



*Elektromotoren und
Gerätebau Barleben GmbH*



GATRON

Kooperationspartner Transformatorgase



**Universal
Breathing Buffer Box (G3B)**

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1. Extension of the life of open-type transformers

(Subsequent) hermetic sealing of transformers using the G3B breathing buffer box

Oxygen in oil causes premature aging of the insulation system and is today one of the major causes of reduced transformer life. Transformers with air sealing ensure a longer life of the fixed insulation, and the oil quality is maintained for a longer period of time so that they have a longer life than open-type transformers.

Therefore, the demand for hermetic sealing of new transformers as well as for subsequent hermetic sealing of existing open-type transformers is increasing.

New transformers with conservator are provided with hydro-type compensator whose operation is, however, often associated with the following disadvantages:

1. High initial costs
2. Intensive maintenance: The membrane ages faster than the transformer; some operators say that it has to be replaced at least three times during the expected transformer life.
3. The replacement costs significantly exceed the initial costs.
4. No moisture transport to outside.
5. Degassed oil affects the gas accumulation function of the Buchholz relay.
6. In practice, monitoring of the hermetic sealing often proves to be difficult.

The breathing buffer box (G3B), as an alternative, provides the following advantages:

1. Low-cost and significant extension of the life of transformers.
2. Proven delayed aging processes of solid insulation of the transformer.
3. No interference with the oil system of the transformer during installation.
4. Monitoring function of the Buchholz relay is maintained.
5. Easy access near floor level (therefore it is particularly suitable for small transformers in areas which are otherwise not easily accessible).
6. After replacement of the transformer, the G3B unit can still be used for other transformers.

2. Construction and function of the G3B unit

The G3B unit consists of a cylindrical box integrated in the breathing line of the transformer directly upstream of the desiccant. Optionally a nitrogen gas cylinder can be integrated (see Figure 1). The box is provided with a bottomless inner cylinder and is partly filled with oil as a service medium for pressure variation and as a diffusion lock. Floating aluminium disks separate the oil from the ambient air so that the low-oxygen air in the gas chamber of the conservator (grey) is separated from dry ambient air (white) as far as possible.

The G3B unit provides two natural end positions for the oil level differences which serve to compensate temperature variations up to 30°C in the oil tank.

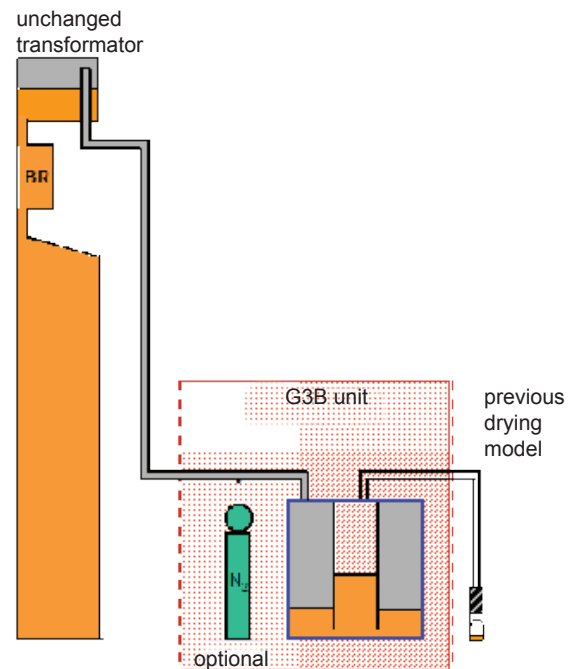


Figure 1 - Construction of the G3B unit

If the atmospheric pressure in the conservator is exceeded by 40 mbar (maximum oil level in the inner cylinder), gas is released into the atmosphere.

If pressure falls below the atmospheric pressure by 20 mbar (minimum oil level in the inner cylinder), either dry ambient air (subsequent natural hermetic sealing) or nitrogen from the pressurised gas cylinder (subsequent N₂-aided hermetic sealing) is supplied.

There are two options for (subsequent) hermetic sealing using G3B units:

Natural (G3B): As the active part starts to age, oxygen consumed is continually replaced by air. Finally, the oil has a very low oxygen concentration.

N₂ aided (G3B/N₂): Oxygen consumed is replaced by nitrogen. Additionally, N₂ is added during cooling down and resaturation. This procedure allows more comprehensive and effective subsequent hermetic sealing of transformers. Finally, the oil has a low oxygen concentration, however, this state is reached significantly faster.

