GEAFOL – certified quality

Answers for energy.

SIEMENS

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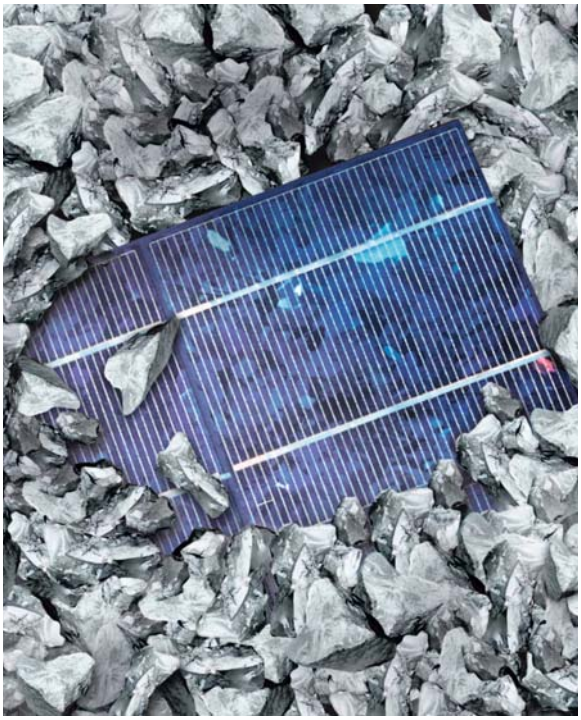


First among supposed equals

If you're going to compare cast-resin transformers, it's a good idea to take a very close look. Because as always, you can expect something exceptional from the inventor of the cast-resin transformer. Tests passed and certificates received with flying colors have been highlighting the excellence of our GEAFOL transformers with aluminum-foil technology since 1966. Roughly 90,000 units are in operation today, in some cases under extremely harsh conditions such as:

- **Ambient temperatures of ± 60 °C**
- **Aggressive, salt-laden atmospheres**
- **Great mechanical stress, for example on ships, cranes or nacelles of wind power plants**

GEAFOL – better than the standard right from the start
When you pioneer new technology, you can only win customer confidence through strict testing. Well aware of this, we've been putting the GEAFOL through the paces right from the start – with very convincing results. We've always made sure that we didn't simply meet the requirements of the applicable standards, but that we far exceeded them in many cases. And as can expected with pioneering technology, there weren't even any national or international tests for some criteria when our GEAFOL came on the market. That's why we conducted fire tests on GEAFOL transformers in conjunction with the Allianz Test Centers long before a corresponding standard was introduced.

GEAFOL – more than standard
Unless other test conditions have been agreed contractually, we always subject every transformer to routine testing in line with IEC 60076-11. That means you can be sure that your GEAFOL transformer was tested in accordance with the valid standards and has met the requirements. And thanks to its versatility, GEAFOL can be used in an especially wide range of applications. In some cases this makes special testing necessary – testing which goes beyond the type tests or the special testing stipulated in the standards – in order to guarantee absolute operational safety. One example of such testing is for nuclear power plants.

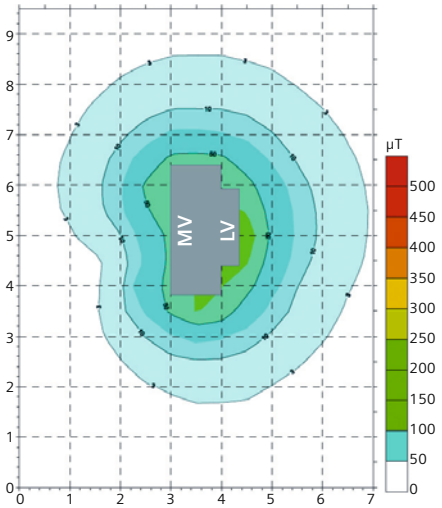
GEAFOL – one for all
Now, however, we have undertaken something completely new: one and the same GEAFOL has passed all routine, type and special tests defined for dry transformers.
The special thing about this is: Because 'in some cases, the tests were performed under conditions that were considerably more rigorous in comparison to the standard. The result clearly shows that the GEAFOL transformer offers you enough reserves for long, successful operation under all conditions.

A new standard is setting new standards – just like GEAFOL

In the course of harmonizing standards, the current IEC 60076-11 or EN 60076-11 and VDE 0532-76-11 replaced the old VDE 0532-726 or EN 0532-726. Though the routine, special and type tests were not changed in the reorganization, the test requirements were specified more clearly in the newer standards and have been adapted to IEC 60076-3.

