



*Elektromotoren und  
Gerätebau Barleben GmbH*



**Monitoring Relay  
for Tap Changers**

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# Company history

Since its foundation the company has passed through an eventful history with regard to ownership, affiliation and change of name associated with such development.

- 1863 Foundation of the company as a sugar factory
- 1921 Invention of the Buchholz relay by Max Buchholz
- 1943 Branch of SIEMENS Magdeburg
- 1948 VEB Elektromotorenwerk Barleben; VEM  
(state-owned firm)
- 1951 VEB Starkstromanlagenbau Magdeburg  
(state-owned firm)
- 1951 Start of manufacture of Buchholz relays in Barleben
- 1965 Start of manufacture of monitoring relays for step changers in Barleben
- 1970 VEB Elektrotechnik und Gerätebau Magdeburg; EGEM  
(state-owned company)
- 1980 VEB Kombinat Elektromaschinenbau Dresden  
VEB Elektromotorenwerk Barleben; VEM; ELMO  
(state-owned company)
- 1990 VEM Antriebstechnik AG Dresden  
Elektromotorenwerk Barleben GmbH; VEM; ELMO  
(public limited company)
- 1993 Elektromotoren und Gerätebau Barleben GmbH; EMB  
(privately owned company)
- 2005 Start of manufacture of Buchholz relays of series NM
- 2009 New premises in Barleben



EMB company building

## 1. Preface

### **More than 1.5 million relays (Buchholz and monitoring relays) have been sold worldwide since about 60 years!**

The monitoring relay for tap changers, also known as the protection relay for tap changers or oil flow relay, is a monitoring device for insulating liquid-filled tap changers with conservators. It protects the tap changer and the transformer from damage. The monitoring relay responds to excessive oil flow in the direction of the conservator and generates a signal disconnecting the tap changer and the transformer immediately from voltage supply.

The monitoring relay is suitable for open-air as well as indoor installation.

Elektromotoren und Gerätebau GmbH (EMB GmbH) provides more than 45 years experience in producing monitoring relays and other protection devices for liquid-cooled and liquid-insulated appliances. It ranks among the most distinguished manufacturers of this type of equipment.

EMB monitoring relays feature easy operation, high reliability and a very long life.

Our staff of highly qualified engineers and experienced skilled workers ensures top quality and high-precision products. The casings are machined on modern CNC controlled machine tools. All products are subjected to final inspection when all functions are checked using special test equipment.

Profound experience and expertise in this special field are a sound basis for high product quality. Extensive references from reputed tap changer and transformer manufacturers as well as other users are proof of the high qualitative level of the products.

EMB GmbH is certified to DIN EN ISO 9001/2008, DIN GOST R, IEC and AEO F.



Figure 1. - Certificates

## 2. Design features

### Casing (Figure 2.1.)

The casing is made of weather-resistant cast aluminium alloy provided with a paint coat.

To check the switching system for proper function, the casing is provided with sight-glasses arranged opposite each other and protected by hinged lids (1).



Figure 2.1. - Casing

### Cover (Figure 2.2.)

The cover is made of weather-resistant cast aluminium alloy provided with a paint coat. The upper section of the cover accommodates the terminal box (1). The test and reset key covered by a cap nut (2), a screw plug (3) or, alternatively on customer's request, a bleeder valve (see section 9. „Explanation on code 97“) are arranged in front of the terminal box. In addition a plate (4) with instructions for actuating the test and reset key is arranged there. The terminal box (1) accommodates the earth terminal (5) and the bushings (6) for the terminals provided in the base of the cover.

The terminal box is sealed by an aluminium cap (7) so that it is safe to touch and protected against pollution. If the cap is opened the graphic symbol and the connection diagram (8) are shown. The cable is inserted through the cable gland (9).

