



*Elektromotoren und
Gerätebau Barleben GmbH*



**Transformer Protection Relays
(Buchholz Principle)**

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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 sugar factory
- 1921 Development of 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 tap changers in Barleben
- 1970 VEB Elektrotechnik und Gerätebau Magdeburg; EGEM
(state-owned firm)
- 1980 VEB Kombinat Elektromaschinenbau Dresden
VEB Elektromotorenwerk Barleben; VEM; ELMO
(state-owned firm)
- 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](#) with analogue gas volume monitoring (NM-series)
- 2006 Taking over the Buchholz relay production from Siemens
- 2009 New premises in Barleben
- 2015 Acquisition of the Buchholz relay production line from Koncar Croatia
- 2017 Start of manufacture of Buchholz relays with sensors for humidity and temperature in oil monitoring
- 2022 Start of manufacture of hermetic transformer switches HTS and pressure controllers



Figure 1 - EMB company building

1 Preface

More than 1.7 million relays have been sold worldwide in 70 years!

The Buchholz relay was developed in 1921 by Max Buchholz, Oberrat (senior councillor) at Preußische Elektrizitäts-A.G. (Prussian electricity company) in Kassel. Since that time it has been 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. It is mounted in the cooling cycle of the device to be protected and responds to faults such as gas generation, loss of as well as high flow rates of the insulating liquid.

For transformers with hermetical closure by means of a hydro-type compensator (rubber sack) in the conservator, the Buchholz relay can be used also a monitoring device (air cell failure relay) of the hydro-type compensator.

The Buchholz relay is suitable for open-air as well as indoor installations.

The type diversity of the Buchholz relay is tailored to norms and standards as well as to special customer demands. The type of relay to be used depends on the nominal rating and construction features of the device to be protected. Our range of products permits optimum adaptation to actual requirements.

Elektromotoren und Gerätebau GmbH (EMB GmbH) provides more than 70 years experience in producing Buchholz relays and other protective devices for liquid-cooled and liquid-insulated devices. It ranks today among the most distinguished manufacturers of this type of equipment.

EMB Buchholz relays are in compliance with EN 50216-2 as well as IEC 60076-22-1 and are known for their easy operation, high reliability and extremely long life.

The functionality of the EMB Buchholz relays is given by using all conventional insulating liquids. The functionality in combination with new insulating fluids will be tested in close cooperation with the manufacturers.

EMB has been certified according to: DIN EN ISO 9001:2015, AEO F, Known Consignor (Airfreight Security) and EAC. Further certifications have been awarded by well-known independent test laboratories such as TÜV Rheinland and TZO.



Figure 2 - Certificates

2 Design features

Casing

The casing is made of weather-resistant cast aluminium alloy provided with a paint coating. It is supplied either with flanged (Fig. 3/ Number 1) or threaded connection (Fig. 3/ No.2). The different casing designs available are shown in Section 5 for single-float Buchholz relays and Section 7 for double-float Buchholz relays, others are available on request.

To check the switching system for proper function, the casing is provided with sightglasses (Fig. 3/ No. 3). The sightglasses provided with scales permit reading of collected gas volume.

The relays can be provided with hinged lids (Fig. 3/ No.4) to protect the sightglasses.

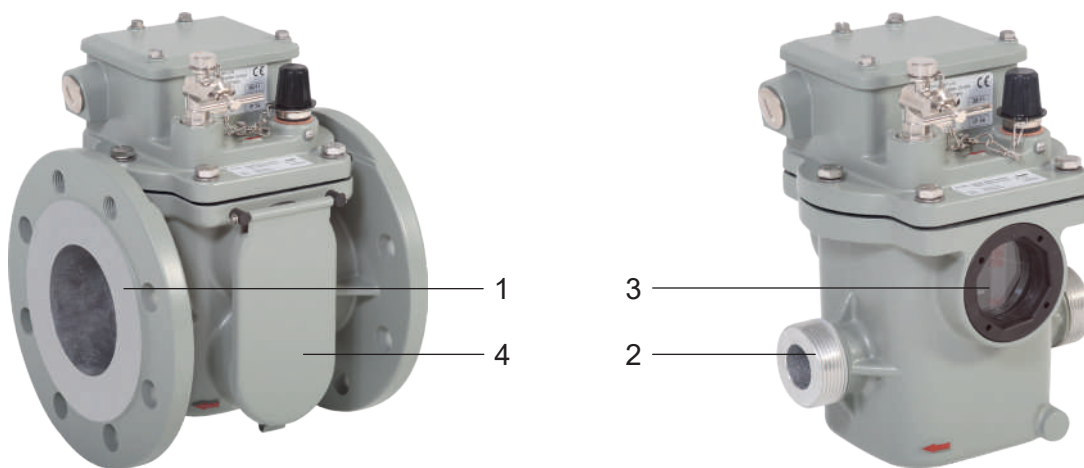


Figure 3 - Figure 3 - Casing with flanged connection, left, and threaded connection, right

Cover

The cover is made of weather-resistant cast aluminium alloy provided with a paint coating. The upper section of the cover accommodates the terminal box (Fig. 4/ No. 1). In front of the terminal box are arranged the bleeding valve (Fig. 4/ No. 2) and the test key covered by a cap nut (Fig. 4/ No. 3) as well as a plate (Fig. 4/ No. 4) with instructions for actuating the test key. The terminal box accommodates the earth terminal (Fig. 4/ No. 5) and bushings (Fig. 4/ No. 6) for the terminals provided in the base of the cover. The number of these bushings determines the design of the switching systems in terms of type and quantity of the magnet contact tubes.

The terminal box is sealed by an cap (Fig. 4/ No. 7) so that it is safe to touch and protected against pollution and water. If the cap is opened instructions for installation (Fig. 4/ No. 8) are shown e.g. the graphic symbol and the connection diagram in working condition. The cable can be inserted through the cable gland (Fig. 4/ No. 9).

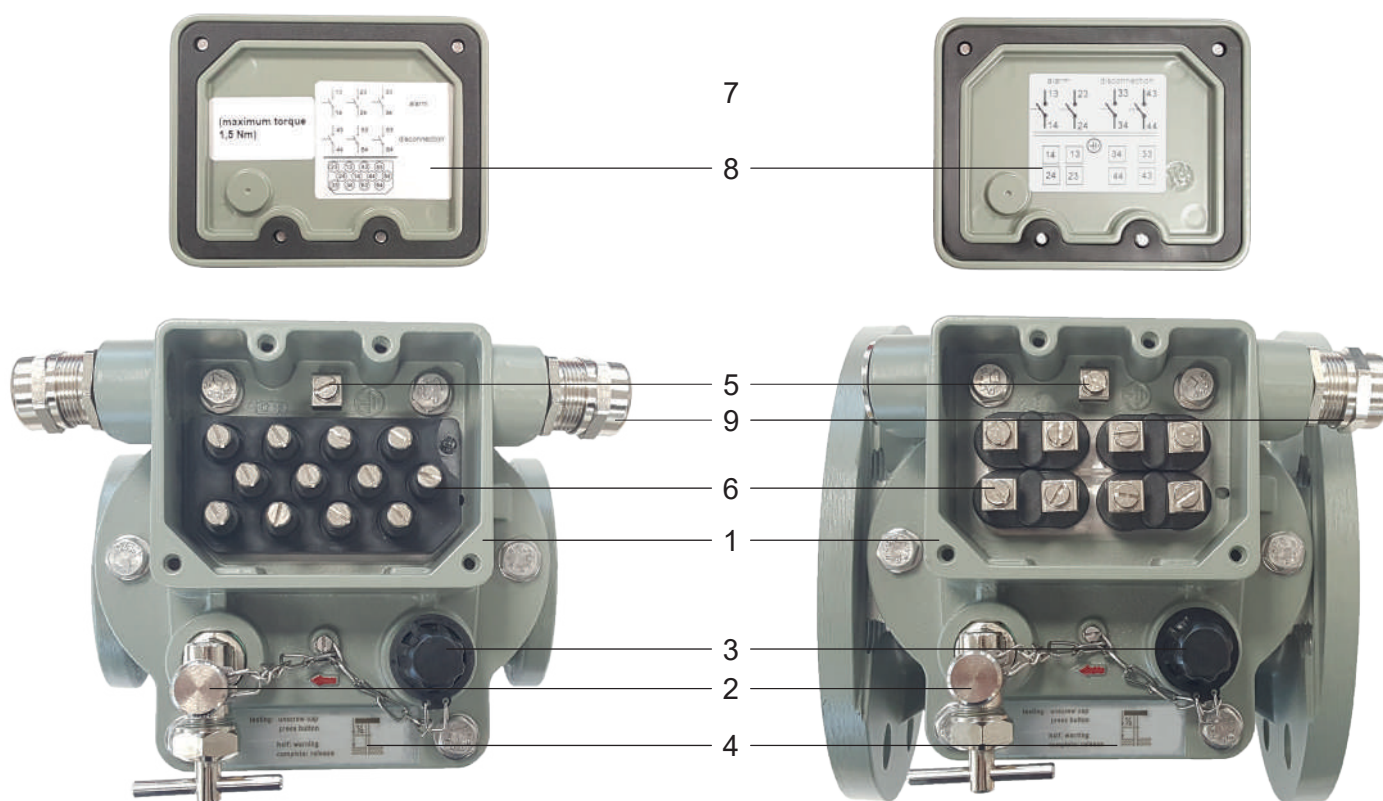


Figure 4 - Top view of Buchholz relay with cap removed, left with six magnet contact tubes and right with four magnet contact tubes

3 Function

The Buchholz relay is used for the protection and monitoring of insulated liquid-filled transformers with expansion tank and earth leakage coils. It is installed in the cooling circuit of the unit to be protected and reacts to faults such as gas formation, loss as well as excessive flow of the insulating liquid with a warning or disconnection signal. This prevents devastating damage to the transformer or even its destruction.

The Buchholz relay is installed in the pipe between the tank of the device to be protected (transformer, reactor) and the conservator. During normal operation it is filled completely with insulating liquid.

Due to buoyancy the float of the single-float relay and both floats of the double-float relay are at their top position.

The upper and lower switching systems form a functional unit in the single-float Buchholz relay so that in the event of a fault the transformer is immediately disconnected from the power system.

In the following the function of a Buchholz relay is explained using the example of a double-float Buchholz relay. If a fault occurs inside the transformer, the Buchholz relay responds as follows:

3.1 Gas accumulation

Fault: Free gas is available in the insulating liquid.

Response: The gas in the liquid moves upwards, accumulates in the Buchholz relay and displaces the insulating liquid level. As the liquid level falls, the upper float moves downwards.

The moving float actuates a switch contact (magnet contact tube). An alarm signal is tripped.

The lower float is not affected as from a certain gas volume the gas flows through a piping to the conservator.

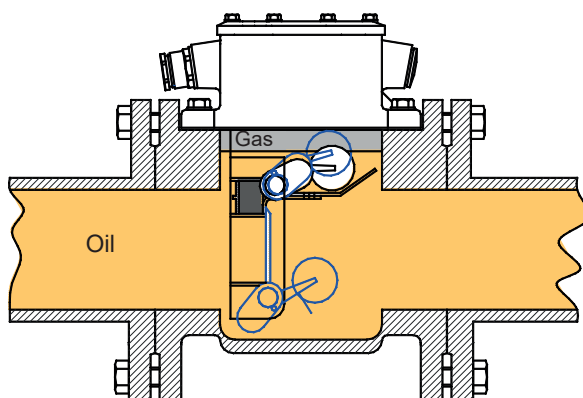


Figure 5 - Gas accumulation

3.2 Insulating liquid loss

Fault: Insulating liquid loss due to leakage.

Response: As the liquid level falls, the conservator, piping and Buchholz relay are emptied. First, the top float lowers and causes an alarm signal. When now the loss of liquid continues, the lower float sinks and actuates a switch contact so that the transformer is shut down.

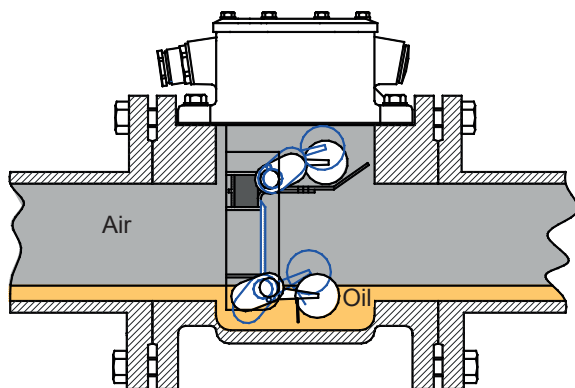


Figure 6 - Insulating liquid loss

3.3 Insulating liquid flow

Fault: A spontaneous incident generates a pressure wave moving in the direction of the conservator.

