

BUCHHOLZ RELAY

CATALOGUE



PENTA
ELECTRICAL SAFETY PRODUCTS

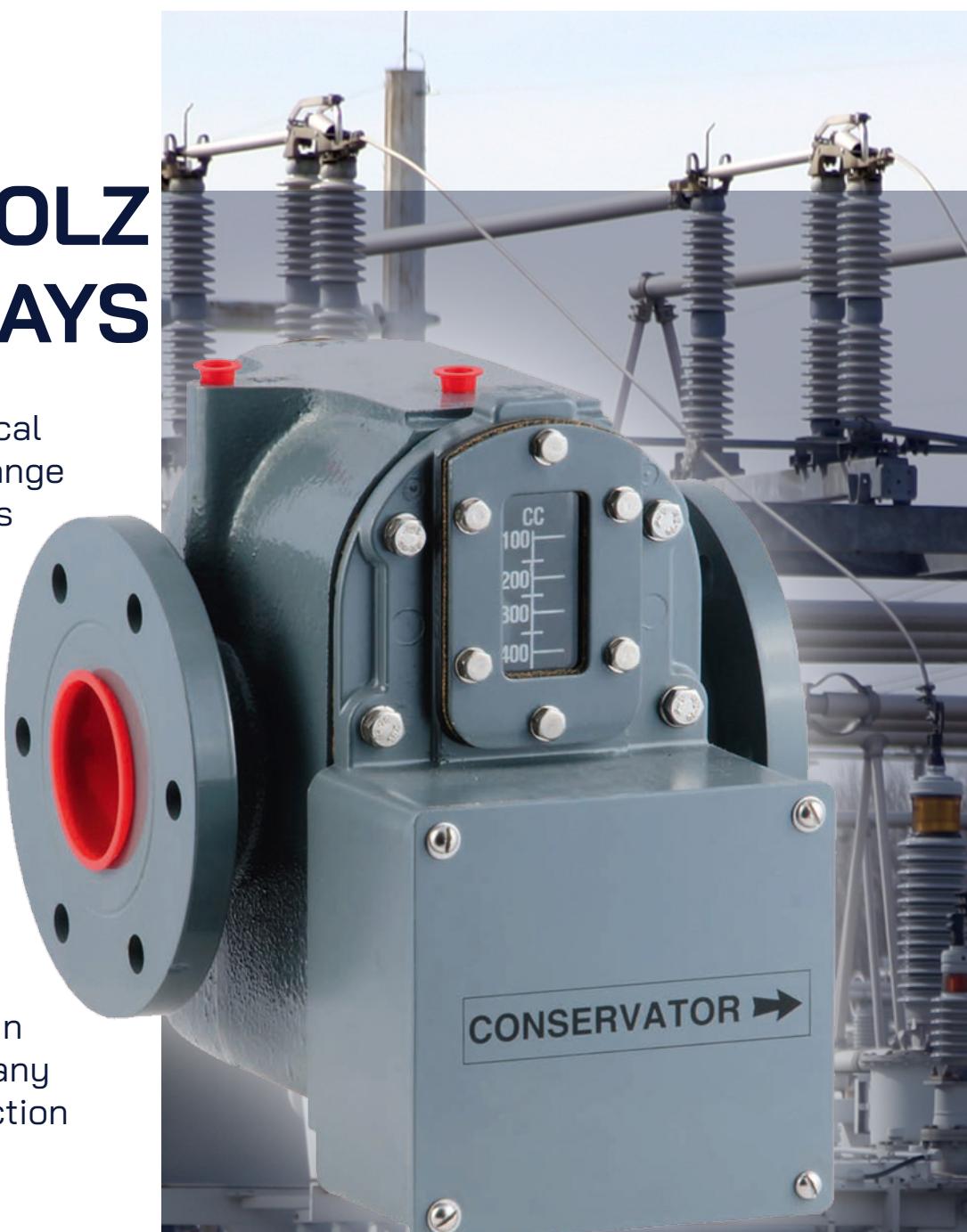
Your life,
Our work.

pentaesp.com



BUCHHOLZ RELAYS

The PENTA Electrical Safety Products range of Buchholz Relays has a proven track record of many years of service. As well as supplying a standard range of approved equipment, PENTA Electrical Safety Products also have the capability to design new solutions for any transformer protection requirement.



Our range includes Buchholz Relays of many sizes and configurations, Diode Protection Units, Dry Air Pumps and Gas Collectors.



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Introduction

Buchholz Relays from PENTA Electrical Safety Products can provide a service for many decades if maintained properly. Our Relays have been providing transformer protection globally for many years.

Applications

Most faults in an oil filled Transformer are accompanied by the generation of gas. By using a suitable Relay the formation of this gas can be used as a warning of a developing fault.

Once a specified volume of gas has collected within the Buchholz Relay, the alarm element will cause an alarm indication.

If there is a more serious fault within the Transformer, the trip element will function. The trip element will cease the functioning of the Transformer to protect it from further damage and protect those working around it.

