iST POWER

INSTALLATION, COMMISSIONING, OPERATION, AND MAINTENANCE

INSTRUCTIONS

MIDEL COOLED 2MVA AUXILIARY TRANSFORMER

SES ENGINEERING SERVICES

for

SEP ENABLING WORKS

TRANSFORMER SPECIFICATION: 0105275

PURCHASE ORDER NUMBER: A322/9001

WORKS ORDER NUMBER: 20190195/196

MANUAL NUMBER: MM0695 issue 1

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Revision Record

Issue	Change	By	Date
1	Original Issue	PWJ	14/10/2020

LIST OF CONTENTS

SECTION 1

DESCRIPTION

1.1 Introduction

The transformer units manufactured by IST Power Limited, supplied as follows: -

The auxiliary transformer is a three-phase delta/star, outdoor, Midel 7131 cooled transformer for 11000Volts 50Hz 3 phase supply. The secondary output voltage is 433 volts 3 phase.

1.2 Technical Description

Type	Midel cooled double wound auxiliary transformer in a KNAN ground mounted tank.
Cooling	KNAN, Midel 7131 to IEC 61099
Continuous Rating	2000kVA
Rated Primary Voltage	11000 volts
Primary Tapping Range	±2.5%, ±5% & ±7.5%
Tapping Method	De-energised, off circuit tapping switch
Rated Primary Current	104.97 Amps
Rated Secondary Voltage	433 volts
Rated Secondary Current	2666.7 Amps
Number of Phases	3 phase
Frequency	50Hz
Vector Group	Dyn11
Impedance	6% @ 2000kVA rating (Measured value stamped on plate).
Test Voltage Level	28/3kV RMS
Weight of Core and Coils	2906kg

Volume of Midel	1170 litres
Total Weight	5580kg
Primary Termination	3 x 36kV 1250-amp Type E Interface 5/8” – 11UNC-2B Equipment Bushings, mounted to accept cables fitted with elbow connectors from above.
Secondary Termination	4 pole 3150A Cast Resin Bushing Plate with 4 take-offs per phase in an air-filled cable box with undrilled gland plate to suit 4 cables per phase entry from above.
Fittings	Name Rating and Diagram Plate Earthing Terminal Pressure relief valve Lifting Lugs Midel Drain and Filter Valves Midel Level Gauge Common Skid Base
Specification	IEC 60076

1.3 Detailed Description

The transformer consists of three single phase coil assemblies each mounted on a common 3-phase core assembly.

The coils are wound from insulated copper strip conductor wound as spiral winding with ducts for cooling. The coils have been dried out prior to immersion in Midel 7131

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The stepped leg/stepped yoke core is built up from laminations of cold rolled silicon steel. The laminations are interleaved with mitred corners and clamped with fabricated steel frames.

The transformer is contained within a fully welded steel tank with a bolted-on lid. The tank is complete with pressure relief device, drain & filter valves, conservator, Buchholz relay and dehydrating breather.

The primary, secondary and tertiary winding leads are made onto bushings mounted on the tank sides.

The unit is filled with Midel 7131. See Appendix A for Product Data Sheet and the Material Safety Data Sheet.

1.3.1 Transformer Tank and Termination Boxes

The transformer tank is of sheet steel welded construction. The tank has been painted with a heavy-duty corrosion protection system to specification 704-60180.

1.3.5 Transformer Secondary Cable Box

The 415V secondary output is via a 4-pole resin cast bushing plate mounted within an air-filled cable box. Each phase has 4 separate take-off points for cable connection. The undrilled gland plate is mounted on the top of the cable box to suit cable entry from above. The cable connections are accessed by a full size removable front cover. The front cover and gland plate are gasketed to provide a sealed enclosure.

1.3.6 Auxiliary Equipment

The transformers are fitted with the following equipment: -

1) A pressure relief valve with alarm/trip contacts mounted on the tank side with a duct to direct any expelled Midel towards ground level.

2) Midel Liquid Temperature Indicator with alarm and trip contacts.

3) Winding Temperature Indicator with alarm and trip contacts.

4) Midel Liquid Level Indicator with low level alarm and trip contacts.

Other fittings include removable cable gland plates, Midel filter and drain valves and Midel sight glass. A loose Envirogel dehydrating breather to be fitted on site is included.

SECTION 2

INSTALLATION INSTRUCTIONS

2.1 Introduction

These instructions are intended to give guidance and assistance in the installation and maintenance of the Midel 7131 filled 3 phase auxiliary power transformer.

2.2 Method of Despatch

Every precaution is taken to ensure that the equipment will arrive at its destination in perfect condition.

The units are despatched completely assembled, finished, and tested on dedicated road transport.

2.3 Unpacking and Examination upon Arrival

Immediately upon arrival the equipment should be thoroughly examined externally. Any damage should be reported at once to the Carrier and to IST Power Ltd quoting the Advice Note details to enable a claim to be lodged with the responsible party. Any deficiencies of material should also be notified to the Carrier and to IST Power Ltd immediately.

2.4 Handling

When lifting the equipment use the four lifting points, painted yellow, provided with the correct lifting slings through each lifting point. Great care must be taken not to knock or damage the equipment. Lifting weight of complete unit is 5580kg. Jacking lugs are provided on each side of the transformer tank. Jacking the transformer should only be undertaken by experienced installation personnel.

2.5 Storage

The unit is suitable for storing outdoors, if required, until commissioned.

2.6 Location

As this equipment is a static unit the location is of course fixed. Care must be taken to protect the unit from severe environments i.e., pollution from active chemicals, hot air blasting unit or any elements not deemed normal. The unit is despatched filled with Midel to the correct operating level for use indoors with heavy duty paint finish.

2.7 Foundation and Connections

1) The equipment must be mounted on a flat level surface. Ensure that the transformer is always positioned on its anti-vibration pads.

2) The LV connection leads to the output terminals should be taken through cable entries provided by others and the connections fastened securely to the terminals. The gland plate is non-magnetic. Approved glands and cable terminations should be used. Ensure the internal earth connections to the gland plate and the box cover are made and secure.

3) The HV leads are connected to the terminals in the input terminal box using proprietary elbow connectors to suit type E interface.

4) Ensure that an efficient earth connection is made to the earth terminals on the tank. Each earth pad is coated with a rust proofing grease, 3M Molykote 111, to provide long term protection against corrosion. If this is removed or damaged during installation, then it should be recoated with the same or similar grease.

5) The transformer breather is shipped as a loose item with the transformer. This will be attached to the outside of the transformer. There will also be a copy of the breather fitting instructions.

   To attach the breather, it is necessary to remove the ¾" BSP cap from the end of the breather tube. During transport, a small quantity of Midel 7131 may find its way into the breather tube. This must be allowed to drain before fitting the breather to prevent the breather material being poisoned. To prevent a spillage of Midel 7131, position a 5-litre container beneath the breather tube before removing the end cap. Dispose of any Midel 7131 in an approved manner.

   Screw the breather onto the end of the breather pipe. The breather must be fitted in accordance with the manufacturer's instruction leaflet. See Appendix F for the breather details and the fitting instruction leaflet.

2.8 Schedule of Erection Drawings

011484	Outline and General Arrangement
011754	Rating and Diagram Plate
011440	Auxiliary Schematic Diagram
011649	Anti-vibration Pad Layout

SECTION 3

COMMISSIONING INSTRUCTION

3.1 General

Check the equipment for any obvious signs of damage, loose items and contamination by water or other substances. Check the Midel level.

3.2 Transformer Commissioning

The following electrical tests should be carried out on the equipment.

NOTE – Testing must be carried out by a suitably qualified and experienced test engineer.

3.2.1 Ratio Measurement

Using a proprietary Transformer Ratiometer, check the transformer ratio. Compare the results with the values given in the test certificate.

3.2.2 Resistance Measurement

With the transformer isolated, measure the resistance of the windings. Compare with results in test certificate.

3.2.3 Insulation Resistance Measurement

With the transformer isolated the insulation resistance should be measured.

3.2.3.1 Measured with a 2500-volt Megger the following are minimum insulation resistance values.

a) Transformer Windings to Earth 200Meg ohms.
b) Primary Winding to Secondary Windings 500Meg ohms.

3.2.3.2 With a 500-volt Megger check the LV wiring to earth. The minimum value of resistance should be 10Mohms.

3.2.3.3 Reconnect all leads.

3.3 Paintwork

The exterior paintwork should be inspected, and any damage caused through transport, installation or commissioning should be made good immediately.

The final colour is Dark Admiralty Grey shade 632 to BS381C, full gloss. The general paint specification is detailed in specification 704-60180 in Appendix G.

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3.4 Pressure Relief Device

An auto re-setting pressure relief device is mounted on the main tank lid. It is set to release any pressure built up above 5.8psi (0.4 atmospheres). A change-over contact indicates operation.

Operation of this device is usually an indication of major failure with the tank.

See Appendix B for manufacturers details.

3.5 Midel Liquid Temperature Indicator

A Midel liquid temperature indicator is mounted on the main tank. It measures the top liquid temperature and is fitted with alarm and trip switches.

See Appendix C for manufacturers details

3.6 Winding Temperature Indicator

A winding temperature indicator is mounted on the main tank. It measures the winding temperature and is fitted with alarm and trip switches.

See Appendix C for manufacturers details
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3.7 Liquid Level Gauge

A liquid level gauge is mounted on the end of the conservator tank. It indicates the liquid temperature and is fitted with alarm and trip switches.

See Appendix D for manufacturers details.

3.8 Buchholz Relay

A Buchholz Gas relay is mounted in the conservator pipework. It monitors any gas generation within the transformer and gives an early indication of an internal fault. The relay is fitted with alarm and trip switches.

See Appendix E for manufacturers details.

3.9 Dehydrating Breather

A dehydrating breather is mounted on the end of the conservator breather pipe. Ensure that the breather is fitted correctly and the Envirogel is in good condition.

See Appendix F for manufacturers details.

SECTION 4

OPERATING INSTRUCTIONS

4.1 Unit Isolation

The transformer has no inherent means of input isolation. The supply to the transformer of 11000 Volts 3 phase must therefore be isolated remotely and the terminals earthed down.

ISOLATE ALL SUPPLIES PRIOR TO WORKING ON THIS EQUIPMENT.

SECTION 5

MAINTENANCE INSTRUCTIONS

MAINTENANCE MUST ONLY BE CARRIED OUT WHEN THE EQUIPMENT HAS BEEN TOTALLY ISOLATED.

5.1 Transformer

The insulating liquid is Midel 7131 synthetic ester. See Appendix A for the safety data sheet. Midel samples should be taken via sampling valve provided for DGA analysis.

Midel Sampling

Following commissioning Midel samples should be taken at the following intervals: -

a) after 6 months
b) after 12 months
c) after 60 months
d) thereafter every 10 years

The samples should have physical analysis, DGA, water content and breakdown strength measured and recorded for on-going monitoring. Any trend that indicates a deterioration of the transformer should be noted and the frequency of sampling increased as required.

After taking any Midel sample check that the liquid level is correct via the liquid level gauge. Taking a liquid sample will remove 2.5 - 3 litres of Midel.

Replace or top up with Midel to BS EN/IEC 61099: 2010 when required

5.2 Pressure Relief Device

The rating of the micro switch is such that no maintenance of the contacts will be required during the life of the transformer. However, it is advisable that the contacts be checked every twelve months for correct switching by manual operation of the switch. See Appendix B for manufacturer's data.

5.3 Midel Liquid Temperature Indicator

The rating of the micro switches is such that no maintenance of the contacts will be required during the life of the transformer. However, it is advisable that the contacts be checked every twelve months for correct switching by manual operation of the switches. See Appendix C for manufacturer's data.

5.4 Winding Temperature Indicator

The rating of the micro switches is such that no maintenance of the contacts will be required during the life of the transformer. However, it is advisable that the contacts be checked every twelve months for correct switching by manual operation of the switches.

See Appendix C for manufacturer's data.

5.5 Liquid Level Gauge

The rating of the micro switches is such that no maintenance of the contacts will be required during the life of the transformer. However, it is advisable that the contacts be checked every twelve months for correct switching by manual operation of the switches.

See Appendix D for manufacturer's data.

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5.6 Buchholz Relay

The rating of the micro switches is such that no maintenance of the contacts will be required during the life of the transformer. However, it is advisable that the contacts be checked every twelve months for correct switching by manual operation of the switches.

See Appendix E for manufacturer's data.

5.7 Dehydrating Breather

Desiccant breather charges must be checked on regular basis in accordance with the manufacturer's instructions supplied in this manual. We recommend that the condition of the gel should initially be checked at least every 12 months to establish a long-term maintenance regime.

Refer to Appendix F for manufacturers details.

5.8 General

The paintwork should be touched up where required. Refer to paint specification 704-60180 in Appendix G.

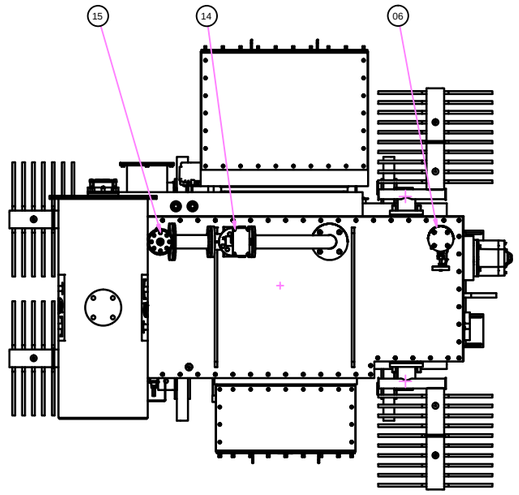
The transformer liquid level should be checked in the sight glass. The level will be affected by the ambient temperature and the operating load on the transformer. The whole transformer should be checked for Midel leaks.