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

Due to this movement a switch contact is actuated so that the transformer is disconnected.

After release of the pressure wave the lower switching system returns to its starting position.

Buchholz relays manufactured by EMB are equipped with a damper held by a permanent magnet.

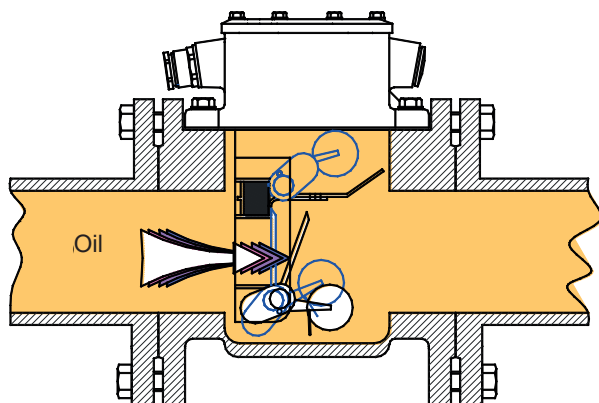


Figure 7 - Insulating liquid flow

4 Tests

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

- Dielectric strength test
- Leakage test
- Functional test
- Flow test.

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

- Operating instructions
- Test certificate.

Note: Flange gaskets are not included in the scope of delivery!

The name plate covers the following information:

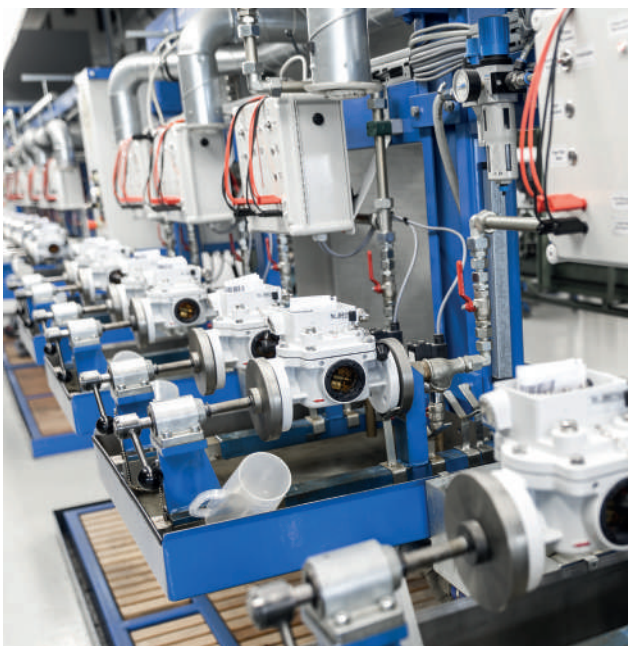
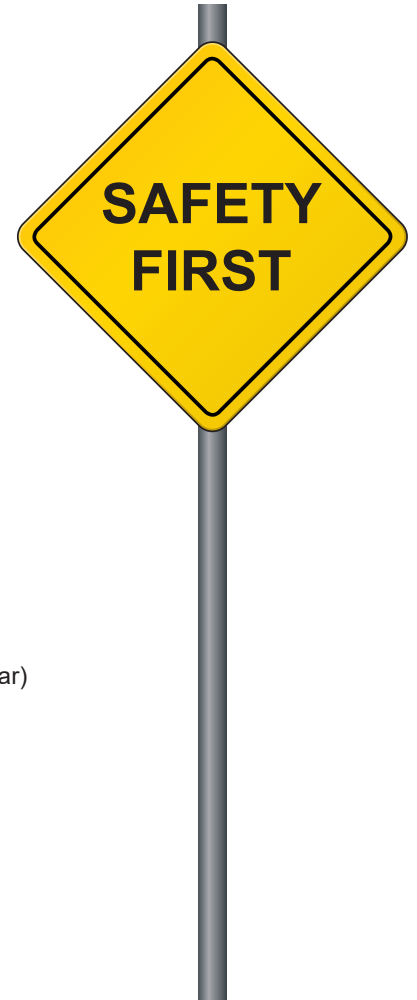
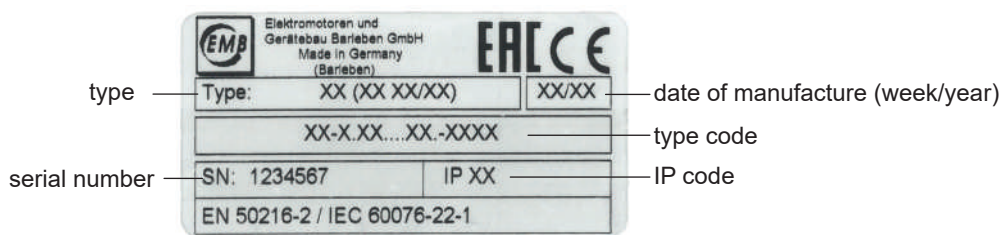


Figure 8 - Functional and leakage test



Figure 9 - Flow test

5 Type list of single-float Buchholz relays

5.1 Single-float Buchholz relays with threaded connection

	Type (Internal description) (Former DIN designation)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)
			d1	d2	d3	d4	d5	f	l	h1	h2	
	01 (AG 25) (CG 25)	Threaded connection G 1½"	25	-	-	-	-	16	185	170	62	3,1

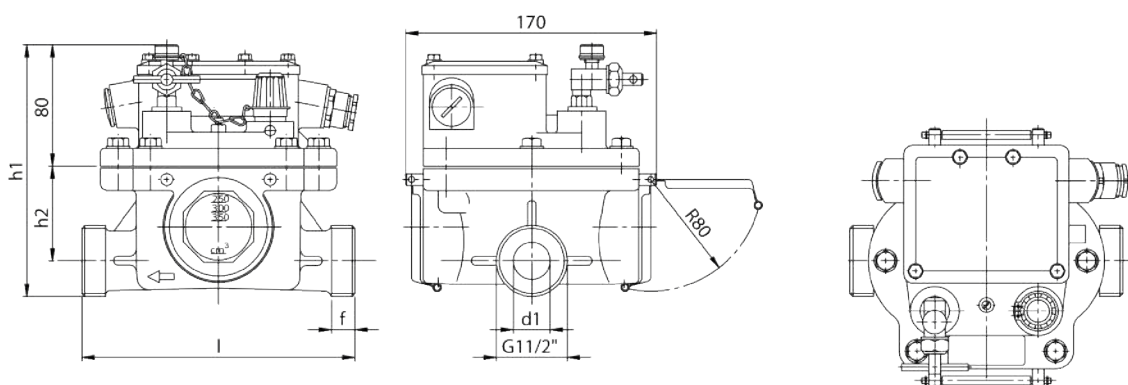


Figure 10 - Dimensional drawing, type 01

5.2 Single-float Buchholz relays with flanged connection

	Type (Internal description) (Former DIN designation)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)
			d1	d2	d3	d4	d5	f	l	h1	h2	
	02 (AF 25/6) (-)	Flange 4-hole	25	100	75	60	12	12	185	195	62	3,6
	03 (AF 25/10) (-)	Flange 4-hole	25	115	85	68	14	16	200	205	62	4,0

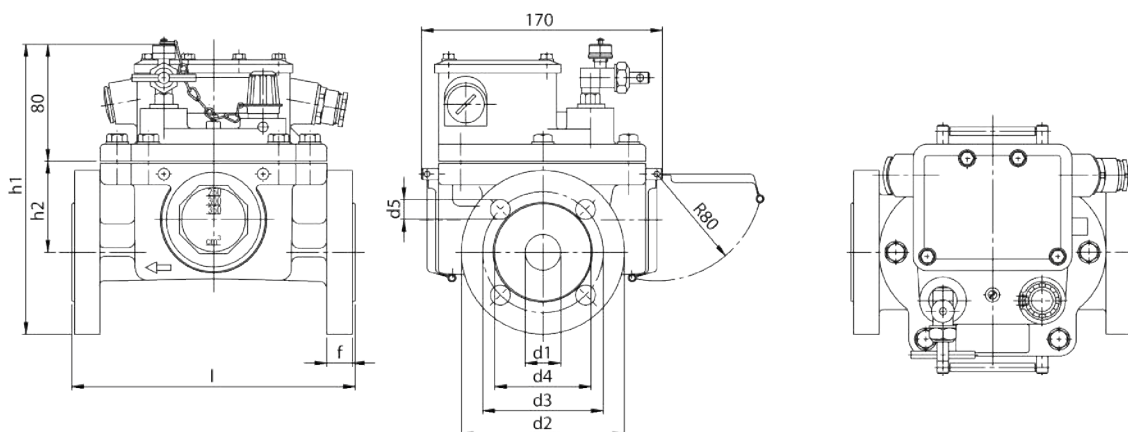


Figure 11 - Dimensional drawing, type 02, 03

	Type (Internal description) (Former DIN designation)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)
			d1	d2	d3	d4	d5	f	l	h1	h2	
	25 (AF 25) (-)	Flange 4-hole	25	115	85	-	M12	15	160	195	62	3,3

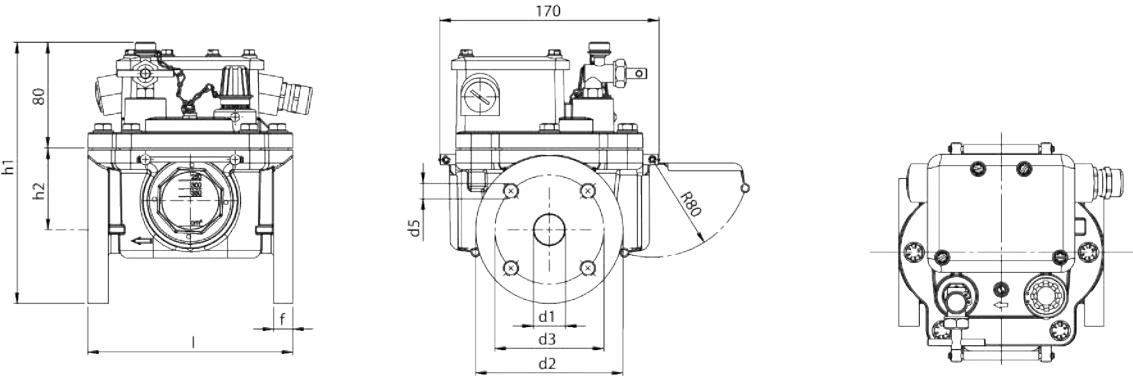


Figure 12 - Dimensional drawing, type 25

5.3 Single-float Buchholz relays with flat flanged connection

	Type (Internal description) (former DIN designation)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)
			d1	d2	d3	d4	d5	f	l	h1	h2	
	30 (AF 25/10 G) (-)	Flange 4-hole	25	115	85	-	14	16	200	205	62	4

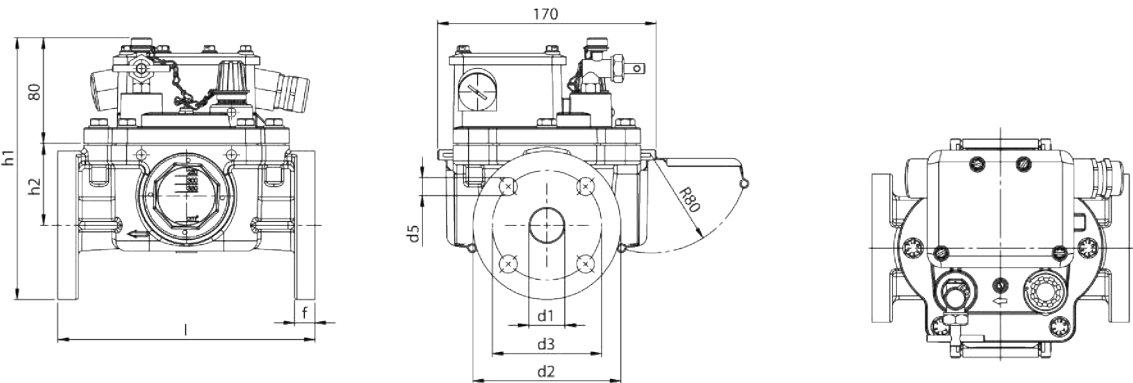


Figure 13 - Dimensional drawing, type 30

6 Type list of double-float Buchholz relays

6.1 Double-float Buchholz relays with threaded connection

	Type (Internal description) (Former DIN designation)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)
			d1	d2	d3	d4	d5	f	l	h1	h2	
	04 (BG 25) (DG 25)	Threaded connection G 1½"	25	-	-	-	-	16	185	235	90	4,2
	21 (BG 25 S) (-)	Threaded connection G 1½"	25	-	-	-	-	16	185	235	90	3,6