Tailored testing
Along with routine tests that every transformer must pass, there are also type and special tests which must be agreed upon separately when an order is placed. In addition to tests to the finished product, precisely defined interim tests are performed for selected process sections and incoming goods inspections on the raw materials used.

Tailored performance
Here Siemens once again pioneered the way with GEAFOL and demonstrated how quality is acheived in actual practice. **One and the same** GEAFOL transformer has passed all defined routine, type and special tests, along with additional tests with flying colors.



Magnetic flux density, measured 0.8 m above the transformer base

Limit values comply with 26. BImSchV:
Electrical field strength 5 kV/m (at 50 Hz)
Magnetic flux density 100 µT (at 50 Hz)

Electrical fields: Simple shielding by means of housing or accommodation in cells

Magnetic fields: Field density behaves proportionally $1/a^2$ to $1/a^3$ (a = distance)
The magnetic flux density decreases very rapidly as the distance increases

Important:
Leakage fields of the US busbar system have great influence on the total field. Options should therefore be specified in the contract.

Routine tests
- Measurement of winding resistance (IEC 60076-11)
- Measurement of voltage ratio and check of phase displacement (IEC 60076-11)
- Measurement of short-circuit impedance and load loss (IEC 60076-11)
- Measurement of no-load loss and current (IEC 60076-11)
- Separate-source AC withstand voltage test (IEC 60076-11)
- Induced AC withstand voltage test (IEC 60076-11)
- Partial discharge measurement (IEC 60076-11)

Type tests
- Lightning impulse test (IEC 60076-11)
- Temperature-rise test (IEC 60076-11)

Special tests
- Measurement of sound level (IEC 60076-11)
- Verification of environmental class (IEC 60076-11)
- Verification of climatic class (IEC 60076-11)
- Fire behavior test (destructive test, IEC 60076-11)

- Magnetic field measurement (IEEE 644-1994 and IEC 61786-1998)

Performance data confirmed by testing and disclosed by the manufacturer

Rated power	1,500 kVA
Number of phases	3
Rated voltage of the high-voltage winding (primary winding)	11 kV / 6.6 kV
Rated voltage of the low-voltage winding (secondary winding)	400 V
Rated frequency	50 Hz
Vector group	Dyn11
Impedance voltage	7.5 %
Insulation level of the high-voltage winding (primary winding)	LI 75 AC 28
Insulation level of the low-voltage winding (secondary winding)	AC 3
Cooling type	AN

The tested model was a transformer that can be reconnected for 11 kV to 6.6 kV at a constant output.

Signed and sealed – quality à la GEAFOL

Accredited test labs, renowned testers
Some of the tests were performed in certified test labs at our manufacturing sites, and others at the CESI in Milan, Italy. Because the transformer was delivered in a special housing, tests were also performed using the housing insofar as it could have influenced measurements.

CE marking
Cast-resin transformers are to be considered passive elements in accordance with IEC 60076-11. As stipulated by the COTREL specification, CE marking of power and distribution transformers with medium- and high-voltage windings is not permissible.

Red-hot test results
The standard specifies permissible limits for the fire test which may not be exceeded. These limits are coordinated with the geometries of the fire chamber and the test specimen. The coils of the GEAFOL transformer to be tested considerably exceeded the device dimensions described in the standard and thus almost reached the limit value for the test chamber, the GEAFOL transformer nevertheless remained far below the permissible maximum values allowed by the standard. For us, this was a further milestone in the success story of the GEAFOL. At no time since the introduction of the standard for fire behavior have we tested a higher rating in the IEC test. Naturally, the fire test is always a special test because it destroys the transformer. But it also serves to verify that operating GEAFOL cast-resin transformers in electrical facilities essentially creates no risks in any operating mode that intensify fire or produce toxic hazards exceeding the normal magnitude of house or industrial fires. So there were good reasons why GEAFOL transformers were classified in the highest fire class F1 according to IEC 60076-11.

Certified quality means even more safety and reliability
With CESI's certification and the more extensive analyses, Siemens again has verified that GEAFOL cast-resin transformers also exceed the highest requirements defined in the standard – an extra safety margin that you shouldn't be without.