The G3B diffusion barrier does not only prevent that air gets into the service area, but also that fault gases (H₂, CO) which are only slightly soluble in oil leave that area what improves reliability of the diagnosis of service conditions.

Reduction of oxygen content of oil by G3B units:

The following graph shows the reduction of the oxygen concentration in oil of aging paper insulation in transformers using G3B units (subsequent natural hermetic sealing (without N₂) and subsequent N₂-aided hermetic sealing). The oxygen concentration is reduced gradually over a longer period whilst the nitrogen concentration is increased up to saturation level.

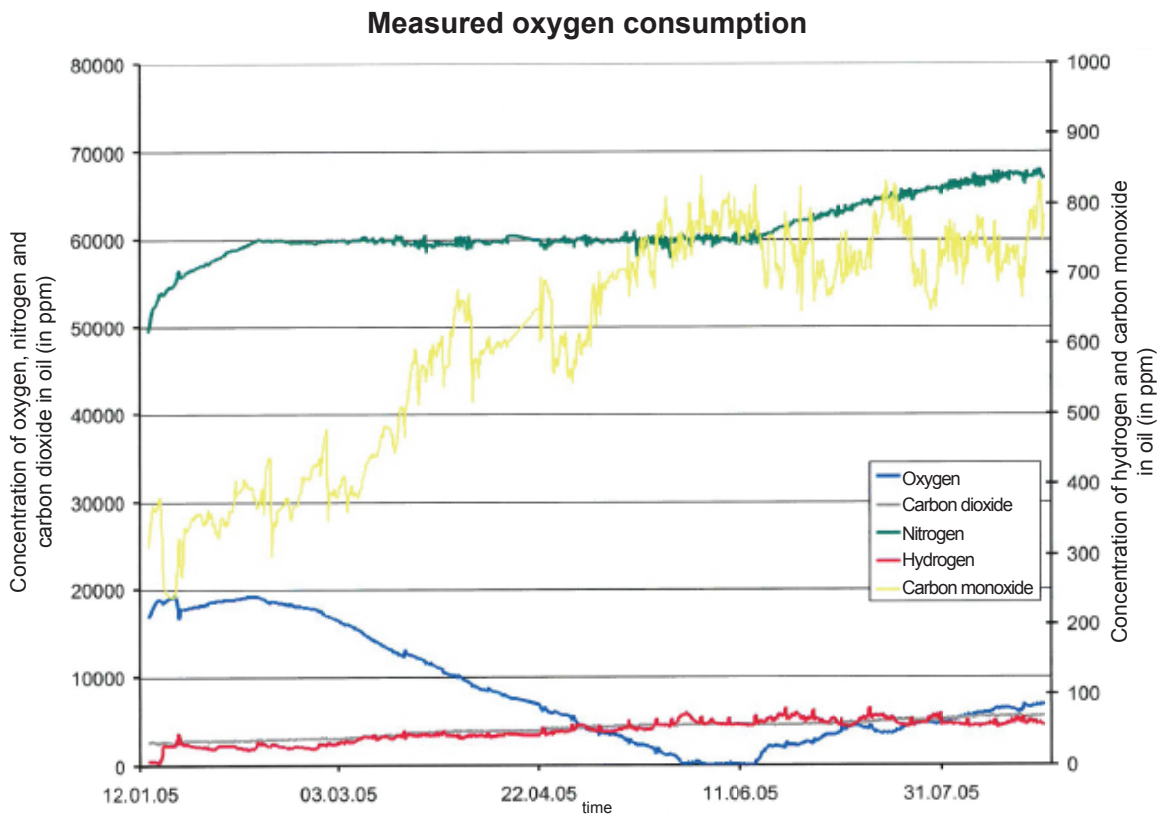


Figure 2: Natural subsequent hermetic sealing

3. Installation of the G3B unit















G3B units are of modular construction including the oil sump of the transformer (for options of installation see point 4). The subsequent hermetic sealing process can be accelerated by flushing the conservator with nitrogen during installation. Figure 4 shows an installed G3B unit with weatherproof cover. The G3B unit does not have any influence on the replacement of the desiccant, neither on the replacement intervals nor the replacement method. The boxes with their oil filling are an additional safety barrier against external moisture.