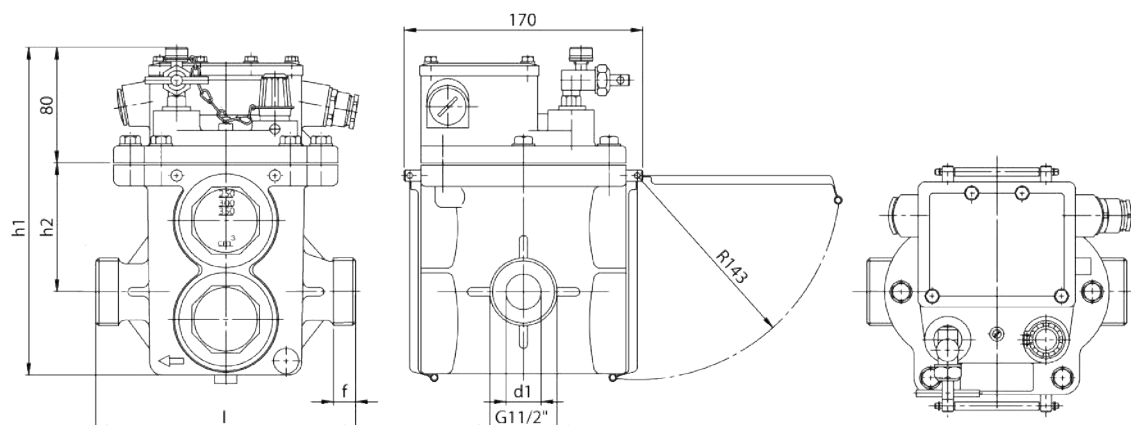


Figure 14 - Dimensional drawing, type 04

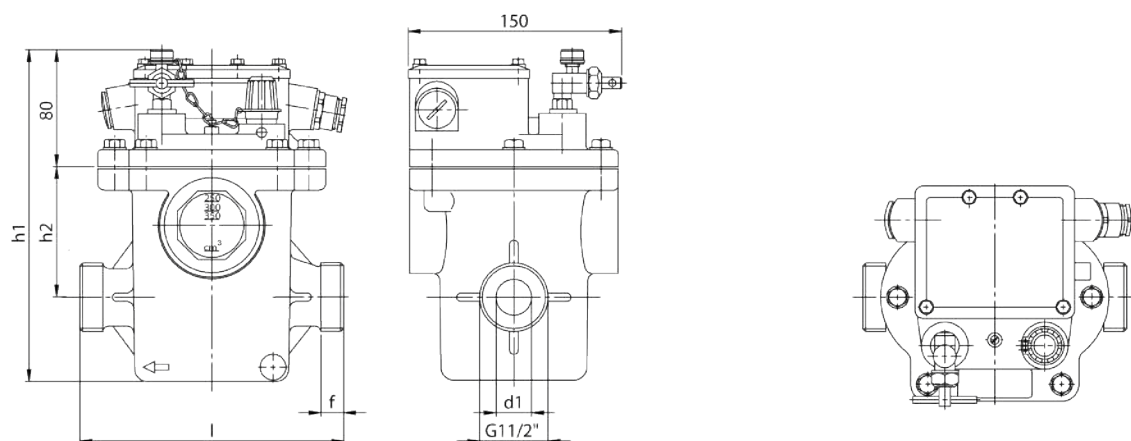


Figure 15 - Dimensional drawing, type 21

6.2 Double-float Buchholz relays with flanged connection (round)

	Type (Internal description) (Former DIN designation)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)						Device dimensions (mm)			Weight without packing (kg)
			d1	d2	d3	d4	d5	f	l	h1	h2		
	05 (BF 25/6) (-)	Flange 4-hole	25	100	75	60	12	12	185	235	90	4,4	
	06 (BF 25/10) (DR 25)	Flange 4-hole	25	115	85	68	14	18	200	235	90	4,8	
	07 (BF 50/6) (-)	Flange 4-hole	50	140	110	90	14	12	185	235	80	4,6	
	08 (BF 50/10) (DR 50)	Flange 4-hole	50	165	125	102	18	16	195	250	80	5,9	
	09 (BF 80/10) (-)	Flange 4-hole	80	200	160	138	18	15	195	265	80	6,2	
	24 (BF 80/6) (-)	Flange 4-hole	80	190	150	130	18	15	195	260	80	6,0	

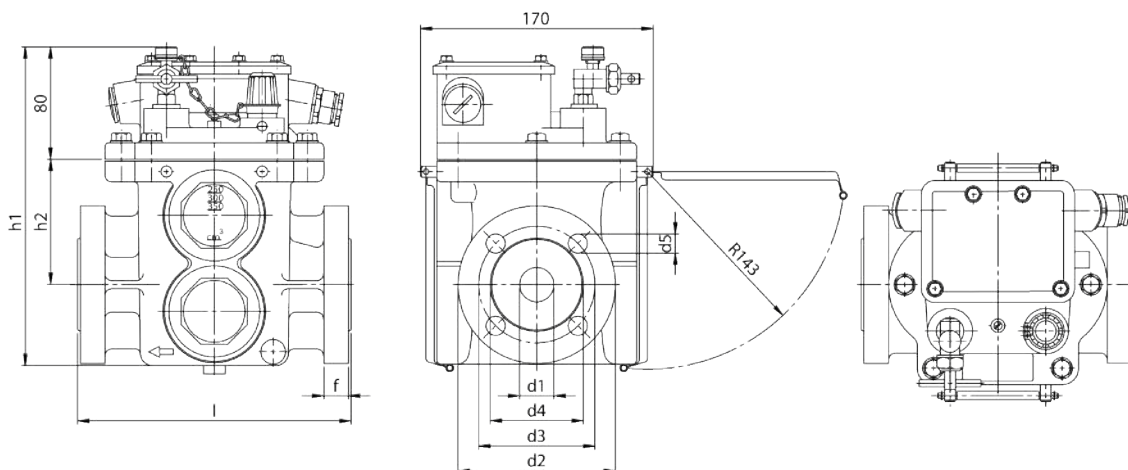


Bild 16 - Dimensional drawing, type 05, 06, 07, 08, 09, 24

	Type (Internal description) (Former DIN designation)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)
			d1	d2	d3	d4	d5	f	l	h1	h2	
	23 (BF 25/10 S) (-)	Flange 4-hole	25	115	85	68	14	18	200	235	90	4,4

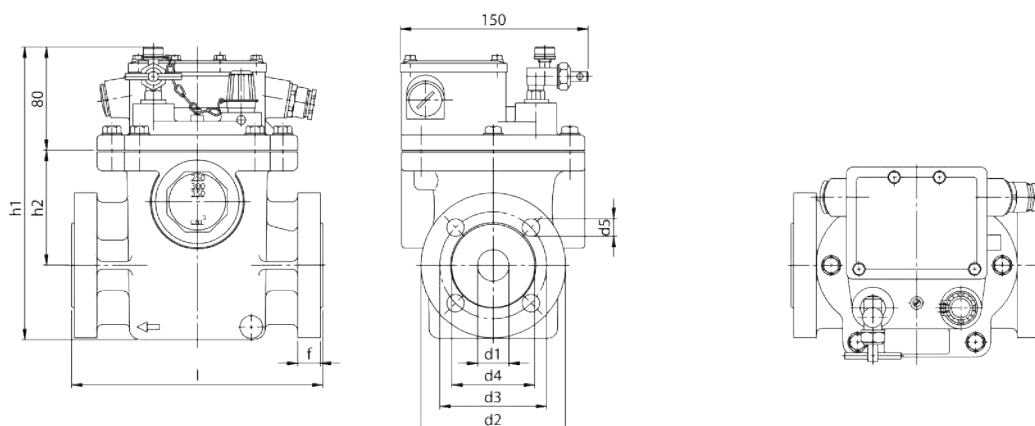


Figure 17 - Dimensional drawing, type 23

	Type (Internal description) (Former DIN designation)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)
			d1	d2	d3	d4	d5	f	l	h1	h2	
	26 (BF80/10/8) (DR 80)	Flange 8-hole	80	200	160	138	18 M16	15	195	265	80	6,2

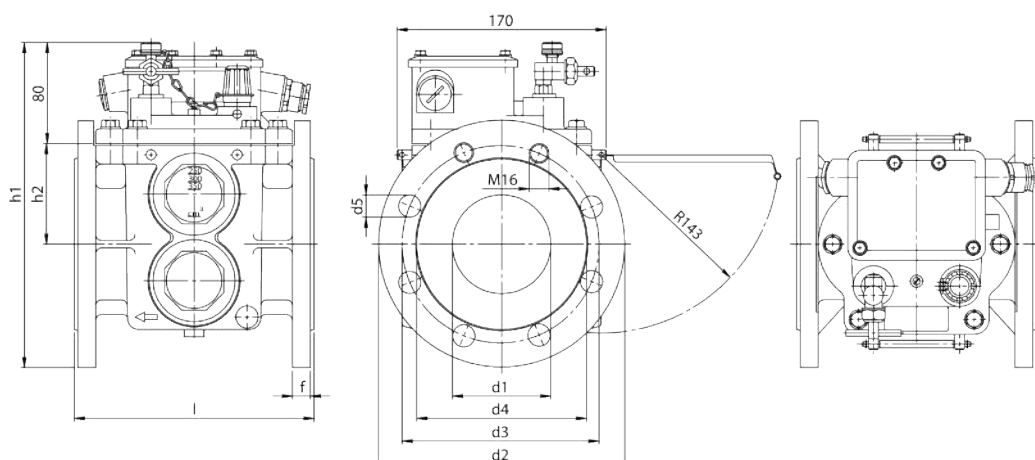


Figure 18 - Dimensional drawing, type 26

6.3 Double-float Buchholz relays with flat flanged connection (round)

	Type (Internal description) (Former DIN designation)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)
			d1	d2	d3	d4	d5	f	l	h1	h2	
	27 (BF 80/10/8 G) (DR 80)	Flange 8-hole	80	200	160	-	18	18	195	265	80	6,2

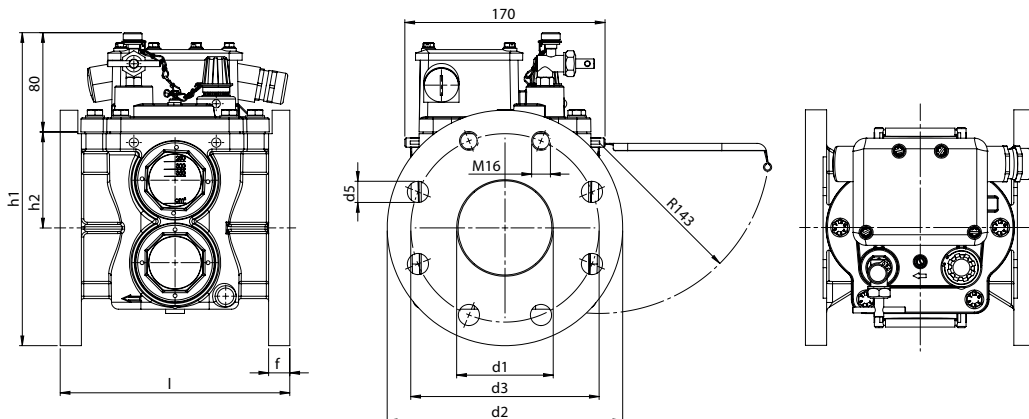


Figure 19 - Dimensional drawing, type 27

	Type (Internal description) (Former DIN designation)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)
			d1	d2	d3	d4	d5	f	l	h1	h2	
	28 (BF 80/10 G) (-)	Flange 4-hole	80	200	160	-	18	18	195	265	80	6,2
	31 (BF 25/10 G) (DR 25)	Flange 4-hole	25	115	85	-	14	20	200	235	90	4,8

