SIEMENS

www.siemens.com/energy

GEAFOL – certified quality

Answers for energy.

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.

More than 100,000 units worldwide 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

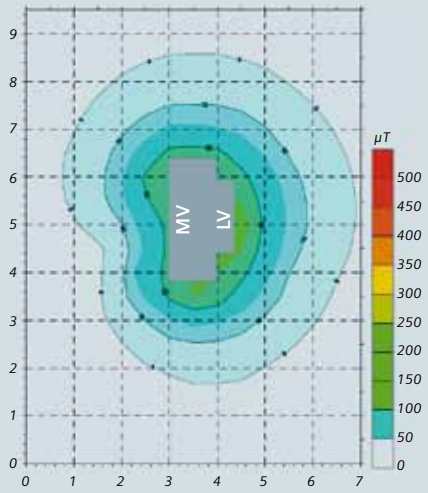
Unless other test conditions have been agreed contractually, we always subject every transformer to routine testing in line with IEC 60076-11. That means you can be sure that your GEAFOL transformer was tested in accordance with the valid standards and has met the requirements. And thanks to its versatility, 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



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.

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.

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	■

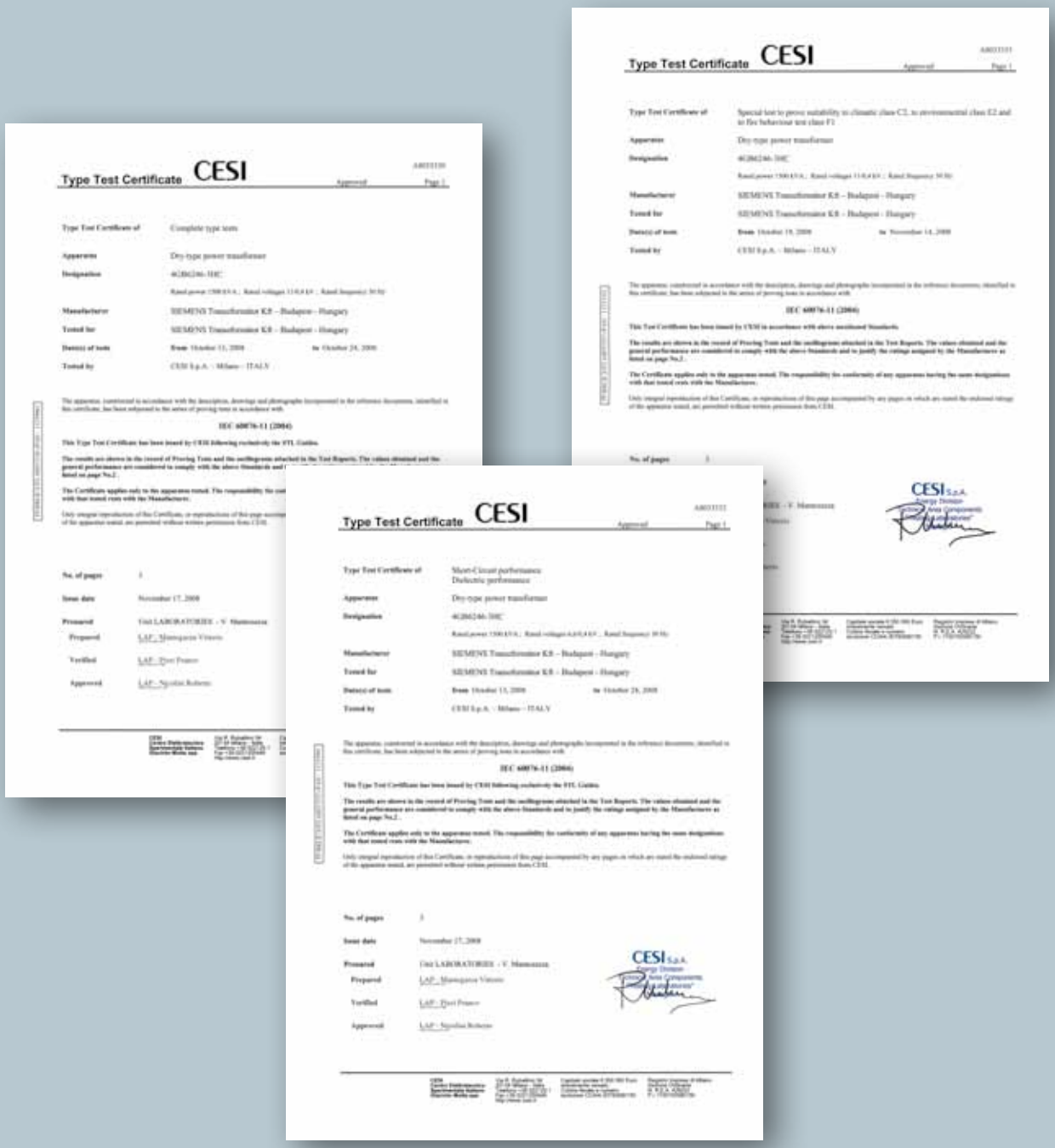
Test performed as a function of the primary voltage			
Type of tests		**6.6 kV**	**11 kV**
Routine	Measurement of winding resistance	■	■
	Measurement of voltage ratio and check of vector group	■	■
	Measurement of impedance voltage and load loss	■	■
	Measurement of no-load loss and no-load current	■	■
	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	■

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.