Figure 3 - G3B-8-30 with weatherproof cover

4. Designs and installation options of G3B-units

The G3B unit consists of the following standard boxes:

Standard boxes	Oil weight of transformers	Installation variants (height incl. weatherproof cover panel)	Unit weight	Usage
G3B-1,8	< 1,8 tons	 ≈ 1170 mm  optional incl. oil sump	ca. 100Kg	All open-type transformers
G3B-8	Up to 8 tons	 ≈ 830 mm	ca. 320Kg	All open-type transformers
G3B-8	Up to 16 tons	 ≈ 1600 mm  ≈ 830 mm	ca. 640Kg	All open-type transformers
G3B-8	Up to 24 tons	 ≈ 2400 mm  ≈ 1600 mm  ≈ 830 mm	ca. 960Kg	All open-type transformers
G3B-8	Up to 24 tons +N ²	 ≈ 1600 mm *  ≈ 830 mm * * plus N ² bottle	ca. 640Kg plus 100Kg N ² bottle	All open-type transformers
G3B-8	Up to 40 tons +N ²	 ≈ 2400 mm *  ≈ 1600 mm *  ≈ 830 mm * * plus N ² bottle	ca. 960Kg plus 100Kg N ² bottle	All open-type transformers
G3B-8	Up to 50 tons +N ²	 ≈ 1600 mm * * plus N ² bottle	ca. 1280Kg plus 100Kg N ² bottle	All open-type transformers

For oil volumes more than 50 t, we gladly calculate the best solution for you. Special designs are available on customer's request.

The number of boxes required for subsequent natural hermetic sealing depends on the weight of the oil. For subsequent hermetic sealing of a transformer with an oil weight of 16 t, for example, two G3B-8 boxes are required which can be placed one above the other in order to minimise space requirements. The unit can be combined with a gas cabinet (N₂) if required. A transformer with 80t oil, for example, can be hermetically sealed with four G3B-8 boxes and additional N₂ supply. Our experience shows that replacement of the N₂ cylinder will not be necessary before one year.

5. Excerpt of existing G3B units

Place of installation	Customer	Design	N2-supply		Weather protection		Date
			yes	no	yes	no	
Neuss	Hydro Aluminium	1 x 4 G3B-5		X	X		Sep/2008
Berlin	Vattenfall Berlin	2 x 3 G3B-5		X		X	Jun/2009
Berlin	Vattenfall Berlin	1 x 3 G3B-5	X			X	Jun/2009
Berlin	Vattenfall Berlin	1 x 2 G3B-5	X			X	Jun/2009
Frankfurt/Main	Mainova	1 x 1 G3B-1		X		X	Feb/2010
Ludwigshafen	BASF	1 x 4 G3B-5		X		X	Feb/2010
Waldkappel	E.ON Mitte	1 x 3 G3B-5		X	X		Mar/2010
Waldkappel	E.ON Mitte	1 x 2 G3B-5		X	X		Mar/2010
Kirchhain	E.ON Mitte	2 x 2 G3B-5		X	X		Mar/2010
Homberg	E.ON Mitte	2 x 2 G3B-5		X	X		Mar/2010
Leuna	TOTAL Raffinerie	1 x 1 G3B-5		X		X	Aug/2010
Szczeczin	ENEA Polen	1 x 2 G3B-5		X	X		Dec/2010
Schwedt	Papierfabrik	1 x 2 G3B-5		X		X	Jun/2011
Schwedt	Papierfabrik	1 x 2 G3B-5		X	X		Jun/2011
Nürnberg	N-Energie	2 x 3 G3B-5		X		X	Feb/2012
Hagen-Kabel	Mark E	2 x 3 G3B-5	X			X	Dec/2011
Aurich	ENERCON	1 x 2 G3B-8		X	X		Aug/2013
Peitz	Vattenfall	3 x 2 G3B-5	X		X		Dec/2013
Boxberg	Vattenfall Boxberg	4 x 2 G3B-5		X	X		Sep/2013
Boxberg	Vattenfall Boxberg	2 x 2 G3B-5	X		X		Jul/2013
Hamburg	Trimet Aluminium	8 x 2 G3B-8	X		X		Mar/2014
Boxberg	Siemens/Vattenfall	3 x 1 G3B-8	X		X		Mai/2014
Dortmund	DEW 21	1 x 2 G3B-8	X			X	Jun/2014
Spremberg	Siemens/Vattenfall	2 x 3 G3B-8	X		X		Sep/2014
Peitz	Siemens/Vattenfall	2 x 3 G3B-8	X		X		Okt/2014
Frankfurt/Main	Netz Service Rhein/ Main	1 x 1 G3B-8		X		X	Okt/2014
Barby	Cargill	1 x 1 G3B-8		X		X	Okt/2014
Berlin	Vattenfall Berlin	3 x 2 G3B-8	X		X		Aug/2015
Wismar	EGGER	1 x 1 G3B-1,8		X		X	Sep/2015
Schinne	ENERCON	1 x 3 G3B-8		X	X		Jun/2016
Worldwide	European wind turbine manufacturer	30 x 1 G3B-2,5		X		X	Sep/2016
Worldwide	European wind turbine manufacturer	30 x 1 G3B-6,5		X		X	Sep/2016
Worldwide	European wind turbine manufacturer	48 x 1 G3B-2,5		X		X	2017
Worldwide	European wind turbine manufacturer	95 x 1 G3B-2,5		X		X	2018