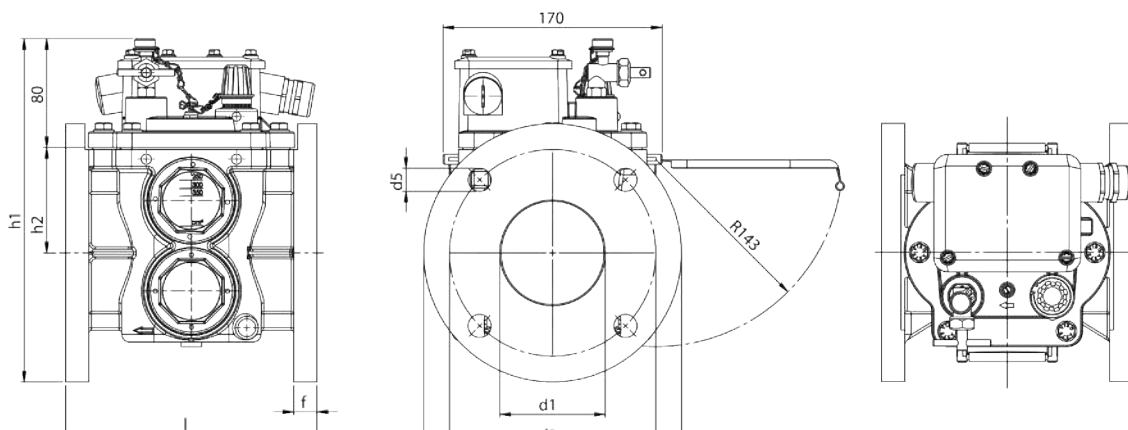


Figure 20 - Dimensional drawing, type 28, 31

6.4 Double-float Buchholz relays with flanged connection (square)

	Type (Internal description) (Former DIN designation)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)
			d1	b	d3	d4	d5	f	l	h1	h2	
	10 (BF 80/Q) (DQ 80)	Flange square 4-hole	80	125	132	-	18	20	200	235	80	5,0

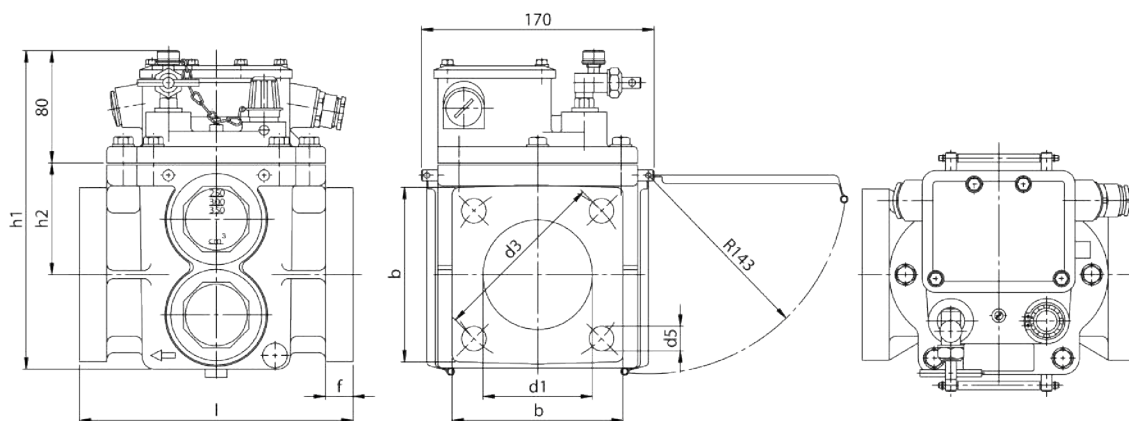


Figure 21 - Dimensional drawing, type 10

6.5 Double-float Buchholz relays with geometrical flange dimensions according to Chinese norm

Suitable for connection to Chinese butterfly valves (square flange). Other types on request.

	Type (Internal description) (Chinese designation)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)
			d1	b	d3	d4	d5	f	l	h1	h2	
	62 (BC 50) (QJ 50)	Flange square 4-hole	50	125	125	-	14	15	185	230	80	5,0
	63 (BC 80) (QJ 80)	Flange square 4-hole	80	160	160	-	18	15	185	245	80	5,0

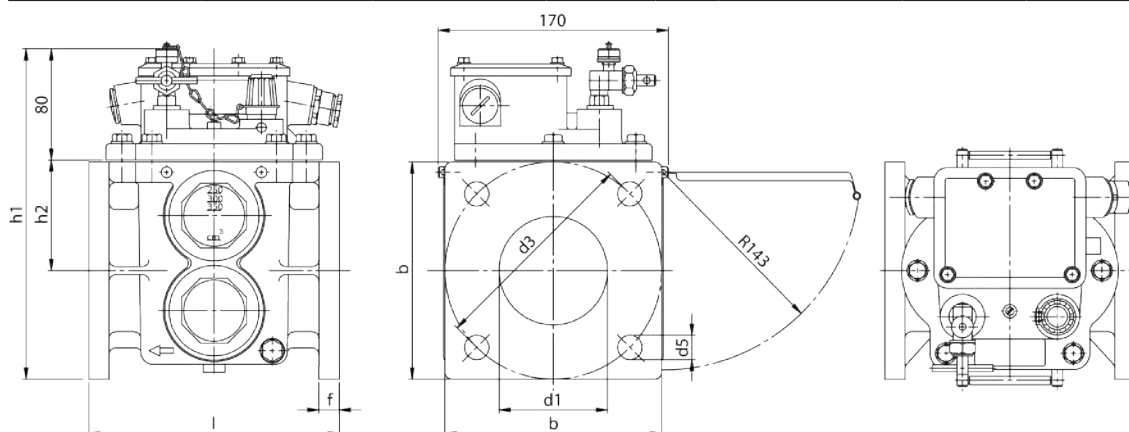


Figure 22 - Dimensional drawing, type 62, 63

6.6 Double-float Buchholz relays with geometrical flange dimensions according to former French norm

	Type (Internal description) (Former french norm)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)
			d1	d2	d3	d4	d5	f	l	h1	h2	
	41 (NF 25) (NF 25)	Flange 4-hole	25	115	85	-	14	8	240	235	90	4,2
	42 (NF 50) (NF 50)	Flange 4-hole	50	165	125	-	18	15	240	250	80	5,1
	43 (NF 80) (NF 80)	Flange 4-hole	80	200	160	-	18	15	240	265	80	5,5

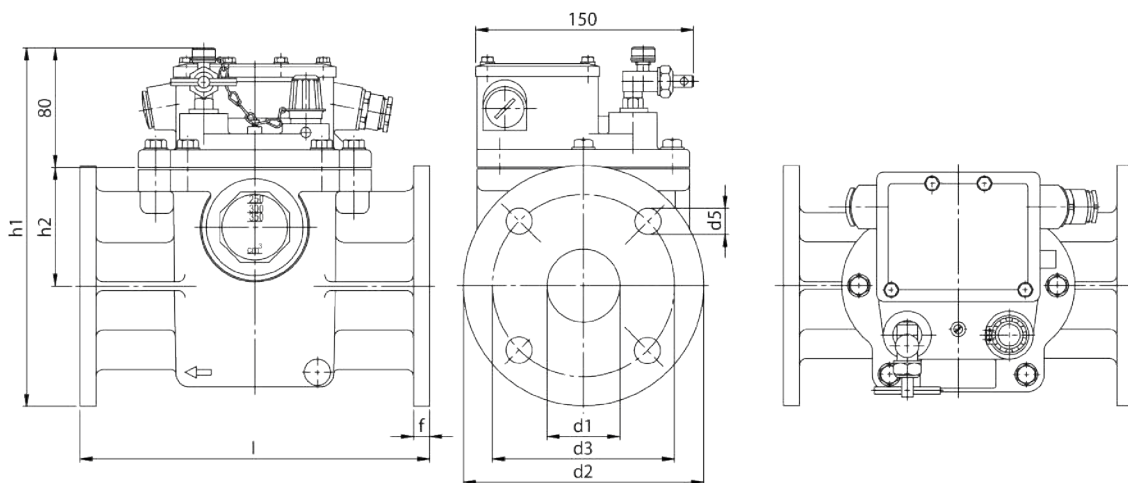


Figure 23 - Dimensional drawing, type 41, 42, 43

6.7 Double-float Buchholz relays with geometrical flange dimensions according to former British standard

	Type (Internal description) (Former British norm)	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm, in)					Device dimensions (mm)			Weight without packing (kg)
			d1	b/d2	d3	d4	d5	f	l	h1	h2	
	51 (BS 25) (BS 25)	Flange square 4-hole	25	76 2,99	72 2,83	- -	M10 M10	- -	127 5	235 9,25	90 3,54	3,7
	52 (BS 50) (BS 50)	Flange round 6-hole	50	140 5,51	110 4,33	- -	12 0,47	12 0,47	185 7,28	235 9,25	80 3,15	4,8
	53 (BS 80) (BS 80)	Flange round 6-hole	80	160 6,30	130 5,12	- -	12 0,47	13 0,51	185 7,28	240 9,45	80 3,15	5,0

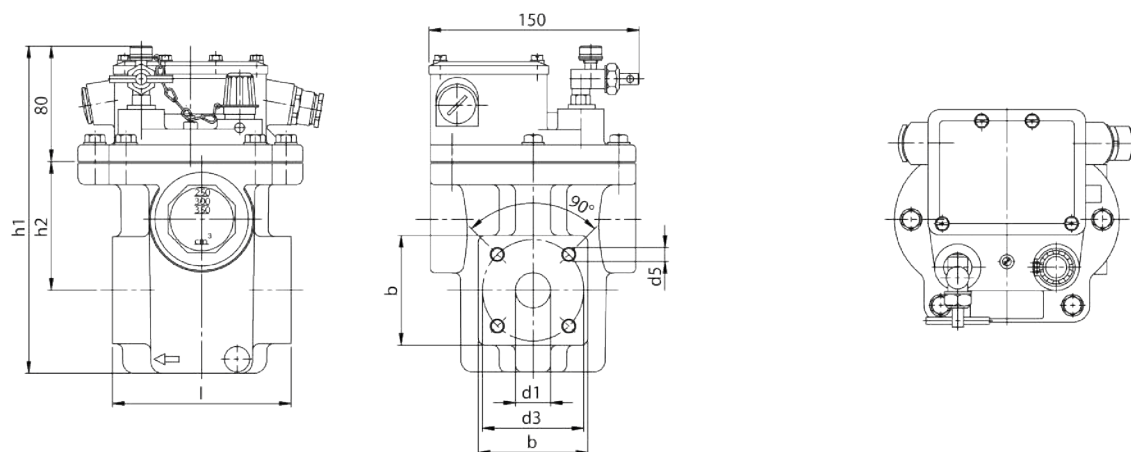


Figure 24 - Dimensional drawing, type 51

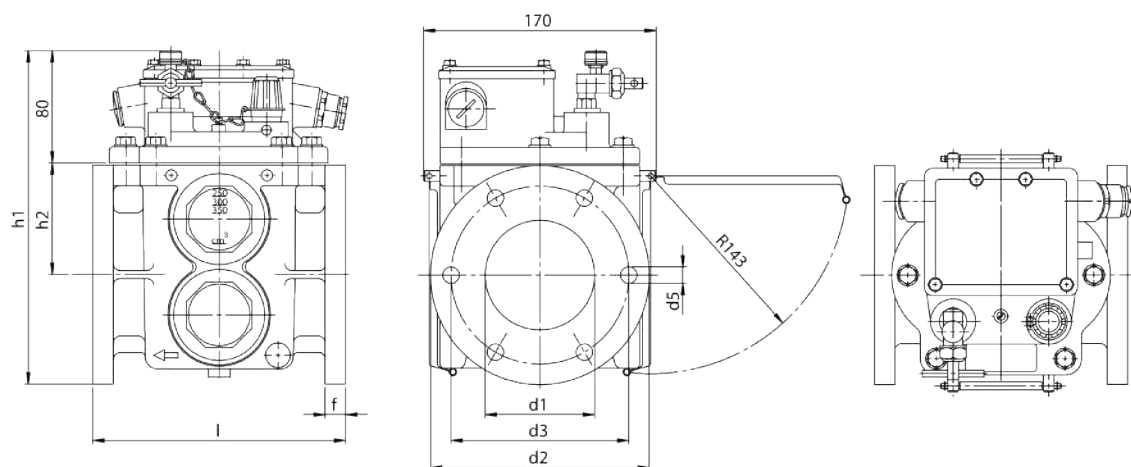


Figure 25 - Dimensional drawing, type 52, 53

7 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 digits of the type code. For coding, see Ordering data/Type code under Section 11.

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 Buchholz relay is filled with insulating liquid up to the required level and the device to be protected operates without any fault.