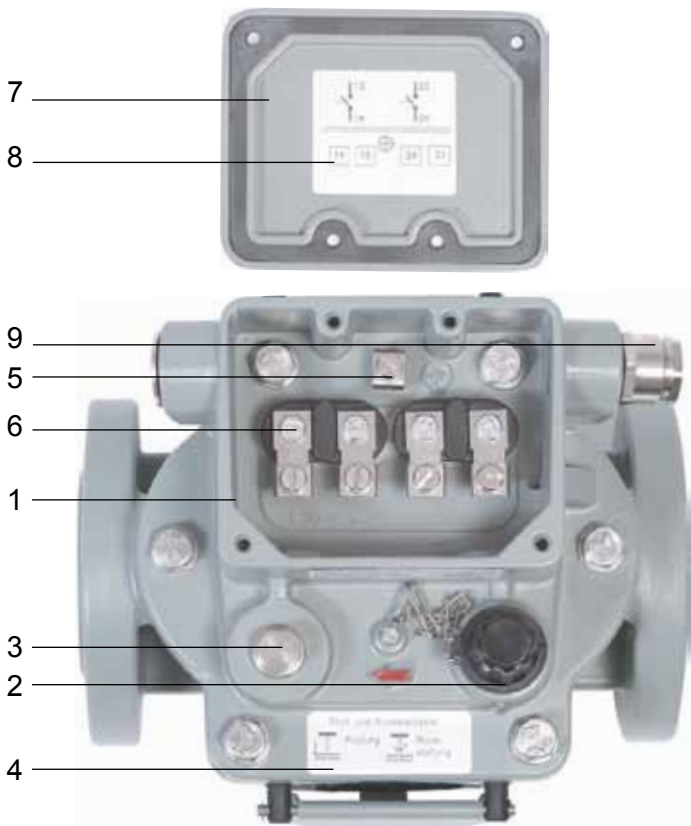


Figure 2.2. - Cover with cap removed

## Switchgear

The switchgear has the following main components:

- Switching system
- Frame
- Mechanical testing unit.

The switching system consists of the following components:

- Damper
- Permanent magnet(s)
- Magnet contact(s).

The damper is retained in its normal and response positions by a magnet. Via a link the permanent magnet is firmly connected with the damper and initiates the contact-making process of the magnet contact tube.

## 3. Function

The monitoring relay is installed in the pipe between the tap changer and the conservator as close as possible to the tap changer head.

During normal operation of the tap changer gases are generated which are collected in the gas dome of the monitoring relay. If the gas volume exceeds the volume of the dome, the gas flows in the direction of the conservator.

**Fault:** An incident causes an oil flow in the direction of the conservator.

**Response:** The liquid flow reaches the damper. If the flow rate exceeds the operating value of the damper, the latter moves in flow direction.

This movement actuates a switch contact, and the tap changer and the transformer are disconnected.

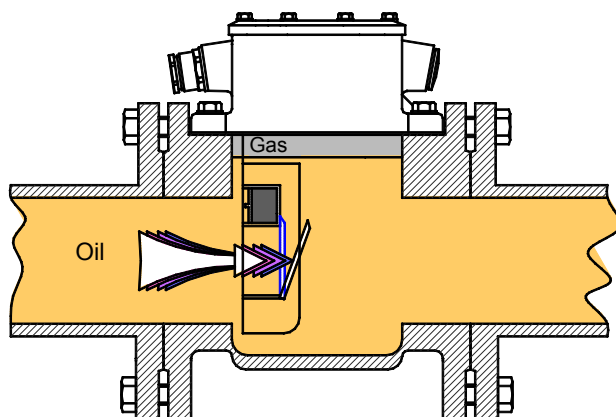


Figure 3. - Functional principle of damper

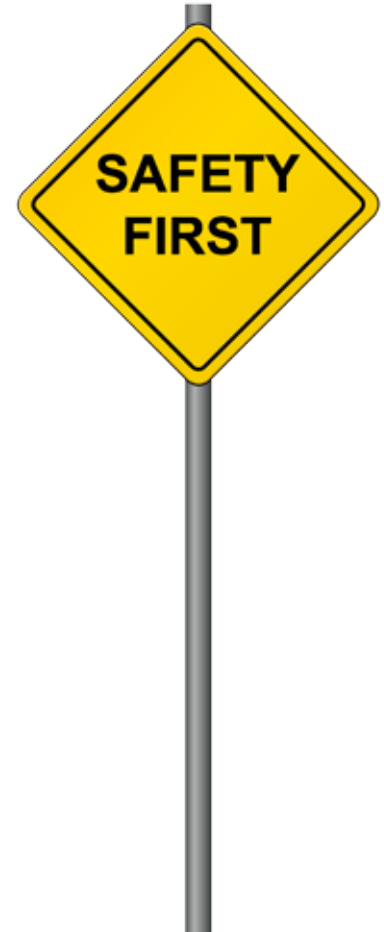
## 4. Tests

Each monitoring relay is provided with a works number that is specified on the test certificate and the name plate. The tests carried out on the monitoring relay are recorded in the test certificate:

- Dielectric strenght test
- Leakage test
- Functional test
- Flow test.

Monitoring relays are delivered in cardboard boxes. For each relay delivered the following documents in the language agreed are provided:

- Operating instruction
- Test certificate.