SECTION 6

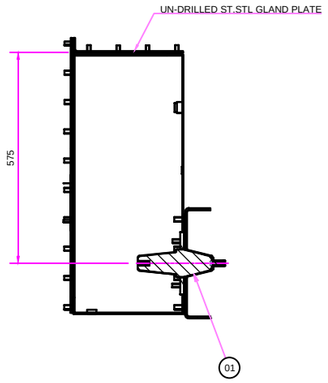
LIST OF DRAWINGS

011484	Outline and General Arrangement
011754	Rating and Diagram Plate
011440	Auxiliary Schematic Diagram
011649	Anti-vibration Pad Layout

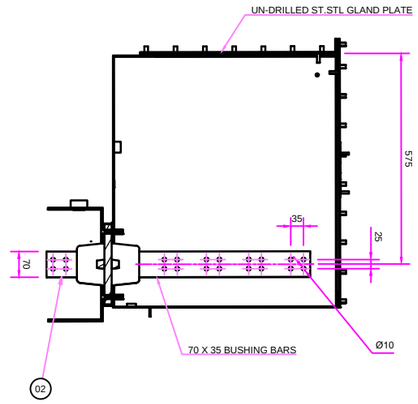
DO NOT SCALE - IF IN DOUBT ASK



B (1:7.5)
DETAILS OF HV CABLE BOX
TO SUIT 1 X 120mm2
3 CORE CABLE (TBC)



C-C (1:7.5)
DETAILS OF LV CABLEBOX
TO SUIT5 - 4 X 630mm2 SINGLE
CORE CABLES PER PHASE AND
NEUTRAL

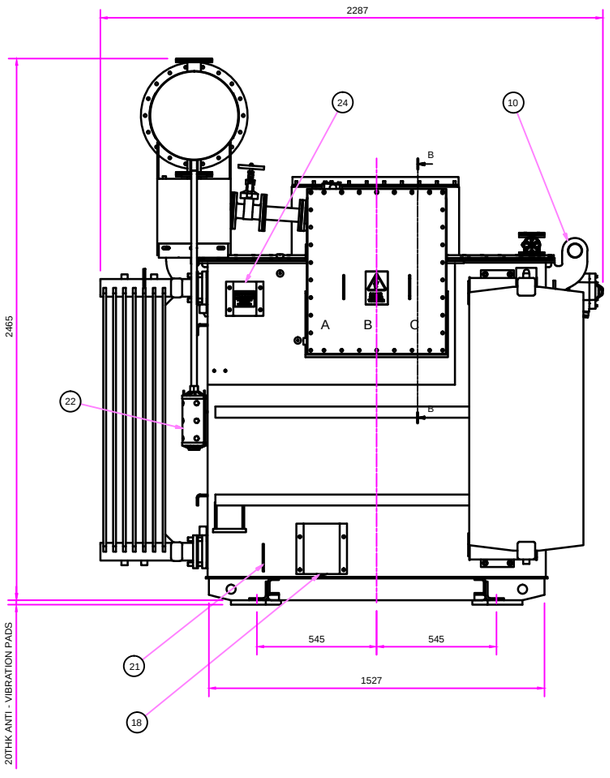


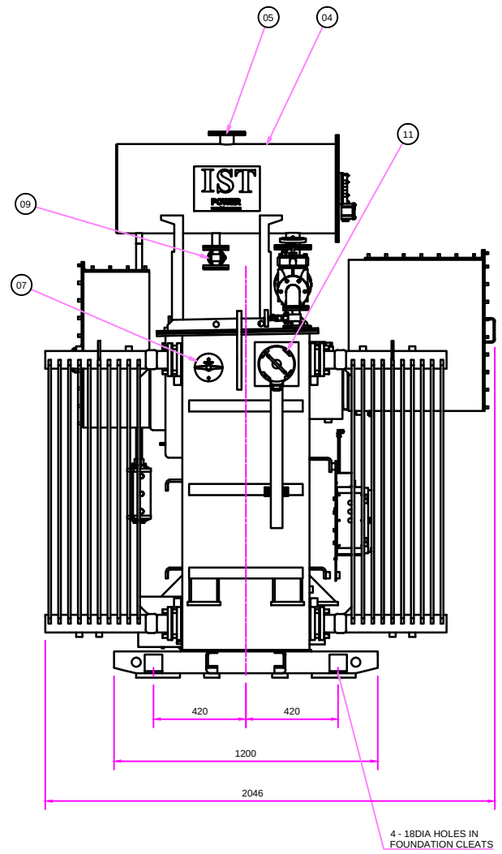
011484 - OUTLINE ARRANGEMENT OF 2000kVA AUXILIARY TRANSFORMER	
REFS	DESCRIPTION
01	3 - EQUIPMENT LINE BUSHING - SERIES 700 - 36kV 1250AMPS TYPE : 77S1 : 5/8" - 11UNC-2B
02	LV MONOBLOCK BUSHING PLATE - 3150A
03	W.T.I - CT TERMINAL BOX
04	CONSERVATOR
05	CONSERVATOR - OIL FILLING FLANGE - DN50
06	TOP FILTER VALVE - DN25
07	OFF CIRCUIT TAP SWITCH
08	THERMOMETER WELL
09	CONSERVATOR DRAIN VALAVE - DN25
10	MAIN LIFTERS - 45DIA HOLE - PAINTED YELLOW
11	COMEM 50M P.R.D WITH OIL DIRECTION DUCT
12	MARSHALLING BOX
13	JACKING POINTS - PAINTED YELLOW
14	BUCHHOLZ RELAY - DN50
15	CONSERVATOR ISOLATING VALVE - DN50
16	REMOVABLE CONSERVATOR END COVER - C/W OILMAG GAUGE
17	LABEL - RATING AND DIAGRAM PLATE
18	BOTTOM DRAIN VALVE WITH OIL SAMPLING DEVICE - DN25 - PADLOCKABLE
19	W.T.I
20	O.T.I
21	EARTH LUGS - 2 WITH - 14 DIA HOLES
22	DEHYDRATING BREATHER
23	SKID TYPE UNDERBASE WITH 42DIA HAULAGE HOLES
24	CORE EARTH BUSHING WITH GUARD
25	RADIATOR
26	RADIATOR VALVES
27	GAS SAMPLING AND BUCHHOLZ TEST PETCOCK VALVES

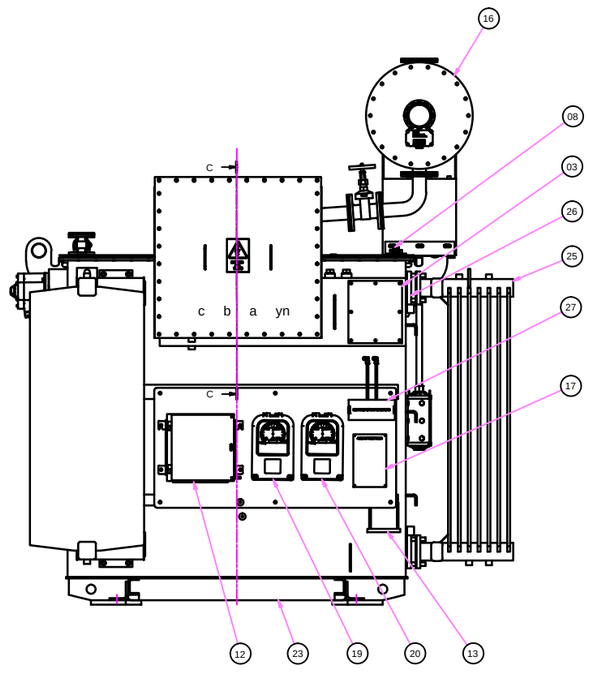
KVA	2MVA
VOLTS	11000/433
AMPS	104.97/2666.74
VECTOR SYMBOL	Dyn11

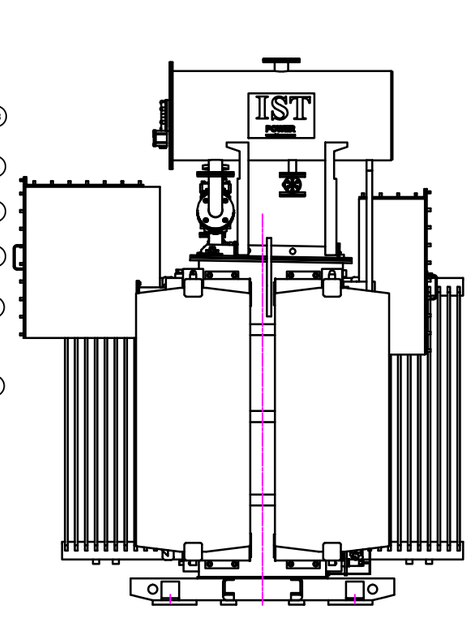
ESTIMATED WEIGHTS	
ITEMS	KG
CORE AND COILS	2906
COMPLETE WITH 1170 LTRS OF MIDEL 7131	5580

TRANSFORMER FINISH - PAINTED DARK ADMIRALTY GREY - GLOSS - SHADE 632 TO BS381C









WHERE USED 0105275 (T5044)	TOLERANCES UNLESS OTHERWISE STATED : NO DECIMAL PLACE ±1mm. ONE DECIMAL PLACE ±0.4mm ANGULAR ±1°	A1 420 x 594

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2				
3				
4				
5				
6				
7				
8				

TITLE

OUTLINE OF 2MVA
11000 / 433V ECO T1 AUXILIARY
TRANSFORMER

iST POWER
IST Power Ltd
LEICESTER : 0116 283 3321
MANCHESTER : 0161 428 9507

DRAWN BY	CHECKED	SCALE	DATE
M.SANDHU		1:12.5 , 1:7.5	05/09/2019

DRAWING No. 011484 SHEET No. 1 OF 1

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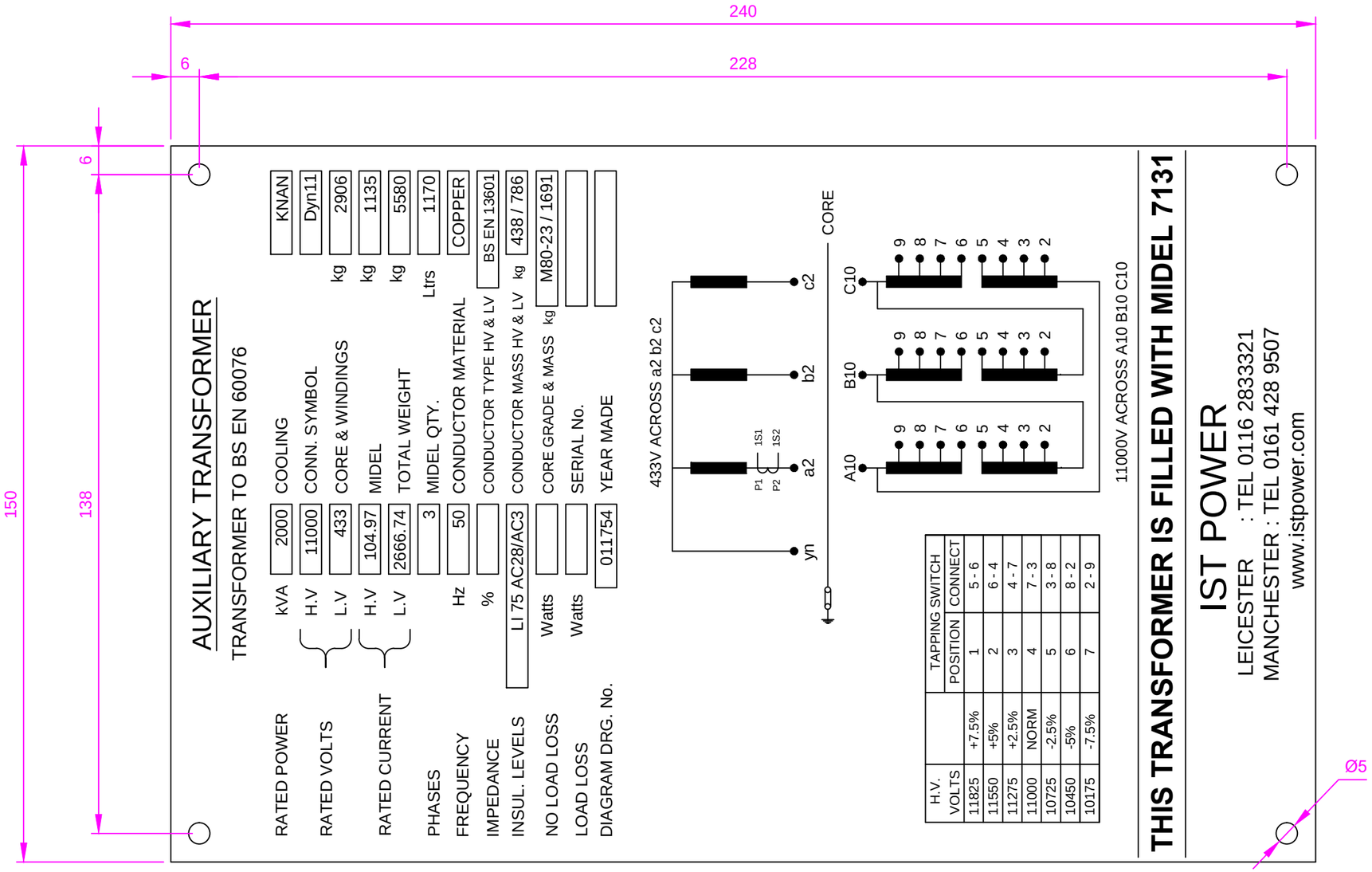


MAT: 1mm THICK STAINLESS STEEL GRADE 304

REMOVE ALL BURRS & SHARP EDGES

TEXT TO BE BLACK TWO PACK EPOXY INK

KEEP PRINTED FACE FREE FROM SCRATCHES

WHERE USED 0105275

TOLERANCES UNLESS OTHERWISE STATED : NO DECIMAL PLACE ±1mm ONE DECIMAL PLACE ±0.4mm ANGULAR ±1°

A3 297 X 420

ISSUE	BY	ECN	DESCRIPTION	DATE
0			NEW	

TITLE

RATING AND DIAGRAM PALTE
11kV 433V AUXILIARY TRANSFORMER
Dyn11

iST POWER
IST Power Ltd.
LEICESTER : 0116 2833321
MANCHESTER : 0161 428 9507

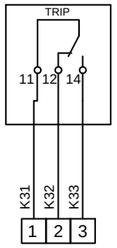
DRAWN	CHECKED	SCALE	DATE
MK	PWJ	1:1	16/10/2019