Possible causes for Alarm indication

- a. Broken-down core bolt insulation
- b. Shorted laminations
- c. Bad contacts
- d. Overheating of part of the windings

Possible causes for Trip

- a. Earth faults
- b. Winding short circuits
- c. Puncture of bushings
- d. Short circuits between phases

Trip Operation

When a serious fault occurs, the generation of gas is so rapid that an oil surge is set up through the relay. This oil flow with impinge upon the flap fitted to the trip element causing it to rotate about its axis and bring the switch to the closed position, which in turn operates the tripping devices. In the event of serious oil loss from the transformer both alarm and trip elements operate in turn, in the manner previously described from has collection.

The oil level in the double element relay can be monitored against graduated scale on the windows both sides.

Mounting Position

The relay should be mounted in the connecting pipe between the transformer and the conservator tank. This pipe should be as long and as straight as possible, and must be arranged to slope upwards, towards the conservator, at an angle within the limits of 3 to 7 degrees to the horizontal.

There should be a straight run on the transformer side of the relay of at least five times the internal diameter of the pipe, and at least three times this diameter on the conservator side.

A machined surface is provided on the relay body for the purpose of testing the mounting of the relay, both in the inclined direction and at right angles to the pipe where it should be horizontal.

Connections

The terminal boxes on double element relays are normally drilled and tapped M20 x 1.5mm for bottom entry by conduit or cable gland. Side entries and alternative thread sizes can be supplied for most types upon request. Alarm and tripping circuit connections are made to OBA terminal stems, in the terminal box, and secured by OBA nuts and washers. The maximum recommended torque valve should not be exceeded when making connections.

Testing on Site

Double element relays are provided with a separate ball valve to enable the injection of compressed air to be used for testing on site.

To test the operation of the alarm element, air from an air bottle should be admitted slowly so that the alarm element falls gradually until the switch operates.

To test the trip element, the valve controlling the bottle is opened quickly so that the air rushes in, depresses the flap, operating the switch. The pressure required is dependent upon the equipment used. To facilitate on-site testing, a portable Dry Air Pump is available.

Routine Testing

Relays are individually calibrated, in accordance with BEBS T2 (1966). Values are recorded for loss of oil/gas collection to operate the alarm switch and steady oil flow to operate the trip switch.

The unit is also observed to ensure the trip switch operates due to a complete loss of oil. Assembled relays are pressure tested with transformer oil at 1.4 bar for 6 hours. Electrical circuits are flash tested at 2000 volts r.m.s. and the insulation resistance measured at 500 Volts is not less than 10 MΩ in air.

Although specifically designed to function with transformer oil according to BS148, successful trials have also been conducted utilising Silicone coolant.



REED SWITCH TYPE

For use in situations subject to seismic disturbances and mining activities such as blasting.

Shock and vibration acting along the tube of a conventional Mercury switch can cause the Mercury within it to move and momentarily bridge the switch electrodes, even though the switch is tilted in the open position. This is considered to be a maloperation of the relay, in that it is caused by external influences and not by a fault within the transformer. Consequently where relays are to be used in situations as described above a more suitable alternative to the usual Mercury switch is required. Magnet operated Reed switches were selected specifically for this purpose and this choice is supported by the following type tests which were successfully withstood.

Ability to withstand power frequency vibrations

The device having its contact electronically monitored by means of an instrument capable of registering and recording a contact closure of 1ms duration, shall be subjected to a sinusoidal vibration having a frequency of 100 Hz and an amplitude of 0.25 ± 0.05 mm peak to peak (thus a maximum acceleration of 6g) in the plane of movement of the contact making arrangement for a period of 1000 hours, during which there shall be no maloperation of the contacts.

Ability to withstand power frequency vibrations

Immediately before and immediately after the vibration test, the stability of the device

and its contacts under earth tremor conditions shall be proved by subjecting the device whilst being vibrated under the conditions of the vibration test above, to further vibrations superimposed on the 100Hz vibration and supplied separately in each of the three perpendicular axes, one of which should be in the same plane as the 100Hz vibration.

These vibrations shall have a constant peak to peak amplitude of 2.5mm and shall be carried by a continuous slow sweep over the range of 0.1 to 33Hz (at which frequency the maximum acceleration will be 5.5g) in order to search out resonances.

The appearance of these relays is the same as Mercury switch types but they are distinguished from them by the symbol /VO or /Vc/o following their type markings.

The letter V (for vibration) indicates that the relay contains Reed switches, the letter O that the contacts are normally open and the symbol c/o indicates change-over contact reeds.

Thus a type 2DE/VO is a 2" (pipe size) Double Element relay with normally open Reed switches. "Normally", in this context means with the relay full of oil.