**Note: Flange gaskets are not included in the scope of supply!**  
**Exception: Type 16 (ÜRUF 25/10-26)**

The name plate covers the following information:

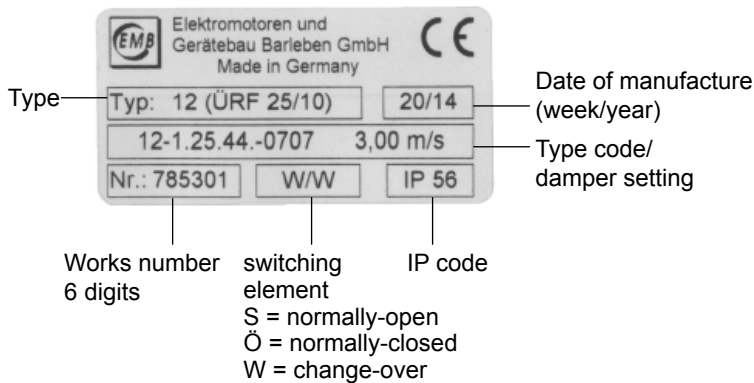





Figure 4.1. - Functional and leakage test



Figure 4.2. - Flow test

## 5. Type list

	Type Internal description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm, in)					Device dimensions (mm)			Weight without packing (kg)
				d2	d3	d4	d5	f	l	h1	h2	
	<b>12</b> <b>(ÜRf 25/10)</b>	Flange 4-hole	<b>25</b>	115	85	68	14	16	200	195	62	4.0
	<b>15</b> <b>(ÜRf 25)</b>	Flange 4-hole	<b>25</b>	115	85	-	M12	15	160	185	62	3.6
	<b>16</b> <b>(ÜRf 25/10-26)</b>	Flange 4-hole	<b>28*</b>	115	85	-	14	16	l1=200 l2=204**	195	62	4.0