DRAWING No. 011754

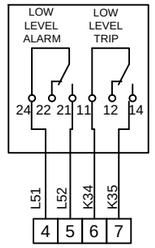
SHEET No. 1 OF 1

IF IN DOUBT ASK

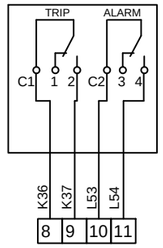
PRESSURE RELIEF DEVICE



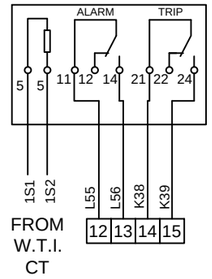
LIQUID LEVEL GAUGE INDICATOR



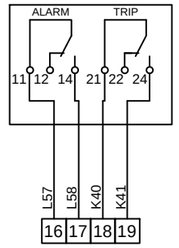
BUCHHOLZ RELAY



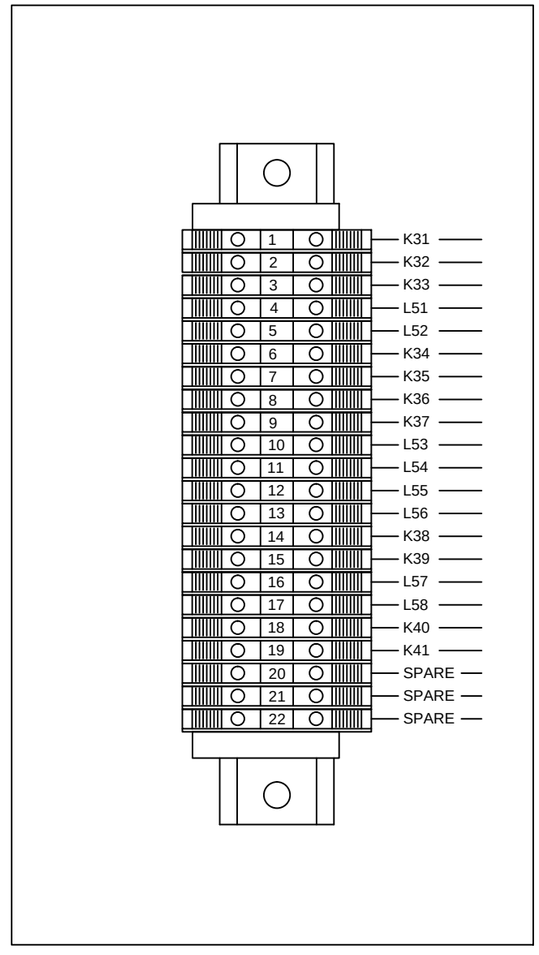
WINDING TEMPERATURE INDICATOR



OIL TEMPERATURE INDICATOR



INSTRUMENT	CONTACTS	OPERATION	COMMENTS
PRESSURE RELIEF DEVICE PRD	1 N.O TRIP	CHANGE OVER ON RELEASE	RELEASE AT 5.8 P.S.I.
LIQUID LEVEL INDICATOR	1 N.O ALARM 1 N.O TRIP	CONTACT MADE WHEN LIQUID FALLS BELOW SET LEVEL	LOW LEVEL LOW LEVEL
BUCHHOLZ RELAY	1 N.O ALARM 1 N.O TRIP	CLOSES ON EXCESS GAS CLOSES ON OIL SURGE	ALARM TRIP
WINDING TEMP INDICATOR	1 N.O ALARM 1 N.O TRIP	CONTACT MADE WHEN SET TEMP EXCEEDED	ALARM 95°C TRIP 105°C
OIL TEMP INDICATOR	1 N.O ALARM 1 N.O TRIP	CONTACT MADE WHEN SET TEMP EXCEEDED	ALARM 90°C TRIP 100°C



AUXILIARY MARSHALLING BOX

TERMINAL BLOCKS ARE SPRING LOADED TYPE :-
WEIDMULLER 10SL/EN
WITH HOOK TYPE CABLE TERMINATION.

NOTE : WIRE NUMBERS / FERRULES
ARE FROM THE TERMINALS
OUTWARDS

WHERE USED 0105275 (T5044)

TOLERANCES UNLESS OTHERWISE STATED : NO DECIMAL PLACE ±1mm ONE DECIMAL PLACE ±0.4mm ANGULAR ±1°

A2 420 X 594

ISSUE	BY	ECN	DESCRIPTION	DATE
0			NEW	
1	MK	M1601	SEE ECN	09/07/2020

TITLE

AUXILIARY WIRING DIAGRAM
2000kVA 11kV/433V TRANSFORMER

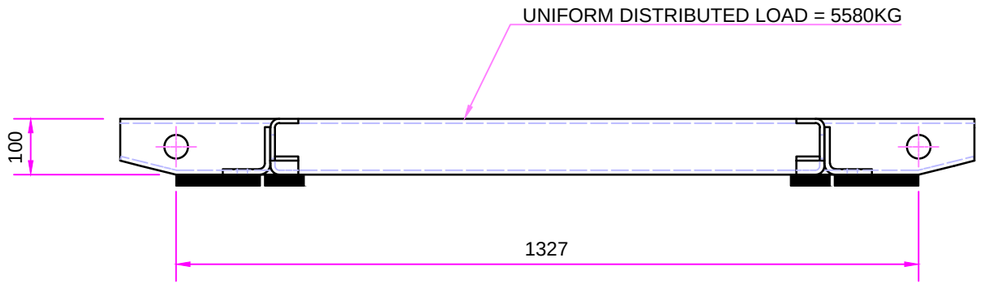
IST POWER PRODUCTS LTD
LEICESTER : 0116 2833321
MANCHESTER : 0161 428 9507

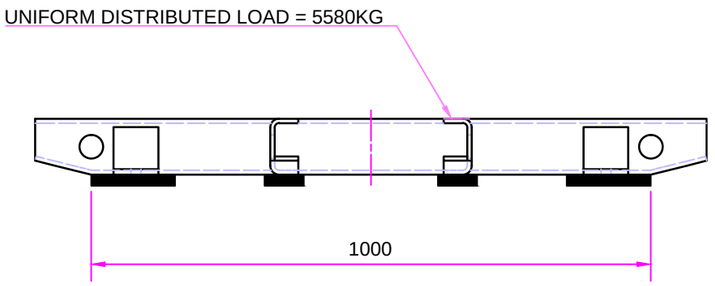
DRAWN	CHECKED	SCALE	DATE
PWJ		NTS	05/09/2019

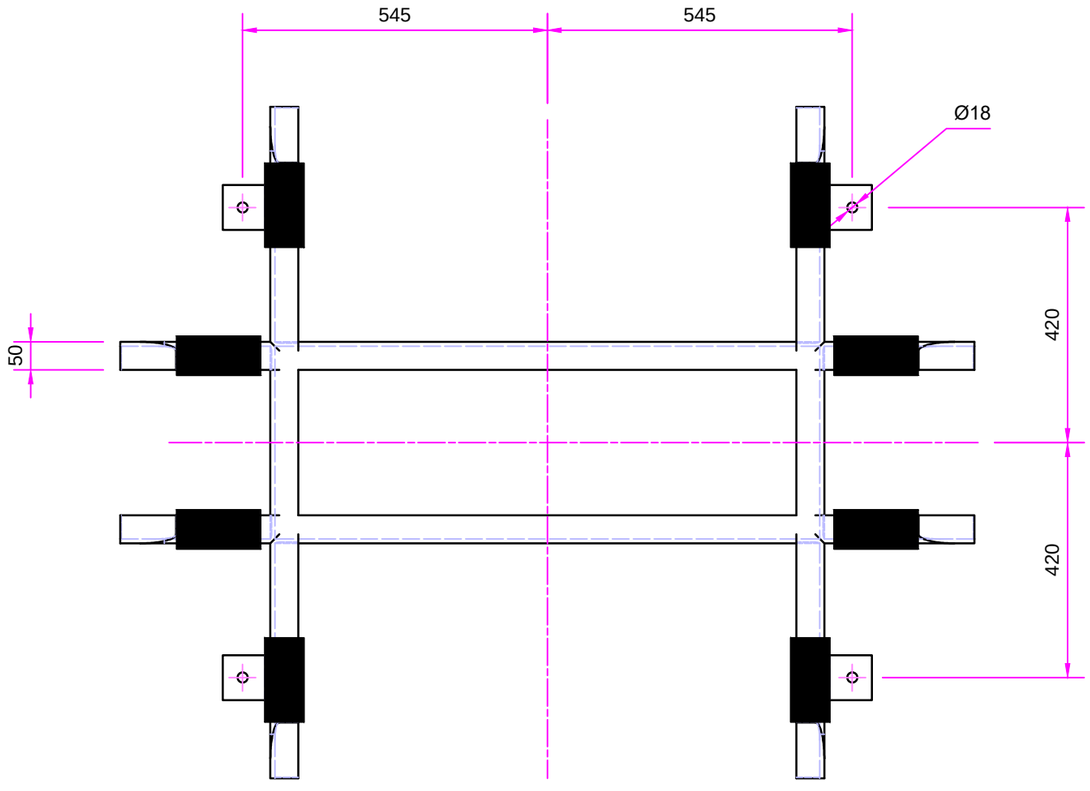
DRAWING No. 011440

SHEET No. 1

DO NOT SCALE - IF IN DOUBT ASK







MAT'L : VC6400 PADS WITH ADHESIVE BACKING

8 - OFF : 150 X 70 X 20THK

POSITIONED AS SHOWN

WHERE USED 0105275

TOLERANCES UNLESS OTHERWISE STATED : NO DECIMAL PLACE ±1mm. ONE DECIMAL PLACE ±0.4mm ANGULAR ±1°

A3 420 x 297

ISSUE	BY	ECN	DESCRIPTION	DATE
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1				
2				
3				
4				
5				
6				
7				
8				

TITLE

FOUNDATION PLAN AND ANTI - VIBRATION PAD LAYOUT

iST POWER
IST Power Ltd
LEICESTER : 0116 283 3321
MANCHESTER : 0161 428 9507

DRAWN BY	CHECKED	SCALE	DATE
M.SANDHU		1:10	21/10/2019

DRAWING No. 011649

SHEET No. 1 OF 1

SECTION 7

Appendix A

Midel 7131 Cooling Liquid

Midel technical Information Pack (18 pages)

MIDEL® 7131
Transformer Fluid

Technical Data Sheets

MIDEL®

MIDEL® 7131

Dielectric Insulating Fluid Overview

MIDEL 7131 Product Overview

MIDEL 7131 is a synthetic ester-based dielectric fluid that has been serving the global transformer market for over 30 years. MIDEL 7131 has been specifically formulated to provide a safe, superior alternative to traditional fluid and dry-type transformers and can be used in indoor or outdoor locations.

MIDEL 7131 is a high performance fluid that offers increased fire safety, greater environmental protection and superior moisture tolerance. Testing has also proven that MIDEL 7131 has excellent dielectric properties.

IEC 61099 Conformity

MIDEL 7131 conforms to IEC 61099 “Specifications for Unused Synthetic Organic Esters for Electrical Purposes”. It is classified as type T1, a halogen-free pentaerythritol ester.

Areas of Application

MIDEL 7131 filled transformers are available from all major transformer manufacturers. MIDEL 7131 is suitable for a wide range of transformer applications, including sealed and breathing.

- Distribution transformers
- Power transformers
- Traction transformers
- Rectifier transformers
- Pole-type transformers
- Tapchangers
- Thyristor cooling

Retrofilling

MIDEL 7131 has been used to retrofill thousands of distribution transformers to improve service life, reduce environmental hazards or increase fire safety.

Corrosive Sulphur

MIDEL 7131 has been tested by independent laboratories to ASTM D1275 B and IEC 62535, it was found to be non-corrosive.

Increased Fire Safety

MIDEL 7131 has a high fire point and a low net calorific value (<32 MJ/kg) and is therefore classified as a K3 class liquid.

- 100% fire safety record
- High fire point (>300°C)
- K-class to IEC 61100 / 61039
- FM Global® approved transformer fluid
- Reduced fire safeguarding costs

Greater Environmental Protection

MIDEL 7131 is an environmentally friendly alternative to conventional transformer fluids because it is classified as readily biodegradable and non-water hazardous.

- Readily biodegradable (OECD 301)
- Fully biodegradable (IEC 61039)
- Classified as non-water hazardous by (UBA)
- Non-toxic
- Will not evaporate into the environment
- Not detrimental to activated sludge in biological treatment plants
- RoHS compliant

High Performance

MIDEL 7131 is an extremely robust fluid that delivers long-term stability even when exposed to extreme temperature variations. MIDEL 7131 also has excellent oxygen stability allowing it to be used in breathing transformers.

- Robust and stable at high temperatures over long periods
- Suitable for compact transformer design
- Superior oxygen stability
- Excellent lubricant
- No sludge formation

Moisture Tolerance

MIDEL 7131 is moisture tolerant and can absorb far more water than alternative fluids, without compromising the breakdown voltage.

- No reduction of breakdown voltage (up to 600ppm / 20°C)
- Allows moisture to migrate from cellulose into the fluid
- Potentially keeps the cellulose drier and slows the rate of ageing
- Very high saturation limit making condensation virtually impossible
- Reduced risk of bubble formation

Delivery

MIDEL 7131 can be delivered in 24.5kg, 195kg or 1000kg sealed containers; bulk tanker deliveries available for >20 tonnes.

Disposal

For disposal, it is recommended that used MIDEL 7131 or remains of the insulating fluid be burnt in a suitable installation.

Dielectric Insulating Fluid Overview

Table 1 - Characterisation of Type T1 Transformer Ester According to IEC 61099 and DIN VDE 0375

	Unit	Test Method	Requirement	MIDEL 7131
Physical Properties According to IEC 61099				
Colour	HU	ISO 2211	max. 200	125
Appearance	-	IEC 61099 7.1.2	clear, free from suspended matter and sediment	clear, free from suspended matter and sediment
Density at 20°C	kg/dm^3	ISO 3675	max. 1.00	0.97
Kinematic Viscosity at 40°C	mm^2/s	ISO 3104	max. 35.0	28
Kinematic Viscosity at -20°C	mm^2/s		max. 3000	1400
Flash Point	°C	ISO 2719	min. 250	260
Fire Point	°C	ISO 2592	min. 300	316
Pour Point	°C	ISO 3016	max. -45	-60
Crystallisation	-	IEC 61099 (2010) Annex A	No crystals	No crystals
Chemical Properties According to IEC 61099				
Water Content	mg/kg	IEC 60814	max. 200	50
Neutralisation Value	mg KOH/g	IEC 62021-2	max. 0.03	<0.03
Oxidation Stability - Total Acid Content - Total Sludge Content	 mg KOH/g % mass	IEC 61125	 max. 0.3 max. 0.01	 0.01 <0.01
Net Calorific Value	MJ/kg	ASTM D 240-02	<32	31.6
Dielectric Properties According to IEC 61099				
Breakdown Voltage	kV	IEC 60156	min. 45	>75
Dielectric Ddissipation Factor Tan δ at 90°C and 50 Hz	-	IEC 60247	max. 0.03	<0.008
Volume Resistivity DC at 90°C	Gohm-m	IEC 60247	min. 2	>30

Data quoted above are typical values, may be altered without notice and do not constitute a specification

Increased Fire Safety

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Increased Fire Safety

Experience shows that transformer fires can be particularly unforgiving, spreading at frightening speeds and causing expensive damage. Unfortunately, these potentially catastrophic fires are all too common in today's modern power distribution networks.