/ Single Element and Tap-Changer Types

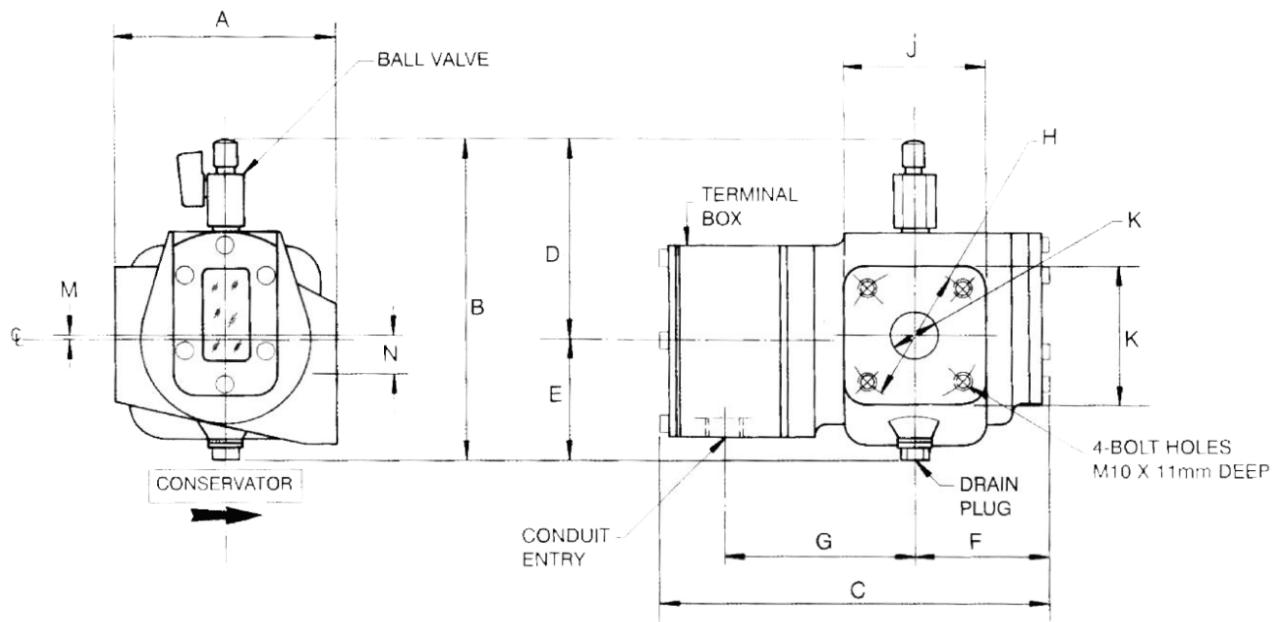
Single element type relays are available for 1" bore size, designated 1SE, which operate indiscriminately for gas or oil collection and are suitable for small oil filled transformer, capacitor and potential transformer protection.

A special range of single element relays are also available for Tap-changer type transformers which operate for a surge condition or loss of oil only and allow gas, normally produced during tap changing operations to pass freely. the SE relay has only one operating element and operates in the same manner as the DE relays.

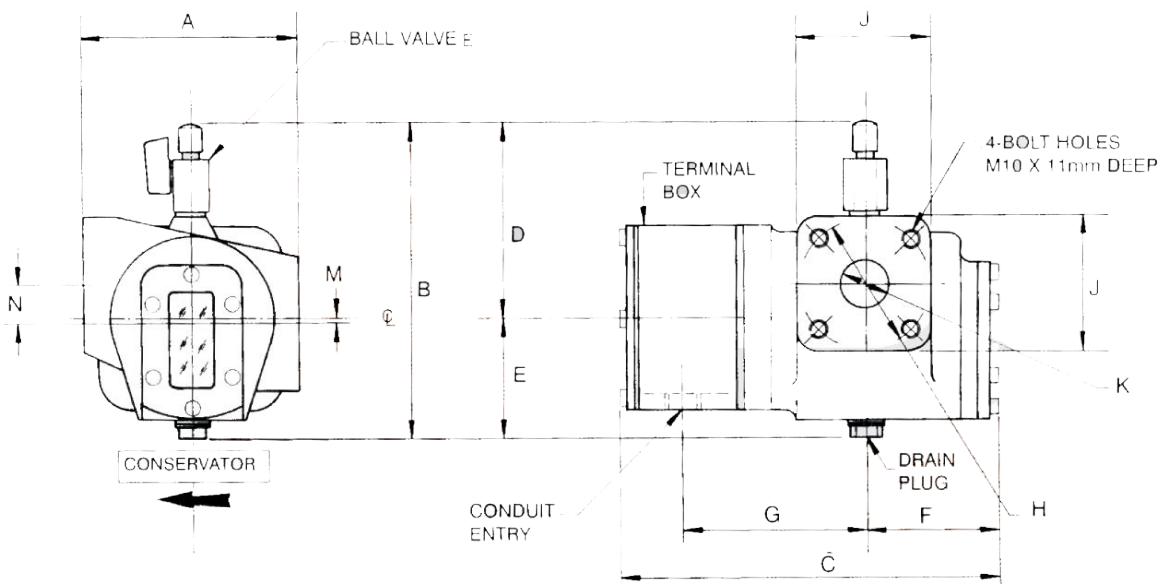
A special open frame unit designated R575/1 suitable for fitting inside the header tank tap-changers which operate due to has collection, oil loss and surge conditions is available.

A protective diode unit type D1 can also be provided to protect Reed switches employed in single element units.

