Elektromotoren und

Gerätebau Barleben GmbH

Transformer Protection Relays (Buchholz Principle)

Table of contents

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 NM series

2009 New premises in Barleben

Figure 1 - EMB company building

1 Preface

More than 1.5 million relays

have been sold worldwide in 60 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 60 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 DIN EN 50216-2 and are known for their easy operation, high reliability and extremely long life.

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

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

EMB has been certified according to: DIN EN ISO 9001/2008, AEO F, Known Consignor (Airfreight Security) and EAC. Further certifications have been awarded by well-known independent test laboratories such as TÜVRheinland and TZO.

Figure 2 - Certificates

2 Design features

Casing

The casing is made of weather-resistant cast aluminium alloy provided with a paint coat. It is supplied either with flanged (Fig. 3/ Number 1) or screwed connection (Fig. 4/1). 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. 4/2). The sightglasses provided with scales permit reading of collected gas volume.

The relays can be provided with hinged lids (Fig. 3/2) to protect the sightglasses.

Figure 3 - Casing with flanged connection

Figure 4 - Casing with threaded connection

Cover

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 (Fig. 5 and 6/1). In front of the terminal box are arranged the bleeding valve (Fig. 5 and 6/2) and the test key covered by a cap nut (Fig. 5 and 6/3) as well as a plate (Fig. 5 and 6/4) with instructions for actuating the test key. The terminal box accommodates the earth terminal (Fig. 5 and 6/5) and bushings (Fig. 5 and 6/6) 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. 5 and 6/7) so that it is safe to touch and protected against pollution. If the cap is opened the graphic symbol and the connection diagram (Fig. 5 and 6/8) are shown. The cable can be inserted through the cable gland (Fig. 5 and 6/9).

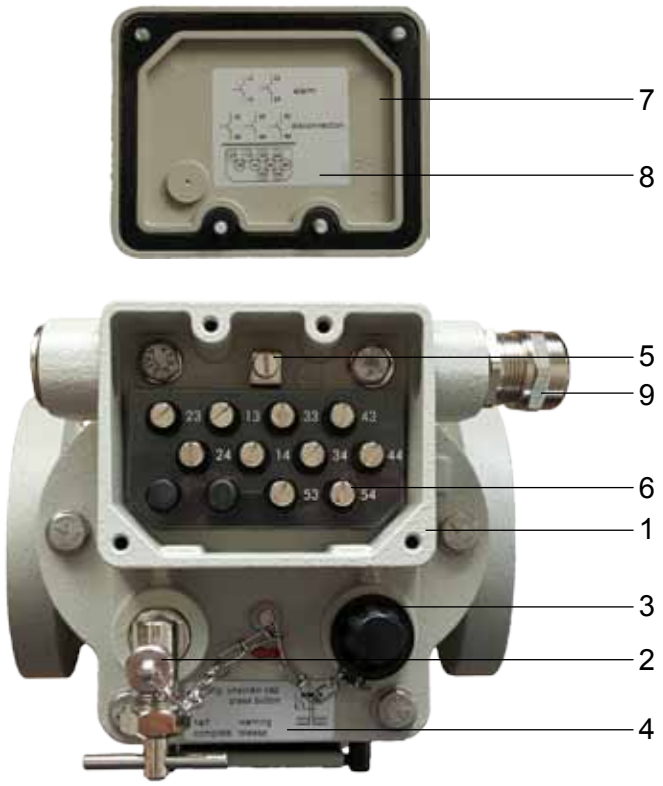


Figure 5 - Cover with cap removed, Buchholz relay with five magnet contact tubes

Figure 6 - Cover with cap removed, Buchholz relay with up to four magnet contact tubes

3 Function

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 (Figure 7)

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.

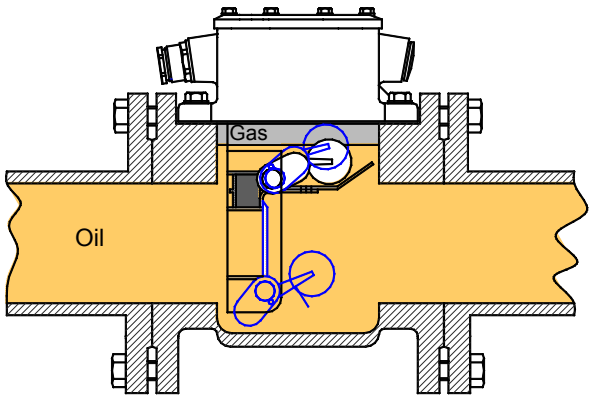


Figure 7 - Gas accumulation

3.2 Insulating liquid loss (Figure 8)

Fault: Insulating liquid loss due to leakage.

Response: As the liquid level falls the top float moves downwards. An alarm is tripped. If the liquid loss continues, conservator and piping as well as the Buchholz relay will be emptied.

As the liquid level falls, the lower float moves downwards. The moving float actuates a switch contact so that the transformer is disconnected.

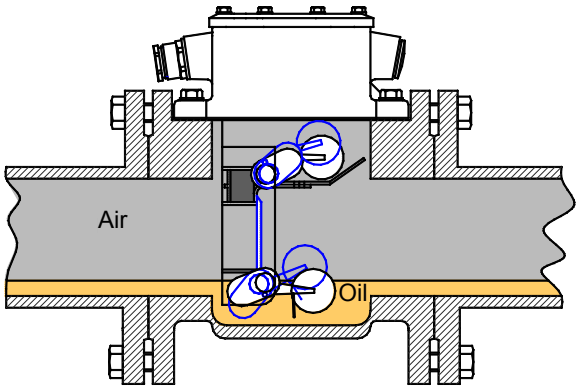


Figure 8 - Insulating liquid loss

3.3 Insulating liquid flow (Figure 9)

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.

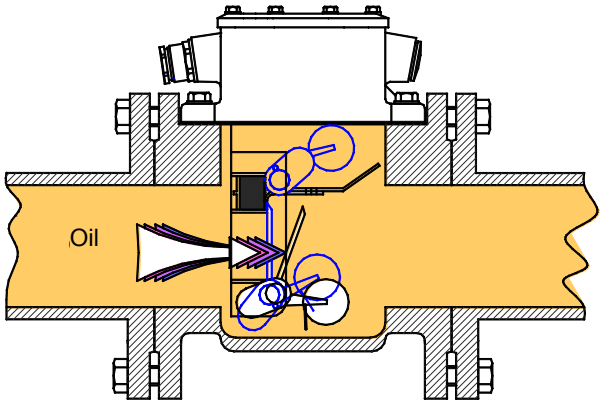
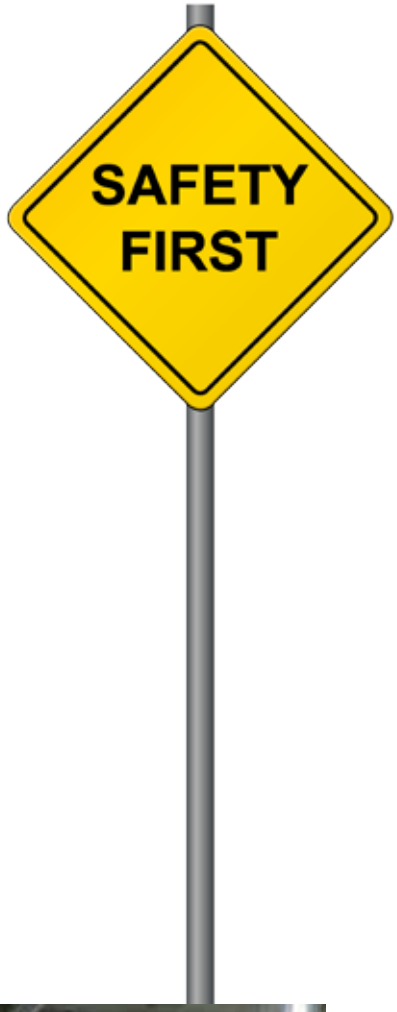


Figure 9 - Insulating liquid flow

4 Tests

Each Buchholz relay is provided with a works-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:

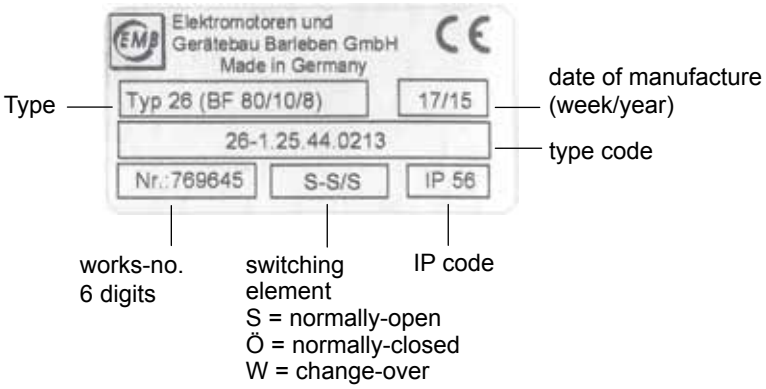


Figure 10 - Functional and leakage test

Figure 11 - Flow test

5 Type list of single-float Buchholz relays

5.1 Single-float Buchholz relays with threaded connection

	Type Internal description DIN description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)	Suited for transformer ratings of
			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	≤1600 KVA

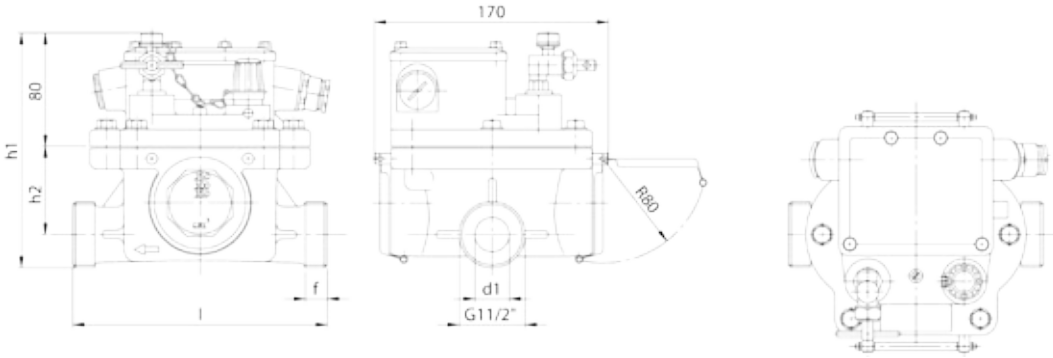


Figure 12 - Dimensional drawing, type 01

5.2 Single-float Buchholz relays with flanged connection

	Type Internal description DIN description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)	Suited for transformer ratings of
			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	≤1600 KVA
	**03 (AF 25/10) (-)**	Flange 4-hole	**25**	115	85	68	14	16	200	205	62	4,0	≤1600 KVA
	**25 (AF 25) (-)**	Flange 4-hole	**25**	100	75	-	12	15	160	195	62	3,3	≤1600 KVA