MIDEL 7131 offers the perfect solution to avoiding the unnecessary risk of a fire. Used and respected worldwide, MIDEL 7131 has an impeccable 100% fire safety record spanning over three decades.

FM Global®, a large internationally recognised insurance company, has approved MIDEL 7131 as a less flammable fluid, requiring less stringent fire safety measures. This can lead to lower safeguarding costs and insurance premiums. In addition MIDEL 7131's fire safe properties allow for use in transformers inside buildings and other critical areas where mineral oil would not be acceptable.

FM APPROVED

Flash and Fire Point

MIDEL 7131 has been specifically formulated to give a high flash and fire point, in excess of those required for K-class rating (IEC 61100 / 61039) and far superior to mineral oil (Table 1).

Ignition Resistance

Method

The flame from an oxy-acetylene torch (>2000°C) is directed onto the surface of a shallow pool of liquid in a metal pan. A thermocouple close to the base of the pan measures the temperature of the bulk liquid away from the surface of the pool.

Table 1 - Flash and Fire Points - IEC 61039 Class K3

Parameter	Test Method	Required	MIDEL 7131	Mineral Oil
Flash Point	ISO 2719	min. 250°C	260°C	150°C
Fire Point	ISO 2592	min. 300°C	316°C	170°C
Net Calorific Value	ASTM D240-02	<32	31.6MJ/kg	46.0MJ/kg

Data quoted above are typical values

Once the torch has been ignited, the temperature of the liquid is recorded. A comparison of the results for mineral oil and MIDEL 7131 are shown in Figure 1.

Results

The temperature of the mineral oil increased quickly and set on fire after only 4 minutes. The mineral oil continued to burn even after the ignition source was removed, emitting a thick black smoke.

In comparison, the temperature of the MIDEL 7131 rose at a much slower rate. After 70 minutes and a temperature of >260°C, the fluid still did not ignite. MIDEL 7131's low heating rate is due to its high specific heat and thermal conductivity, which combines with the high fire point to give MIDEL 7131 an excellent resistance to ignition.

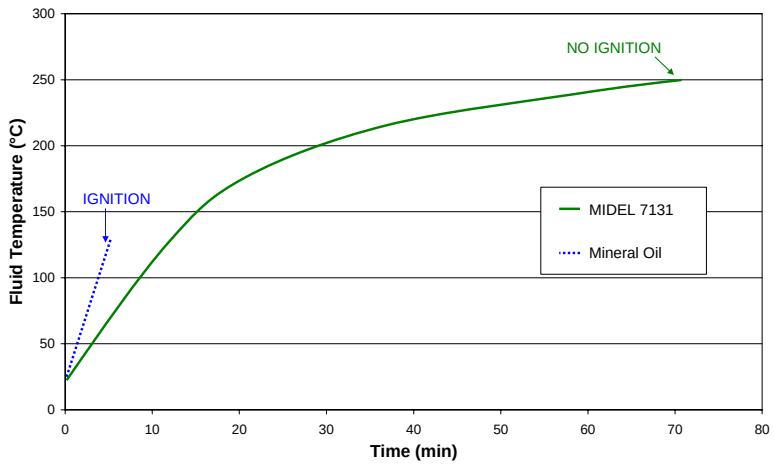
Smoke and Combustion Products

In the extremely unlikely event of MIDEL 7131 igniting it would produce a non toxic, much lighter smoke in comparison to that of burning mineral oil. MIDEL 7131's smoke is also not as dense as the white silica smoke produced by silicone liquid fires. This is very pertinent when considering evacuation and rescue procedures.

Method

The quantity of smoke produced by transformer fluids is measured using Tewarson apparatus fitted with a light source and a photocell. This is designed to have response characteristics similar to those of the human eye.

Figure 1 - Ignition Resistance Comparison between MIDEL 7131 and Mineral Oil



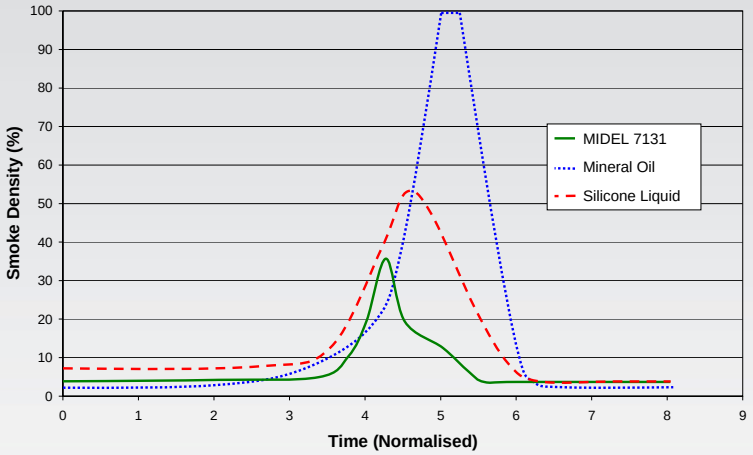
Increased Fire Safety

Results

The results in Figure 2 clearly demonstrate the low smoke properties of MIDEL 7131. The time axis is normalised to the start of ignition to provide an easy comparison of the smoke density figures. Predictably, mineral oil produced thick black smoke, silicone liquid produced a grey smoke and both were denser than the thin white smoke produced by MIDEL 7131. It should also be noted that in the test, MIDEL 7131 took over twice as long as mineral oil to ignite.

The results of the tests summarised in this data sheet confirm MIDEL 7131 is a fire safe alternative to mineral oil. Further fire testing has been conducted by M&I Materials and external laboratories and details are available on request. In terms of protection of personnel and property MIDEL 7131 is the obvious choice when specifying a fire safe fluid.

Figure 2 - Smoke Density Comparison for MIDEL 7131, Silicone Liquid and Mineral Oil



Greater Environmental Protection

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Greater Environmental Protection

Companies are under increasing pressure to ensure their activities cause as little damage as possible to the environment. A call for change is evident from the introduction of strict governing standards and legislation designed to encourage best practice and punish the neglect of our communities.

Companies with progressive thinking have realised that as well as helping to save the planet, they can also benefit from the positive PR and cost advantages associated using 'greener options'.

MIDEL 7131 has been proven to be non-toxic and readily biodegradable, and as such is an environmentally friendly alternative to mineral oil and silicone liquid. MIDEL 7131's classification as non-water hazardous by UBA further supports this assertion.

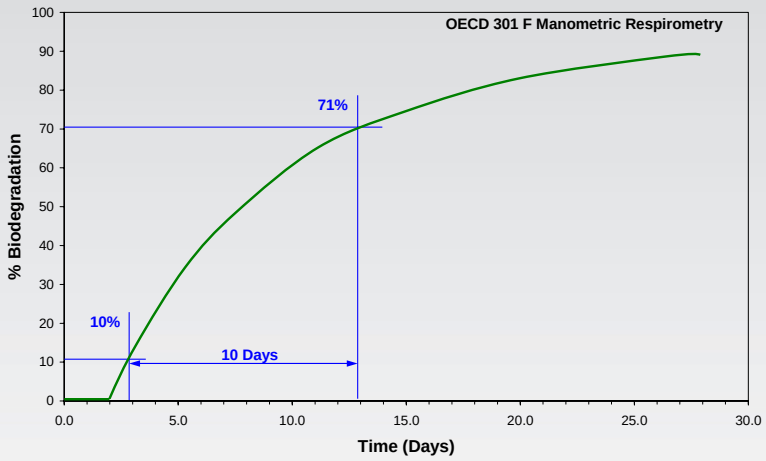
Biodegradation

Biodegradation is the process by which organic substances degrade and become harmlessly absorbed by the environment. The biodegradation of MIDEL 7131 has been assessed by an accredited laboratory using a standard test method developed by the Organization for Economic Cooperation and Development (OECD), a worldwide standard-setting body.

Method

Tests for biodegradation use micro-organisms, of the type present in wastewater treatment plants. These organisms are put into glass jars with the test compound for 28 days. Measurements are taken of the oxygen consumed, or carbon dioxide produced, to determine the biodegradation percentage.

Figure 1 - Biodegradation of MIDEL 7131



Results

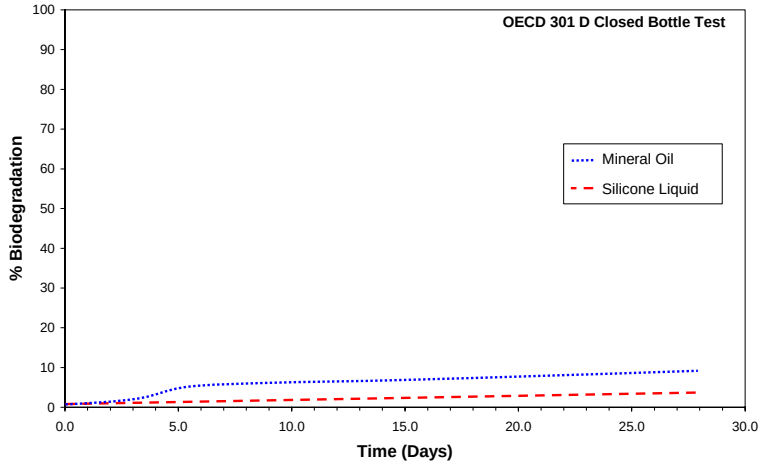
Figure 1 demonstrates that MIDEL 7131 achieved 10% degradation by day 3 and 10 days later it was 71% degraded. On the 28th day MIDEL 7131 reached 89% degradation, putting it comfortably in the Readily Biodegradable OECD and the Fully Biodegradable IEC 61039 categories.

MIDEL 7131 will not biodegrade in a transformer. This is due to the fact that the conditions within the transformer are too hot and dry to sustain microbial life.

Comparative independent studies examining the biodegradation of mineral oil and silicone liquid show a stark contrast to the environmentally friendly MIDEL 7131.

In Figure 2, the graph clearly demonstrates that neither of MIDEL 7131's counterparts managed to achieve even a 10% level of degradation at the end of the 28 day test period. Therefore MIDEL 7131's excellent biodegradable properties make it the sensible solution for use in a transformer.

Figure 2 - Biodegradation of Mineral Oil and Silicone Liquid



Greater Environmental Protection

UBA Water Hazard Classification

Germany's central environmental authority, Umwelt Bundes Amt (UBA), evaluates chemicals and provides them with ratings, either as non-water hazardous (nwg) or one of three hazard levels.

The UBA classification is based on the biodegradability of the chemical combined with the potential effect on aquatic life. The classification for various transformer fluids is shown in the Table 1. MIDEL 7131 is classified as non-water hazardous, while silicone liquid and mineral oils do present some hazard and therefore require extra containment measures incurring further costs.

Effect on Aquatic Life

In addition to the importance of biodegradability, it is favourable if a transformer fluid does not represent a hazard to the ecosystem. In extreme concentration levels of 1000mg/l it has been demonstrated that MIDEL 7131 will have no ill effects on aquatic life in the event of a spillage into a watercourse.

Table 1 - Common Test Parameters and Guidance Limits

Fluid	CAS Number	UBA Classification
MIDEL 7131	68424-31-7	nwg
Silicone Liquid	63148-62-9	1
Mineral Oils	Variety	1

Wastewater

Biological sewage treatment plants use 'activated' or microbially active sludge to break down organic matter within sewage. Contaminating chemicals can destroy these micro-organisms and a total cessation of the sewage treatment process may result. This is a very costly and time consuming problem for the sewage treatment industry.

Tests carried out by the global chemical company, BASF; demonstrate that MIDEL 7131 has no effect on the respiratory inhibition of activated sludge even at very high concentrations of up to 1000mg/l. The conclusion is that MIDEL 7131 does not represent a risk to biological treatment plants.

Advantages of Using Biodegradable MIDEL 7131

Local regulations and insurance companies usually determine the containment requirements for transformers. Over the years it has become more common for insurance companies to identify reduced containment requirements for transformers containing safer alternatives to mineral oils.

FM Global® is an internationally recognised insurance company. In its loss prevention datasheets for MIDEL 7131 filled outdoor transformers, containment is not required until the fluid volume exceeds 2640 gal (10,000 litres). In contrast for mineral oil bunding is required when the fluid volume exceeds 500 gal (1900 litres).

High Performance

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High Performance

On average the service life of a transformer is forty years and subsequently the fluid used to insulate and cool the system is expected to perform reliably for an equivalent length of time. Oxidation and ageing are two factors that can seriously affect the dependability of some fluids. The lubrication properties of fluids are also important to ensure long equipment life time.

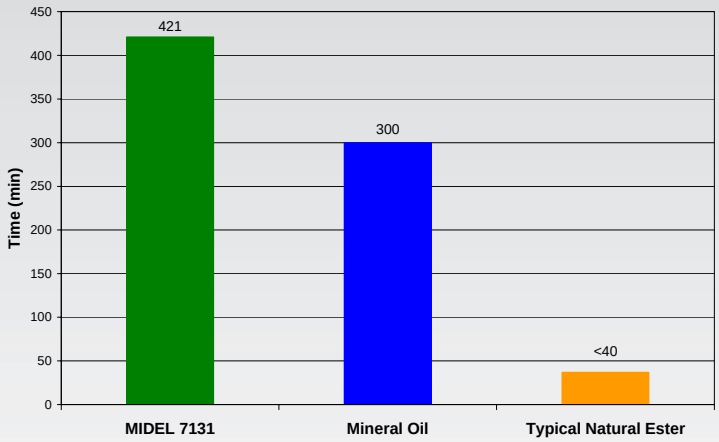
Oxidation Resistance

Oxygen has been shown to contribute to the ageing of mineral oil in transformers. This in turn causes sludging and degradation of the fundamental characteristics of the oil. In addition, at high temperatures the effects of oxidation are accelerated and even in sealed systems, the oil can age.

MIDEL 7131's resistance to oxidation has been demonstrated in high temperature breathing applications, such as traction transformers, where variable loads and compact designs highly stress the transformer fluid.

One way to compare transformer fluid oxidation stability is using the ASTM D 2112 Pressurised Vessel Oxidation Test. It measures the time taken for oxygen to be consumed and hence indicates the reactivity of the fluid. Figure 1 shows the time in minutes for a set pressure drop in the test vessel. The longer the time for this pressure drop, the more oxidation stable the fluid. MIDEL 7131 gives the longest time in this example, demonstrating its excellent oxidation stability. Natural ester gives the lowest numbers, showing that it has poor oxidation stability.

