aluminum	6	± 5% ± 2x2.5%	0.4	Dyn11 Yyn0	0.4	1.57	4	47	0.8
125						0.47	1.85		48	0.8
160						0.54	2.13		49	0.8
200						0.62	2.53		50	0.8
250						0.72	2.76		50	0.8
315						0.88	3.47		50	0.8
400						0.98	3.99		50	0.8
500						1.16	4.88	50	0.8	
630						1.34	5.96	50	0.6	
800						1.52	6.96	51	0.6	
1000						1.77	8.13	52	0.6	
1250						2.09	9.69	54	0.5	
1600						2.45	11.73	54	0.5	
2000						3.05	14.45	56	0.5	
2500						3.6	17.17	60	0.5	
3150						4.52	21.16	62	0.4	

B. Mechanical data

Rated Power	Winding Material	Truck dimension (Length×Width)	Weight	Outline Dimensionmm (Length×Width×Height)	Enclosure Dimension (IP20) (Length×Width×Height)
kVA			kg	mm	mm
200	Copper	520×520	1040	1310×765×955	1600×1100×1500
250		520×520	1280	1310×760×975	1600×1100×1500
315		670×660	1320	1380×820×1060	1700×1300×1500
400		670×660	1450	1410×820×1120	1700×1300×1500
500		670×660	1690	1460×820×1210	1800×1300×1500
630		670×660	1890	1480×820×1210	1800×1300×1500
800		670×660	2260	1570×850×1350	1900×1300×1700
1000		820×820	2700	1650×990×1400	1900×1400×1700
1250		820×820	3180	1730×990×1430	2100×1400×1700
1600		820×820	3830	1780×990×1500	2100×1400×1900
2000		1070×1070	4810	1910×1280×1630	2200×1650×2100
2500		1070×1070	5760	2020×1280×1750	2400×1650×2200
3150		1070×1070	7220	2180×1280×1840	2500×1650×2200
100		Aluminum	520×520	770	1290×760×940
125	520×520		780	1270×755×945	1600×1100×1500
160	520×520		870	1310×760×960	1600×1100×1500
200	520×520		950	1310×710×1045	1600×1100×1500
250	520×520		1030	1320×660×1090	1600×1100×1500
315	670×660		1180	1360×820×1195	1700×1300×1500
400	670×660		1360	1410×820×1225	1700×1300×1500
500	670×660		1590	1490×835×1260	1740×1300×1500
630	670×660		1900	1510×830×1450	1800×1300×1700
800	670×660		2060	1580×850×1650	1900×1300×1900
1000	820×820		2460	1620×990×1700	2000×1400×2100
1250	820×820		2870	1730×990×1725	2000×1400×2100
1600	820×820		3650	1890×990×1650	2300×1400×2100
2000	1070×1070		4330	2000×1280×1870	2400×1600×2200
2500	1070×1070		5020	2150×1280×2000	2500×1650×2300
3150	1070×1070		6220	2330×1280×2280	2700×1650×2600

Selection of ordering data for Standard 20kV/22kV/24kV

A. Electrical data

Rated Power	Winding Material	Rated primary voltage	Tapping of HV	Rated secondary voltage	Vector group	No-load Loss	On-load Loss 120°C	Short Circuit Impedance	Noise (Lpa-1)	No-load Current	
kVA		kV		kV		kW	kW	%	dB	%	
200	Copper or Aluminum	20 22 24	± 5% ± 2x2.5%	0.4	Dyn11 Yyn0	0.74	2.95	6	50	0.8	
250						0.85	3.84		52	0.8	
315						0.97	4.09		52	0.8	
400						1.16	4.85		52	0.8	
500						1.35	5.79		52	0.8	
630						1.53	6.84		53	0.6	
800						1.76	8.2		53	0.6	
1000						2.07	9.8		53	0.6	
1250						2.38	11.5		54	0.6	
1600						2.79	13.87		56	0.6	
2000						3.24	16.4		58	0.5	
2500						3.87	19.4		59	0.5	
3150						4.88	22.4		8	62	0.4