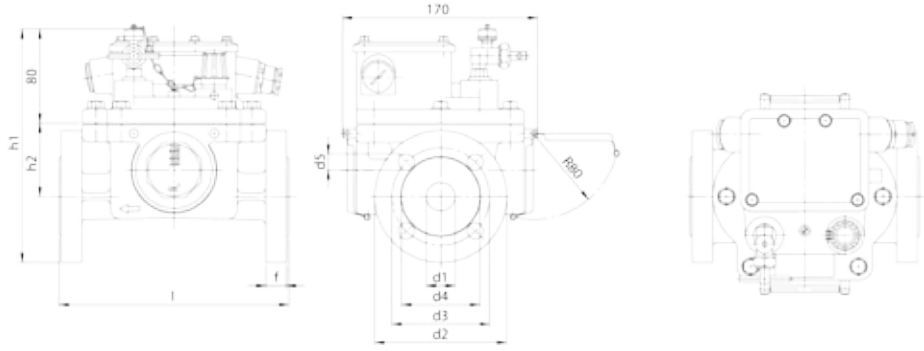


Figure 13 - Dimensional drawing, type 02, 03

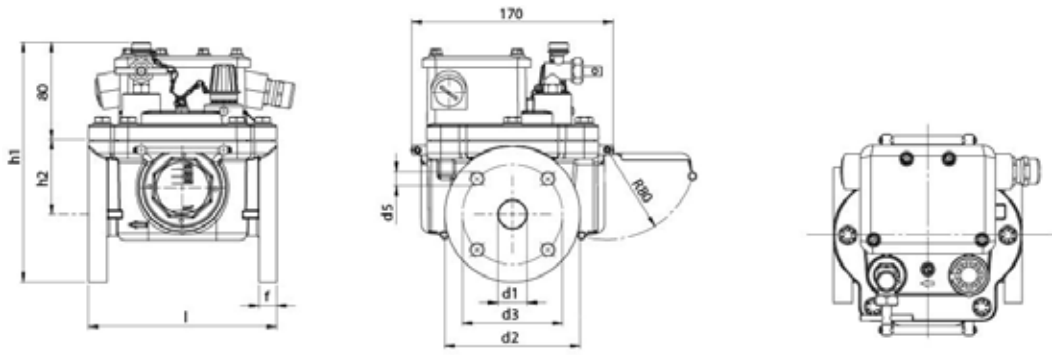


Figure 14 - Dimensional drawing, type 25

5.3 Single-float Buchholz relays with flat flanged connection

	Type Internal description DIN description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)	Suited for transformer ratings of
			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	≤1600 KVA

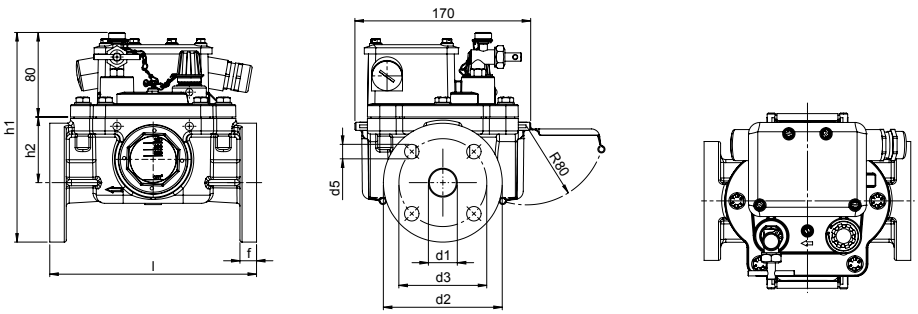
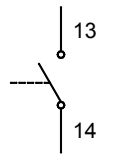
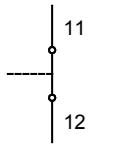
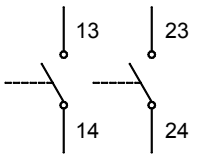
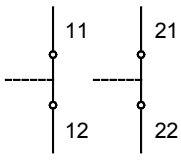
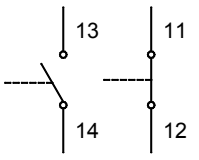
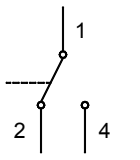
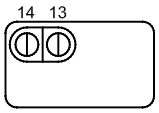
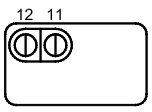
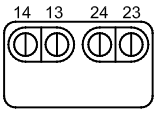
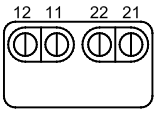
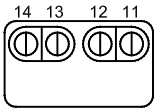
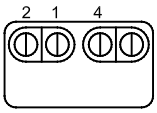
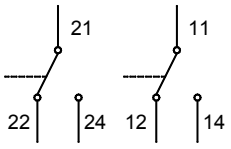
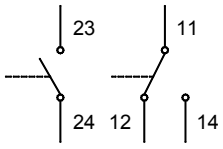
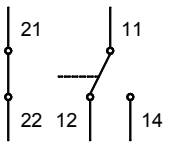
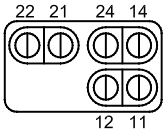
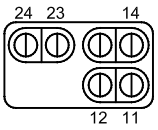
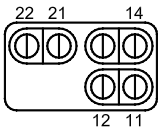


Figure 15 - Dimensional drawing, type 30

6 Switching system design options for single-float Buchholz relays

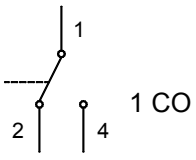
Magnet contact tubes are used as switching elements. These are normally-open (NO), normally-closed (NC) and change-over (CO) contacts. The magnet contact tube design can be derived from the last digit of the type code. For coding, see Ordering data/Type code under Section 12.1.

...1	...2	...3	...4	...5	...6
1 NO	1 NC	2 NO	2 NC	1 NO and 1 NC	1 CO
					
					

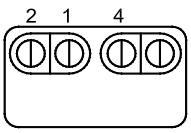
...7	...8	...9
2 CO	1 NO and 1 CO	1 NC and 1 CO
		
		

Explanation of symbols:

Example: coding „ ... **6** “
Magnet contact tube(s) 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 Buchholz relay is filled with insulating liquid up the required level and the device to be protected operates without any fault.

7 Type list of double-float Buchholz relays

7.1 Double-float Buchholz relays with threaded connection

	Type Internal description DIN description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)	Suited for transformer ratings of
			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	≤5000 KVA
	**21 (BG 25 S) (-)**	Threaded connection G 1½ “	**25**	-	-	-	-	16	185	235	90	3,6	≤5000 KVA

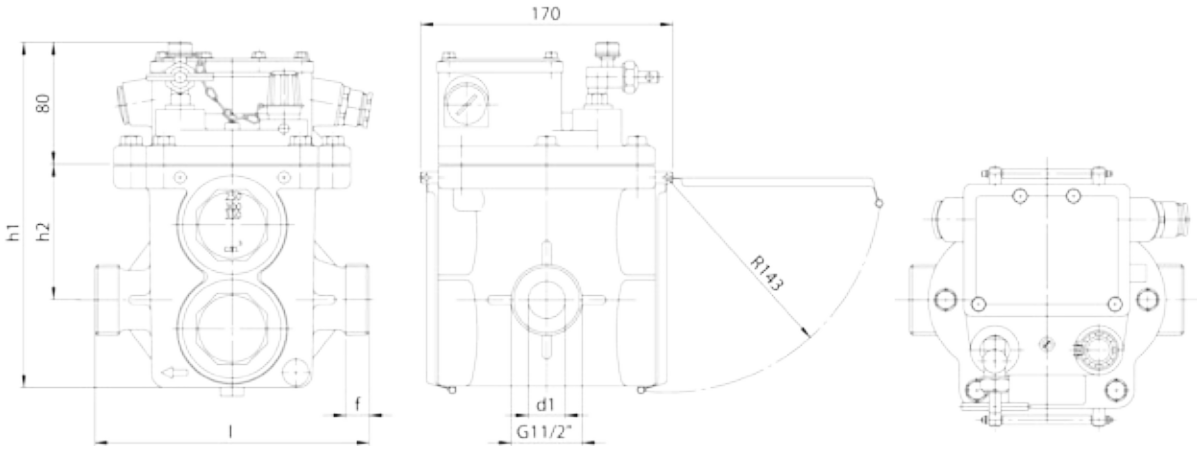


Figure 16 - Dimensional drawing, type 04

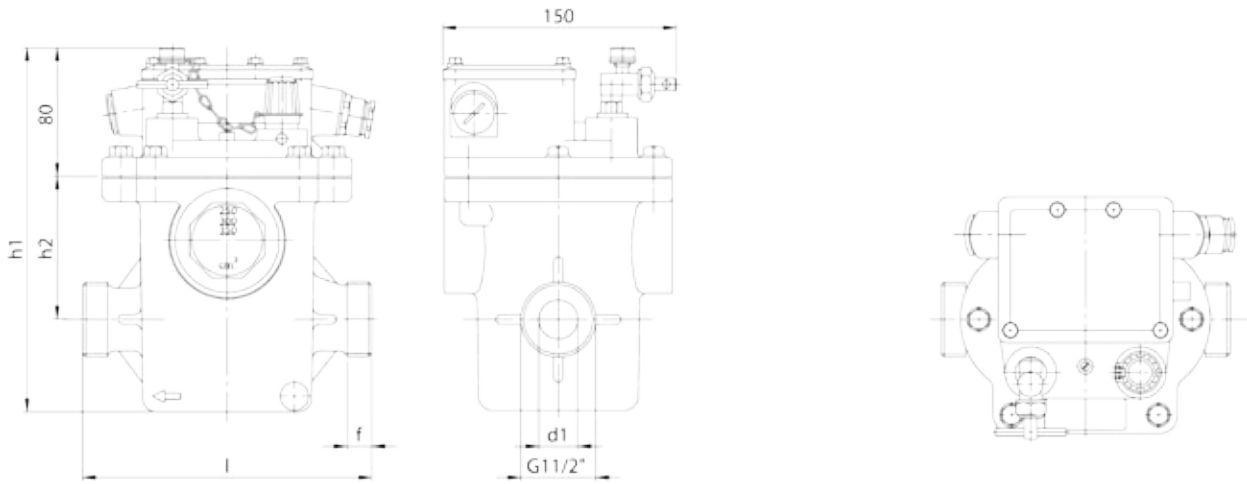


Figure 17 - Dimensional drawing, type 21

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

	Type Internal description DIN description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)	Suited for transformer ratings of
			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	≤5000 KVA
	**06 (BF 25/10) (DR 25)**	Flange 4-hole	**25**	115	85	68	14	18	200	235	90	4,8	≤5000 KVA
	**07 (BF 50/6) (-)**	Flange 4-hole	**50**	140	110	90	14	12	185	235	80	4,6	≥5000 KVA ≤10000 KVA
	**08 (BF 50/10) (DR 50)**	Flange 4-hole	**50**	165	125	102	18	16	195	250	80	5,9	≥5000 KVA ≤10000 KVA
	**09 (BF 80/10) (-)**	Flange 4-hole	**80**	200	160	138	18	15	195	265	80	6,2	≥10000 KVA
	**24 (BF 80/6) (-)**	Flange 4-hole	**80**	190	150	130	18	15	195	260	80	6,0	≥10000 KVA