8 Technical data

The technical data listed in table named below are applicable to all Buchholz relays in standard version manufactured by EMB. EMB Buchholz relays are in compliance with DIN EN 50216-2 as well as IEC 60076-22-1.

Parameter	Data	Notes
Voltage	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	Cos $\varphi > 0.5$ L/R < 40 ms
Switching capacity	AC max. 1500 VA DC max. 1250 W	
Dielectric strength	AC 2500 V AC 2000 V (normally-open contact, normally-closed contact) AC 1000 V (change-over contact)	Between electric circuit and earth Between open contacts
Temperature range: - Ambient temperature - Operating range * Temperature of the insulating liquid * Viscosity of the insulating liquid	- 40 °C to + 55 °C - 40 °F to + 131 °F - 40 °C to + 115 °C - 40 °F to + 239 °F Till + 135 °C requires type code 21 1 mm ² /s to 1100 mm ² /s	Climatic testing acc. to DIN EN 60068-2-78 Others on request
Insulating liquid	Mineral oil	Others on request
Resistance against vibration	Vibration: 2-200 Hz, 2 g Shock: 25 g, 6 ms	Acc. to class 4M6 following DIN EN 60721-3-4
Resistance to pressure	0.25 MPa	
Resistance to vacuum	< 2.5 kPa	
Insensitivity to magnetic fields	25 mT	Static magnetic field of any direction and polarity
Switching system: - Switching element - Damper Response time of damper	Magnet contact tube Held by magnets < 0.1 s	
Response of switching system in case of: - Gas accumulation - Insulating liquid flow Pipe diameter DN of 25 mm, 50 mm or 80 mm	200 cm ³ to 300 cm ³ Min. 0.65 to max. 3.00 m/s $\pm$ 15%	Others on request For possible data see Ordering data/Type code under Section 11 Others on request
Cable gland	M20x1.5; M25x1.5	For more see under point 9
Nominal installation position	0° to 5°	Ascending towards conservator
IP code	IP 56	Others on request
Casing colour	Two-component texture paint	On polyurethane basis

Options available are specified in tables of Section 9. These special designs are coded using the respective code when ordering Buchholz relays.

More options on request available.

9 Options/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 glands plus 1 additional dummy plug	3B
M25x1,5: 2 cable glands	4
M25x1,5: 2 cable glands plus 1 additional dummy plug	4B
M20x1,5: 1 Harting connector and 1 dummy plug	5
1/2" NPT: 1 cable gland and 1 dummy plug	6
1/2" NPT: 2 cable glands	7
Cable gland: Special request	9

Sensors (only double-float Buchholz relays)

Gas volume sensor - NM series (Note: Explanations to code 60)	60
Temperature sensor (Note: Explanations to code 61)	61
Moisture-temperature sensor (Note: Explanations to code 62)	62

Casing colour *

Casing colour RAL 7001 (silver-grey)	41
Casing colour RAL 7033 (cement-grey)	44
Casing colour RAL 7038 (agate-grey)	45
Casing colour RAL 7035 (light-grey)	46
Casing colour RAL 9002 (grey-white)	48
Casing colour RAL 7032 (siliceous-grey)	49

Climate-proof version/IP code

Climate-proof version for extreme frigid open-air conditions below - 40 °C	34
Climate-proof version for Offshore	36
IP code 66	39
IP code 67	39B

Insulating liquid

Insulating liquid silicone oil	20
Insulating liquid based on ester	21

Equipment

Metal plate	15
With oil drain plug (only double-float Buchholz relays)	28
With premounted Harting connector (The option is indicated by a letter after the code. For further information, please ask for special reference material.)	59

Switching system

Upper switching system equipped with two magnet contact tubes	35
Lower switching system equipped with two magnet contact tubes	25
Upper and lower switching system each equipped with two magnet contact tubes	33

* **Mandatory order data, for other mandatory data see Section 12.**

Lower switching system equipped with three magnet contact tubes	99
Upper switching system equipped with two magnet contact tubes, Lower switching system equipped with three magnet contact tubes	55
Upper and lower switching system each equipped with three magnet contact tubes	77
Lower switching system equipped with four magnet contact tubes	88
Upper switching system equipped with two magnet contact tubes, Lower switching system equipped with four magnet contact tubes	89
Two-level gas alarm system (only double-float Buchholz relays, Note: Explanations to code 17A)	17A
Separate disconnection (only double-float Buchholz relays, Note: Explanations to code 17B)	17B
Testing of the switching systems by means of compressed-air and test key (only double-float Buchholz relays, Note: Explanations to code 32)	32
Damper held in response position (only double-float Buchholz relays, Note: Explanations to code 23)	23
Solid floats (Insulating liquid flow max. 1,50 m/s $\pm$ 15%)	16
Alarm for gas accumulation between 250 and 300 cm ³	18

Special request

Special design approved by RWE, Germany	24
Special design approved by E.ON, Germany	24B
Special design approved by LEAG, Germany	24C
Special request (on special agreement with customer)	29

For engineering reasons the following special designs **cannot** be combined in the same device:

	60	61	62	34	36	39	39B	20	21	15	28	59	35	25	33	99	55	77	88	89	17A	17B	32	23	16	18
60																										
61																										
62																										
34																										
36																										
39																										
39B																										
20																										
21																										
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77																										
88																										
89																										
17A																										
17B																										
32																										
23																										
16																										
18																										

9.1 Explanations to code 17A

Gases formed in the transformer rise to the conservator. In this way gases are collected in the Buchholz relay. When a certain volume is reached, the gases generate an alarm signal. This special design informs the transformer operator much earlier about a gas accumulation.

With the two-level gas alarm system in combination with **normally open contacts**, the first warning occurs at a gas volume of 100 - 200 cm³ and the second warning at a gas volume of 250 - 300 cm³. With the two-level gas alarm system in combination with **normally closed contacts**, the first warning is given at a gas volume of 200 - 250 cm³ and the second warning at a gas volume of 300 - 350 cm³ for design reasons.

9.2 Explanations to code 17B

A shutdown of the transformer by the Buchholz relay occurs as standard either in case of loss of the insulating liquid or too strong a current.

With the solution of the „separate disconnection“, the operator is now able to differentiate between the two causes of faults.

In the case of disconnection due to loss of insulating fluid, both the warning contacts and a disconnection contact react (Fig. 26).

If the flow rate is too high, only the disconnection contacts react (Fig. 27).

For separate disconnection, at least two contacts are necessary for the lower switching system.

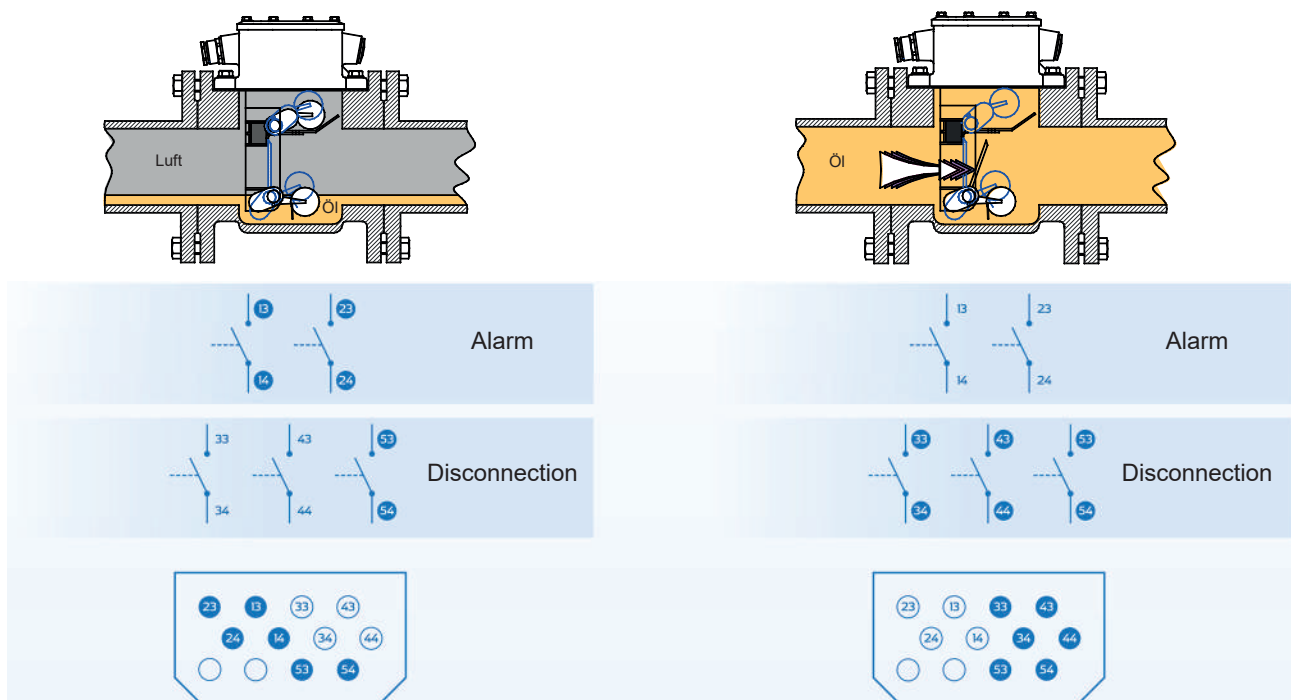


Figure 26 - Reacting contacts in case of loss of insulating liquid

Figure 27 - Reacting contacts in case of too high insulating liquid flow

9.3 Explanations to codes 23

Buchholz relays with the feature „damper held in response position“ are designed such that the damper after it was operated due to an unacceptable high flow rate of the insulating liquid is locked in its position and, hence is kept in this position even after the flow rate has been reduced. This means that the signal generated is maintained.

The damper has to be unlocked manually by turning the test key anticlockwise. When unlocking the damper, also check the insulating liquid level in the Buchholz relay. Bleed the Buchholz relay, if required.

9.4 Explanations to code 32

For Buchholz relays provided additionally with an air nipple (code 32), the mechanical function of the two switching systems can be tested by means of test key (Fig. 28/ No. 1), and the upper switching system (alarm) can be tested by pumping in air via the bleeding valve (Fig. 28/ No. 2) using a suitable test pump. Additionally, the switching systems can be tested pneumatically. To this end, air is supplied via an air supply nipple (Fig. 28/ No. 3) provided with a check valve. Perform the test while the Buchholz relay is filled with insulating liquid up to the required level.

Pneumatic test of the upper switching system (alarm) using compressed air:

Air is introduced **slowly** into the Buchholz relay through the air supply nipple and the pipe air until the alarm contact is made when the upper float is lowered.

Pneumatic test of the lower switching system (disconnection) using compressed air:

Through the air supply nipple and the pipe air is applied **suddenly** to the damper. When the damper responds the disconnection contact is made.

After any test using air, bleed the Buchholz relay through the bleeding valve.

This special design of EMB GmbH combines the requirement of functional testing using compressed air according to the former British standard B.E.B.S. T2 of 1966 and of functional testing using the test key according to DIN EN 50216-2 as well as IEC 60076-22-1.

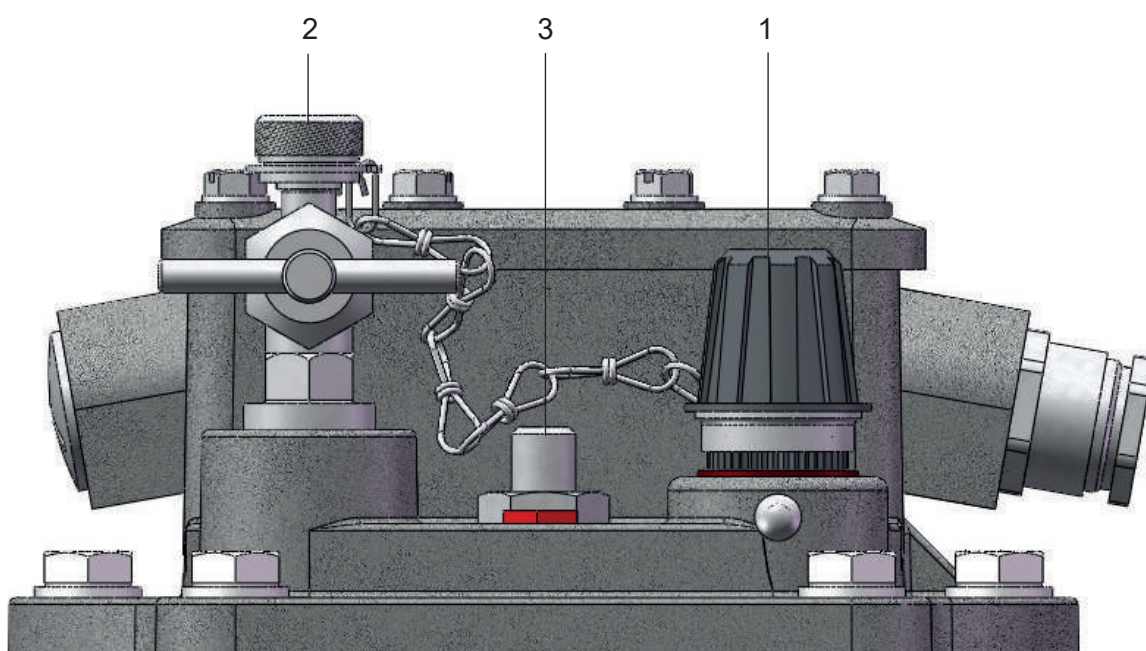


Figure 28 - Cover with additional air supply nipple

10 SMART-Buchholz relay

In addition to the standard function of the Buchholz relay, i.e. a mechanical switching mechanism responds to the release of gas, oil surge or complete loss of oil, the sensor technology offers a number of useful functions allowing extended and reliable monitoring of the transformer.