Environmental Class E2 – E0	Climatic Class C2	Fire Class F1
		
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.	**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.	**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.



Type Test Certificate CESI

Type Test Certificate of: Complete type tests

Apparatus: Dry-type power transformer

Designation: 4GB6246-3HC

Manufacturer: SIEMENS Transformator Kft – Budapest – Hungary

Tested for: SIEMENS Transformator Kft – Budapest – Hungary

Date(s) of tests: from October 13, 2008 to October 24, 2008

Tested by: CESI S.p.A. – Milano – ITALY

IEC 60076-11 (2004)

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

No. of pages: 3

Issue date: November 17, 2008

Prepared: Unit LABORATORIES – V. Mannozzoni

Prepared: LAP – Mannozzoni Vittorio

Verified: LAP – Pozzi Franco

Approved: LAP – Nigoline Roberto

Type Test Certificate CESI

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

Manufacturer: SIEMENS Transformator Kft – Budapest – Hungary

Tested for: SIEMENS Transformator Kft – Budapest – Hungary

Date(s) of tests: from October 13, 2008 to November 14, 2008

Tested by: CESI S.p.A. – Milano – ITALY

IEC 60076-11 (2004)

This Type Test Certificate has been issued by CESI in accordance with above mentioned Standards.

CESI S.p.A. Energy Division Area Componenti

Type Test Certificate CESI

Type Test Certificate of: Short-Circuit performance; Dielectric performance

Apparatus: Dry-type power transformer

Designation: 4GB6246-3HC

Manufacturer: SIEMENS Transformator Kft – Budapest – Hungary

Tested for: SIEMENS Transformator Kft – Budapest – Hungary

Date(s) of tests: from October 13, 2008 to October 24, 2008

Tested by: CESI S.p.A. – Milano – ITALY

IEC 60076-11 (2004)

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Verified: LAP – Pozzi Franco

Approved: LAP – Nigoline Roberto

CESI S.p.A. Energy Division Area Componenti

CERTIFICATE

DQS GmbH

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

ISO 9001 : 2008
ISO 14001 : 2004
BS OHSAS 18001 : 2007

Certificate registration no. 001052 QM08 UM 8

Date of certification 2010-03-01

Valid until 2013-02-28

Michael Drechsel
Managing Director

Jan Bilge
Managing Director

August-Schanz-Straße 21, 60433 Frankfurt am Main

DET NORSKE VERIT

MANAGEMENT SYSTEM CE

Certificate No.: 98024-2011-AHSO-GER-TG

This is to certify that

Siemens AG
Energy Sector
Division Power Transmission
Transformers E T TR
with the locations

Katzwanger Str. 150
90461 Nürnberg - Germany

Hegelstr. 20
73230 Kirchheim unter Teck - Germany

Siemens Transformers Austria GmbH & Co K
Eisgasse 3
8160 Weiz - Austria

has been found to conform to the Management System S

ISO 9001:2008
ISO 14001:2004
BS OHSAS 18001:2007

This certificate is valid for the following product or servic

Marketing, Sales, Design, Production and T
Transformers as well as for Commissioning

Initial Certification date: 01.03.2000

This certificate is valid until: 28.02.2013

The audit has been performed under the supervision of

Britta Nockenberg Arandia
Lead Auditor

TGA-ZM-04-92-00
TGA-ZM-04-92-60

This certificate replaces

To this certificate belongs the follow

Lack of fulfilment of conditions as set out i

DNV Zertifizierung und Umweltgutachter GmbH, Schnieringshof 14,

Certificate

Standard BS OHSAS 18001:2007

Certificate Regist. No. 01 113 060509

TÜV Rheinland Cert GmbH certifies:

Certificate Holder: SIEMENS

Siemens Zrt.
Transformer Division
1214 Budapest
II. Rákóczi Ferenc út 189.
Hungary

Scope: Design, production, servicing and sale of medium-voltage transforms and reactors

An audit was performed, Report No. 060509.
Proof has been furnished that the requirements according to BS OHSAS 18001:2007 are fulfilled.
The due date for all future audits is 30-04 (dd.mm).

Validity: The certificate is valid from 2011-08-08 until 2014-08-07.

2011-08-08

DGA-ZM-08-06-04

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Certificate

Standard ISO 14001:2004

Certificate Regist. No. 75 110 0151

TÜV Rheinland InterCert Kft. certifies:

Certificate Holder: Siemens Transzformátor Kft.
II. Rákóczi Ferenc utca 189.
H - 1214 Budapest
Hungary

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

An audit was performed. Proof has been furnished that the requirements according to ISO 14001:2004 are fulfilled.

Validity: The certificate is valid from 2011.01.25 until 2014.01.24.
First certification: 2002.

TÜVRheinland®
Precisely Right.

Certificate

Standard ISO 9001:2008

Certificate Regist. No. 75 100 8283

TÜV Rheinland InterCert Kft. certifies:

Certificate Holder: Siemens Transzformátor Kft.
II. Rákóczi Ferenc utca 189.
H - 1214 Budapest
Hungary

Scope: Design, production, servicing and sale of medu
transforms and reactors.

An audit was performed. Proof has been furnish
requirements according to ISO 9001:2008 are f

Validity: The certificate is valid from 2009.12.28 until 201
First certification: 1998.

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(Charges depending on provider)

E-mail: support.energy@siemens.com

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