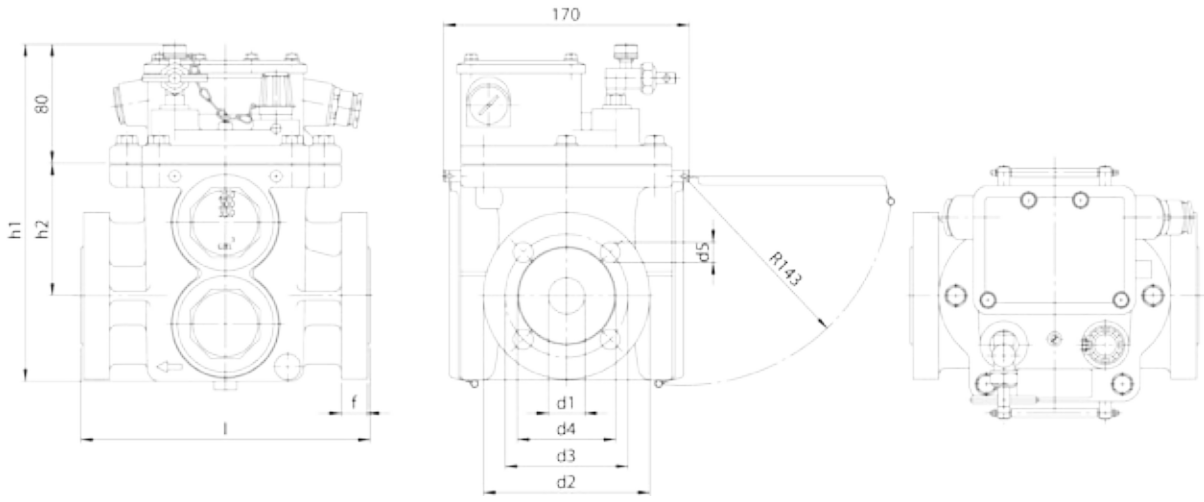


Figure 18 - Dimensional drawing, type 05, 06, 07, 08, 09, 24

	Type Internal description DIN description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)	Suited for transformer ratings of
			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	≤5000 KVA

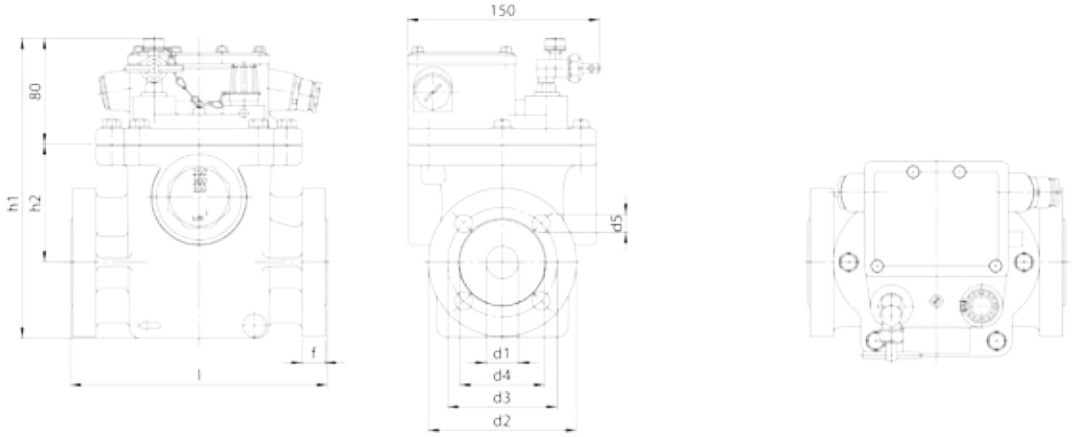


Figure 19 - Dimensional drawing, type 23

	Type Internal description DIN description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)	Suited for transformer ratings of
			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	≥10000 KVA

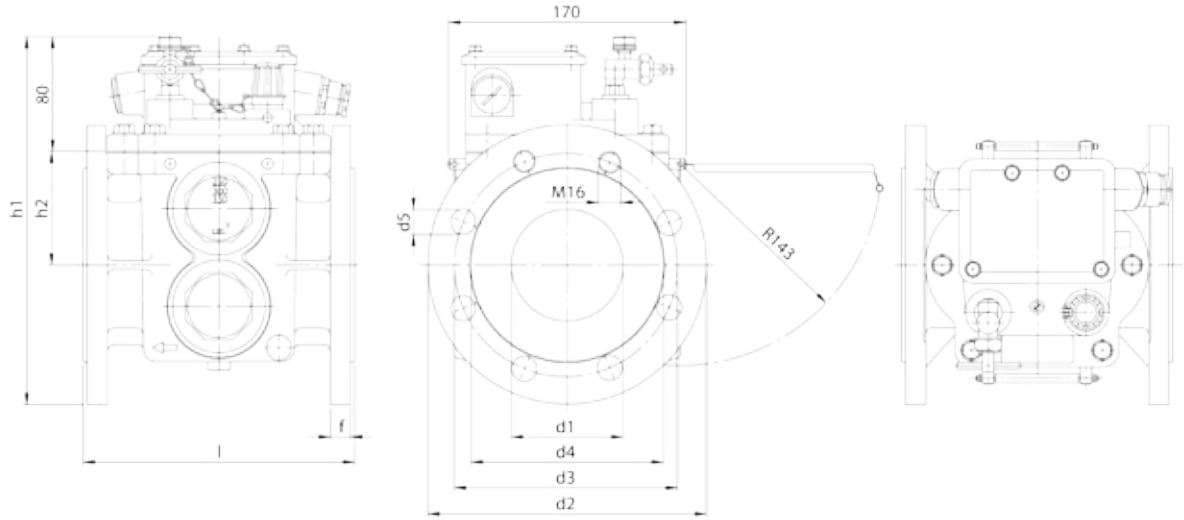


Figure 20 - Dimensional drawing, type 26

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

	Type Internal description DIN description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)	Suited for transformer ratings of
			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	≤10000 KVA
	**31 (BF 25/10 G) (DR 25)**	Flange 4-hole	**25**	115	85	-	14	20	200	235	90	4,8	≤5000 KVA

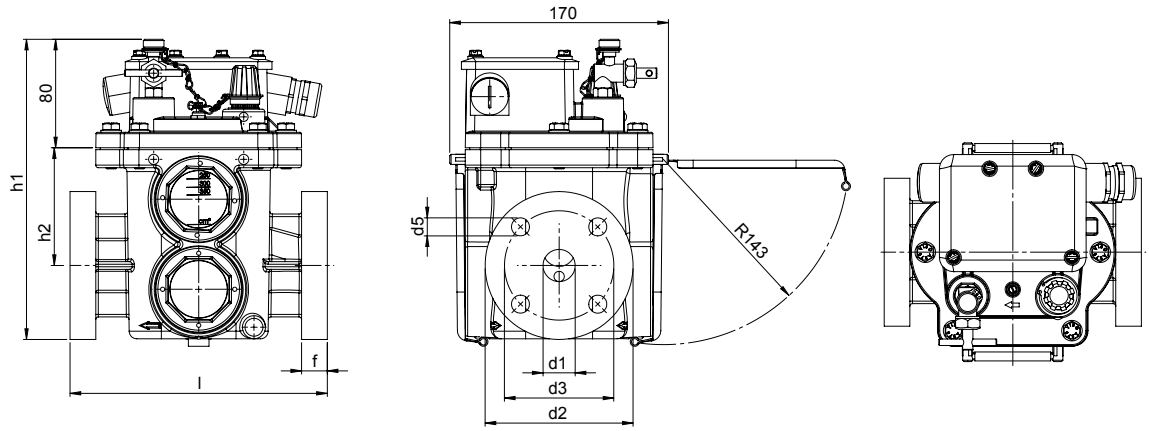


Figure 21 - Dimensional drawing, type 28, 31

	Type Internal description DIN description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)	Suited for transformer ratings of
			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	≤10000 KVA

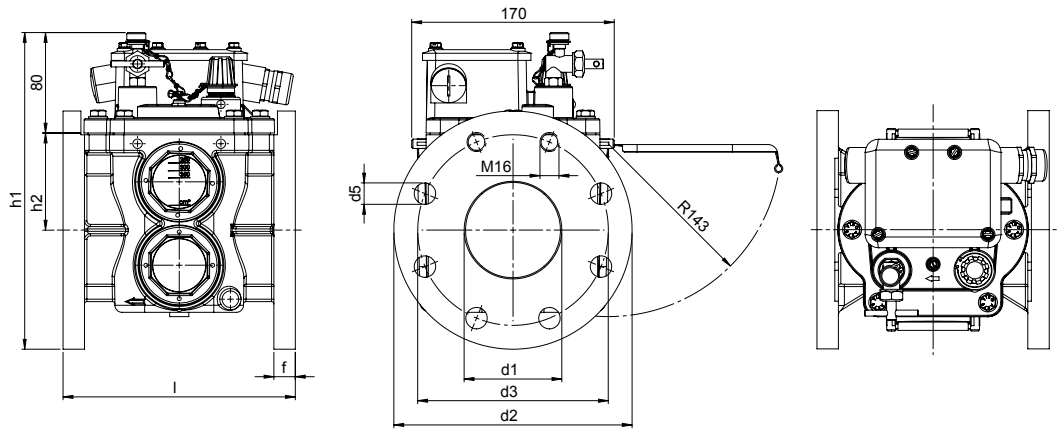


Figure 22 - Dimensional drawing, type 27

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

	Type Internal description DIN description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)	Suited for transformer ratings of
			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	≥10000 KVA