The Buchholz relay can be equipped with the following sensors:

- Gas volume sensor - NM series (Fig. 29/ No. 1)
- Temperature sensor (Fig. 29/ No. 2)
- Moisture-temperature sensor (Fig. 29/ No. 3)

These allow permanent monitoring of gas generation, water in oil and temperature so that transformer defects can be detected and corrective measures taken at an early time and finally the transformer life extended.

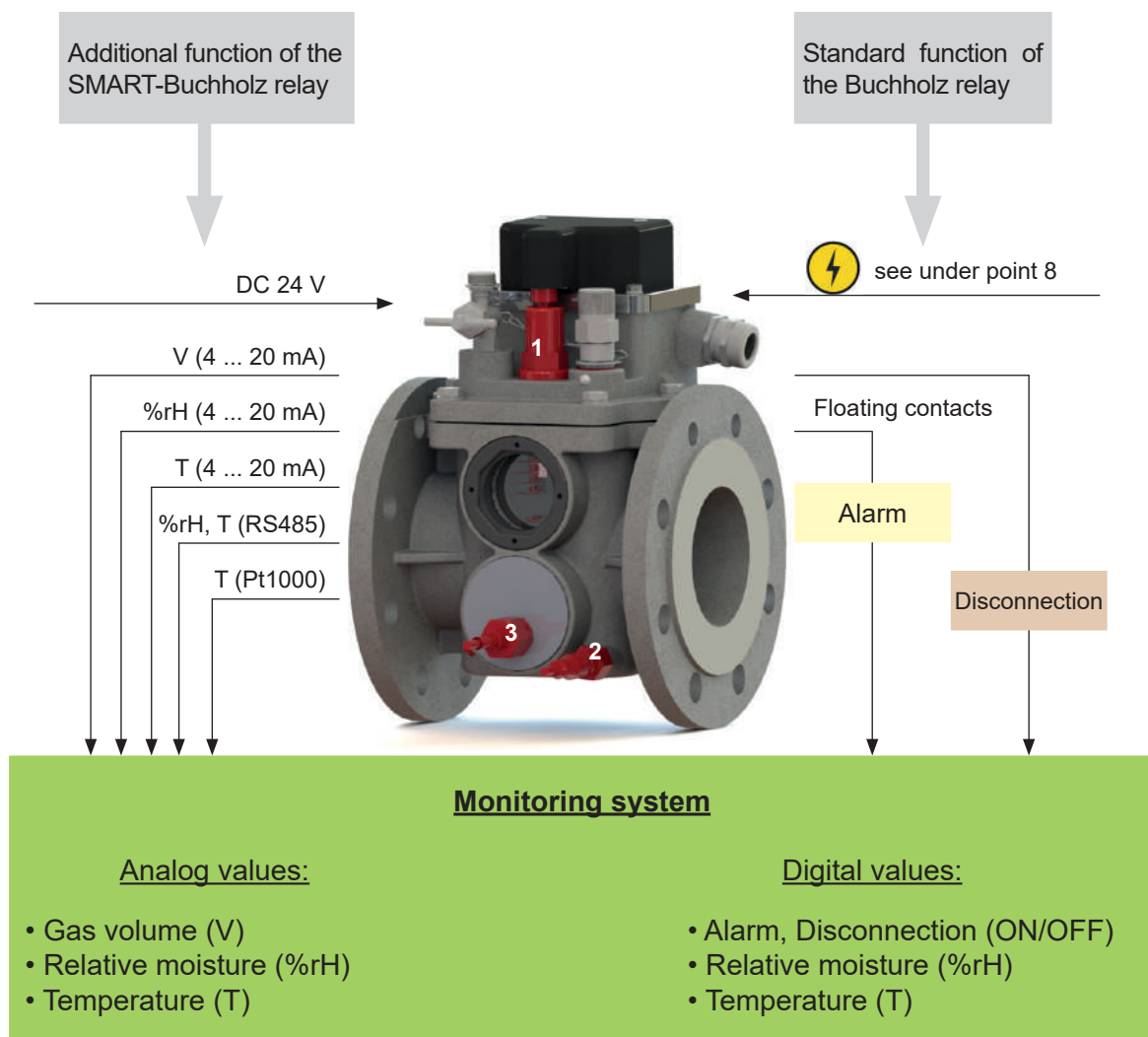


Figure 29 - Additional functions of the SMART-Buchholz relay

10.1 Explanations to code 60 - Gas volume sensor - NM series

10.1.1 Construction of Buchholz relay with gas volume sensor

With floats, damper and their electromechanical functions the Buchholz gas relay with gas volume sensor has the same principal construction as the standard Buchholz relay.

It is equipped additionally with a gas volume sensor and is fitted with metal name plates as standard. A shielded connection cable with a length of 25 m, with a open cable end is supplied ex works. The probe is installed in the cover of the Buchholz relay. The cap of the terminal box accommodates the electronic amplifier of the measuring device. A shielded cable with plug connector connects the probe and amplifier of the measuring system. Voltage supply of the system and pick off of the output signal are through a shielded connecting cable.

Figure 30 shows the arrangement of the measuring probe using the example of the type 26 (BF 80/10/8) Buchholz relay. It further shows that with the exception of the cover and cap of the terminal box which are higher by approx. 40 mm, the mounting dimensions of the relay have not changed. This means that relays with analog measuring device can be installed in existing systems.

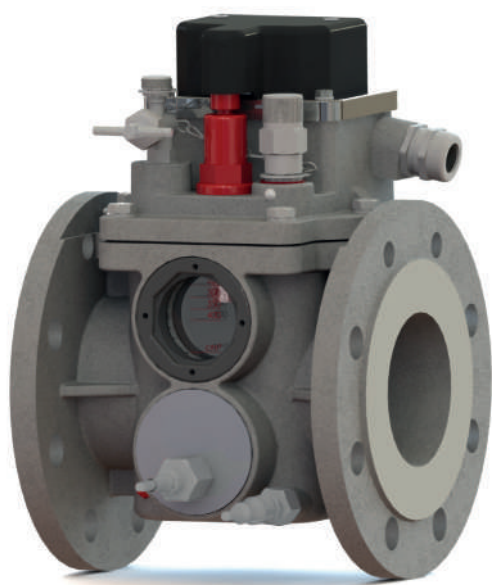


Figure 30 - Buchholz relay type 26 with gas volume sensor – NM series

10.1.2 Additional function of Buchholz relay with gas volume sensor

The standard Buchholz relay detects unsolved gases in the insulating liquid and generates a signal indicating the presence of gases when the specified threshold is exceeded, i.e. up to a certain gas volume no signal is generated. It does not allow conclusions with regard to the time of generation of gases.

The time of the generation of unsolved gases in the insulating liquid is a significant criterion for the evaluation of the defect. The composition and volume of the fault gases depend on the type and energy content of the defect leading to the generation of gases. Spontaneous and high-energy faults cause significant gas volumes within a short period of time whilst minor and low-energy faults produce low gas volumes.

Continuous and analog measurements in the Buchholz relay by the gas volume sensor supply information about the development of unsolved gases which allow early evaluation of the defect.

The additional function is realised by a gas volume sensor with capacitive action. The supply voltage of this component is 24 V DC provided by the user. The output signal is a current signal of 4 to 20 mA DC. Processing of the information supplied by this standardised signal is the user's responsibility.

10.1.3 Analog measuring device - analog gas volume measurement

The measured value is based on capacity changes of the measuring probe caused by variation of the insulating liquid level in the Buchholz relay.

Gas volumes between 50 and 300 cm³ are measured analogously. The design of the device does not allow precise measurement of lower gas volumes. Due to the response of the top switching system volumes in excess of the above need not be measured and cannot be measured because of the design of the Buchholz relay (higher gas volumes are diverted to the conservator). The operating point of the top switching system (top float) is a gas volume between 200 and 300 cm³.

Fault: The insulating liquid contains unsolved gas.

Reaction: The gas in the liquid moves upwards, accumulates in the Buchholz relay and displaces the insulating liquid. This causes the insulating liquid level to fall. As the filling level changes, the capacity of the measuring probe changes. An analog current signal is generated that corresponds to the extent of the capacity variation.

It should be noted that for design reasons the current value of the probe remains relatively constant up to a gas volume of approx. 50 cm³. It is only when the current signal becomes smaller and hence the calculated gas volume increases clearly, that the actual volume can be derived from the course of the characteristic of the analog measuring system.

10.2 Explanations to code 61 - SMART Buchholz relay with temperature sensor

10.2.1 Construction of SMART Buchholz relay with temperature sensor

With floats, damper and their electromechanical functions the Buchholz relay with temperature sensor has the same principal construction as the standard Buchholz relay.

The double-float Buchholz relay equipped with a temperature probe is identified by code 61. The sensor is a temperature-dependent Pt1000 resistor in a stainless steel casing. The temperature probe is fitted in the lower casing area next to the sightglass. Connection is by a shielded cable with plug connector.

Figure 31 shows the arrangement of the temperature probe using the example of the type 26 (BF 80/10/8) Buchholz relay. The Buchholz relay with temperature sensor can be installed in existing systems.



Figure 31 - Buchholz relay type 26 with temperature sensor

10.2.2 Additional function of SMART Buchholz relay with temperature sensor

The temperature sensor monitors the insulating liquid temperature in the Buchholz relay continuously. The common Pt1000 resistance sensor type allows straightforward integration in the monitoring system of the transformer. Via a shielded connector the temperature sensor is connected (two-wire technology) to a signal transducer to be provided by user.

10.3 Explanations to code 62 - SMART Buchholz relay with moisture-temperature sensor

10.3.1 Construction of the SMART Buchholz relay with moisture-temperature sensor

With floats, damper and their electromechanical functions the Buchholz relay with moisture-temperature sensor has the same principal construction as the standard Buchholz relay.

With the double-float Buchholz relay the lower sightglass is replaced by the combined water in oil and temperature sensor. The sensor is provided with two analog outputs and one digital RS 485 output for serial communication via the Modbus protocol. Voltage supply of the sensor, reading out of measured values as well as serial communication are via the shielded connecting cable.

Figure 32 shows the arrangement of the sensor using the example of the type 26 (BF 80/10/8) Buchholz relay. To allow installation, the sightglass of the Buchholz relay on the sensor side must not be provided with a cover. Use of the sensor leads to a greater installation depth of the relay. Nevertheless the relay can be installed in existing systems.



The combined humidity-temperature sensor can be selected in three different models:

- **Standard version**
- **High temperature version**
- **Offshore version**

The individual sensors are again available in numerous versions and must be specified by the customer using an additional form.

For further information, please request specific documentation.

Figur 32 - Buchholz relay type 26 with moisture-temperature sensor

10.3.2 Additional function of the Buchholz relay with moisture-temperature sensor

The measuring device is a combined sensor measuring water content and temperature of transformer oil. Measurement is performed independent of type and age of oil and its additives. The water content can be expressed as water activity, relative saturation or as an absolute value. The temperature range is scalable.