/ RELAY SIZE 1 SE



/ RELAY SIZE 1 SET





BUCHHOLZ RELAY

Double Element and Tap-Changer Types

In the double element relay, collection of gas causes the oil level with the relay to fall. This in turn causes the upper element to rotate on its pivots, bringing the magnet it carries into a position where it operates the alarm switch. An oil surge through the relay will cause the lower element to rotate about its pivots and bring its magnet into a position so as to operate the tripping switch.

Operating characteristics

All double element relays are adjusted so that their performance lies within the limits specified in BEBS T2. Alternative values may be available upon request. These switches have Rhodium contacts located midway along the length of their glass tubes. The tubes contain an atmosphere of Nitrogen.

Connected in series with each Reed switch, and mounted within the terminal box is an inductor of approximately 30 microhenries and 0.04ohm. These inductors are intended to protect the Reed switch contacts from the effects of capacitive loads, such as those imposed by long leads or pilot cables, and must not be removed from relays in service.

Protection of Reed switch contacts against the effect of inductive loads, such as are imposed by tripping relays is achieved by means of a diode wired across each load. This diode must be rated with forward current at least as high as the steady load current and connected observing polarity so as to absorb the back e.m.f. A protection unit, designated D2, fitted with suitably rated diodes for this purpose is available.

/ Table 1: Reed Switch Data

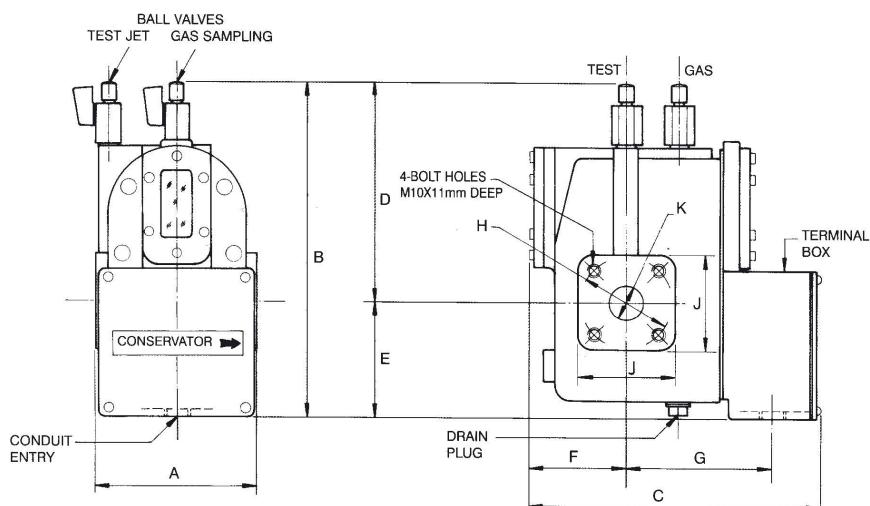
	Single Contact	Change-over Contact
Type	Gunther Type 1526	Gunther Type 1621
Switch Capacity	Max. 250 VA/W	Max. 60 W/80VA
Switching Current	Max. 5A	Max. 2A
Switching Voltage (0-60Hz)	Max. 250 V	Max. 220 V
Initial Contact Resistance	Max. 100 millionohms	Max. 100 millionohms
Breakdown Voltage	Min. 600 v r.m.s	500/400 V d.c
Resonance Frequency	900Hz	-
Shock Resistance	Max. 50g (durations 11ms)	Max. 50g (durations 11ms)
Vibration Resistance	Max. 35g (50-500Hz)	Max. 35g (50-500Hz)
Temperature Resistance	-55°C to +150°C	-40°C to +50°C

/ Table 2: Operational Characteristics

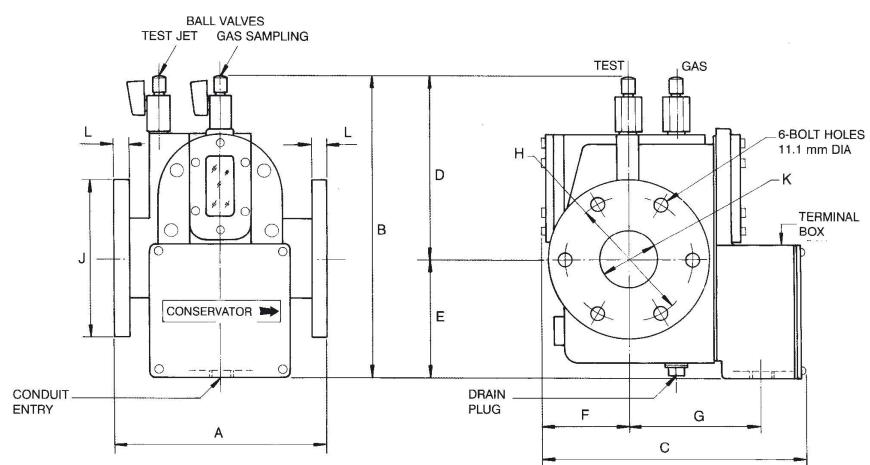
Model	Steady Oil Flow (mm/sec) to Operate Trip Element Switch		Oil level (cc) to operate Alarm Element Switch @ 50° Inclination		
	Pipe angle 1° Not less than	Pipe angle 9° Not more than	Min	Max	For equipment containing
1SE	650	900	140	200	
1SE/VO	650	900	120	160	
1SE/VK/ML	900	1050	150	230	
1SET 1SET/VO	450	600	N/A	N/A	
1SET/HF	650	750	N/A	N/A	
1DE 1DE/VO 1DE/Vc/o	1000	1300	200	300	Up to 1000 litres 1000 kVA
2DE 2DE/VO 2DE/Vc/o	1100	1400	200	300	1001/10,000 litres 1001/10,000 kVA
3DE 3DE/VO 3DE/Vc/o	1200	1600	200	300	10,000/50,000 litres 10,001 kVA/99 MVA
3DE/HF2 3DE/HF2/VO	1900	2500	250	350	50,000 litres + 100 MVA +