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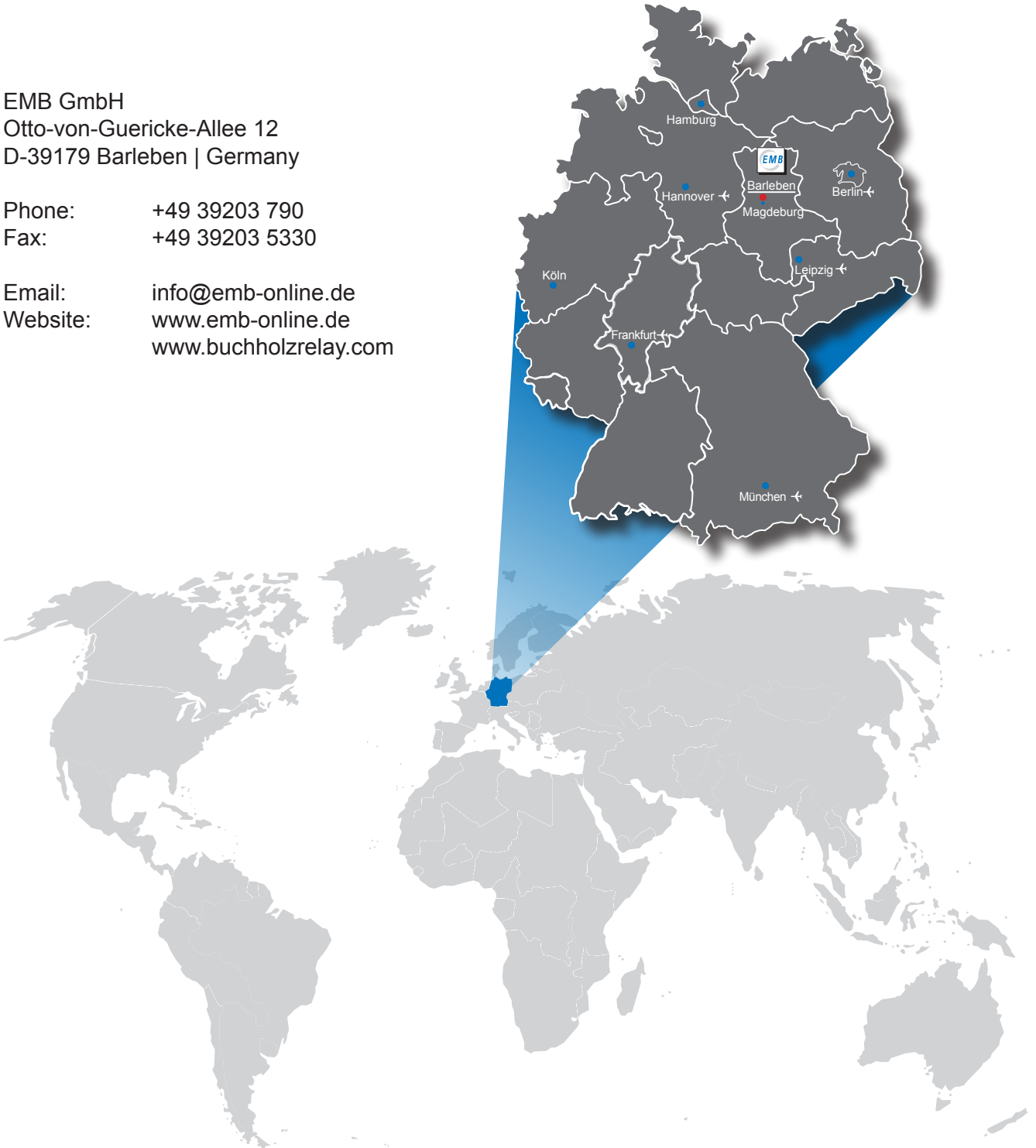
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