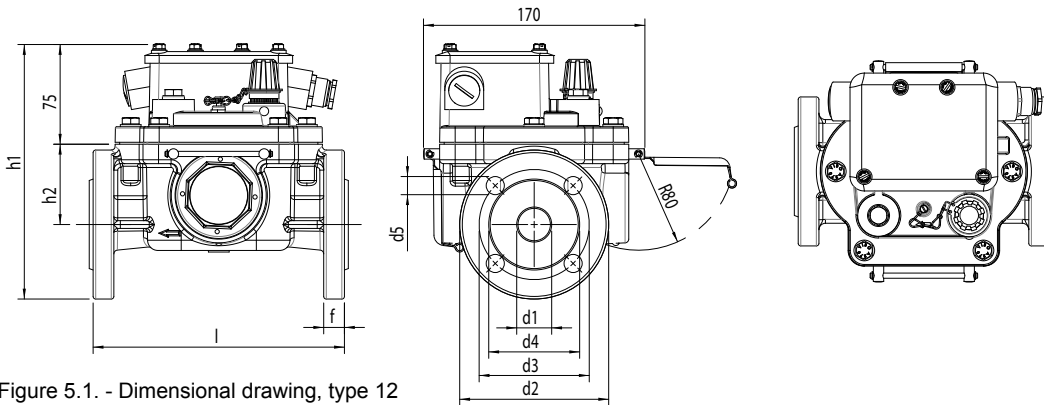


Figure 5.1. - Dimensional drawing, type 12

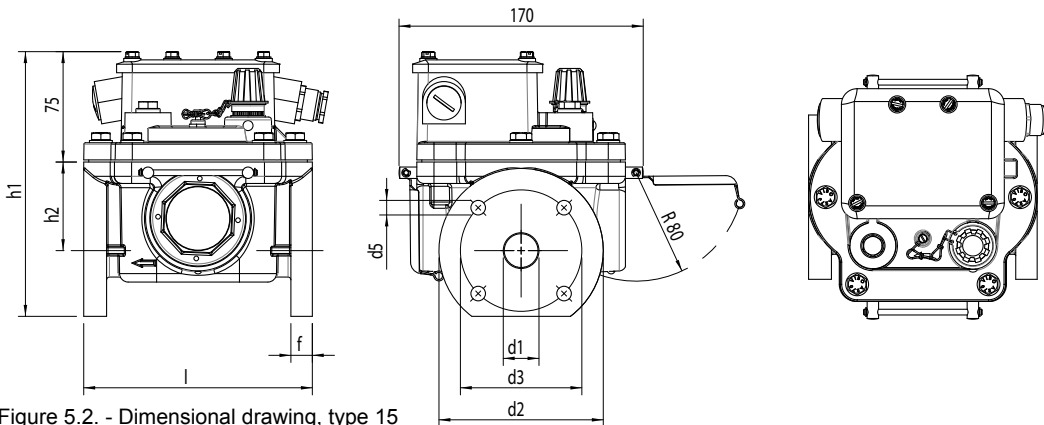


Figure 5.2. - Dimensional drawing, type 15

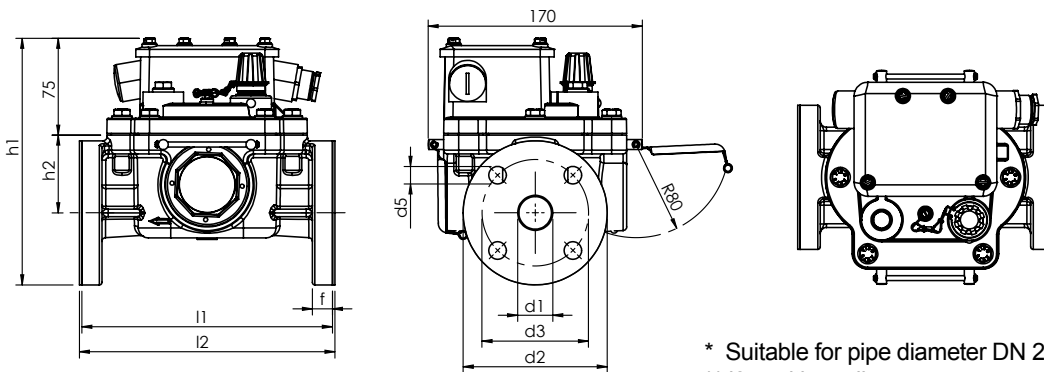


Figure 5.3. - Dimensional drawing, typ 16

\* Suitable for pipe diameter DN 25 and 26 mm

\*\* l2 = with sealing

l1 = without sealing



## 6. Switching system design options

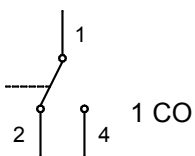
Magnet contact tubes are used as switching elements. These are normally-open (NO), normally-closed (NC) and change-over (CO) contacts. The magnet contact tube design can be derived from the last two digits of the type code. For coding, see Ordering data/type code under Section 11. on page 14.

...01	...02	...03	...04	...05	...06
1 NO	1 NC	1 CO	2 NO	2 NC	1 NO and 1 NC

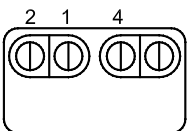
...07	...08	...09	...10	...11
2 CO	1 NO and 1 CO	1 NC and 1 CO	3 NO	2 NO and 1 NC

### Explanation of symbols:

Example: Coding „...03“  
Magnet contact tube design



→ Graphic symbol with terminal marking



→ Connection diagram in terminal box

The inner side of the cap accommodates a plate with the graphic symbol and the connection diagram. The schemes show the switching systems in their neutral position. The neutral position is the operating condition when the device to be protected operates without any fault.

## 7. Technische Daten

The technical data in the table apply to all monitoring relays of standard design manufactured by EMB.

Parameter	Value/data	Remarks
Voltage	AC 5 V - max. 250 V DC 5 V - max. 250 V	Note max. switching capacity.
Current	AC 0.01 A - max. 6 A DC 0.01 A - max. 6 A	Cos $\varphi$ > 0.5 L/R < 40 ms Note max. switching capacity.
Switching capacity	AC max. 1500 VA DC max. 1250 W	
Dielectric strength	AC 2500 V AC 2000 V (NO, NC) AC 1000 V (CO)	between electric circuit and earth between open contacts
Temperature range: - Ambient temperature  - Operating range * Temperature of insulation liquid  * Viscosity of insulation liquid	- 40 °C to + 55 °C - 40 °F to + 131 °F  - 40 °C to + 115 °C - 40 °F to + 239 °F  1 mm <sup>2</sup> /s to 1100 mm <sup>2</sup> /s	Climatic test acc. to DIN EN 60068-2-78: 2002-09  Up to + 135 °C requires version 21
Insulating liquid	Mineral oil	
Resistance to vibration	Vibration: 2-200 Hz, 1 g Shock: 10 g, 11 ms	
Resistance to pressure	0.25 MPa	
Resistance to vacuum	< 2.5 kPa	
Resistance to magnetic fields	25 mT	Magnetic balance in any direction and polarity
Switching system: - Number of switching contacts - Switching element - Damper  Response time of damper	1 Magnet contact tube held by magnets  < 0.1 s	See section 6. on page 9
Insulation liquid flow Pipe diameter DN: 25 mm oder 26 mm	Min. 0.90 to max. 4.00 m/s ± 15%	For potential data, see order data/ type code under section 11. on page 14.
Cable gland	M20x1.5; M25x1.5	
Nominal installation position	2° to 4°	Ascending towards conservator
IP code	IP 56	
Casing paint	2-component texture paint	On polyurethane basis

**Other versions and special designs are listed under section 8. on page 11. These additional versions are provided with a separate code in the ordering data/type code.**