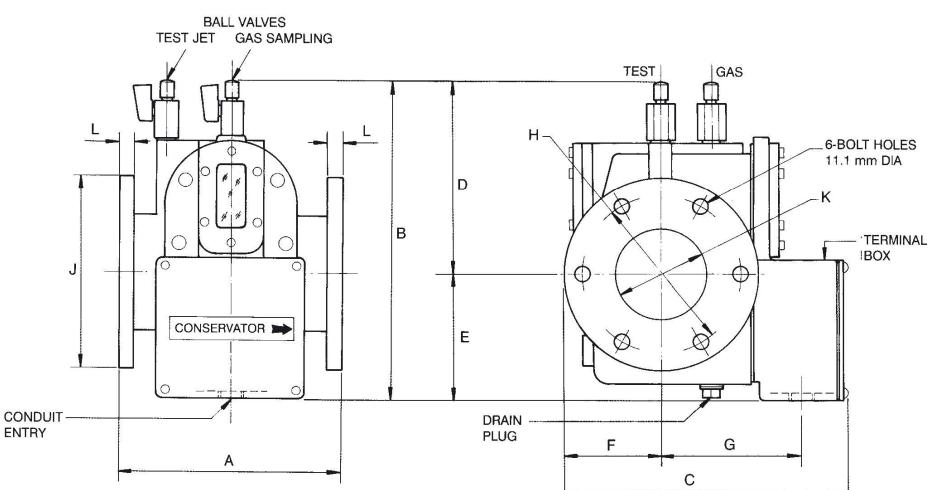
/ 1DE RELAY



/ 2DE RELAY



/ 3DE RELAY



/ Table 3: Dimensions

Type	Dims	A	B	C	D	E	F	G	H	J	K	L	M	N
1DE	mm	127	269	232	171	98	76	114	72	76	25	-	-	-
	in.	5.0	10.6	9.13	6.75	3.9	3.0	4.5	2.84	3.0	1.0			
2DE	mm	184	269	232	158	111	76	114	110	139	51	13	-	-
	in.	7.25	10.6	9.13	6.2	4.37	3.0	4.5	4.33	5.5	2.0	0.5		
3DE	mm	184	269	234	158	111	80	114	130	160	76	13	-	-
	in.	7.25	10.6	9.21	6.2	4.37	3.15	4.5	5.12	6.31	3.0	0.5		
1SE	mm	120	174	212	110	64	76	103	72	76	25	-	3.0	22
	in.	4.75	6.85	8.35	4.33	2.52	3.0	4.0	2.84	3.0	1.0		0.13	0.85
1SET	mm	120	174	212	104	70	76	103	72	76	25	-	3.0	22
	in.	4.75	6.85	8.35	4.1	2.75	3.0	4.0	2.84	3.0	1.0		0.13	0.85



BUCHHOLZ RELAY

As well as conventional MK10 model Relays, PENTA Electrical Safety Products also provide DIN style relays depending upon your requirements.

We can also supply bespoke flange sizes, paint types and numbers of fitting holes.
Please contact us for more information on this service.