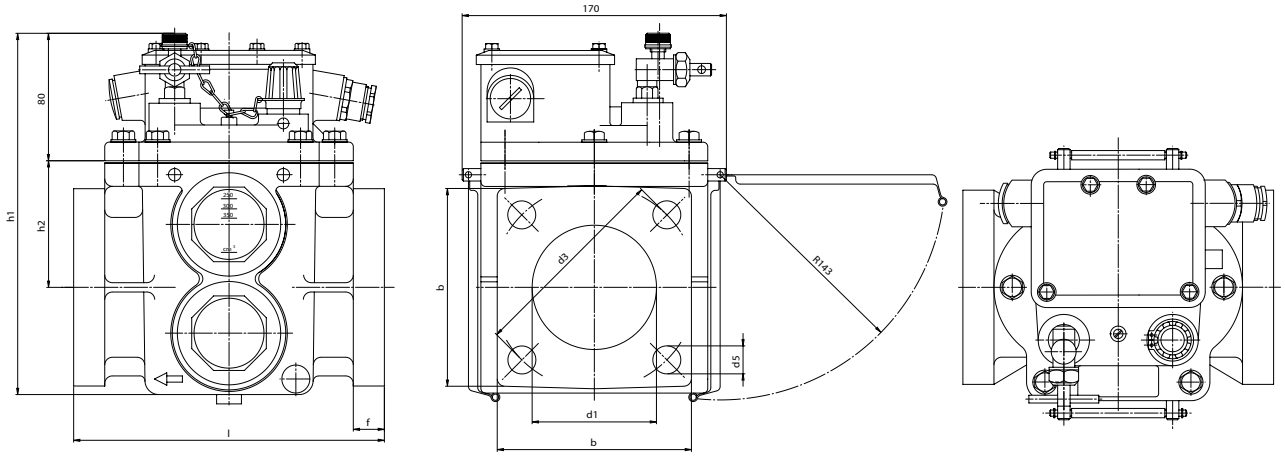


Figure 23 - Dimensional drawing, type 10

7.5 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 DIN description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)	Suited for transformer ratings of
			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	≥5000 KVA ≤10000 KVA
	**63 (BC 80) (QJ 80)**	Flange square 4-hole	**80**	160	160	-	18	15	185	245	80	5,0	≥10000 KVA

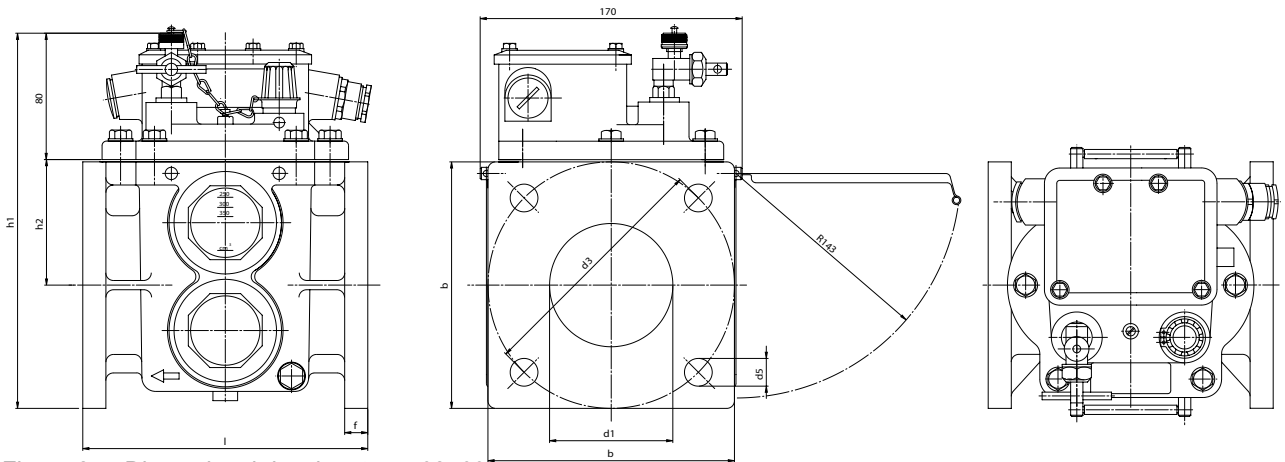


Figure 24 - Dimensional drawing, type 62, 63

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

	Type Internal description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm)					Device dimensions (mm)			Weight without packing (kg)	Suited for transformer ratings of
			d1	d2	d3	d4	d5	f	l	h1	h2		
	**41 (NF 25)**	Flange 4-hole	**25**	115	85	-	14	8	240	235	90	4,2	≤5000 KVA
	**42 (NF 50)**	Flange 4-hole	**50**	165	125	-	18	15	240	250	80	5,1	≥5000 KVA ≤10000 KVA
	**43 (NF 80)**	Flange 4-hole	**80**	200	160	-	18	15	240	265	80	5,5	≥10000 KVA

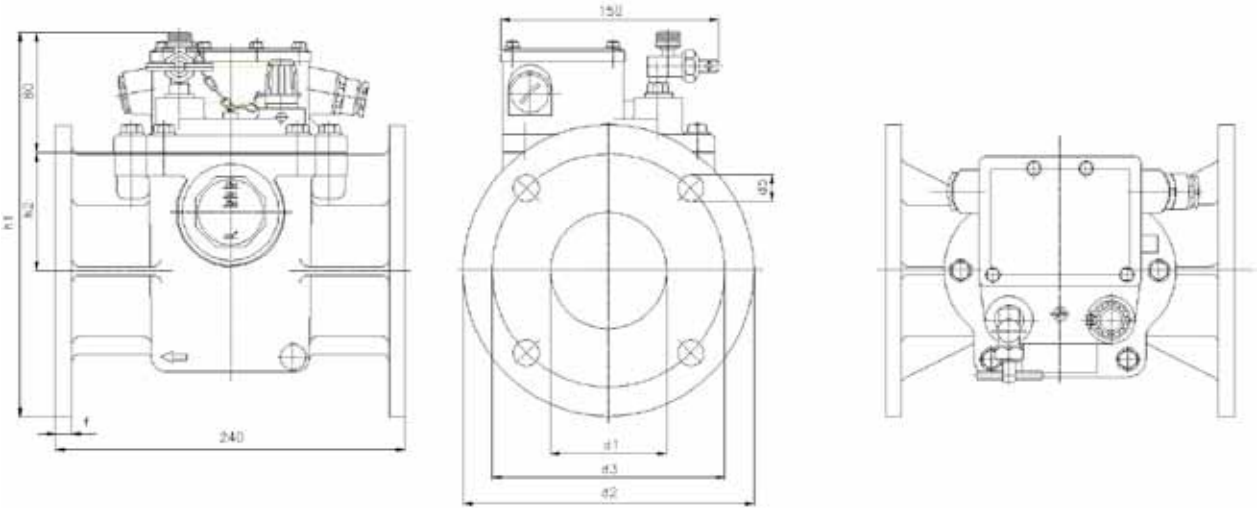


Figure 24 - Dimensional drawing, type 41, 42, 43

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

	Type Internal description	Type of connection	Pipe diameter DN (mm)	Flange dimensions (mm, in)					Device dimensions (mm)			Weight without packing (kg)	Suited for transformer ratings of
			d1	**b**/d2	d3	d4	d5	f	l	h1	h2		
	**51 (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	≤ 5000 KVA
	**52 (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	≥5000 KVA ≤10000 KVA
	**53 (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	≥10000 KVA