Figure 1 - Oxidation Stability Pressurised Vessel Test Results



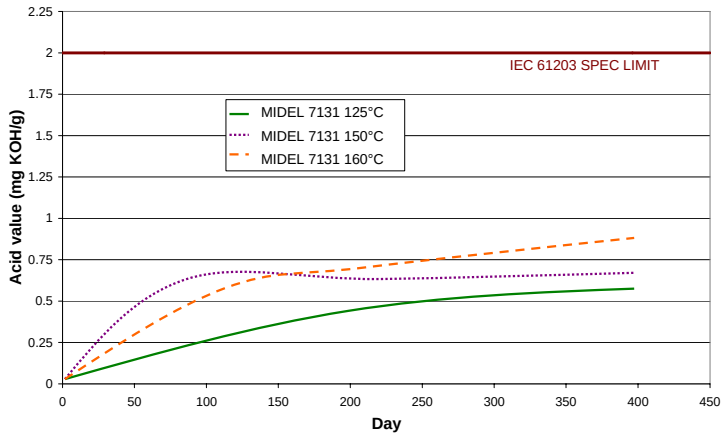
High Temperature Performance

Extensive testing has demonstrated that MIDEL 7131 is a robust and stable fluid which is suitable for both sealed and breathing transformers.

One key indicator of ageing in transformer fluids is the acid value. Figure 2 shows the acid value of MIDEL 7131 over a period of more than one year, in a sealed system with common transformer materials such as copper. The fact that the acid value remains well below the IEC 61203 specification limit throughout the trial, shows that MIDEL 7131 is very resistant to ageing.

A number of other parameters were monitored during the sealed ageing trial, such as viscosity, density and fire point. There was no significant change in any of these, further demonstrating the high temperature stability of MIDEL 7131.

Figure 2 - Acid Value of MIDEL 7131 during Sealed Ageing Experiment

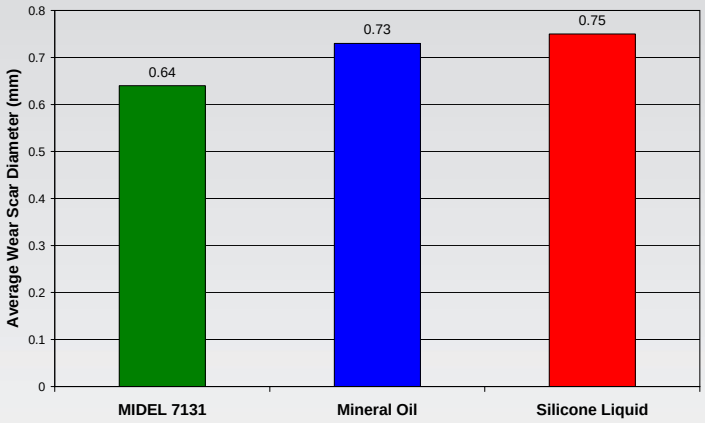


Lubrication Properties

MIDEL 7131 is an excellent lubricant as well as being a high quality dielectric and cooling fluid. Lubrication is important in many transformers for continuous efficient working. For example, in tap-changer contacts, if the fluid does not prevent a metal to metal seizure or even a small increase in friction, it is likely that the system would be prone to early failure. Similarly, in systems with more demanding lubrication requirements, such as high speed pumping devices used in circulating cooler systems, efficient lubrication is also needed to prevent a breakdown.

Figure 3 shows the results of a Four Ball Wear Test with the lower wear scar number indicating better lubricity. MIDEL 7131 gave the lowest result demonstrating that it has the best lubrication properties of the three fluids compared. This gives assurance that when used in tap changers and pumped systems MIDEL 7131 will provide excellent longevity for components.

Figure 3 - Four Ball Wear Test



Moisture Tolerance

Moisture Tolerance

MIDEL 7131 has a very high moisture tolerance. This means it can absorb far greater amounts of water than mineral oil and silicone liquid without compromising its dielectric properties. MIDEL 7131 can also trap more water which may slow down cellulose ageing. In the case of mineral oil, there is a danger that this water will be released as condensation.

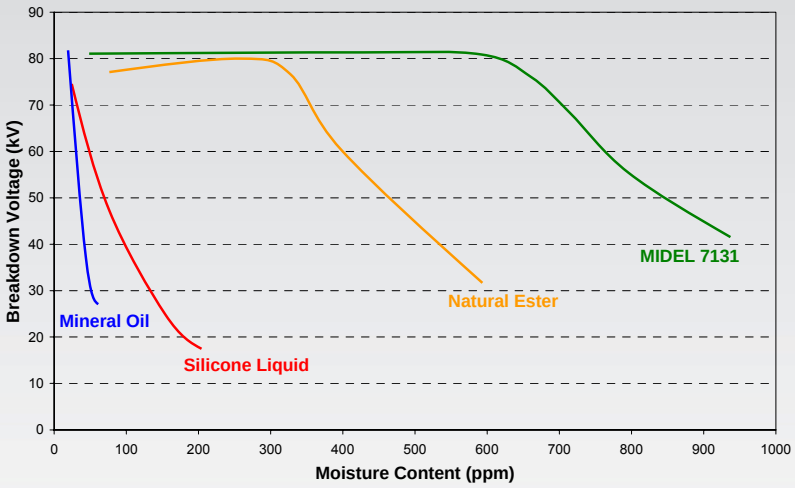
Why Moisture Tolerance Is Important in Transformers:

- Dielectric strength - reduces as moisture content increase
- Rate of paper ageing - increases with higher moisture content
- Bubble formation during overloads - bubbles form at a lower temperature when there is a high moisture content in the paper
- Condensation during cool down - risk of release of free water from mineral oil

Dielectric Strength

Figure 1 shows the breakdown voltage at ambient temperature of MIDEL 7131, mineral oil and silicone liquid with increasing moisture levels. It clearly illustrates that even a small amount of water in mineral oil and silicone liquid cause a rapid deterioration in breakdown voltage. In contrast, MIDEL 7131 maintains a high breakdown voltage of >75kV even when moisture levels exceed 600ppm.

Figure 1 - Breakdown Voltage vs. Moisture Content at 20°C



Rate of Paper Ageing

The rate of paper ageing is directly related to the water content. Various studies have shown that the lifetime of the paper reduces by as much as a factor of ten for each extra 1% of water content in the cellulose. As the cellulose ages it releases water, thus accelerating the ageing process. Therefore it is vital that cellulose is kept as dry as possible.

MIDEL 7131 has the ability to trap more moisture than mineral oil, which can reduce the amount of water in the paper and hence reduce the ageing rate.

Using moisture equilibrium curves it is possible to show that for MIDEL 7131 at 60°C, water content in fluid of 200ppm would equate to water content in the cellulose of 1.1%. At the same temperature, mineral oil with a water content of 20ppm would lead to water content in the cellulose of 2.6%. The extra 1.5% of moisture would equate to at least a ten fold decrease in the life of the cellulose.

Bubble Evolution During Overloads

Bubbles in dielectric fluids are undesirable since they are electrically weak. According to IEC 60076-14, bubble evolution temperature is directly related to the moisture content of cellulose. During overload conditions the temperature of paper wrapped conductors will rise, increasing the risk of reaching critical temperatures for bubble evolution. For example, with a paper water content of 2.6% the temperature at which bubbles form will be 130°C. With a water content of 1.1% the bubble evolution temperature is 165°C. Since MIDEL 7131 has the ability to keep paper drier it gives a greater margin of safety during overloads.

Moisture Tolerance

Condensation During Cool Down

With mineral oil there is a potential for water to be released when a transformer cools from operating temperature to ambient. This is due to the fact that mineral oil has a low moisture saturation limit which reduces as the temperature drops. MIDEL 7131 has a much higher saturation limit, which means that it is far more difficult to reach the saturation point.

For example if a transformer with mineral oil and a paper water content of 1.5% was running at 90°C the water content of the mineral oil would be 65ppm. If the transformer then shut down the water would tend to stay in the mineral oil. At 20°C the saturation limit of mineral oil is 55ppm, so the mineral oil would be 118% saturated, releasing free water into the transformer. The breakdown voltage of the mineral oil will also be very low, increasing risk of failure when restarting.

Using the same example for MIDEL 7131 at 90°C the water content would be 700ppm. The saturation limit for MIDEL 7131 at 20°C is 2700ppm, so even if all the water stays in the MIDEL 7131 it will only be 26% saturated. This means there is no free water and still an excellent breakdown voltage.

Table 1 - Standards for Moisture Content

Standard	Moisture Content
IEC 61099 - New Esters	max. 200ppm
IEC 61203 - In-service Esters	max. 400ppm
BS 148 - New Mineral Oil	max. 30ppm
BS 5730 - In-service Mineral Oil	max. 30ppm

Note: The typical value for new MIDEL 7131 is 50ppm

Moisture Content Testing

The standards relating to moisture content for new and in-use fluids are shown in the Table 1. New MIDEL 7131, as delivered, is manufactured to very high standards with typical moisture content of 50ppm.

MIDEL 7131 will still be within specification up to 400ppm. In contrast, mineral oil will be out of specification above just 30ppm. This has practical implications for the interpretation of moisture level analysis. Also, if moisture-monitoring equipment is integrated within a transformer, its tolerance settings should be adjusted accordingly.

Please contact M&I Materials Limited for further advice.

Moisture Removal

Should the moisture content rise above the maximum in-service limit, the same methods and equipment that are used for removing moisture from mineral oil can also be used to remove moisture from MIDEL 7131. For example molecular sieves and vacuum filtration units.

Comparison to Alternative Technologies

MIDEL 7131 versus Alternative Fluids

MIDEL 7131 is a high performance fluid that offers the advantages of increased fire safety, greater environmental protection and excellent moisture tolerance. Research carried out over many years by the Technical Department at M&I Materials Limited has proven the superior behaviour of MIDEL 7131 in comparison to other fluids.

Table 1 compares the main properties of MIDEL 7131 with mineral oil, natural ester and silicone fluid.

Table 1 - Comparison of Main Properties of MIDEL 7131 with Alterative Fluids

	Units	MIDEL 7131	Silicone Liquid	Mineral Oil	Natural Ester
General Properties General Properties					
Density at 20°C	kg/dm^3	0.97	0.96	0.88	0.92
Specific Heat at 20°C	J/kg K	1880	1510	1860	1848
Thermal Conductivity at 20°C	W/m K	0.144	0.151 (@ 50°C)	0.126	0.177
Kinematic Viscosity at 20°C	mm^2/s	70	50 (@ 25°C)	22	85
Kinematic Viscosity at 100°C	mm^2/s	5.25	15	2.6	8.4
Pour Point	°C	-60	<-50	-50	-21
Expansion Coefficient	/°C	0.00075	0.00104	0.00075	0.00074
Flash Point to ISO 2719	°C	260	260	150	316
Fire Point to ISO 2592	°C	316	>350	170	360
Fire Hazard Classification to IEC 61100/ IEC 61039		K3	K3	O	K2
Biodegradability at 28 Days - OECD 301 F - OECD 301 D	 % %	 89 N/A	 N/A <5	 N/A <10	 97 N/A
Chemical Properties					
Neutralisation Value	mg KOH/g	<0.03	<0.01	<0.03	<00.03
Net calorific Value	MJ/kg	31.6	28.0	46.0	37.5
Dielectric Properties					
Breakdown Voltage	kV	>75	50	> 70	>75
Dielectric Dissipation Factor Tan ð at 90°C		<0.008	<0.001	<0.002	<0.003
Permittivity at 20°C		3.2	2.7 (@ 25°C)	2.2	3.1

Data quoted above are typical values, may be altered without notice and do not constitute a specification

Comparison to Alternative Technologies

MIDEL 7131 versus Cast Resin

Cast resin transformers are sold as a fire safe solution for indoor installations and used in applications such as wind turbines. Although these types of transformers have found wide application they do have some disadvantages and their reliability record has been called into question in some of the more demanding transformer applications. MIDEL 7131 filled transformers can offer a fire safe solution, without the drawbacks associated with cast resin transformers.

Table 2 - Comparison of Main Properties of MIDEL 7131 with Cast Resin

Property	MIDEL 7131	Cast Resin
Fire Resistance	Excellent	Moderate
Environmental Impact	Excellent	Moderate
Life Expectancy	High	Moderate
Efficiency	High	Low to Moderate
Sound Level	Low	Moderate
Operating Temperature	Low	Moderate
Contamination Resistance	Excellent	Moderate
Overload Capacity	Excellent	Moderate
Maintenance	*None on sealed transformers	Regular cleaning and crack detection
Fault Diagnosis (DGA)	Yes	No
Repair Possible	Yes	Difficult

*Subject to transformer manufacturer's recommendations

Table 3 - Efficiency and Recycling Cost Comparison of 20 kV Fluid Filled Compact Transformer Design with a Typical Cast Resin Transformer

	Fluid Filled	Cast Resin
Dimensions, mm	2210 x 770 x 2200	2000 x 840 x 2170
Mass, kg	4500	4600
No Load Loss, kW	2.1	3.9
Load Loss @125°C, kW	19	19.2
Recycling Cost, €/kg	0.07	0.14

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MIDEL® 7131

Fluid Maintenance Guide - Distribution Transformers

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General

MIDEL 7131 is a very robust fluid which is capable of giving long service, even in the most demanding of applications. As with mineral oil, in order to ensure that MIDEL 7131 gives continued good service it is possible to monitor a number of the fluid parameters throughout the life of the transformer. Testing the fluid also has the added benefit of picking up any potential problems with the transformer before a failure occurs.

Generally, for distribution transformers, sampling of the fluid is recommended before energising, after the first year of service and at five year intervals from then on. For larger power transformers, highly loaded or critical units, the frequency of testing may be increased.

It is important to understand some fundamental differences between MIDEL 7131 and mineral oils when carrying out fluid testing for maintenance. Many laboratories are now experienced in the testing of MIDEL 7131, but at times a failure can be logged against a sample when the incorrect mineral oil limits are applied.

Table 1 shows the typical fluid testing parameters and the limits according to IEC 61203 'Synthetic organic esters for electrical purposes - Guide for maintenance of transformer esters in equipment'. It should be noted that this guide and the IEC 61203 standard do not apply to retrofilled transformers, i.e. those that have previously been filled with another fluid.