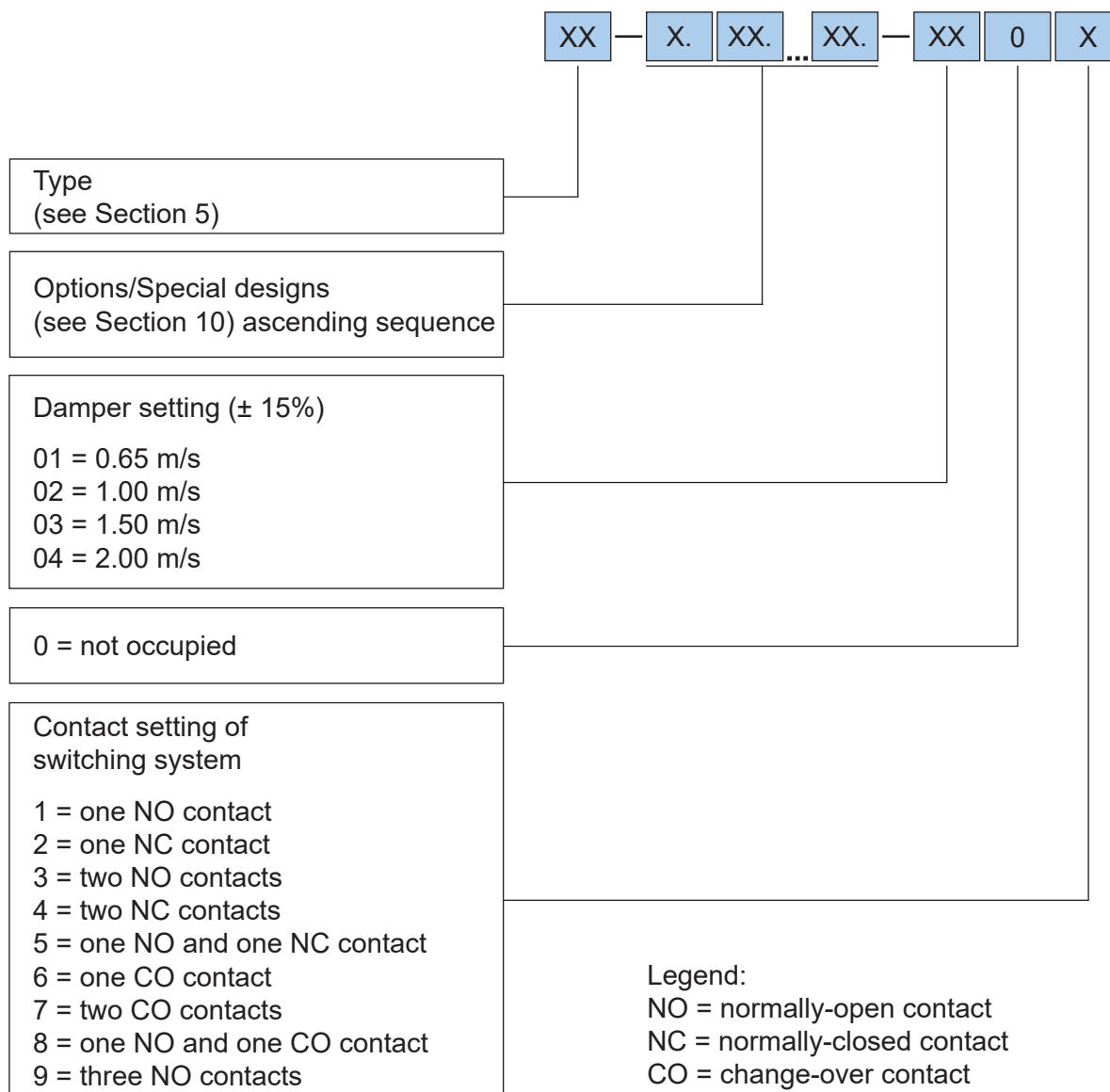
The risk of free water generation can be derived directly from both measured values.

The supply voltage of this component is 24 V DC and made available by user. Measured data output is via either an analog signal (0(4) ... 20 mA) or a digital signal (RS-485 with Modbus RTU). The device can also be parameterised via a digital interface.

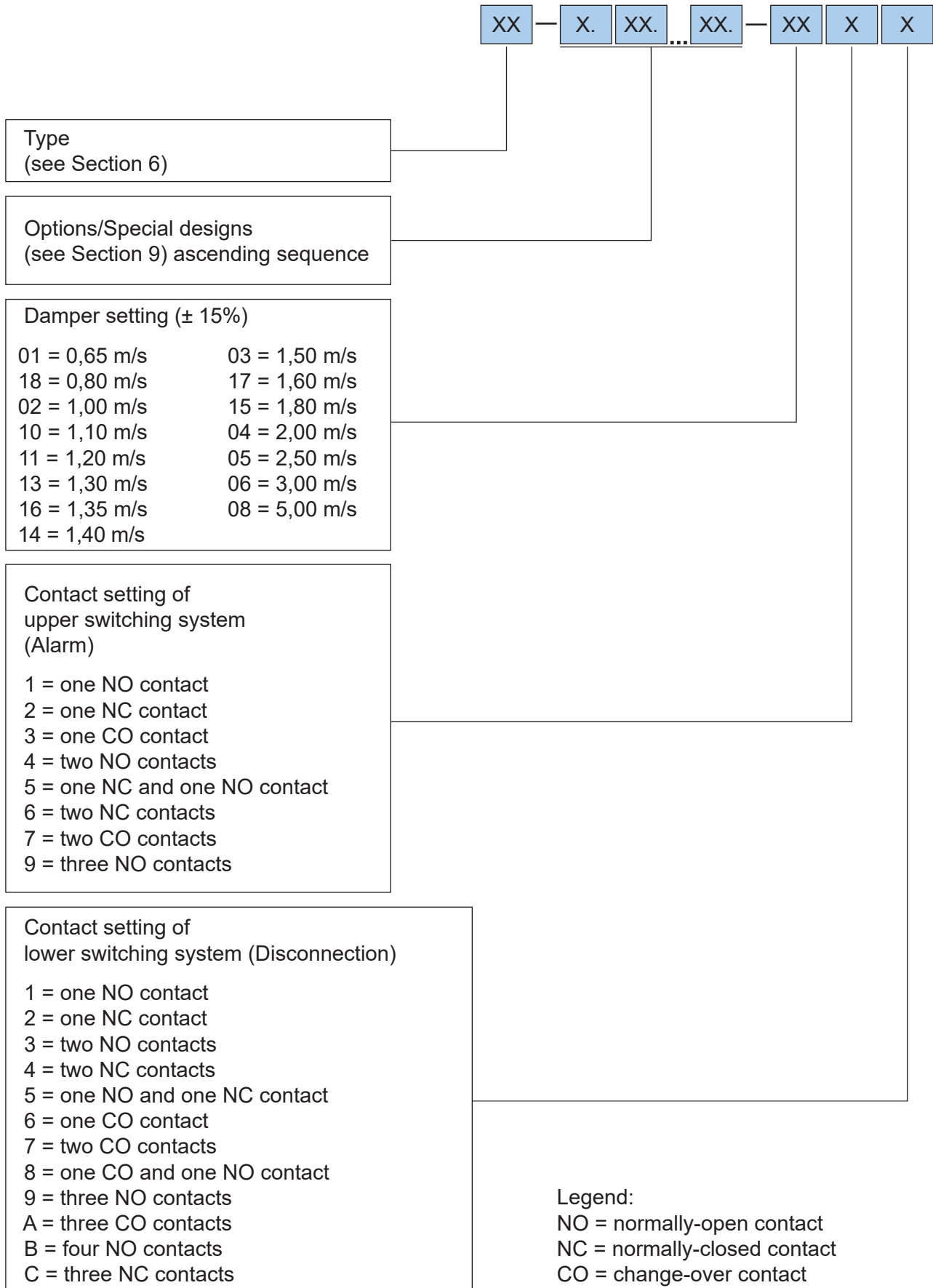
11 Ordering data/Type code

For placing orders, please, use the following key:

11.1 Single-float Buchholz relays



11.2 Double-float Buchholz relays



11.3 Ordering example

You need a double-float Buchholz relay of type 10 (BF 80/Q) with one cable gland of M20 x 1.5 and one dummy plug. The damper should respond at a insulating liquid flow of 1.50 m/s. The upper switching system should be equipped with one switching element (magnet contact tube) and the lower with two switching elements (magnet contact tubes). The upper switching element should be designed as one normally open contact, and the lower as two normally open contacts. The device should be delivered in colour RAL 7033 and should have one oil drain plug. Based on the data of section 9 the relay ordered has the following

Type code: 10-1.25.28.44.-0313

Explanation:

- 10 = Double-float Buchholz relay type 10 (BF 80/Q)
- 1 = M20x1.5: 1 cable gland and 1 dummy plug
- 25 = Lower switching system equipped with 2 magnet contact tubes
- 28 = With oil drain plug
- 44 = Casing colour RAL 7033 (cement-grey)
- 03 = Damper setting: 1.50 m/s $\pm$ 15 %
 - 1 = Contact setting of upper switching system: 1 NO
 - 3 = Contact setting of lower switching system: 2 NO

12 Additional devices for Buchholz relays

12.1 Gas sampling device ZG 1.2.

The gas sampling device (Fig. 33/ No. 1) is mounted on the transformer and connected to the Buchholz relay by means of a pipe (Fig. 33/ No. 2).

It allows sampling of the relay gas at normal operating level.

The gas sampling device is provided additionally with a sightglass cover (Fig. 37).

The length of the pipe can be selected by the customer (see technical data of gas sampling device ZG 1.2).

The device can be delivered with a lockable box (Fig. 35) and with a flexible PTFE pipe with a braiding made of stainless steel.

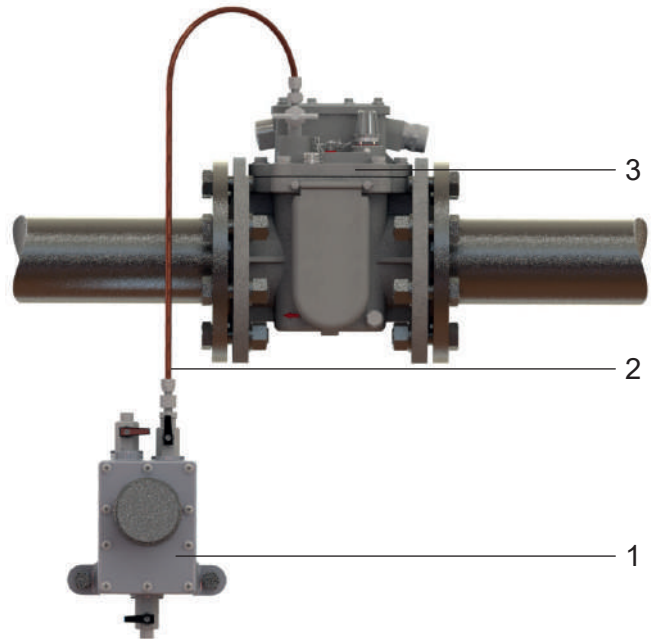


Figure 33 - Mounting of the gas sampling device ZG 1.2.



Figure 34 - Gas sampling device ZG 1.2.



Figure 35 - Gas sampling device ZG 1.2.
in lockable box (without padlock)



Figure 36 - Pipe of gas sampling device ZG 1.2.



Figure 37 - Sightglass cover for gas sampling device ZG 1.2.