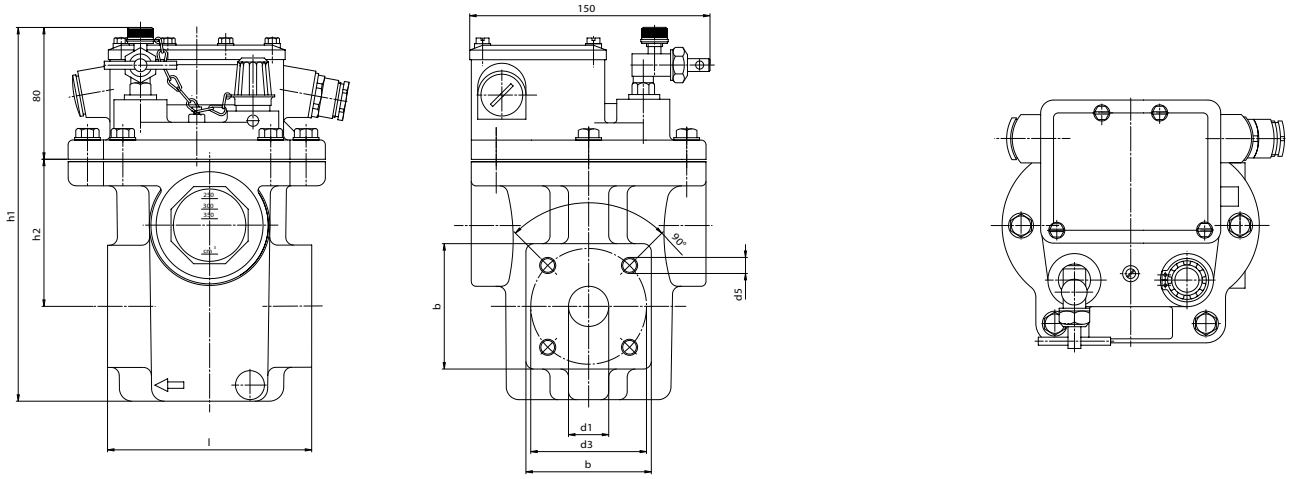


Figure 26 - Dimensional drawing, type 51

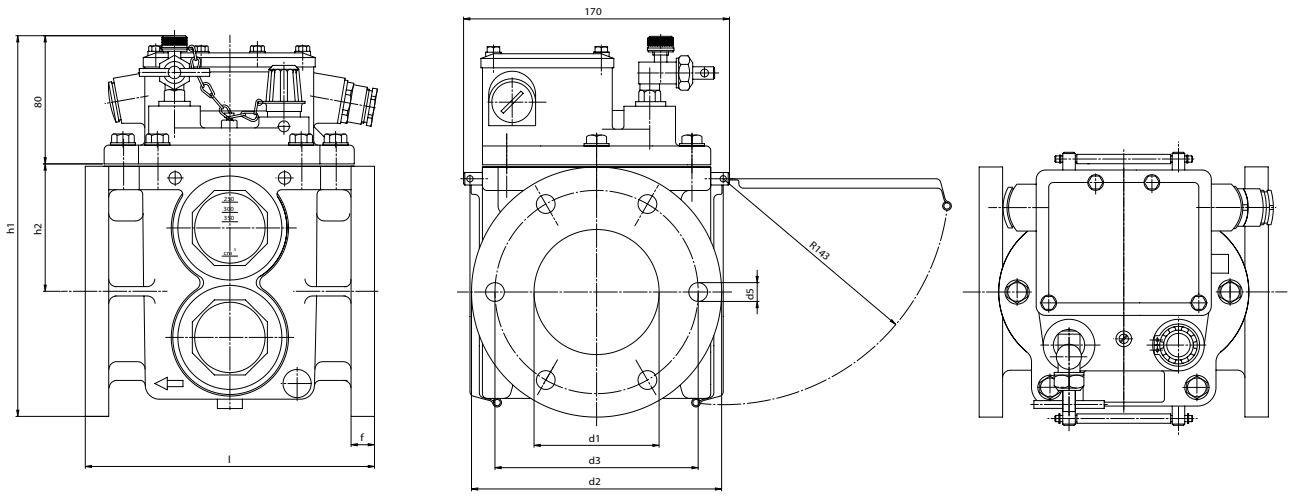
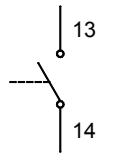
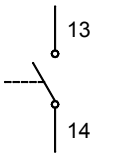
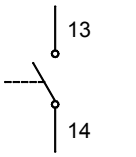
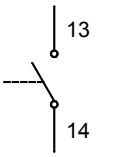
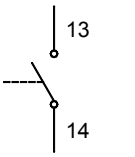
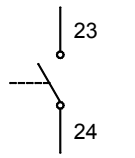
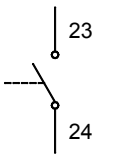
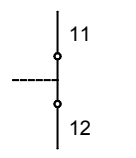
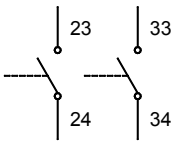
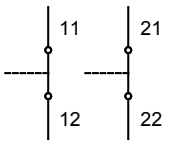
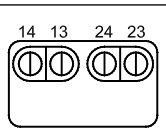
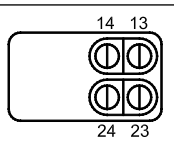
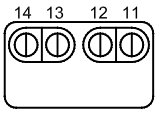
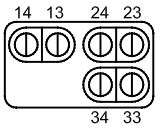
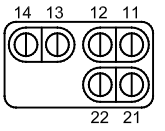
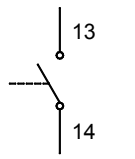
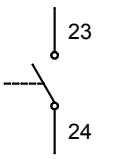
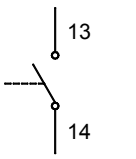
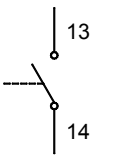
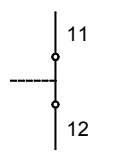


Figure 27 - Dimensional drawing, type 52, 53

8 Switching system design options for double-float Buchholz relays

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 12.2.

...11	BS 25...11	...12	...13	...14
Alarm	Alarm	Alarm	Alarm	Alarm
1 NO	1 NO	1 NO	1 NO	1 NO
				
Disconnection	Disconnection	Disconnectiong	Disconnection	Disconnection
1 NO	1 NO	1 NO	2 NO	2 NC
				
				

...15	...16	...17	...19	...21
Alarm	Alarm	Alarm	Alarm	Alarm
1 NO	1 NO	1 NO	1 NO	1 NC
				
Disconnection	Disconnection	Disconnection	Disconnection	Disconnection
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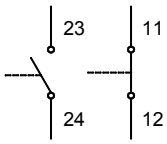
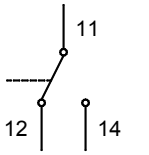
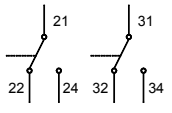
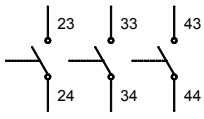
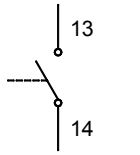
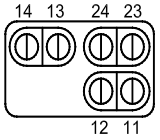
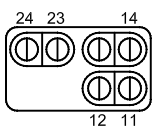
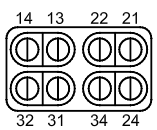
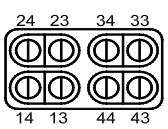
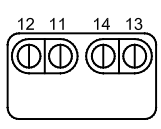
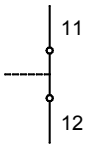
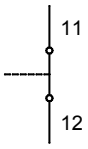
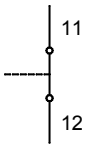
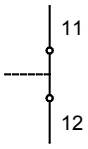
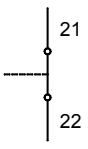
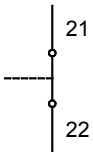
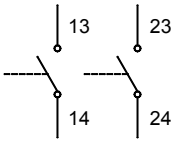
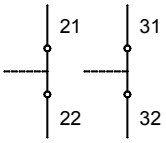
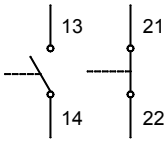
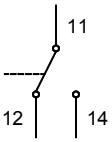
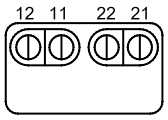
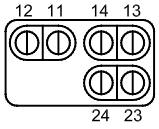
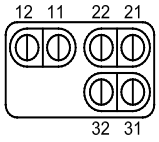
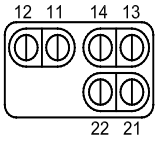
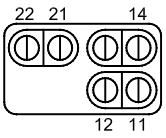
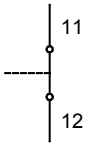
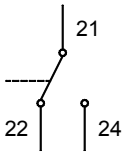
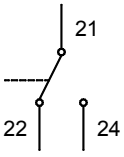
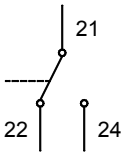
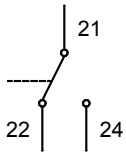
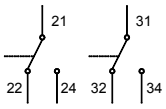
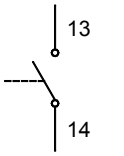
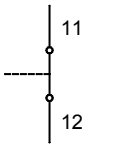
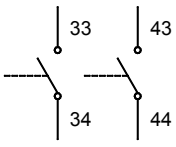
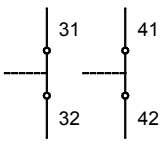
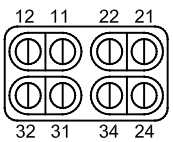
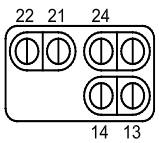
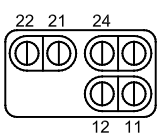
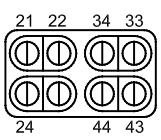
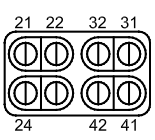
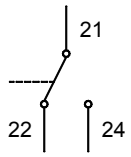
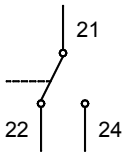
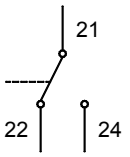
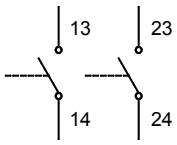
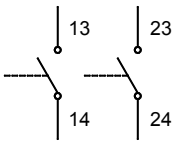
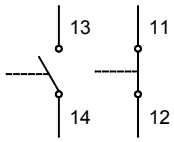
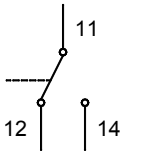
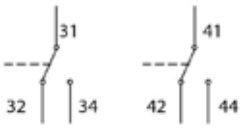
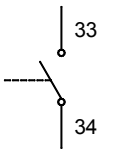
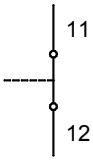
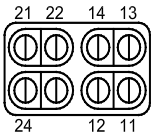
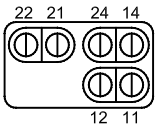
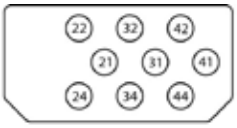
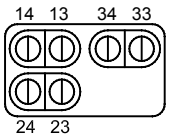
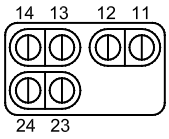
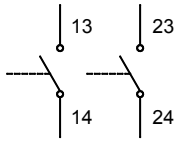
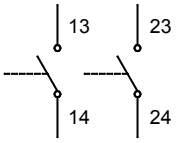
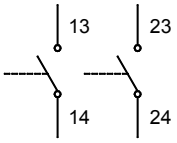
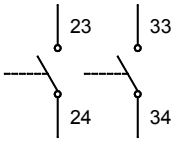
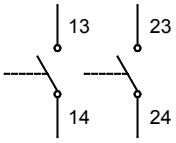
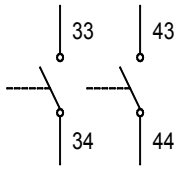
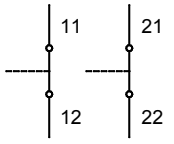
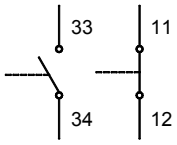
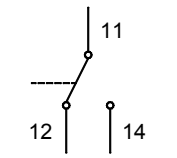
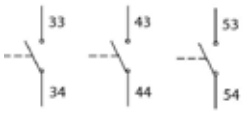
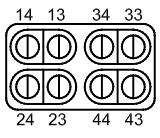
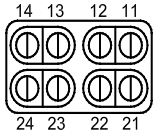
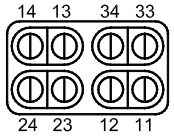
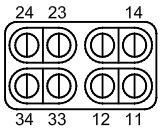
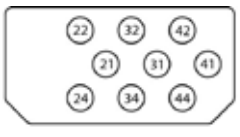
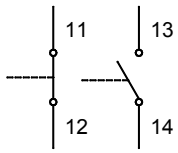
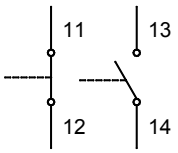
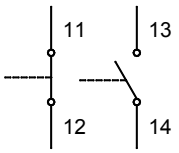
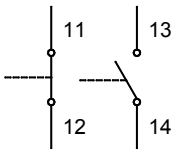
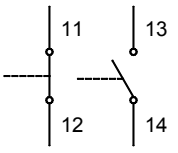
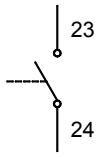
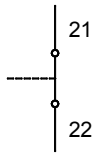
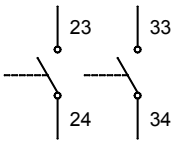
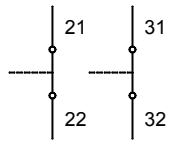
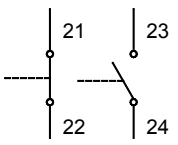
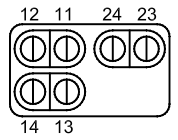
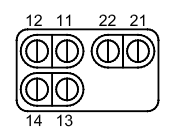
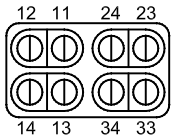
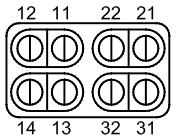
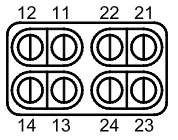
				