**Other options are available on request.**

## 8. Versions/special designs

### Cable gland \*

Explanation	Code
M20x1.5: 1 cable gland and 1 dummy plug	1
M25x1.5: 1 cable gland and 1 dummy plug	2
M20x1.5: 2 cable glands	3
M20x1.5: 2 cable gland and 1 dummy plug (enclosed)	3B
M25x1.5: 2 cable glands	4
M25x1.5: 2 cable gland and 1 dummy plug (enclosed)	4B
1/2" NPT: 1 cable gland and 1 dummy plug	6
1/2" NPT: 2 cable glands	7
Cable gland: on customer's request	9

### Casing colour \*

RAL 7001 (silver-grey)	41
RAL 7012 (basalt-grey)	42
RAL 7022 (umber-grey)	43
RAL 7033 (cement-grey)	44
RAL 7038 (agate-grey)	45
RAL 7035 (light-grey)	46
RAL 7016 (anthracite-grey)	47
RAL 9002 (grey-white)	48
RAL 7032 (siliceous-grey)	49

### Climate-proof version/IP code

Climate-proof version (extreme frigid open-air conditions below - 40°C)	34
Climate-proof version (offshore)	36
IP 66	39

### Insulation liquid

Insulating liquid, silicone oil	20
Insulating liquid on ester basis	21

### Casing

Metal name plate	15
With bleeder valve	97
With gasket (ÜRF 25/10-26 only)	98

### Switching system (for design options, see section 6. on page 9)

Switching system equipped with two magnet contact tubes	25
Switching system equipped with three magnet contact tubes	99

### Customer's request

Special request (as agreed with customer)	29
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\* **Mandatory ordering data, for other mandatory data see section 11. on page 14**

## 9. Explanations on code 97

Monitoring relays for tap changers with bleeder valve (1) can be vented through the bleeder valve, if required.

**For further information about the construction of the monitoring relay, see section 2. on page 5.**

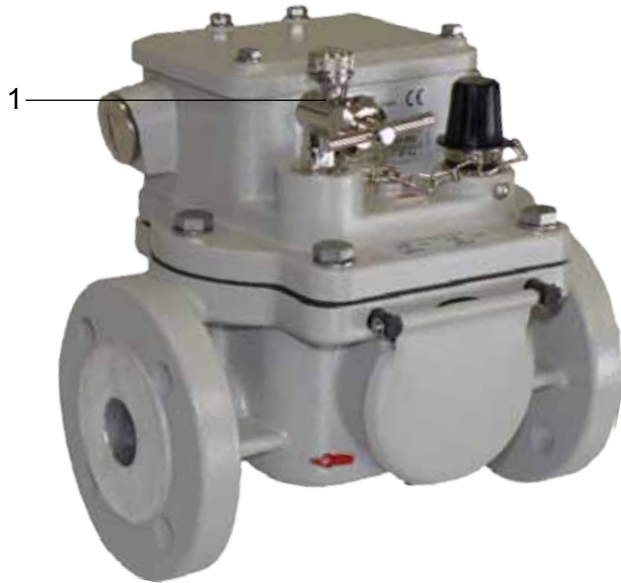


Figure 9.1. - Monitoring relay with bleeder valve

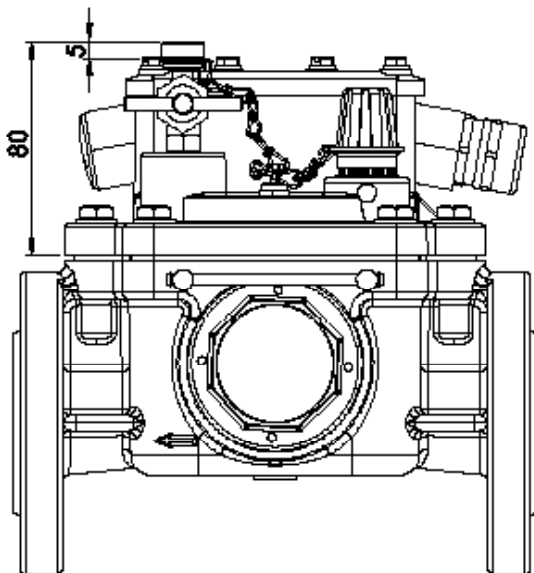


Figure 9.2. - Changed dimensions compared to standard version

**For other dimensions of the monitoring relay, see section 5. on page 8.**

## 10. Use of monitoring relays in combination with Buchholz relays

EMB monitoring relays were developed to reliably protect tap changers and transformers from damage. In the event of excessively high oil flows in the direction of the conservator a signal is sent that immediately disconnects the tap changer and the transformer from voltage supply.