Technical data of gas sampling device ZG 1.2.:

Parameter	Data	Notes
Gas outlet opening	G 1/8"	Others on request
Oil outlet opening	G 1/8"	Others on request
Temperature range: - Ambient temperature - Operating range * Temperature of the insulating liquid * Viscosity of the insulating liquid	- 40 °C to + 55 °C - 40 °F to + 131 °F - 40 °C to + 115 °C - 40 °F to + 239 °F 1 mm ² /s to 1100 mm ² /s	Others on request
Weight without piping	2,2 kg	
Dimensions of pipe	Ø 6x1 copper	Others on request
Length of pipe	max. 25 m	As requested by customer
Casing colour	Powder coating	On polyester resin basis

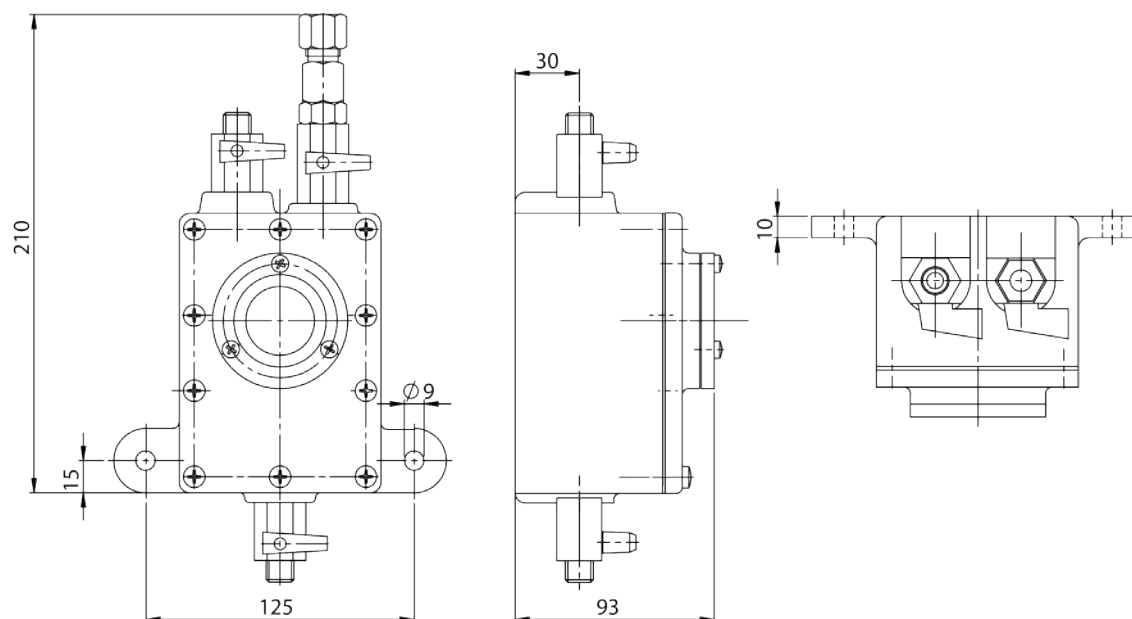


Figure 38 - Dimensional drawing, type ZG 1.2.

Special designs of gas sampling device ZG 1.2.:**Casing colour**

Explanation	Code
Casing colour RAL 7001 (silver-grey)	41
Casing colour RAL 7033 (cement-grey)	44
Casing colour RAL 7038 (agate-grey)	45
Casing colour RAL 7035 (light-grey)	46
Casing colour RAL 9002 (grey-white)	48
Casing colour RAL 7032 (siliceous-grey)	49

Equipment

Metal plate	15
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Climate-proof version

Climate-proof version for extreme frigid open-air conditions below - 40 °C	34
Climate-proof version for Offshore	36

Insulating liquid

Insulating liquid silicone oil	20
Insulating liquid based on ester	21

Climate-proof version/IP code

Climate-proof version for extreme frigid open-air conditions below - 40 °C	34
Climate-proof version for Offshore	36

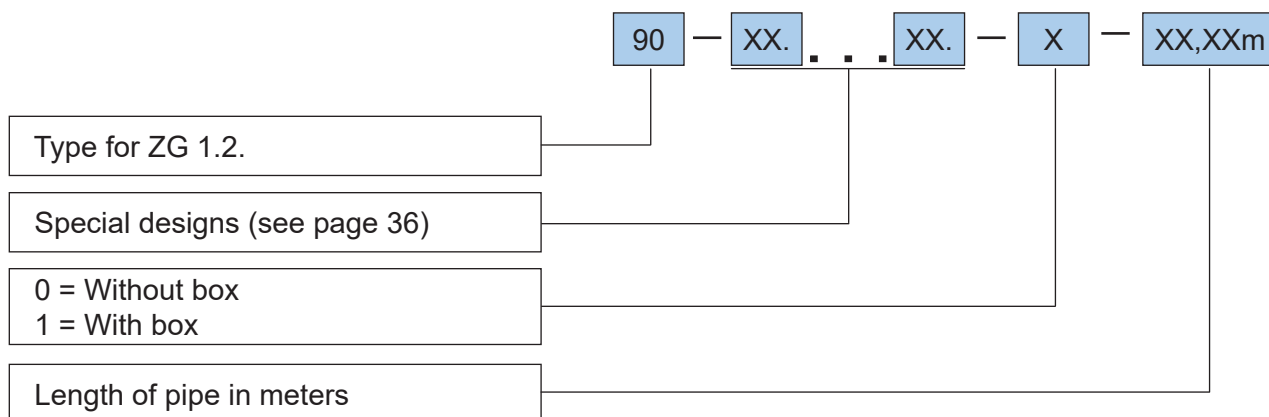
Special request

Special request (on special agreement with customer)	29
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Box

Without box	0
With box	1

Ordering data/Type code of gas sampling device ZG 1.2.



Ordering example of gas sampling device ZG 1.2.:

Type code: 90-34.44.-0-10,00m

Explanation: 90 = Gas sampling device ZG 1.2.

34 = Climate-proof version for extreme frigid open-air conditions below - 40 °C

44 = Casing colour RAL 7033 (cement-grey)

0 = Without box

10,00m = Length of pipe 10,00m

12.2 Other additional devices for Buchholz relays



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 testers BGT 4.1 and BGT 4.2

The Buchholz gas tester is used to measure and analyse the free gases in the oil which have accumulated in the Buchholz relay.

The BGT 4.1 is used to measure the hydrogen concentration in the Buchholz gas.

The BGT 4.2 allows the measurement of hydrogen, carbon dioxide, carbon monoxide, total hydrocarbon and ethyne concentrations in the Buchholz gas.

A BGS is included in the scope of delivery.



Gas testing device ZG 3.1.

The gas testing device is used to test the gas accumulated in the Buchholz relay. It can be installed either directly on the bleeding valve of the Buchholz relay or on the gas outlet tap of the gas sampling device. The Buchholz gas flows through two different chemical solutions and its colour reactions indicate the nature of the fault.

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

For further information on the additional devices, 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 pump ZG 5.1., ZG 5.2. and ZG 5.3.

The test pump checks the functioning 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 bleeding 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



- ZG 5.3. manually 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 the customer's specifications.

13 Other protection devices



Buchholz relay for use in rail vehicles

Type 22 (BB 25)

Pipe diameter DN: 25 mm (1")

Type of connection: threaded

as well as

Type 04 (BG 25)

Type 21 (BG 25 S)

Type 06 (BF 25/10)

Type 08 (BF 50/10) u.a.



Monitoring relay for tap changers

Type 12 (ÜRF 25/10)

Type 15 (ÜRF 25)

Type 16 (ÜRF 25/10-26)

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 conservator. 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.

Pipe diameter DN: 25 mm (1")

Type of connection: flanged

For further information on the additional devices, please ask for special reference material.

Gas relay for transformers

Type 80 (CF 38)



Due to its specific design, the gas relay is especially suitable for use on hermetically sealed transformers. Mounted on the transformer tank, the gas relay can be completely filled via an oil filler neck and thus monitors the oil level reliably. Optionally integrated pressure switches as well as a temperature sensor provide additional significant monitoring options for the transformer.

Furthermore, the gas relay can also be used on open-type transformers with conservator. On the one hand it serves as an air cell failure relay monitoring the hydro-type compensator (rubber bag) in the conservator and, on the other hand, the gas relay can also be used on the transformer cover.

Pipe diameter DN: 38 mm
Type of connection: flange

Oil Flow Indicator

Type 13 (SG 25)

Type 11 (SF 25)

Type 14 (SF 25/10)



The oil flow indicator is a protective relay monitoring the circulating oil lubrication or cooling on machines and transformers. It indicates faults in the circulating oil system and/or shuts the equipment down to avoid damage.

The oil flow indicator operates at a very low service pressure and can therefore be installed even in oil return pipes where the oil flow is caused by the oil pipe gradient.

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

For further information on the additional devices, please ask for special reference material.



HermeticTransformerSwitch HTS

Type HTS 1.0

Type HTS 1.1

The hermetic transformer switch HTS is mainly used on hermetically sealed transformers and is mounted on the main tank.

As soon as the HTS has been completely filled with insulating liquid, it reliably monitors the oil level of the transformer and triggers a signal in the event of an incident.

Optionally, up to two integrated pressure switches provide an additional monitoring function.



Pressure controller

Type 97

The pressure controller is designed for precise and long-life monitoring of the transformer pressure and can be easily mounted on the transformer.

Up to two pressure switches can be connected at once via an adapter and provide two independent switching points.

The switching pressure is pre-set at the factory and can be selected between 0.2 and 0.5 bar according to specification.

14 Breathing Buffer Box



Breathing buffer box G3B to extend the life of transformers

Ageing of the transformer's insulation system is accelerated by oxygen dissolved in oil. With open-type transformers oxygen consumed is replenished from the atmosphere. This longtime effect has negative implications.

The breathing buffer box (G3B) inserted in the transformer's breathing line upstream of the dessicant layer is deemed to solve this problem. This ensures hermetical sealing of the transformer.

For further information on the additional devices, please ask for special reference material.

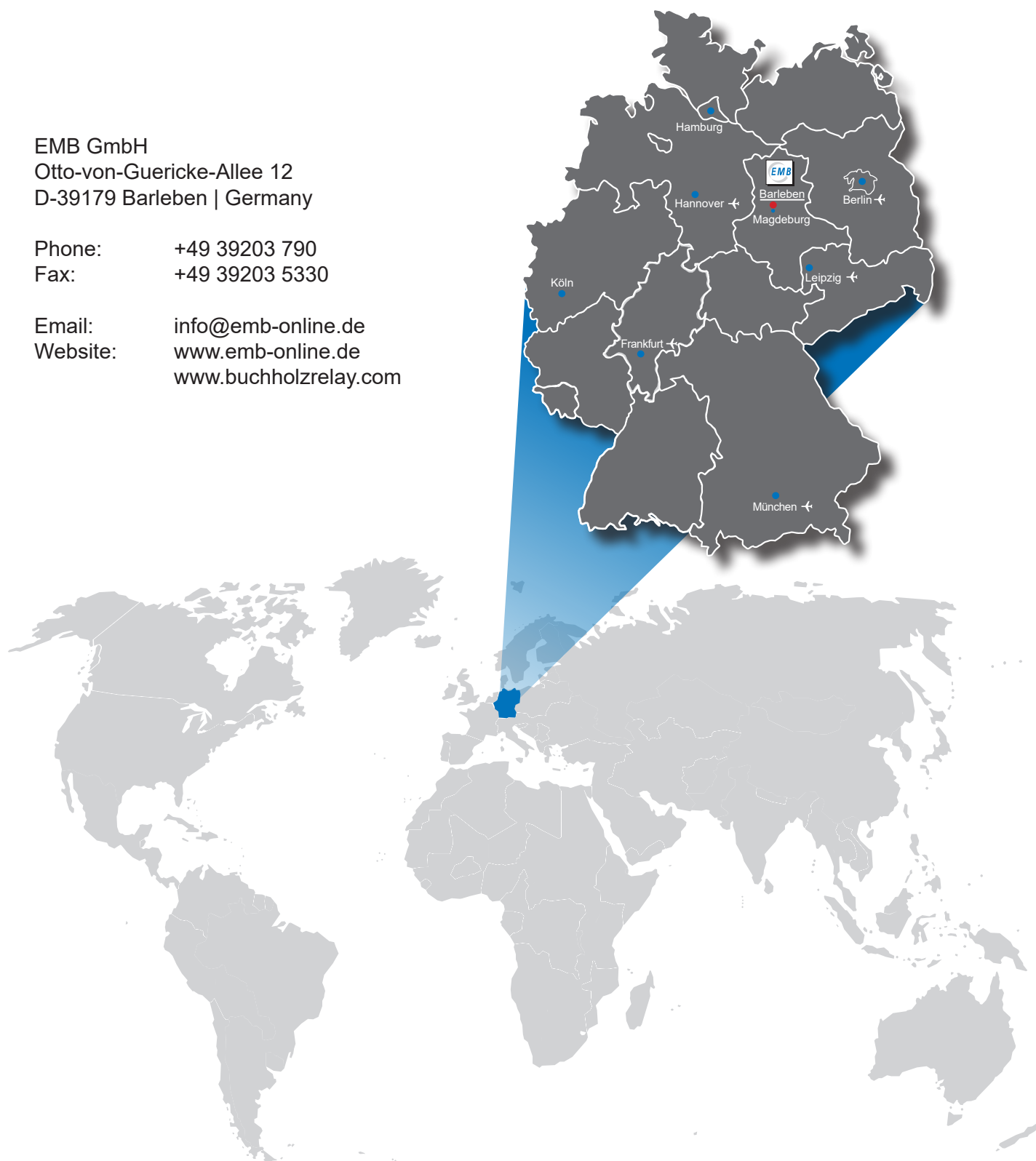


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