				

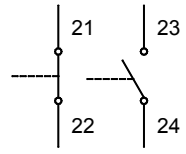
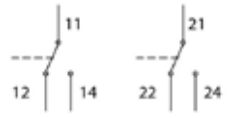
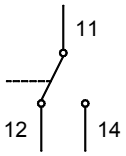
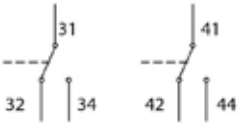
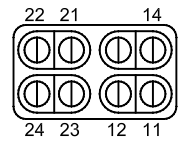
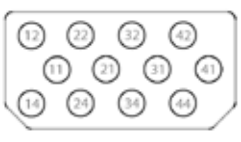
...22	...23	...24	...25	...26
Alarm	Alarm	Alarm	Alarm	Alarm
1 NC	1 NC	1 NC	1 NC	1 NC
				
Disconnection	Disconnection	Disconnection	Disconnection	Disconnection
1 NC	2 NO	2 NC	1 NO and 1 NC	1 CO
				
				

...27	...31	...32	...33	...34
Alarm	Alarm	Alarm	Alarm	Alarm
1 NC	1 CO	1 CO	1 CO	1 CO
				
Disconnection	Disconnection	Disconnection	Disconnection	Disconnection
2 CO	1 NO	1 NC	2 NO	2 NC
				
				

...35	...36	... 37	...41	...42
Alarm	Alarm	Alarm	Alarm	Alarm
1 CO	1 CO	1 CO	2 NO	2 NO
				
Disconnection	Disconnection	Disconnection	Disconnection	Disconnection
1 NO and 1 NC	1 CO	2 CO	1 NO	1 NC
				
				

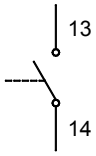
...43	...44	...45	...46	...49
Alarm	Alarm	Alarm	Alarm	Alarm
2 NO	2 NO	2 NO	2 NO	2 NO
				
Disconnection	Disconnection	Disconnection	Disconnection	Disconnection
2 NO	2 NC	1 NO and 1 NC	1 CO	3 NO
				
				

...51	...52	...53	...54	...55
Alarm	Alarm	Alarm	Alarm	Alarm
1 NC and 1 NO	1 NC and 1 NO	1 NC and 1 NO	1 NC and 1 NO	1 NC and 1 NO
				
Disconnection	Disconnection	Disconnection	Disconnection	Disconnection
1 NO	1 NC	2 NO	2 NC	1 NC and 1 NO
				
				

...56	...77
Alarm	Alarm
1 NC and 1 NO	2 CO
	
Disconnection	Disconnection
1 CO	2 CO
	
	

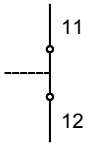
Explanation of symbols:

Example: coding „ ...**1 2** “
Magnet contact tube(s) design
Upper switching system - Alarm
Lower switching system - Disconnection

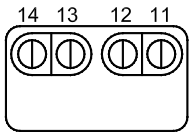


Alarm
1 NO

→ Graphic symbol with terminal marking



Disconnection
1 NC



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

9 Technical data

The technical data listed in table named below are applicable to all Buchholz relays manufactured by EMB. EMB Buchholz relays are in compliance with DIN EN 50216-2.

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 φ > 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: 2002-09 Others on request
Insulating liquid	Mineral oil	Others on request
Resistance against vibration	Vibration: 2-200 Hz, 1 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: - Number of switching contacts - Switching element - Damper Response time of damper	 1 Magnet contact tube Held by magnets < 0.1 s	 More on request
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 +/- 15%	 Others on request For possible data see Ordering data/Type code under Section 12 on pages 28 and 29. Others on request
Cable gland	M20x1.5; M25x1.5	Others on request
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 10. These special designs are coded using the respective code when ordering Buchholz relays.

More options on request available.

10 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

Buchholz relay NM series

Buchholz relay with analogue measurement of the gas volume (only double-float Buchholz relays, Note: Explanations to code 60)	60

Casing colour *

Casing colour RAL 9006 (white-aluminium)	40
Casing colour RAL 7001 (silver-grey)	41
Casing colour RAL 7012 (basalt-grey)	42
Casing colour RAL 7022 (umber-grey)	43
Casing colour RAL 7033 (cement-grey)	44
Casing colour RAL 7038 (agate-grey)	45
Casing colour RAL 7035 (light-grey)	46
Casing colour RAL 7016 (anthracite-grey)	47
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
Climate-proof version for aggressive industrial atmosphere	36B
IP code 66	39

Insulating liquid

Insulating liquid silicone oil	20
Insulating liquid based on ester	21

Casing

Metal name 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

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

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
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
Two-level gas alarm system (Note: Explanations to code 17A)	17A
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 codes 23 and 24)	23
Special design approved by RWE, Germany (only double-float Buchholz relays, Note: Explanations to codes 23 and 24)	24
Special design approved by E.ON, Germany (only double-float Buchholz relays, Note: Explanations to codes 23 and 24)	24B
Solid floats (Insulating liquid flow max. 1,50 m/s +/- 15%)	16
Alarm for gas accumulation between 250 and 300 cm³	18

Special request

Special request (on special agreement with customer)	29

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

Code combination	Code combination	Code combination
60 - 32	32 - 17A	33 - 23, 24, 24B
60 - 34	32 - 23, 24, 24B	
	32 - 35	35 - 23, 24, 24B
	32 - 55	
	32 - 99	55 - 23, 24, 24B
		99 - 23, 24, 24B

10.1 Explanations to code 17 A

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.

With the two-level alarm system the initial alarm signal is generated at a gas volume of 100-200 cm³, and the second alarm signal at a gas volume of 250-300 cm³. This special design allows a gas sample to be taken for fault analysis already when the initial warning signal is received.

10.2 Explanations to codes 23 and 24

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.

10.3 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. 28/1), and the upper switching system (alarm) can be tested by pumping in air via the bleeding valve (Fig. 28/2) 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. 28/3) 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 the former German norm DIN 42566.

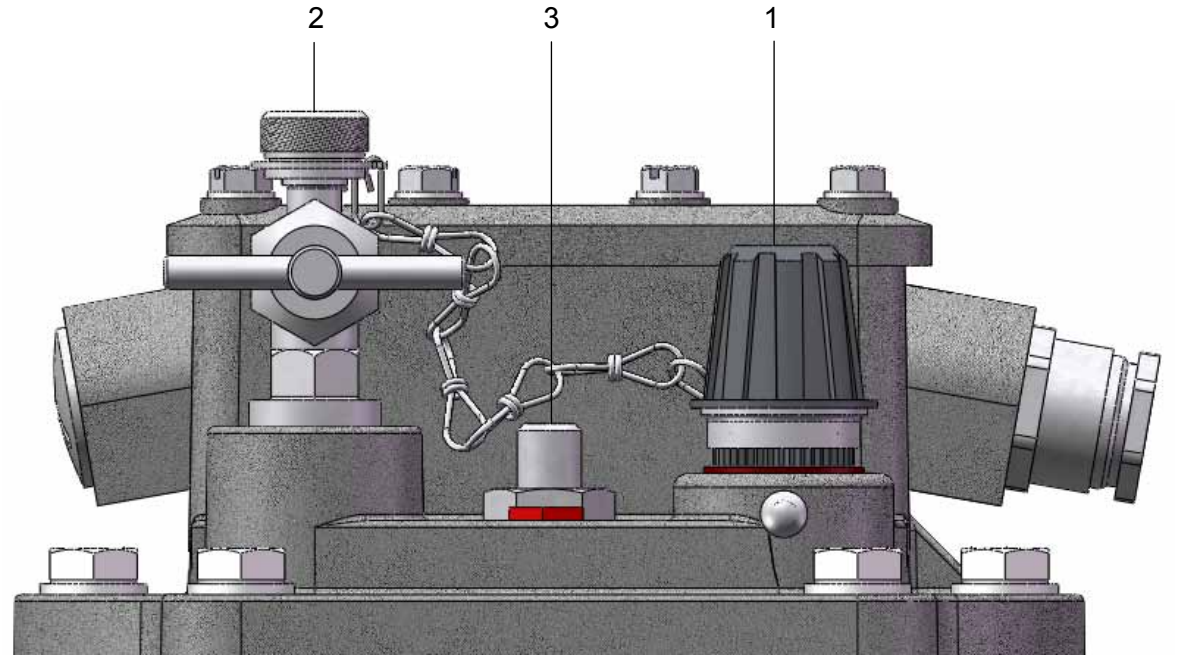


Figure 28 - Cover with additional air supply nipple

11 Explanations to code 60 - Buchholz relay NM series

11.1 Design features of Buchholz relay NM series

The principal construction of the Buchholz relay with floats and damper as well as their electro-mechanical functions have been maintained.

The Buchholz relay of series NM is equipped additionally with a capacitive sensor. The sensor is installed in the cover of the Buchholz relay. The cap of the terminal box accommodates the electronic amplifier of the measuring unit. Sensor and amplifier are connected by a shielded cable in three-wire technology with a cable connector. This cable is used for the supply voltage and the output signal.

Figure 29 shows the arrangement of the measuring unit using the example of a Buchholz relay BF 80/10/8. Apart from the dust hood and the cap of the terminal box which are higher by approx. 40 mm, the installation dimensions of the relay have not been changed. Hence, relays with analogue measuring units can be installed in existing systems.