B. Mechanical data

Rated Power	Winding Material	Truck dimension (Length×Width)	Weight	Outline Dimensionmm (Length×Width×Height)	Enclosure Dimension (IP20) (Length×Width×Height)	
kVA			kg	mm	mm	
200	Copper	670×660	1370	1420×875×1220	2000×1400×1600	
250		670×660	1380	1400×870×1230	2000×1400×1600	
315		670×660	1480	1430×910×1295	2000×1400×1600	
400		670×660	1660	1480×910×1355	2000×1400×1700	
500		670×660	1820	1490×860×1405	2000×1400×1700	
630		670×660	2030	1540×870×1430	2040×1400×1700	
800		670×660	2380	1590×880×1550	2090×1400×1900	
1000		820×820	2740	1620×990×1570	2120×1500×1900	
1250		820×820	3330	1710×990×1615	2210×1500×1900	
1600		820×820	4070	1810×1010×1680	2310×1550×2100	
2000		1070×1070	5130	1940×1280×1765	2530×1780×2100	
2500		1070×1070	6070	2030×1280×1885	2530×1780×2200	
3150		1070×1070	7350	2180×1280×1975	2600×1750×2300	
200		Aluminum	820×820	1210	1450×990×1340	1950×1500×1700
250			820×820	1250	1420×990×1340	1950×1500×1700
315	820×820		1310	1440×990×1395	1950×1500×1700	
400	820×820		1470	1490×990×1470	1990×1500×1800	
500	820×820		1640	1530×990×1480	2030×1500×1800	
630	820×820		1890	1580×990×1525	2080×1500×1800	
800	820×820		2170	1630×890×1570	2130×1500×1900	
1000	820×820		2680	1720×995×1640	2220×1500×1900	
1250	820×820		3040	1810×1005×1735	2310×1550×2000	
1600	820×820		3810	1870×1015×1955	2370×1550×2200	
2000	1070×1070		4440	2000×1280×2045	2500×1780×2400	
2500	1070×1070		5510	2190×1280×2075	2690×1780×2400	
3150	1070×1070		6560	2430×1280×2155	2900×1750×2500	

Selection of ordering data for Standard 33kV/35kV

A. Electrical data

Rated Power	Winding Material	Rated primary voltage	Tapping of HV	Rated secondary voltage	Vector group	No-load Loss	On-load Loss 120°C	Short Circuit Impedance	Noise (Lpa-1)	No-load Current
kVA		kV		kV		kW	kW	%	dB	%
200	Copper or Aluminum	35~38.5	± 5% ± 2x2.5%	0.4	Dyn11 Yyn0	0.88	3.33	6	56	1.2
250						0.99	3.8		56	1.2
315						1.18	4.51		57	1.2
400						1.38	5.42		57	1.1
500						1.62	6.65		58	1.1
630						1.87	7.65		58	1
800						2.16	9.11	60	1	
1000						2.43	10.45	60	1	
1250						2.84	12.73	61	0.9	
1600						3.15	15.45	61	0.9	
2000						3.83	18.24	62	0.9	
2500						4.46	21.85	62	0.9	
3150						5.62	25.53	64	0.7	

B. Mechanical data

Rated Power	Winding Material	Truck dimension (Length×Width)	Weight	Outline Dimensionmm (Length×Width×Height)	Enclosure Dimension (IP20) (Length×Width×Height)	
kVA			kg	mm	mm	
200	Copper	670×660	2380	1830×1025×1405	2500×1800×1800	
250		670×660	2440	1840×1025×1420	2500×1800×1800	
315		670×660	2480	1800×1090×1550	2500×1800×2000	
400		820×820	2900	1850×1095×1660	2500×1800×2000	
500		820×820	3000	1800×1090×1710	2500×1800×2100	
630		820×820	3510	1860×1100×1800	2600×1800×2100	
800		1070×1070	3760	1890×1100×1820	2600×1800×2100	
1000		1070×1070	4440	1890×1100×1820	2700×1900×2100	
1250		1070×1070	4650	1980×1210×1900	2700×1900×2300	
1600		1070×1070	6120	2160×1230×1970	2800×1900×2300	
2000		1070×1070	6720	2160×1380×2027	2800×2000×2300	
2500		1070×1070	8170	2310×1300×2140	3100×2000×2500	
3150		1070×1070	8990	2410×1320×2195	3100×2000×2500	
200		Aluminum	670×660	1920	1840×1065×1365	2600×1800×1800
250			670×660	2140	1860×1030×1430	2600×1800×1800
315	670×660		2300	1840×1095×1610	2600×1800×2000	
400	820×820		2570	1870×1100×1675	2600×1800×2000	
500	820×820		2820	1870×1100×1780	2600×1800×2100	
630	820×820		3080	1880×1100×1790	2600×1800×2100	
800	820×820		3430	1940×1110×1830	2700×1800×2100	
1000	820×820		4060	2010×1160×1890	2800×1900×2300	
1250	820×820		4480	2040×1120×1980	2800×1900×2300	
1600	820×820		5690	2150×1130×2190	2900×1900×2500	
2000	1070×1070		6170	2200×1290×2290	2900×2000×2600	
2500	1070×1070		7820	2400×1310×2440	3100×2000×2800	
3150	1070×1070		8810	2620×1345×2395	3300×2000×2800	

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