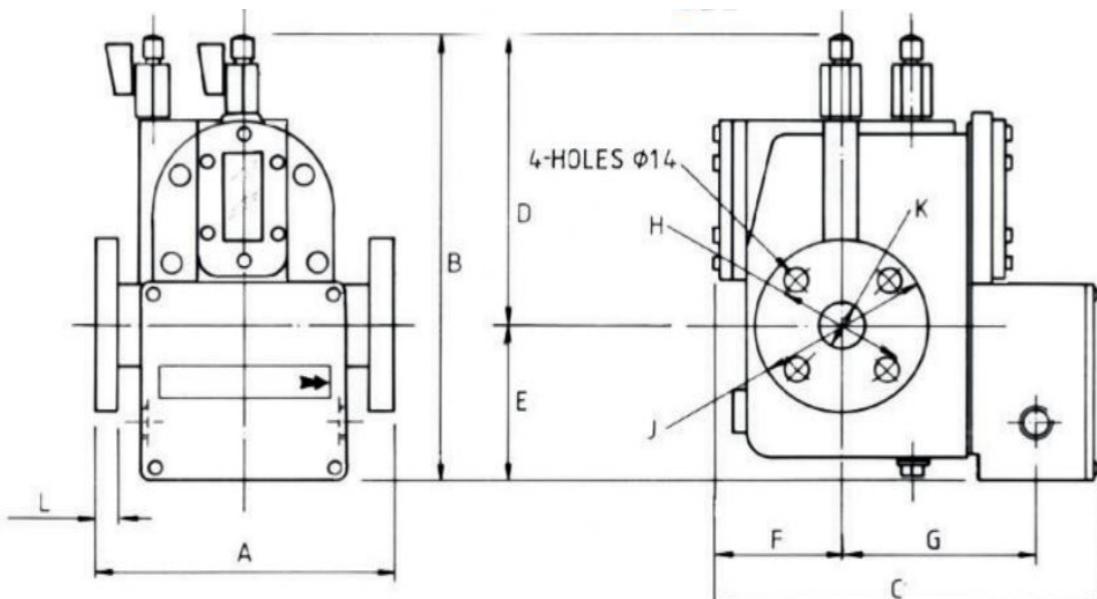
/ Table 4: Operational Characteristics

Model	Steady Oil Flow (mm/sec) to Operate Trip Element Switch		Oil level (cc) to operate Alarm Element Switch @ 50° Inclination		
	Pipe angle 1° Not less than	Pipe angle 9° Not more than	Min	Max	For equipment containing
25DE	1000	1300	200	300	Up to 1000 litres 1000 kVA
25DE/VO					
25DE/Vc/o					
50DE	1100	1400	200	300	1001/10,000 litres 1001/10,000 kVA
50DE/VO					
50DE/Vc/o					
75DE	1200	1600	200	300	10,000/50,000 litres 10,001 kVA/99 MVA
75DE/VO					
75DE/Vc/o					
75DE/HF2	1900	2500	250	350	50,000 litres+ 100 MVA +
50DE/HF2/VO					
50DE/HF2/Vc/o					

/ Table 5: Dimensions

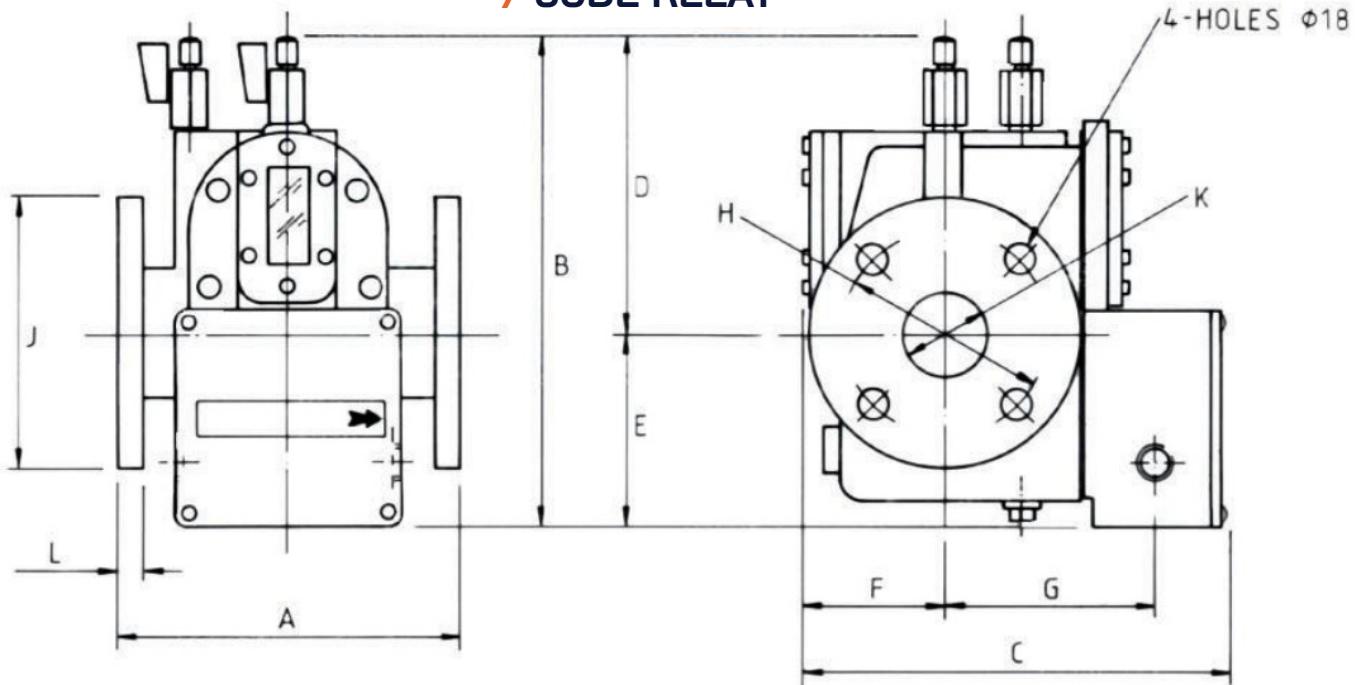
Type	Dims	A	B	C	D	E	F	G	H	J	K	L
25DE	mm	200	269	232	171	98	76	114	85	115	25	16
	in.	7.87	10.6	9.13	6.75	3.9	3.0	4.5	3.35	4.53	1.0	0.63
50DE	mm	184	269	232	158	111	76	114	125	165	51	13
	in.	7.25	10.6	9.13	6.2	4.37	3.0	4.5	4.95	6.5	2.0	0.5
75DE	mm	184	269	254	158	111	100	114	160	200	76	13
	in.	7.25	10.6	10	6.2	4.37	3.94	4.5	6.3	7.87	3.0	0.5