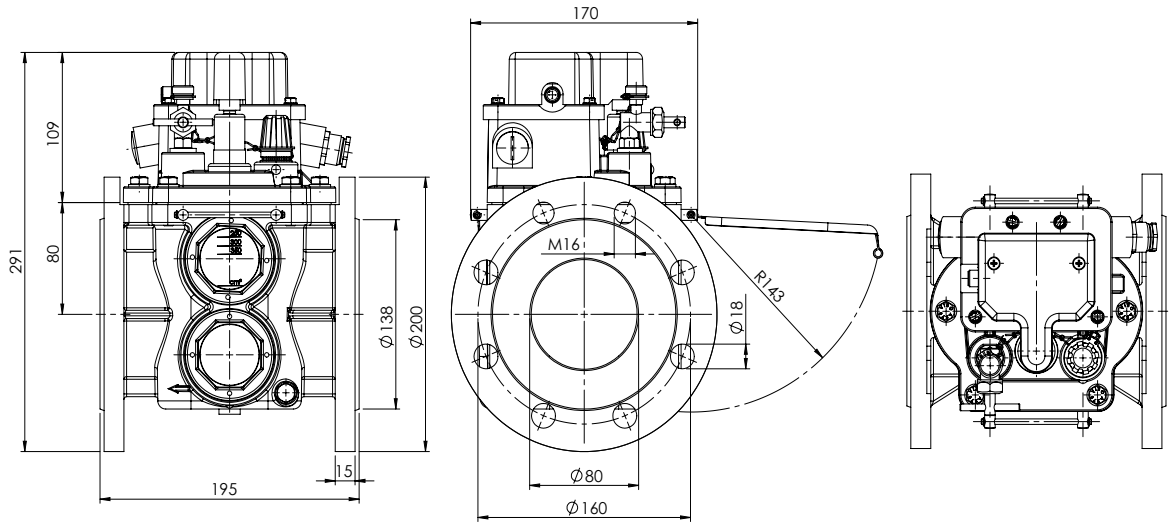


Figure 29 - Dimensional drawing Buchholz relay NM series type 26 (BF 80/10/8)

11.2 Extra function of Buchholz relay NM series

The standard Buchholz relay detects undissolved gases in the insulating liquid and indicates their presence when a specified threshold is exceeded, meaning that up to a certain gas volume, no signal is generated. Neither is it possible to gather information about the length of time it takes for gas to accumulate.

The process of the generation of unsolved gases in the insulating liquid over time is a very important criterion for the evaluation of the fault as the quantity and composition of the fault gases depend on the kind and quantity of the energy of the underlying fault. Spontaneous and energy-rich faults cause large gas quantities within a short period of time, whilst small volumes of gas are generated in the case of minor and insidious faults.

The Buchholz relay of NM series 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 the analysis of the fault at an early stage.

The extra function of the NM series relays is ensured by a capacitive sensor and the appropriate electronic components. Supply voltage of this assembly is DC 24 V. This voltage must be made available by the user. The output signal of the measuring unit is a standard current signal of DC 4 to 20 mA. It depends on the user how and in what form this signal is processed.

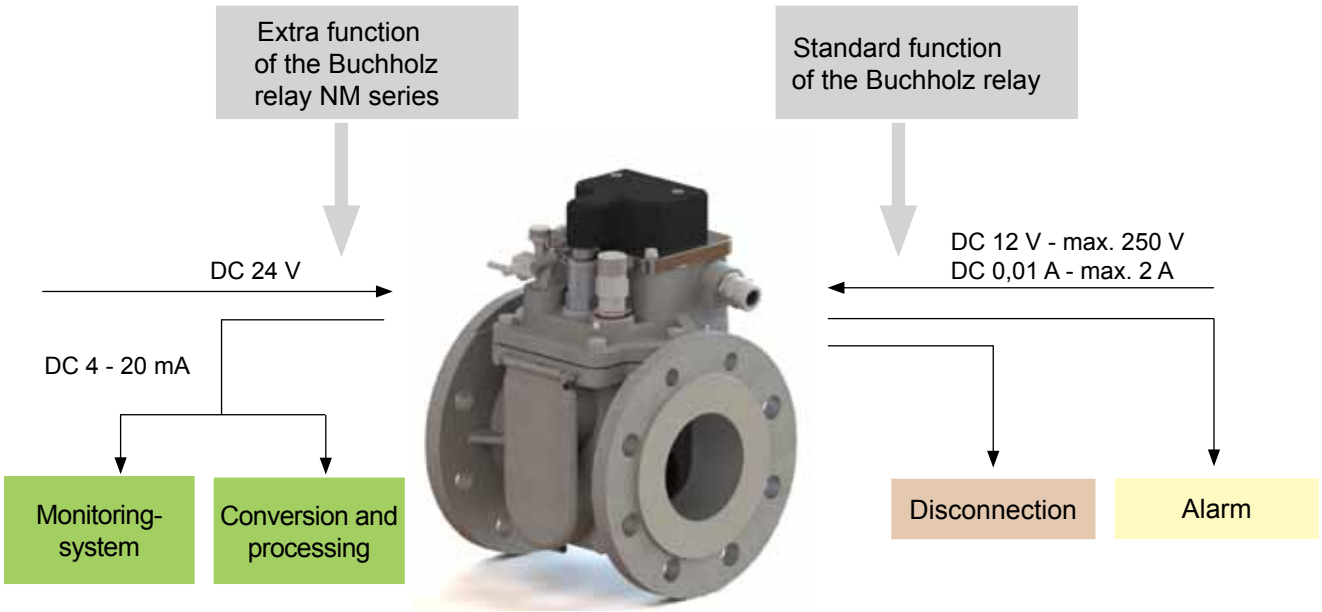


Figure 30 - Extra function of Buchholz relay NM series

11.3 Analogue measuring unit - Analogue measurement of gas volume

The measured value is based on capacitance variation of the sensor caused by variation of the insulating liquid level in the Buchholz relay.

Analogue measurement of the gas volume is possible between 50 cm^3 and 300 cm^3. Lower gas volumes cannot be measured reliably because of high inaccuracies. Measurements beyond this range are not necessary as in this case the upper switching system will respond. Besides, the construction of the Buchholz relay (larger gas volumes escape towards the conservator) does not allow such measurements. The operating point of the upper switching system (upper float) is a gas volume between 200 and 300 cm^3.

Fault: Free gas is available in the insulating liquid.

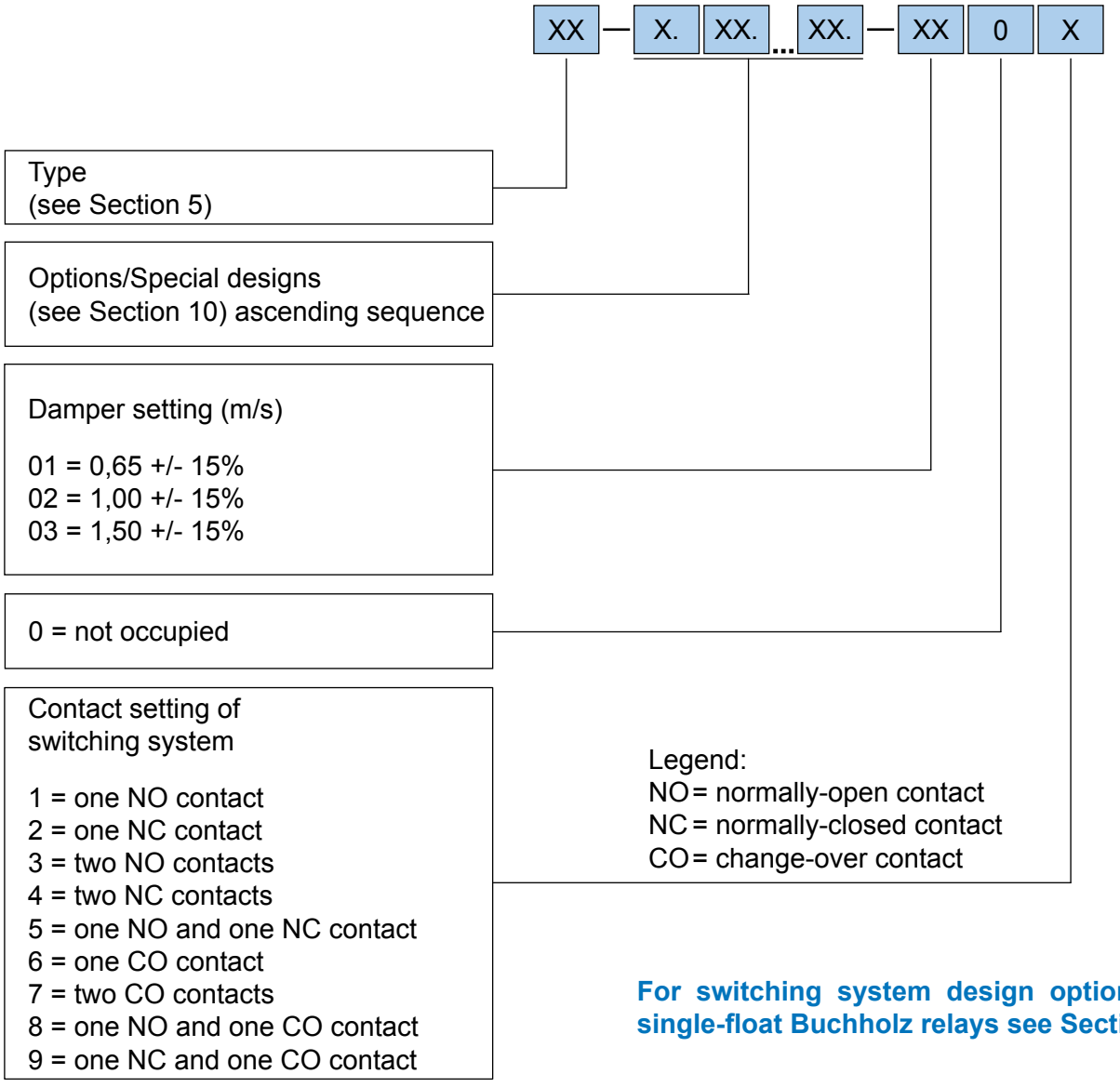
Response: The gas in the liquid moves upwards, accumulates in the Buchholz relay and displaces the insulating liquid. This decreases the level of insulating liquid. Liquid level changes lead to variation of the capacity of the sensor. This change is converted into an analogue current signal.

It should be noted that for design reasons the current value of the sensor remains relatively constant up to a gas volume of approx. 50 cm^3. The function equation will provide the actual volume only when the current signal becomes smaller and, hence the calculated volume noticeably larger.