Table 1 - Common Test Parameters and Guidance Limits

Parameter	Test Method	IEC 61203
Appearance	IEC 61203 3.1	Clear, without visible contamination
Water Content*	IEC 60814	max. 400 ppm
Neutralisation Value	IEC 61099 9.11	max. 2.0 mg KOH/g
Breakdown Voltage	IEC 60156	min. 30 kV
Fire Point	ISO 2592	min. 300 ºC

*At ambient temperature

Breakdown Voltage Testing

The breakdown voltage of new MIDEL 7131 is typically in excess of 75kV when tested to the IEC 60156 2.5mm gap method. Testing has demonstrated that even after long term ageing of the fluid there is little deterioration of the breakdown voltage. In addition, even at very high moisture contents, up to 1000ppm at ambient temperature, testing has shown that the breakdown voltage will be preserved well above the 30kV lower limit.

There are some issues that can cause a drop in breakdown voltage and the first is particulate matter in the fluid. Particles can float between the test probes and cause a localised weakness when carrying out the breakdown test. This can usually be identified by erratic results when comparing a series of breakdowns. If particles are suspected to be causing a breakdown issue then the fluid can be filtered through a fine paper filter and re-tested.

Another issue that can arise is if enough settling time is not allowed between each breakdown test. In this case gas bubbles formed by the breakdown arc are not given sufficient time to dissipate and can cause a weak link between the probes. Typically an average of six breakdown tests are taken and it is recommended to leave a minimum settling time of ten minutes before the first breakdown test and then five minutes between each subsequent breakdown test to ensure that gas bubbles have sufficient time to disperse.

DGA and Furan Analysis

Diagnosis of transformer performance by traditional DGA and Furan analysis is still applicable to MIDEL 7131 filled transformers. The methods used to diagnose faults with DGA in mineral oil can be used with MIDEL 7131 provided minor adjustments are made to Duval triangle boundaries and table ratios. For further information contact M&I Materials Ltd technical department.

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MIDEL® 7131

Storage & Handling Guide

December 2010 Page 1 of 1

Introduction

MIDEL 7131 is a very robust fluid and studies have demonstrated its long term stability, even at elevated temperatures. For years, it has been successfully used worldwide in breathing and sealed transformer systems. It is still necessary, however to take precautions when handling and storing MIDEL 7131 to ensure that it is kept in optimum condition.

Table 1 - Viscosity Values Versus Temperature

Temperature °C	Absolute Viscosity mPa s	Kinematic Viscosity mm^2/s
0	236	240
20	68	70
40	27	28
60	13	14

Data quoted above are typical values

Receiving New MIDEL 7131

MIDEL 7131 can be delivered in 24.5kg, 195kg or 1000kg sealed containers; bulk tanker deliveries are available for >20 tonnes. Prior to filling the containers the fluid is dried and degassed. On receipt of the fluid users may notice a slight deformation of the containers. This is due to the degassed fluid absorbing the small amount of air in the headspace, thus creating a vacuum. This is perfectly normal and a good indication that the seal has not been compromised.

The vacuum seal in 1000kg IBCs needs to be broken and the recommendation is to contact IBC supplier Schütz to obtain the correct lid removal tool (part no. 16659).

Storage

If kept in the unopened containers MIDEL 7131 has an indefinite shelf life. Once opened precautions should be taken to avoid contact with moist air for prolonged periods because the fluid is hygroscopic and will absorb atmospheric moisture. If a partially emptied container is used for storage the head space should ideally be back-filled with dry nitrogen or dry air prior to resealing. If this is not possible, then ensuring the lid is properly sealed will help keep the fluid dry.

If the fluid is kept in intermediate bulk containers the ideal location will be indoors to avoid extremes of temperature and exposure to the weather. Where outdoor storage is unavoidable exposure to direct sunlight should be prevented using a simple covering.

Storage tanks which are suitable for standard mineral oil can be used for MIDEL 7131. It is recommended that the tank headspace has a dry nitrogen blanket to keep out moisture. If this is not possible then dry air should be used in the headspace and a suitable breather unit fitted to any vent system. If a silica gel breather is used to dry the headspace air then this must be properly maintained to ensure that the fluid quality is preserved.

Pumping

MIDEL 7131 is an excellent lubricant, so no specialist pumping equipment is required. The viscosity of MIDEL 7131 is slightly higher than mineral oil at ambient temperatures and this must be taken into account when specifying pumping systems. A higher capacity pump is will be needed to maintain the same flow rate as mineral oil at a given temperature. Table 1 shows viscosity values versus temperature for reference.

As with any dielectric fluid there is a possibility of static charge build up when MIDEL 7131 is flowing through the pipes. The user should ensure that all pumps, lines and vessels are adequately bonded and earthed during pumping operations.

Transformer Filling and Cellulose Impregnation

To avoid air entrapment in the transformer cellulose the tank should be filled from the bottom or if possible under vacuum.

In order to aid impregnation of the cellulose it is recommended that MIDEL 7131 be heated to approximately 60°C when filling. At 60°C the viscosity of the fluid is very close to that of mineral oil at 20°C, and a similar impregnation rate has been observed in laboratory testing. It is further recommended that the transformer is filled slowly to aid impregnation and left for at least 24 hours prior to energising for the first time.

Throughout all stages of the filling operation it is essential that the introduction of moisture or particulate matter be avoided. The outlet side of any pump used during filling should be protected by a fine mesh or paper element filter.

The use of degassing and vacuum filling is possible with MIDEL 7131, using the same type of equipment and methods employed with mineral oil.

MIDEL®

MIDEL® 7131

Safety Data Sheet

1. Substance/Company Identification

Product Name:	MIDEL® 7131.
Product Type:	Dielectric fluid.
REACH No:	01-2119542596-31-0000.
CAS No:	68424-31-7.
Substance Name:	Fatty acids, C5-10 (linear and branched), mixed esters with pentaerythritol.
Company Details:	M&I Materials Ltd. Hibernia Way, Trafford Park, Manchester, M32 0ZD, UK.
Telephone: +44 (0)161 864 5411	Fax: +44 (0)161 864 5444.
Emergency Telephone:	+44 (0)161 864 5439.
Email:	RussellMartin@mimaterials.com.

2. Hazards Identification

Not classified under Directive 67/548/EEC or Regulation (EC) no. 1272/2008 (CLP).

3. Composition/Ingredients

Composition:	Fatty acids, C5-10 (linear and branched), mixed esters with pentaerythritol.
Hazardous Ingredients:	None.

4. First Aid Measures

Eyes:	Wash immediately with plenty of water for at least 15 to 20 min. Obtain medical attention if irritation develops.
Skin:	Wash with soap and water for at least 15 to 20 min. Obtain medical attention if irritation develops.
Ingestion:	Do not induce vomiting. Obtain medical attention.

5. Fire Fighting Measures

Suitable Extinguishing Media:	Carbon dioxide, dry powder, foam or water fog. Do not use water jets.
Protective Equipment:	Self-contained breathing apparatus may be required.

6. Accidental Release Measures

Personal Precautions:	Spilt product can constitute a slip hazard. Avoid contact with skin and eyes.
Environmental Precautions:	Do not contaminate any lakes, streams, ponds, groundwater or soil. Avoid flushing into drains. In the event of a large spillage contain product as thoroughly as possible and dispose of in accordance with local regulations.
Cleaning Procedures:	Use an inert absorbent material (e.g. sand, earth, etc.) and place in labelled containers.

7. Handling and Storage

Handling:	Avoid eye and prolonged skin contact.
Storage:	Store in a cool dry place.
Specific Use:	Exposure to air should be minimised. Opened containers should be properly resealed.

8. Exposure Controls/ Personal Protection

Respiratory Protection:	Not required for normal use.
Hand Protection:	Wash hands after use. For prolonged or repeated skin contact gloves are recommended.
Eye Protection:	If splashes are likely to occur wear safety glasses.
Skin Protection:	Wear coveralls.

Safety Data Sheet

9. Physical & Chemical Properties

Physical State:	Organic liquid.
Odour:	Faintly sweet.
Melting Point/ Freezing Point:	-57°C.
Boiling Point:	>300°C.
Flash Point (Closed Cup):	260°C.
Flammability:	Non flammable.
Vapour Pressure at 20°C:	<0.001Pa.
Relative Density @ 20°C:	970kg/m^3.
Water Solubility:	<1mg/l.
Partition Coefficient, log K_{ow}.	>6.74.
Explosive Limits:	Not determined.
Auto-ignition Temperature:	No auto-ignition expected.
Viscosity @ 40 °C:	28mm^2/s.
Explosive Properties:	Non-explosive.
Oxidising Properties:	Non-oxidising.

10. Stability & Reactivity

Stability:	Stable under normal ambient conditions.
Conditions to Avoid:	Temperatures >250°C.
Materials to Avoid:	Strong oxidising agents.
Hazardous Decomposition Products:	None known.

11. Toxicological Information

Eyes:	May cause transient irritation.
Inhalation:	Low volatility makes inhalation unlikely.
Ingestion:	May cause nausea, vomiting and diarrhoea.
Skin:	Repeated and prolonged skin contact may cause irritation.
Acute Toxicity	
Oral LD50, OECD 401:	>2000mg/kg bw.
Dermal LD50, OECD 402:	>2000mg/kg bw.
Irritation	
Skin, OECD 404:	Not irritating.
Eye, OECD 405:	Not irritating.
Sensitisation	
Skin, OECD 406:	Non sensitising.

12. Ecological Information

Biodegradation, OECD 301 F:	Readily biodegradable, 89% after 28 days.
Acute Aquatic Toxicity	
Salmo Gairdneri LC50 (96h), OECD 203:	>1000 mg/l.
Daphnia Magna EL50 (48h), OECD 202:	>1000 mg/l.
Bioaccumulation Potential:	No potential for bioaccumulation.

13. Disposal Considerations

Product and packaging must be disposed of in accordance with local and national regulations. May be incinerated. Unused product may be returned for reclamation.

14. Transport Classification

Not classified as hazardous under air (ICAO/IATA), sea (IMDG), road (ADR) or rail (RID) regulations.

15. Regulatory Information

Substance is registered under the REACH regulation, EU directive 1907/2006/EC and included in the TSCA Inventory of Chemical Substances.

Safety Data Sheet

16. Other Information

Compiled according to EU Commission Regulation (EU) 453/2010.	
Changes from last issue:	Total rewrite following REACH registration.

The information provided in this Safety Data Sheet is correct to our best knowledge, information and belief at the date of its publication. It is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not be construed as guaranteeing any specific property of the product.

SECTION 8

Appendix B

Pressure Relief Device

ABB/Comem 50M PRD (8 pages)

Pressure Relief Device - M

COMEM "M" pressure relief devices are used to control pressures inside tanks. They are used where accidental, instantaneous and uncontrolled increases in pressure may create the danger of explosion. They are designed to discharge the pressure increases that have taken place to the exterior in a very short time period (a few thousandths of a second).
They are widely used in the metal tanks of oil-cooled electric transformers. Sudden and violent short circuits inside these tanks, in fact, instantly generate an enormous amount of gas with a great increase in interior pressures. If the pressure cannot discharge to the exterior there is danger that the transformer may explode, with all the possible harm and damages this may cause. This danger can be prevented by installing one or more pressure relief device with discharge sizes proportional to the volume of oil contained in the transformer. It is always good practice to install these pressure relief devices in all situations where internal pressure values must not exceed specific safety limits.

M

They are widely used in large distribution transformers and traction transformers.

Total pressure relief completely opening

Pressure relief device opening is total each time the pressure relief device operates for pressure settings between 20 and 90 kPa. The discharge opening area, for each pressure relief device operation, is equal to that for higher pressure settings even when pressure settings are lower than 20 kPa. If, however, pressures are generated inside the tank that are much higher than the setting then the spring, further compressed, allows the closing disk to create even larger discharge areas when it operates.

Operating performance

Nominal operating pressure: the pre-fixed overpressure value shall be agreed between supplier and purchaser within the standard range from 20 up to 90 kPa, with 10 kPa steps, with a tolerance of - 5 kPa to + 7 kPa. For model 50M the standard operating pressure range comes up to 200kPa, with 10kPa steps.

Construction

Our pressure relief devices are totally protected against external corrosion and against penetration of foreign bodies between cover and protective cap. This ensures perfect operating efficiency even for extended periods of time.

"M" pressure relief device

These consist of a flanged body and a corrosion-proof aluminium alloy disk. A brass rod that holds the spring is applied to the central part of the disk. There are two gaskets in the pressure relief device: a special shaped upper gasket and a lip seal.
When the pressure relief device is closed the upper gasket is pressed against the disk. The shape of the gasket permits a perfect seal even if the disk lifts 1-2 mm. The disk also makes a seal against the lip seal gasket as it moves upwards. If, due to interior pressure, the disk rises beyond this amount then the upper seal is no longer maintained while the lip seal remains.

At this instant the surface of the washer invested by internal pressure is multiplied in area as is the total force applied on the spring. This causes total and instantaneous opening of the pressure relief device which consequently discharges excess pressures to the exterior.
When pressure has been discharged the disk, pushed back by the spring, lowers down and closes the valve. As the disk moves downwards it first closes against the side gasket and then against the upper gasket.
This latter gasket, because of its special shape, is pressed down 1- 2 mm. and the disk moves further down, breaking the seal on the lip seal gasket. This releases any pressure that may have been trapped between the two gaskets. Now the pressure relief device is ready to work.

Routine tests

It is necessary to carry on operational tests, with compressed air:

- to check the correct functioning of the device at operating pressure values
- to check the functioning of the optic signal and of the electric contacts.

Installation guidelines

Our "M" pressure relief devices come in 2 sizes and have different discharge areas. This allows users to select the type that is best suited for the volume of oil contained in the tank. The following table gives guideline values:

Volume of oil tank:	Type of pressure relief device
up to 3000 dm^3	50 M*
up to 25000 dm^3	125 M*

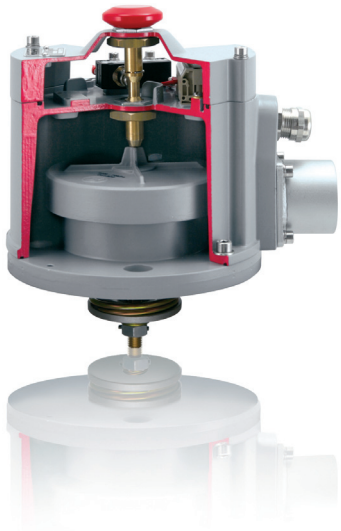
* These guideline sizes are based on experience.

We recommend using multiple pressure relief devices when oil volumes exceed these levels. It is always good practice to use multiple pressure relief device with smaller discharge areas rather than a single pressure relief device with a large area. The reason for this, in the case of transformers, is that it is better to install one pressure relief device above each winding column since these are the points where maximum interior pressures are generated in case of a short circuit. Instantaneous pressure relief device opening implies direct contact between the closing disk and oil. For this reason the pressure relief device are equipped with a screw to bleed out air that may accumulate during oil tank filling procedures.