However, monitoring relays do not provide protection from gas accumulation as is required increasingly today for the protection of vacuum tap changers. In order to ensure both reliable protection from excessive oil flows and warning in the case of gas accumulation, EMB monitoring relays of type 16 (ÜRF 25/10-26) can be combined with an EMB Buchholz relay of type 06 (BF 25/10). In this case, the Buchholz relay also provides protection from loss of insulating liquid.

For that purpose, BF 25/10 is installed in series directly downstream of ÜRF 25/10-26. In the event of an excessive oil flow, the monitoring relay will disconnect the tap changer from voltage supply. In order not to affect this reaction, the damper of the Buchholz relay is usually set to a response value of 3.0 or 4.0 m/s. The Buchholz relay will respond by generating an alarm signal in the event of gas accumulations, and by disconnection in the event of loss of insulating liquid.

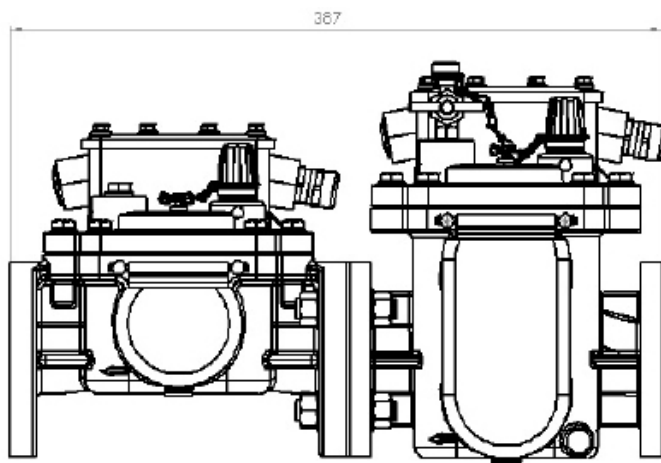


Figure 10. - Combination of monitoring relay and Buchholz relay

### Installation material supplied to connect monitoring relays and Buchholz relays

Qty.	Description
1	Flange gasket 115 x 40 mm
4	Stud bolt 12 x 60
8	Hexagon nut M 12
8	Spring washer, corrugated 12 mm