12 Ordering data/Type code

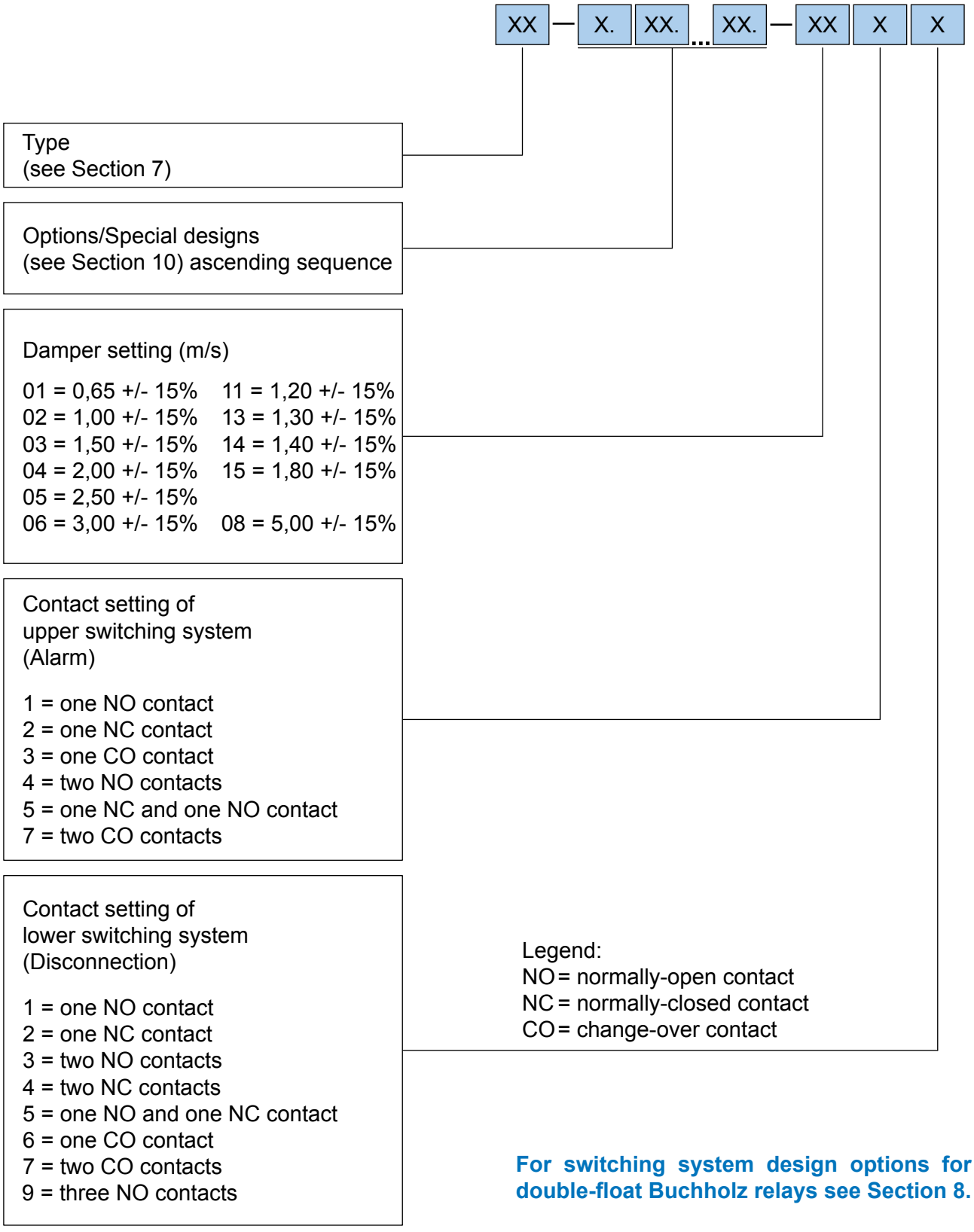
For placing orders, please, use the following key:

12.1 Single-float Buchholz relays



For switching system design options for single-float Buchholz relays see Section 6.

12.2 Double-float Buchholz relays



For switching system design options for double-float Buchholz relays see Section 8.

12.3 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 on page 28 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 +/- 15 %
1	=	Contact setting of upper switching system: 1 NO
3	=	Contact setting of lower switching system: 2 NO

13 Additional devices for Buchholz relays

13.1 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 and will be delivered with sightglass cover.

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.

Figure 31 - Gas sampling device ZG 1.2.

Figure 32 - Gas sampling device ZG 1.2. in lockable box

Figure 33 - Pipe of gas sampling device ZG 1.2.

Figure 34 - 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	
Length of pipe	max. 25 m	As requested by customer
Casing colour	Two-component texture paint	On polyurethane basis

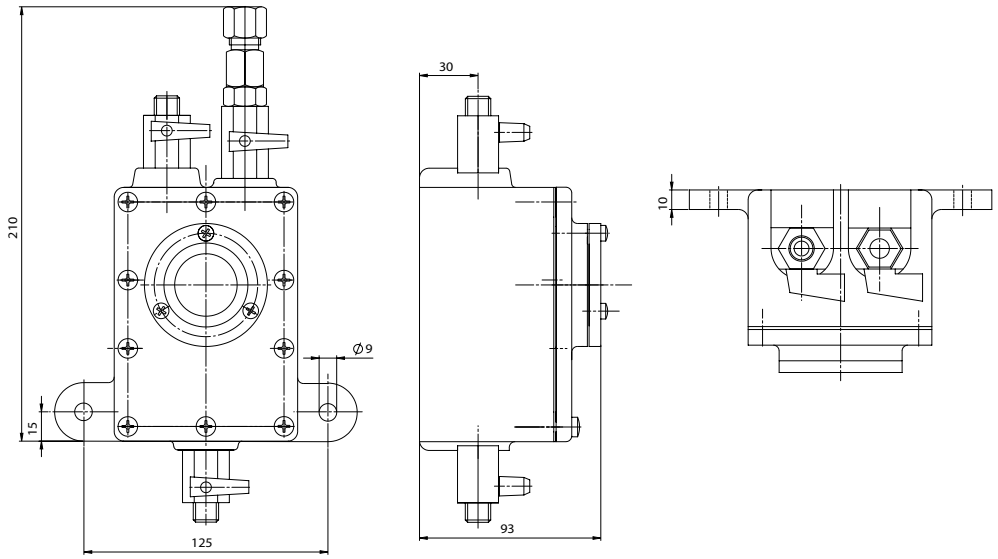
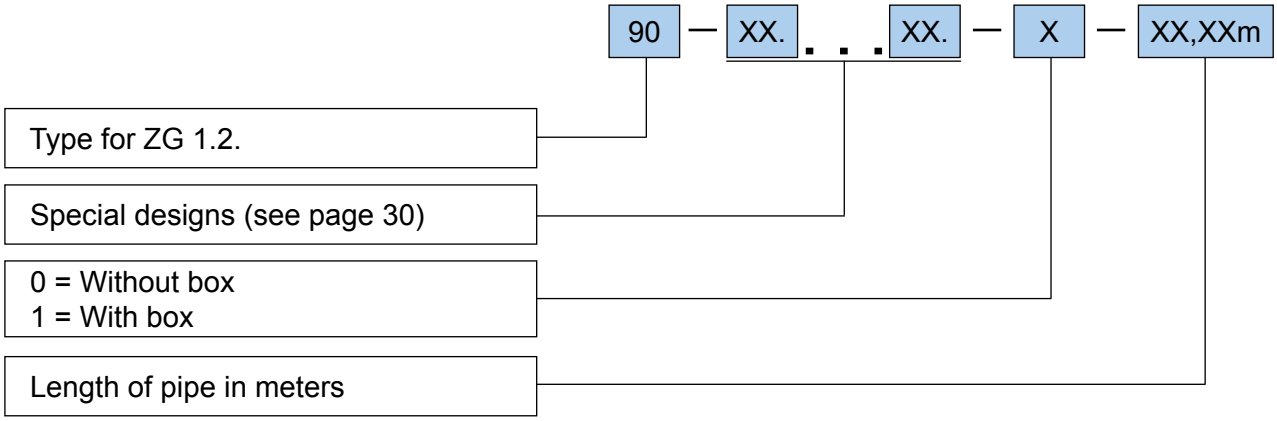


Figure 35 - Dimensional drawing, type ZG 1.2.

Special designs of gas sampling device ZG 1.2.:

Explanation	Code
Casing colour	
Casing colour RAL 9006 (white-aluminium)	40
Casing colour RAL 7001 (silver-grey)	41
Casing colour RAL 7012 (basalt-grey)	42
Casing colour RAL 7022 (umber-grey)	43
Casing colour RAL 7033 (cement-grey)	44
Casing colour RAL 7038 (agate-grey)	45
Casing colour RAL 7035 (light-grey)	46
Casing colour RAL 7016 (anthracite-grey)	47
Casing colour RAL 9002 (grey-white)	48
Casing colour RAL 7032 (siliceous-grey)	49
Climate-proof version	
Climate-proof version for extreme frigid open-air conditions below - 40 °C	34
Climate-proof version for Offshore	36
Climate-proof version for aggressive industrial atmosphere	36
Insulating liquid	
Insulating liquid silicone oil	20
Insulating liquid based on ester	21
Special request	
Special request (on special agreement with customer)	29
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.-0-10,50m

Explanation:
90 = Gas sampling device ZG 1.2.
34 = Climate-proof version (extreme frigid open-air conditions below - 40 °C)
44 = Casing colour RAL 7033 (cement-grey)
0 = Without box
10,50m = Length of pipe 10,50 m

13.2 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 tester BGT 3

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

The Buchholz gas sampler BGS as a component of the Buchholz gas tester BGT is included in the scope of supply.

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.

Gas testing device ZG 3.2.

EMB's ZG 3.2. gas tester serves to test the gases in the gas sampler or the Buchholz relay for the presence of carbon monoxide and hydrogen. The gases are analysed qualitatively.

The ZG 3.2. gas tester can be combined with EMB's Buchholz gas sampler. When using the BGS and introducing the defined gas volume (100 ml), the residual gas volume in the Buchholz relay or in the gas sampling device can be used for further analytical purposes.

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. and ZG 5.2.

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

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.

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

14 Other protection devices

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

Buchholz Relay Type 22 (BB 25)
for use in rail vehicles

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

Other types of Buchholz Relays
for use in rail vehicles

Type 04 (BG 25)
Type 21 (BG 25 S)
Type 06 (BF 25/10)
Type 08 (BF 50/10) et.al.

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

Monitoring device for hydro-type compensator („air cell failure relay“)

Type 80 (CF 38)

This device monitors the hydro-type compensator (air sack) in the expansion vessel.

Single-float Buchholz relays manufactured by EMB GmbH are also used as air cell failure relays (see Section 5 and 6).

Pipe diameter DN: 38 mm
Type of connection: flanged

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.

15 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 tr

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

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