Oil tightness duct

It is a good practice to prevent harm to persons or property from violent jets of hot oil evacuating from the pressure relief device, for pressure relief device discharges to be ducted towards points properly designed to receive the hot oil. The protection of the environment is also another important target which has to be pursued by everybody. Our protection duct allows to drain the oil evacuated by the pressure relief device. The perfect hydraulic tightness of the system guarantees that not any drop of oil is dispersed in the environment, but collected through a pipe in a tank (pipe and tank are not supplied). The sealing oil duct is made of die-casted aluminium; a terminal flanged tube made of steel is also provided if someone wants to weld the pipeline. O-ring gaskets have been adopted for the duct sealing. Detailed assembling instructions are supplied with the equipment.

Pressure Relief Device - M



Visual signal that the pressure relief device is open

Pressure relief devices are equipped with a visual signal that shows when they have opened. This signal consists of a red knob that protrudes from the central part of the duct when the pressure relief device has opened. Just press it down in order to make it go back to its normal position and reset the switches, too.

Electrical signalling switch

Maximum 3 "pressure relief device open signal" contacts can be mounted on request. These are a fast tripping limit switch with switching contact contained inside a watertight room IP 65. The contacts simultaneously act with the visual signal.

The switches have the following characteristics:

Specifications:

Breaking and making capacity (NO and NC contacts)		
Voltage	**Uninterrupted current (making capacity)**	**Interrupted current (breaking capacity)**
24 VDC to 220 VDC	2 A	100 mA L/R<40 ms
230 VAC	2 A	2 A cos φ>0.5

Other characteristics:

- The pressure relief device is supplied with a "locking system" which allows the pressure relief device to be blocked during the transformer oil leakage test. The locking system has been tested to withstand max 2 bar pressureand can also be used during the transformer transport.
  WARNING!: the locking system must be removed before powering-up the transformer.
- The pressure relief device is supplied with a M25x1.5 cable gland.
- Colour: RAL 7001.

Outer surface protection

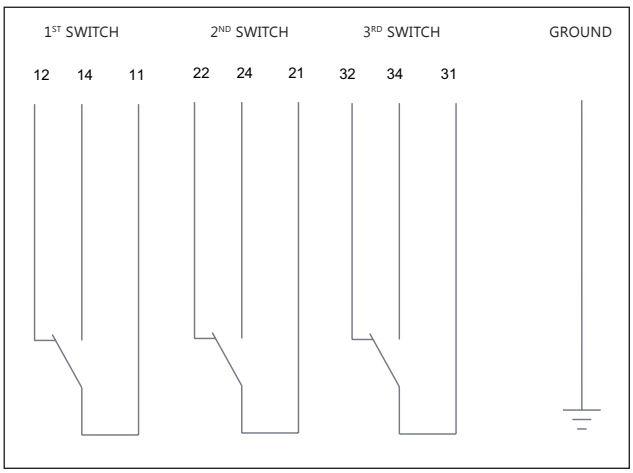
External surfaces are protected against weather corrosion. Aluminum alloy components are non-corroding and their surfaces are protected with a double layer of paint offering high level protection against all atmospheric agents and resisting temperature variations between -40 °C and +100 °C. Special painting for severe climate applications is also available on request.

Contact diagram

- FIRST SWITCH (terminals 12-14-11)
  change-over contact:
  – 14-11 normally open
  – 11-12 normally closed

- SECOND SWITCH (terminals 22-24-21)
  change-over contact:
  – 23-21 normally open
  – 21-22 normally closed

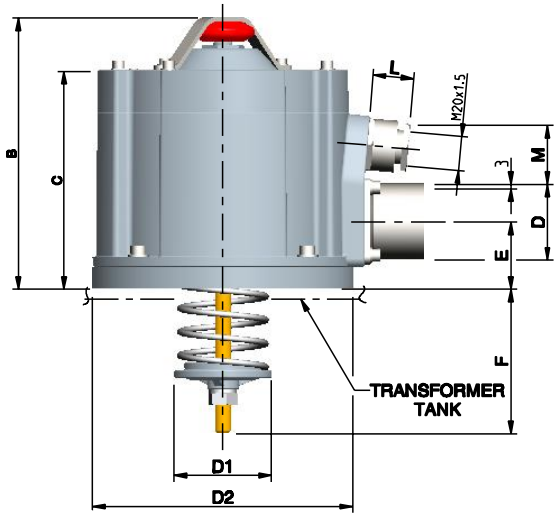
- THIRD SWITCH (terminals 32-34-31)
  change-over contact:
  – 34-31 normally open
  – 31-32 normally closed

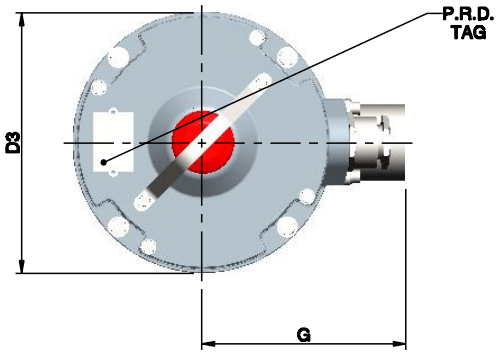


Pressure Relief Device - M

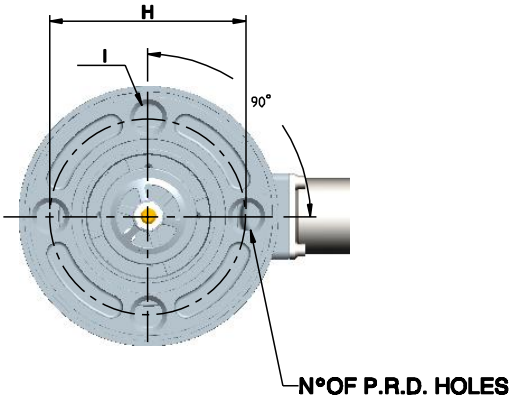
Overall dimensions

Type 50M





50M

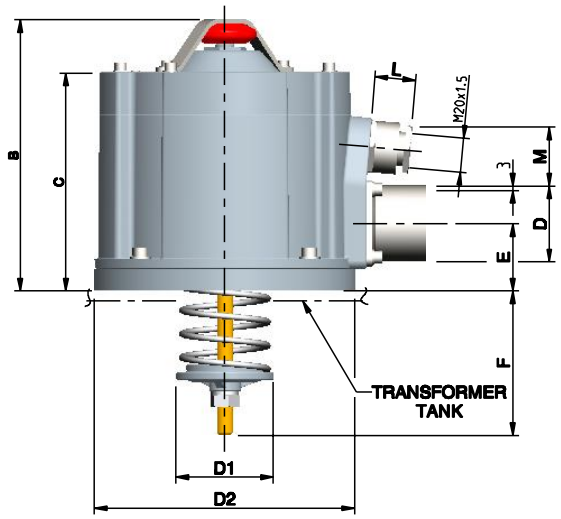


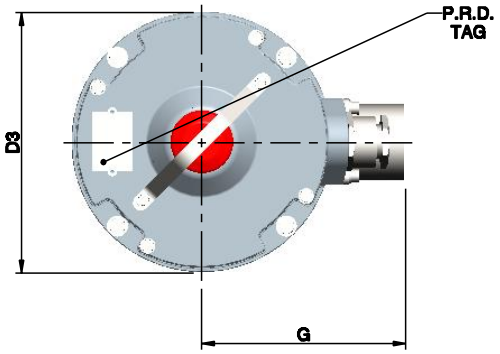
Type	B	C	D	D1	D2	D3	E	F20KPA *	F70KPA *	G	H	I	L	M	kg
50 M	170	139	Ø48.3	Ø62	Ø165	Ø166	41.5	95	60	130	Ø125	Ø18	23	38	2.1

* F = the dimension varies with set pressure

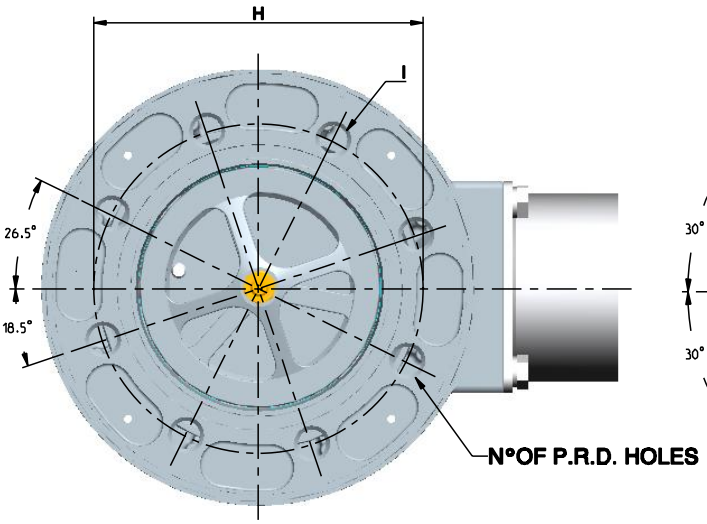
Overall dimensions

Type 125 M8 and 125 M6

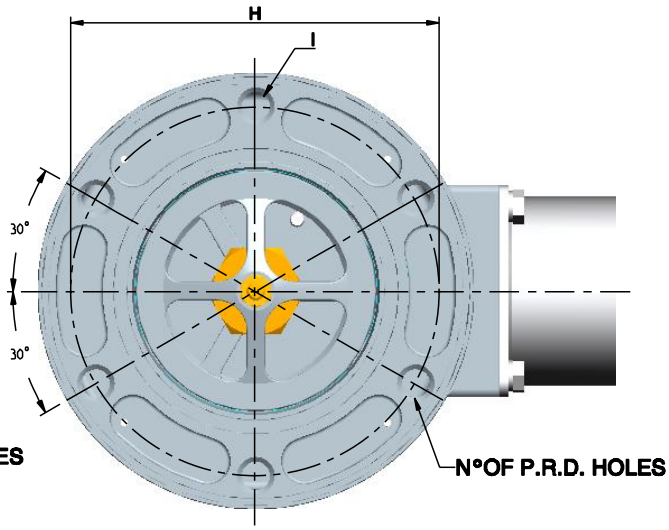




125M-8



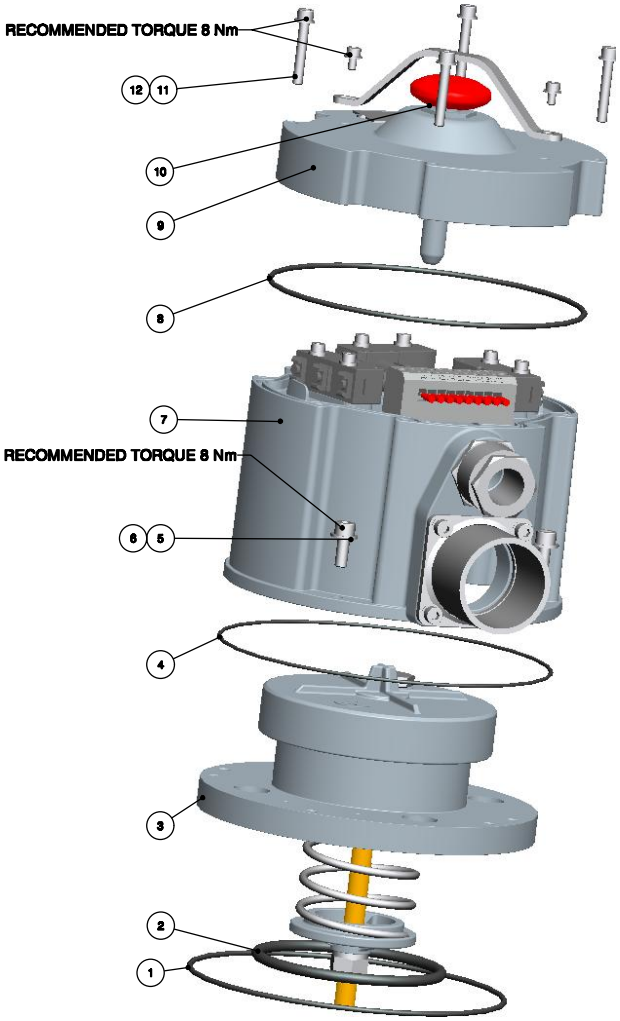
125M-6

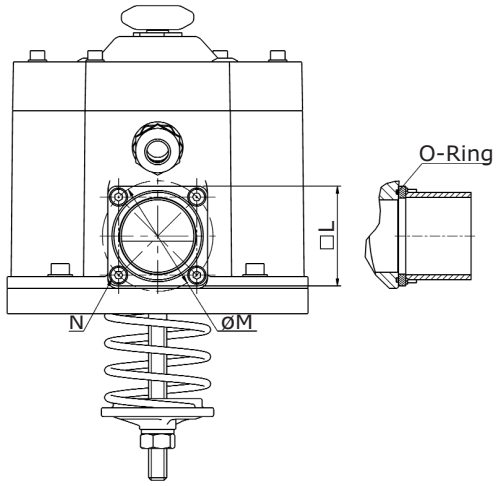


Type	B	C	D	D1	D2	D3	E	F20KPA	F70KPA	G	H	I	No. of holes
125 M-8	278	228	Ø120	Ø153	Ø278	Ø278	86	175	80	230	Ø210	Ø18	8
125 M-6	278	228	Ø120	Ø153	Ø278	Ø278	86	175	80	230	Ø235	Ø18	8

Pressure Relief Device - M

Assembling sequence





Type	□L	ØM	N	O-Ring
50 M	55	61	4 Screws M5x12	5G0D002187
125 M-8	135	152	4 Screws M12x25	5G0D004475
125 M-6	135	152	4 Screws M12x25	5G0D004475

Type 50 M

Ref.	Q.ty	Code	Description
1	1	5G0D003600*	GASKET O.R. 3600
2	1	5G0D000183*	GASKET O.R. 6337
3	1	-	50M SAFETY VALVE
4	1	5G0D002637	GASKET O.R. 2637
5	1	5V51106012	UNI 5931 M6X12 FIXING SCREW
6	1	5400800861	WASHER
7	1	-	OIL DUCT 50M
8	1	5G0D003600	GASKET O.R. 3600
9	1	-	OIL DUCT COVER 50M
10	1	-	VISUAL SIGNAL
11	1	5V50605035	UNI 5931 M5X35 FIXING SCREW
12	1	5RG0600050	WASHER