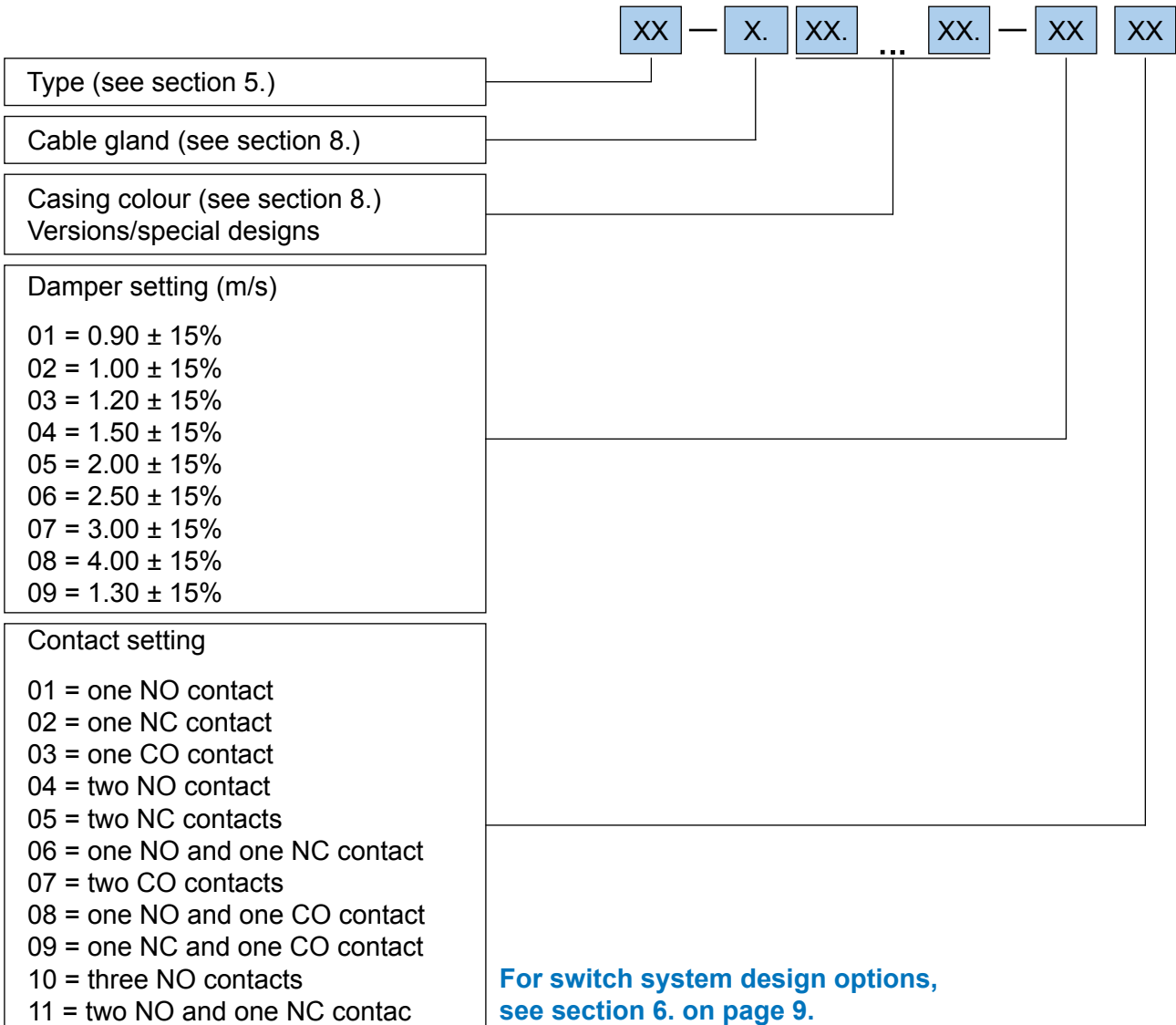
### Technical data

Parameter	Monitoring relay Type 16 (ÜRF 25/10-26)	Buchholz relay Type 06 (BF 25/10)
Voltage	AC 5 V - max. 250 V DC 5 V - max. 250 V	AC 5 V - max. 250 V DC 5 V - max. 250 V
Current	AC 0.01 A - max. 6 A DC 0.01 A - max. 6 A	AC 0.01 A - max. 6 A DC 0.01 A - max. 6 A
Switching capacity	AC max. 1500 VA DC max. 1250 W	AC max. 1500 VA DC max. 1250 W
Dielectric strength: - between electric circuit and earth - between open contacts	AC 2500 V AC 2000 V (NO, NC) AC 1000 V (CO)	AC 2500 V AC 2000 V (NO, NC) AC 1000 V (CO)
Gas accumulation	-	250 ml ± 15 %
Insulation liquid flow	0.90 to max 1.5 m/s ± 15 %	3.00 to max. 4.00 m/s ± 15 %

**For further information, please ask for special reference material.**

## 11. Ordering data/type code

For placing orders, please use the following key:



### Ordering example:

A customer needs a monitoring relay of type ÜRF 25/10 with cable gland and a dummy plug M20x1.5. The damper should respond at a flow rate of 2.00 m/s. The switching system should be equipped with 2 switching elements (magnet contact tubes). One contact should be normally-closed, the other one normally-open. The device should be delivered in colour RAL 7033.  
(Note: The unit is suitable for use of standard mineral oils and standard degree of protection IP 56)

Based on the above data the relay ordered has the following

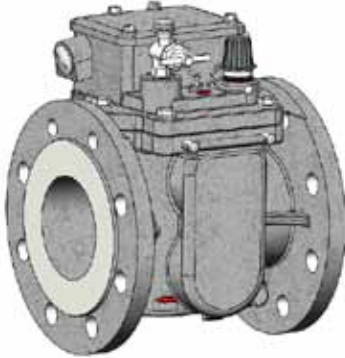
Type code: 12-1.25.44.-0506

Explanation: 12 = ÜRF 25/10  
 1 = M20x1.5: 1 Cable gland and 1 dummy plug  
 25 = Switching system with two magnet contact tubes  
 44 = Casing colour RAL 7033 (cement-grey)  
 05 = Damper setting: 2.00 m/s +/- 15%  
 06 = Contact setting of switching system: one NO and one NC contact

## 12. Other products of EMB GmbH

Elektromotoren und Gerätebau Barleben GmbH also offers protective and control units for liquid-insulated transformers and choke coils.

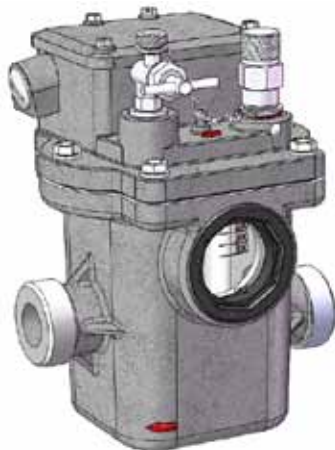
### 12.1. Transformer protection relays (Buchholz principle)



**Single and double float Buchholz relays** manufactured to various norms and standards as well as special requirements.

The Buchholz relay is an important protection and monitoring device for insulating liquid filled transformers with conservator and choke coils. It also allows separate monitoring of oil-filled bushings or cable terminal boxes.