25DE RELAY

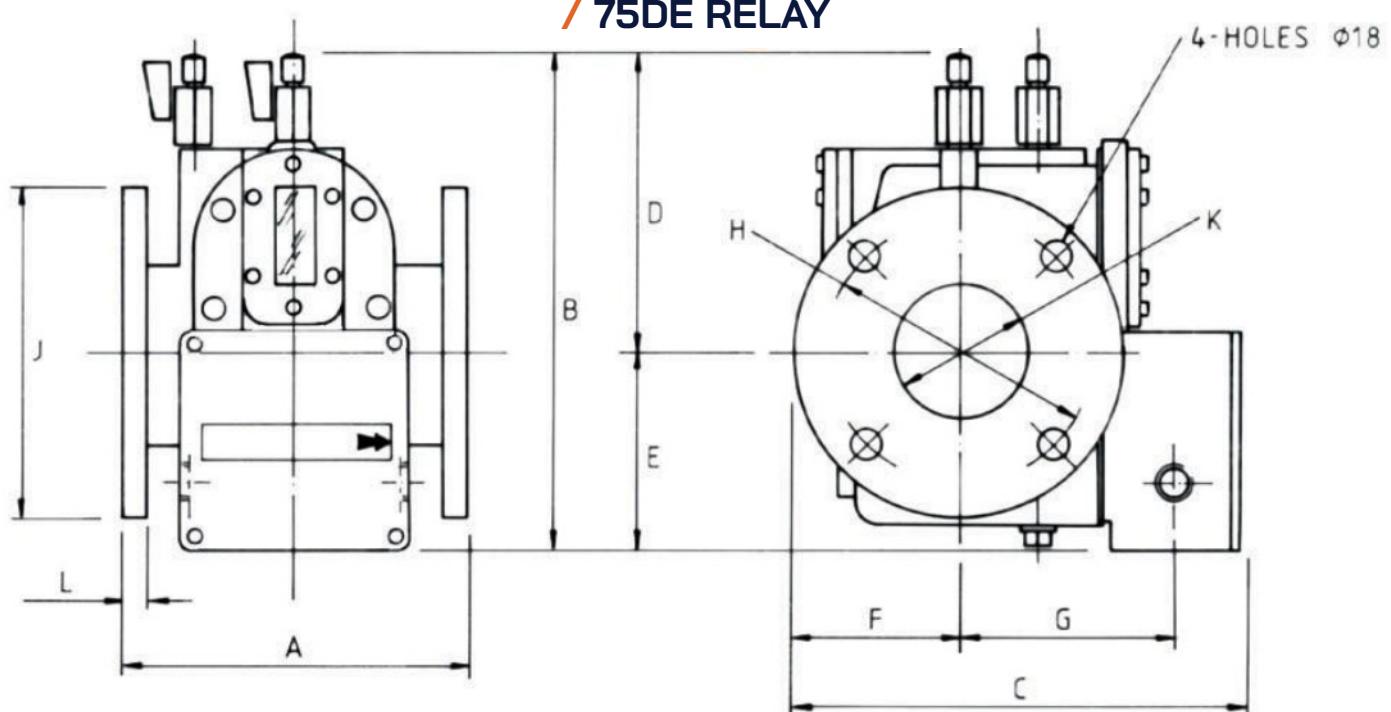




/ 50DE RELAY



/ 75DE RELAY





DRY AIR PUMP

The Dry Air Pump from PENTA Electrical Safety Products provides a portable solution for on-site testing of Gas and Oil operated Buchholz Relays.

A charge of air is created in the polycarbonate cylinder by means of a foot-operated pump. The cylinder contains an indicating silica gel which absorbs the moisture present in the air.

The pressure of the air charge is monitored on the built-in pressure gauge. When a suitable pressure has been attained, the air charge is then quickly passed to the Buchholz via a flexible tube by opening the ball valve fitted to the cylinder. To prevent backpressure forcing oil back down the flexible pipe, a non-return valve is incorporated in the unit.

The indicating silica gel is a crystalline material, which absorbs moisture readily. The properties of the crystals can be easily regenerated by heating/drying. The crystals are impregnated with Iron compounds which give them an orange colour. Upon absorption of moisture, these crystals change from their orange colour to a pale yellow and then become colourless.

When the crystals change to pale yellow, they should be regenerated. This gel is not classified as dangerous.

On-site testing of Buchholz Relays

These instructions are for guidance only. All testing should be carried out in accordance with substation guidelines and safety procedures.