Tests performed with housing attached

Type of additional tests	with housing
Measurement of impedance voltage	■
Separate-source AC withstand voltage test	■
Induced AC withstand voltage test and partial discharge measurement	■
Measurement of load loss	■
Lightning impulse test	■
Temperature-rise test	■
Measurement of sound level	■
Verification of short-circuit withstand capability	■

Test performed as a function of the primary voltage

Type of tests		6.6 kV	11 kV
Routine	Measurement of winding resistance	■	■
	Measurement of voltage ratio and check of vector group	■	■
	Measurement of impedance voltage and load loss	■	■
	Measurement of no-load loss and no-load current	■	■
	Separate-source AC withstand voltage test	■	■
	Induced AC withstand voltage test	■	■
	Partial discharge measurement	■	■
Type	Lightning impulse test	■	■
	Temperature-rise test	–	■
Special tests	Measurement of sound level	≙11 kV	■
	Verification of short-circuit withstand capability	■	■
	Verification of climatic class C2 (thermal shock)	■	■
	Verification of fire class F1 with check of gas emissions	≙11 kV	■
	Verification of environmental class E2	≙11 kV	■
	Electromagnetic compatibility measurement	≙11 kV	■

Environmental Class E2 – E0

E0
The transformer operates in a clean, dry environment with no condensation or relevant environmental contamination.

E1
The transformer operates in an environment with the occasional formation of condensate and negligible contamination.

E2
The transformer is exposed to considerable condensate formation and heavy contamination or both.

Climatic Class C2

C1
The transformer is not suitable for operation at temperatures under –5 °C, but can be transported and stored at up to –25 °C.

C2
Storage, transport and operation of the transformer is possible at up to –25 °C.

Fire Class F1

F0
The transformer operates in an environment with no fire hazards, which is why no measures are necessary to limit the risk of flammability.

F1
The transformer is used in an environment where fire hazards exist; as a result, reduced risk of flammability is required. A transformer fire must be extinguished within certain specifications.

GEAFOL – in all circumstances

IEC Standard 60076-11 (HD 464 S1 1988) specifies environmental, climatic and fire classes for cast-resin transformers and their operating conditions. GEAFOL transformers have also subjected their special classes to verification in this case. With Environmental Class **E2**, Climatic Class **C2** and Fire Class **F1**, they meet the highest requirements defined in each case and are equal to the hardest requirements.

Type Test Certificate CESI

A8033333

Approved Page 1

Type Test Certificate of	Special test to prove suitability to climatic class C2, to environmental class E2 and to fire behaviour test class F1
Apparatus	Dry-type power transformer
Designation	4GB6246-3HC

l power 1500 kVA ; Rated voltages 11/0,4 kV ; Rated frequency 50 Hz

fENS Transzformátor Kft – Budapest - Hungary

fENS Transzformátor Kft – Budapest - Hungary

October 19, 2008 **to** November 14, 2008

.p.A. – Milano – ITALY

description, drawings and photographs incorporated in the reference documents, identified in proving tests in accordance with

IEC 60076-11 (2004)

accordance with above mentioned Standards.

ests and the oscillograms attached in the Test Reports. The values obtained and the ith the above Standards and to justify the ratings assigned by the Manufacturer as

apparatus having the same designations

Type Test Certificate CESI

A8033330

Approved Page 1

Type Test Certificate of	Complete type tests
Apparatus	Dry-type power transformer
Designation	4GB6246-3HC
	Rated power 1500 kVA ; Rated voltages 11/0,4 kV ; Rated frequency 50 Hz
Manufacturer	SIEMENS Transzformátor Kft – Budapest - Hungary
Tested for	SIEMENS Transzformátor Kft – Bud
Date(s) of tests	**from** October 13, 2008
Tested by	CESI S.p.A. – Milano – ITALY

The apparatus, constructed in accordance with the description, drawings and phot
this certificate, has been subjected to the series of proving tests in accordance wi

IEC 60076-11 (2

This Type Test Certificate has been issued by CESI following exclusively

The results are shown in the record of Proving Tests and the oscillogram general performance are considered to comply with the above Standard listed on page No.2 .

The Certificate applies only to the apparatus tested. The responsibility with that tested rests with the Manufacturer.