Pipe diameter DN: 25 mm (1"), 50 mm (2"), 80 mm (3") Type of connection: threaded or flanged



#### **Buchholz relay of type 22 (BB 25) for use in rail cars**

Pipe diameter DN: 25 mm (1")  
Type of connection: threaded

#### **Other Buchholz relay types for use in rail cars**

Type 04 (BG 25)  
Type 21 (BG 25 S)  
Type 06 (BF 25/10)  
Type 08 (BF 50/10) and others



#### **NM series – New generation of Buchholz relays Buchholz relay with analogue measurement of gas volume**

The Buchholz relay of NM series is equipped additionally with a capacitive sensor. It allows continuous and analogue gas volume measurement so that gases which have accumulated in the relay are detected at an early stage, information about the generation of the gases obtained and the conditions provided for fault analysis at an early stage. Analogue measurement of the gas volume is possible between 50 cm<sup>3</sup> and 300 cm<sup>3</sup>.

Pipe diameter DN: 25 mm (1"), 50 mm (2"), 80 mm (3")  
Type of connection: threaded or flanged

**For further information, please ask for special reference material.**

## 12.2. Additional devices for Buchholz relays



### Gas sampling device ZG 1.2.

The gas sampling device is mounted on the transformer and connected to the Buchholz relay by means of a pipe. It allows sampling of the relay gas at normal operating level. The length of the pipe can be selected by the customer. The device can be delivered with a lockable box.

### Gas testing devices ZG 3.1. and ZG 3.2.

The gas testing devices are used to test the gas accumulated in the Buchholz relay. They can be installed either directly on the test valve of the Buchholz relay or on the gas outlet tap of the gas sampling device.



#### - ZG 3.1.

The Buchholz gas flows through two different chemical solutions and the colour reactions indicate the nature of the fault.

**Note: Chemical solutions are not included in the scope of supply.**

Use of the gas testing device is no substitute for a gas chromatographic analysis.



#### - ZG 3.2.

The Buchholz gas flows through two different test tubes, and the colour reactions allow conclusions about the availability of carbon monoxide and hydrogen.

Use of the gas testing device is no substitute for a gas chromatographic analysis.

**For further information, please ask for special reference material.**





#### **Reflux lock ZG 4.1.**

The device prevents insulating liquid from flowing into the gas testing device. The device is installed between the Buchholz relay or gas sampling device and the gas testing device.



#### **Test pumps ZG 5.1. and ZG 5.2.**

The test pumps check the function of the upper switching system (alarm) of the Buchholz relay by pumping in air. The test can be performed directly on the Buchholz relay. For that purpose, the test pump is connected to the test valve of the Buchholz relay. When the test is performed via the gas sampling device, the test pump is connected to the gas outlet tap of the gas sampling device.

- ZG 5.1. manually operated
- ZG 5.2. pedal operated



#### **Oil sampling device ZG 6.1.**

The oil sampling device is connected to the Buchholz relay via a pipe and is used to take oil samples from the Buchholz relay (suitable for use with Buchholz relays with an oil drain plug). The pipe is supplied to customer's specifications.

**For further information, please ask for special reference material.**



### **Buchholz gas sampler BGS**

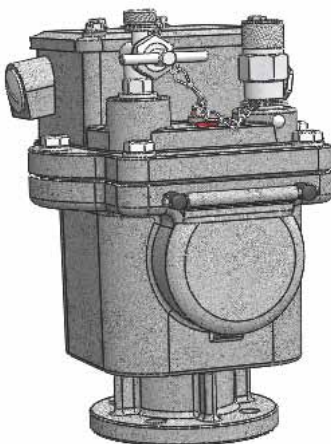
The Buchholz gas sampler provides a safe method of taking and transporting gas samples from the Buchholz relay or the gas sampling device. Its capacity is 100 ml.



### **Buchholz gas tester BGT 3**

The Buchholz gas tester is used to measure the hydrogen concentration of the Buchholz gases. The measurement can be performed directly at the place where the sample is taken.

## **12.3. Monitoring device for hydro-type compensator**



### **Type 80 (CF 38)**

This device serves to monitor the hydro-type compensator (air sack, membrane) in the conservator. Single and double-float Buchholz relays manufactured by EMB GmbH are also used as air-cell failure relays.

**For further information, please ask for special reference material.**

## 12.4. Breathing buffer box



### **Breathing buffer box G3B to extend the life of transformers**

Aging of the insulation system of a transformer is accelerated by oxygen dissolved in oil. In open-type transformers the oxygen consumed in this process is replenished from the atmosphere. This has negative long-term effects.

The breathing buffer box (G3B) installed in the breathing line of the transformer upstream of the desiccant solves this problem. It ensures hermetic sealing of the transformer.

**For further information, please ask for special reference material.**



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