- 1) Place pump on stable area of ground.
- 2) Open unit and attach flexible pipe to non-return valve outlet using suitable spanner. Do not overtighten Brass fasteners.
- 3) Ensure that outlet valve is closed at right angle to ballvalve body.
- 4) When access clear, connect flexible hose to TEST ballvalve upon Buchholz. Open TEST valve.
- 5) Connect suitable test meter to Buchholz terminals in accordance with substation requirements. It is recommended that the switch resistances be measured to avoid damaging switches.
- 6) On the ground, unfasten the foot pump. Pump air into the polycarbonate cylinder until the pressure gauge reads a value of approximately 40 p.s.i.
- 7) Quickly open the ballvalve on the unit, and monitor the TRIP switch, which should operate and then return to its "normal" position.
- 8) The air passed into the Buchholz during the test should be sufficient to operate the ALARM switch.
- 9) Air should be removed from the Buchholz by opening the GAS ballvalve.
- 10) It should be noted that where a long length flexible hose is used, the pressure might need to be increased due to the loss of pressure this causes. Repeat test as necessary with increasing pressures.
- 11) After satisfactory testing close TEST ballvalve, remove flexible hose and replace dust caps.
- 12) Remove test meter from Buchholz terminals and refit terminal box cover.
- 13) Fasten foot pump and close ballvalve on unit and refit dust cap.
- 14) Inspect silica gel and if orange colour faint, regenerate as detailed.



Dry Air Pump

Max. Recommended Operating pressure	60 p.s.i.
Size	475 x 250 x 128mm
Weight	8kg
Reference	RFA-05040

DIODE PROTECTION UNIT



To protect Buchholz Relays models fitted with reed switches PENTA Electrical Safety Products offers a wide range of Diode Protection Units. These protect the reed switch contacts against the effect of inductive loads, such as those caused by tripping relays within the marshalling kiosk or control room, typically used to provide multiple simultaneous switching signals.

The protection is achieved by means of a suitably rated diode wired across each load. The diode must be rated with forward current at least as high as the steady load current and connected observing polarity so as to absorb the back e.m.f.



/ D1 DIODE PROTECTION UNIT

Reference

RFA-04905



/ D1 DIODE UNIT FOR BHARAT

Reference

RFA-04905B



/ D2 DIODE PROTECTION UNIT

Reference

RFA-04900



/ D2 C/O DIODE PROTECTION UNIT

Reference

RFA-04900/1



GAS SAMPLING KIT

PENTA Electrical Safety Products offer a number of kits to enable on-site gas and oil sampling at ground level. These are particularly useful when access to the Buchholz Relays is restricted on-site, which may make it difficult to fit standard equipment to draw Gas or Oil as required. Kits are suitable for 6mm Copper tube which can be readily obtained.

Each kit provides all of the fittings required to carry out the testing function required, be that oil sampling via ground mounted ball valve, air injection via ground mounted Ballvalve (with or without retention of Buchholz mounted ballvalve) or Gas collection at ground level ballvalve (with or without retention of Buchholz mounted ballvalve). Lockable ballvalves are also available. All ballvalves have 1/8" BSPP male threads, supplied with a dust cap.

Testing on Site

Double element relays are provided with a separate ballvalve to enable the injection of compressed air to be used for testing on site.

To test the operation of the alarm element, air from the PENTA Electrical Safety Products Dry Air Pump or an air bottle should be admitted slowly so that the alarm element falls gradually until the switch operates.

To test the trip element, the valve controlling the Dry Air Pump or bottle is opened quickly so that the air rushes in, impinges on the flap and depresses it, operating the switch. The pressure required is dependent upon the equipment used.



/ GAS COLLECTOR

A handy alternative to the gas/oil sampling kits is the RAGA Gas Sampling Vessel. The RAGA provides a simple ground based auxiliary unit to the Buchholz, which is suitable to carry out the functions of gas and oil sampling. It also allows the volume of gas to be read easily from ground level where in certain conditions it may be difficult to see the dual window scales upon the Buchholz.

This is done by a series of operations which exhausts the gas from the Buchholz chamber and transfers this to the gas drawing vessel (RAGA) where it will be displaced against the window scale.

Reference

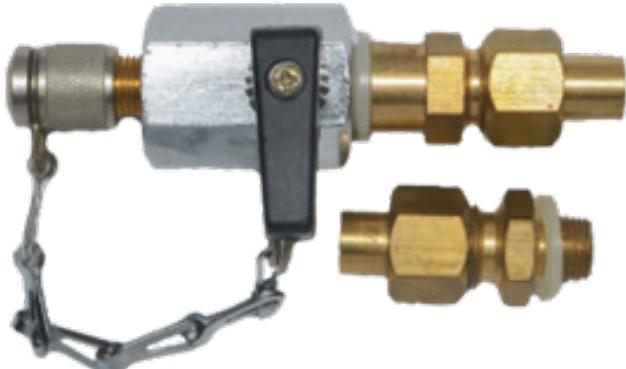
MISC-00123



/ GAS COLLECTOR

Reference

RAZ-03496/2



/ OIL DRAIN SAMPLING KIT

Reference

RAZ-03496/3



/ GAS SAMPLING KIT LOCKING

Reference

RAZ-03496/4



/ GAS SAMPLING KIT GRND END

Reference

RAZ-03496/1



/ BALLVALVE ASSEMBLY

Reference

RFZ-03400



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