Only integral reproduction of this Certificate, or reproductions of this pag
of the apparatus tested, are permitted without written permission from CE

PUBBLICATO A8033330 (PAD - 1123900)

No. of pages	3
Issue date	November 17, 2008
Prepared	Unit LABORATORIES - V. Ma
Prepared	LAP - Mantegazza Vittorio
Verified	LAP - Pizzi Franco
Approved	LAP - Nicolini Roberto

CESI
Centro Elettrotecnico
Sperimentale Italiano
Giacinto Motta spa

Type Test Certificate CESI

A8033332

Approved Page 1

Type Test Certificate of	Short-Circuit performance Dielectric performance
Apparatus	Dry-type power transformer
Designation	4GB6246-3HC
	Rated power 1500 kVA ; Rated voltages 6,6/0,4 kV ; Rated frequency 50 Hz
Manufacturer	SIEMENS Transzformátor Kft – Budapest - Hungary
Tested for	SIEMENS Transzformátor Kft – Budapest - Hungary
Date(s) of tests	**from** October 13, 2008 **to** October 24, 2008
Tested by	CESI S.p.A. – Milano – ITALY

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in the reference documents, identified in this certificate, has been subjected to the series of proving tests in accordance with

IEC 60076-11 (2004)

This Type Test Certificate has been issued by CESI following exclusively the STL Guides.

The results are shown in the record of Proving Tests and the oscillograms attached in the Test Reports. The values obtained and the general performance are considered to comply with the above Standards and to justify the ratings assigned by the Manufacturer as listed on page No.2 .

The Certificate applies only to the apparatus tested. The responsibility for conformity of any apparatus having the same designations with that tested rests with the Manufacturer.

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PUBBLICATO A8033332 (PAD - 1123899)

No. of pages	3
Issue date	November 17, 2008
Prepared	Unit LABORATORIES - V. Mantegazza
Prepared	LAP - Mantegazza Vittorio
Verified	LAP - Pizzi Franco
Approved	LAP - Nicolini Roberto

CESI S.p.A.
Energy Division
Technical Area Components
"Testing Laboratories"

CERTIFICATE

TÜV CERT

Management system as per
ISO 14001:2004

In accordance with TÜV CERT procedures, it is hereby certified that

Siemens Transzformátor Kft.
1214 Budapest
II. Rákóczi Ferenc u. 189.
Hungary

applies an environmental management system in line with the above standard for the following scope

design, production, servicing and sale … voltage transformers and reactors.

Certificate Registration No. **75 110 0151**
Contract No. 0041-40142/1114

TÜV CERT Certification Body
at TÜV Rheinland InterCert

This certification was conducted in accordance with the …
subject to regular surveillance audits.
TÜV Rheinland InterCert Kft. 1061 Budapest, Paulay E…

IAF

TGA-ZM-25-96-60

CERTIFICATE

TÜV CERT

Management system as per
ISO 9001:2000

In accordance with TÜV CERT procedures, it is hereby certified that

Siemens Transzformátor Kft.
1214 Budapest
II. Rákóczi Ferenc u. 189.
Hungary

applies a quality system in line with the above standard for the following scope

design, production, servicing and sale of medium-voltage transformers and reactors.

Certificate Registration No. **75 100 8283**
Contract No. 0041-40094/525

Valid until **2010-01-07**
Initial certification: January 1998.

TÜV CERT Certification Body
TÜV Rheinland InterCert

Budapest, 2007-01-22

This certification was conducted in accordance with the TÜV CERT auditing and certification procedures and is subject to regular surveillance audits.
TÜV Rheinland InterCert Kft. 1061 Budapest, Paulay Ede utca 52. www.tuv.hu

IAF

TGA-ZM-25-96-00

TÜV Rheinland Group

THE INTERNATIONAL CERTIFICATION NETWORK

CERTIFICATE

IQNet and
DQS GmbH Deutsche Gesellschaft zur Zertifizierung von Managementsystemen
hereby certify that the company

Siemens AG

Energy Transmission Transformers (E T TR)
Katzwanger Str. 150
90461 Nürnberg

Hegelstraße 20
73230 Kirchheim

Overbeckstraße 44
01139 Dresden

for the scope

Marketing/Sales, Design and Production of
Transformers as well as for Commissioning and Service

has implemented and maintains a

Quality and Environmental Management System.

An audit, documented in a report, has verified that this
management system fulfills the requirements
of the following standards:

ISO 9001 : 2008 and ISO 14001 : 2004

This certificate is valid until 2010-03-05

Frankfurt am Main 2009-02-27

Registration Number: DE-001052 QM08 UM

René Wasmer
President of IQNet

Ass. iur. M. Drechsel
S. Heinloth
Managing Directors of DQS GmbH

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