Type 125 M-8

Ref.	Q.ty	Code	Description
1	1	5G0D041050**	GASKET O.R. 41050
2	1	5G0L000227**	GASKET O.R. 8650
3	1	-	125M-8 SAFETY VALVE
4	1	5G0D041050**	GASKET O.R. 41050
5	1	5V50606060	UNI 5931 M6X60 FIXING SCREW
6	1	5400800861	WASHER
7	1	-	OIL DUCT 125M
8	1	5G0D041100	GASKET O.R. 41100
9	1	-	OIL DUCT COVER 125M
10	1	-	VISUAL SIGNAL
11	1	5V50605035	UNI 5931 M5X35 FIXING SCREW
12	1	5RG0600050	WASHER

Type 125 M-6

Ref.	Q.ty	Code	Description
1	1	5G0D041050**	GASKET O.R. 41050
2	1	5G0L000227**	GASKET O.R. 8650
3	1	-	125M-6 SAFETY VALVE
4	1	5G0D041050**	GASKET O.R. 41050
5	1	5V50606060	UNI 5931 M6X60 FIXING SCREW
6	1	5400800861	WASHER
7	1	-	OIL DUCT 125M
8	1	5G0D041100	GASKET O.R. 41100
9	1	-	OIL DUCT COVER 125M
10	1	-	VISUAL SIGNAL
11	1	5V50605035	UNI 5931 M5X35 FIXING SCREW
12	1	5RG0600050	WASHER

* ALTERNATIVE PLANE GASKET CODE 5C0V412501
** ALTERNATIVE PLANE GASKET CODE 5C0V452900

Order sheet

Number of pieces			
Model	50 M ☐	125 M-8 ☐	125 M-6 ☐
Contacts	**1** ☐	**2** ☐	**3** ☐
Pressure setting 20÷90 kPa Up to 200kPA for 50M only	Value ..... kPa		
For use in:	Moderate salinity areas acc. to ISO 12944 ☐		
	Off-shore areas acc. to ISO 12944 ☐		
Gaskets type	Viton ☐	silicone oils and/or high temperature -10°C up to + 150°C	
	NBR -40°C ☐	mineral oils and low temperature -40°C up to + 120°C	

SECTION 9

Appendix C

Midel Liquid & Winding Temperature Indicator

Qualitrol AKM 345 (6 pages)

OTIWTI™

Remote mount thermometers (AKM)

The next generation thermometer from the global leader

- Six switch capability, sequentially independent, with adjustable hysteresis
- Reduce failure costs with reliable AKM bellows operation
- Widest range of inputs and outputs including double gradient onboard
- Simple to work on with the new smart design case
- Further reduce your costs with the high switching capability no extra components for fan bank control and alarm trip

Product Summary

Description Capillary based, mechanical, remote indicating thermometer where electrical power is not required for indication. Configurations for oil temperature measurement and winding temperature simulation. Features up to 6 flexible switches for alarm, trip, and cooling system functions and can be equipped with various electronic outputs for SCADA and remote monitoring applications.

Application For oil (liquid) or simulated winding temperature indication with integrated features for control or alarm functions. Designed for use where the point of measurement (the well or pocket) is not easily viewed by personnel requiring separate or remote indication.

QUALITROL®
Defining Reliability

OTIWTI™ Remote mount thermometers (AKM)

The next generation thermometer from the global leader	• Over 75 years of experience designing mechanical temperature measurement devices for transformers • Over 250,000 capillary type thermometers in service worldwide in all environmental conditions • Improved connection ease with a greater number cable glands; 3xM25 style and 2xM20 style • Improved switching flexibility with up to 6 fully configurable switches • New and improved swing out case design allows for easy cable connection, switch configuration and testing without removal of the cover
Accomplish the most demanding control and alarm configurations	• Up to 6 fully independent switches flexible enough for most control and alarm schemes • Each switch can be specified by switch type, hysteresis range, and set point, without limitation of sequential set points • Standard switch rated for up to 15 Amps AC and up to 10 Amp DC, switches also available for higher VDC (magnetic blow out, M.B.O.), and switches for milliamp loads-- see technical specifications for more information • Various analog outputs also available (mA, Pt 100, and Cu 10) -- see technical specifications for more information • Each switch can be specified with adjustable hysteresis (5 to 25°C)
Reduce costs with reliable AKM bellows operation	• Non-pressured bellows system better resists leakage when compared to bourdon tube (pressurized) style capillary thermometers • Integrated heating element in bellows for winding temperature indication eliminates extra cost and complexity of accessories to simulate the winding • AKM bellows system provides a 260° dial deflection (angle the pointer travels from minimum to maximum) making it easier to interpret temperature reading from a distance
Minimize installation complexity with all-in-one design	• Single enclosure design minimizes need for additional accessories such as matching units and heated wells commonly used by other mechanical temperature solutions • New hinged cover enables easy access to switch settings and connections during installation while shielding device from elements. Features all captive screws and can be completely removed, if necessary • Same installation footprint and mounting options as the previous generation AKM 345 • Improved wiring installation with addition of 2 cable glands (for a total of 5) and an increase in size to 3xM25 and 2xM20 versus the previous generation
Simplify operations by using one family of thermometer for all environmental conditions	• Wide range of options allow for standard use of one thermometer series across a wide array of applications and operating conditions • Extreme temperature survivability with polar executions for use down to -60°C • Enclosures with IP55 or IP65 rating with numerous mounting configurations available • The most flexible switching capabilities available for implementation of any control and alarm configuration

New improved AKM OTIWTI™

AKM BELLOWS TECHNOLOGY
System provides a 260° dial deflection (angle the pointer travels from minimum to maximum) making it easier to interpret temperature reading from a distance

AKM BELLOWS TECHNOLOGY
Non-pressured bellows system better resists leakage when compared to bourdon tube (pressurized) style capillary thermometers

AKM BELLOWS TECHNOLOGY
Integrated heating element in AKM bellows for winding temperature indication eliminates extra cost and complexity of accessories to simulate the winding

ONE FAMILY OF THERMOMETER FOR ALL ENVIRONMENTAL CONDITIONS
Enclosures with IP55 or IP65 rating with numerous mounting configurations available including extreme temperatures down to -60°C

NEW CASE DESIGN
Swing out case design allows for easy terminal block connection, switch configuration and testing without removal of the cover

NEW 6 SWITCH CAPABILITY
Up to 6 fully independent switches flexible enough for most control and alarm schemes

IMPROVED WIRING INSTALLATION
Improved wiring installation with addition of 2 cable glands (for a total of 5) and an increase in size to 3xM25 and 2xM20 versus the previous generation

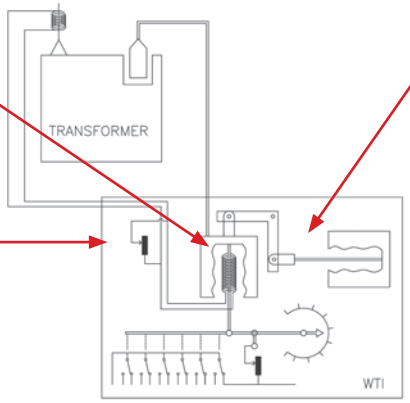
ELECTRONIC OUTPUTS (USER UPGRADE KITS AVAILABLE)
Various analog outputs available (mA, Pt 100, and Cu 10) -- user upgrade possible via rear access panel by trained personnel.

AKM345 DOUBLE GRADIENT OPTION
The Double Gradient option allows for setting two separate winding simulations in the same Winding Temperature Indicating Thermometer.

Winding system

Integrated heating element in AKM Measurement bellows simplifies winding temperature indication by eliminating the complexity of accessories to simulate the winding

Single enclosure design minimizes need for additional accessories such as matching units and heated wells commonly used by other mechanical temperature solutions



AKM Compensation bellow automatically compensates for ambient temperature

Options and accessories

Pockets/wells

46950
46949
44595-1

- Pockets and wells available to fit all bulb types including IEC and ANSI standards

Remote indicators

47875 47877 47877-1

- Digital and analog indicators available for remote display of temperature measurement
- For use with 4-20 mA output option

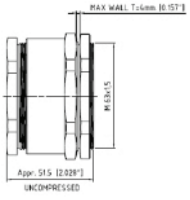
Power supply

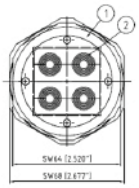
48510 48515

- For use with remote indicators and remote electronic outputs when 24 VDC is not available
- Universal Power Supply 85-264 VAC, 90-250 VDC
- Tolerance +10% or -15%
- DIN rail mounting

Pass through capillary gland

RG 63/4





- For environmental isolation when capillary needs to pass through an enclosure

Electronic output user upgrade kit

47675

- Add electronic output capability to units previously purchased without output
- Upgrade possible through back access panel by trained personnel only

Don't see what you need?
QUALITROL regularly creates models with special customer requirements.
Contact your local sales representative or QUALITROL Application Engineer to review your special requirements.

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www.qualitrolcorp.com

OTIWTI™ Remote mount thermometers (AKM)

TECHNICAL SPECIFICATIONS

Materials	Housing	Die-cast aluminum, polyester powder coat finish
	Capillary	Copper or copper/nickel with stainless steel jacket
	Lens	UV stabilized polycarbonate (standard), glass optional
Functional specification	Indication accuracy	±1.5% full-scale
	Standard measurement range	0 to 150°C (32°F to 302°F)
	Bulb types	Standard: 14mm diameter x 156mm length Available: for wells per DIN 42554, ASA C57.12.00
	Winding thermal image	Internal winding simulation: TD50 5 Amp/TD50 (up to 2.2A CT Max) or TD76 (up to 2.65A CT max) External winding simulation: (AKM 44678) up to 2A CT or (AKM 44674) up to 1.2A CT max, matching unit (AKM 44677) for up to 5A CT max
	Mounting styles	Stainless steel anti-vibration mount (standard), elastomeric seismic mount optional
	Cover	Swing up cover design, fully detachable, with all captive hardware
	Cable glands	3 x M25, 2 x M20
Output parameters	Number of switches	2 to 6 switches (independently specified types)
	Switch types	VAC, VDC, M.B.O. (magnetic blow out, high DC)
	Switching differential (hysteresis)	10° to 14°C for most dial ranges, optional adjustable differential from 5° to 25°C
	Switching accuracy	± 3% full-scale
	Optional remote outputs	Current loops: 0 to 1 or 4 to 20mA
		Voltage: 1-5V, etc...
		Resistive: Pt 100 or Cu 10 ohm
Environmental	Protection class	IP55 (standard), IP65 optional
	Dielectric isolation (hi pot)	2500 VAC at 50Hz, 60 seconds, all terminals to ground
	Surge withstand capability	IEEE C37.90.1 (TD111 output board only)
	Operating temperature	-40°C to 70°C (-40°F to 158°F), polar execution available -60°C to 50°C (-76°F to 122°F)
	Storage temperature	-50°C to 80°C (-58°F to 176°F)
	Humidity	95% non-condensing relative humidity @ 95°C (203°F)
	Vibration	50Hz/60Hz @ 0.1mm inch displacement, 3-axes
	Shock	10 G's half-sine, in three orthogonal planes

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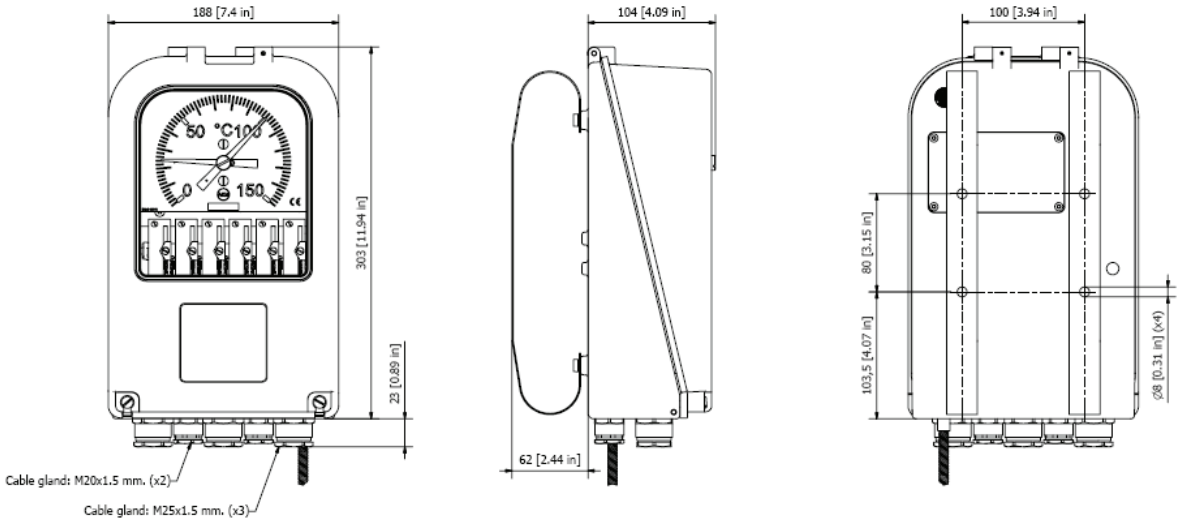
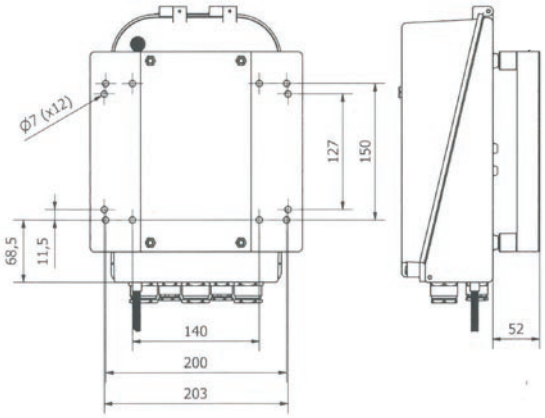
OTIWTI™ - Mounting styles and dimensions

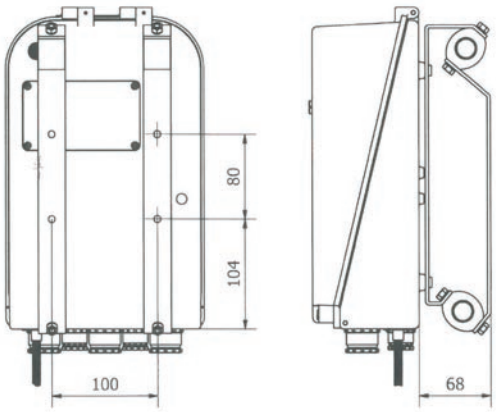
Standard mounting



Universal mounting



Siesmic mounting



QUALITROL® Field Services

To further improve reliability, QUALITROL provides comprehensive education and on-site commissioning services, maintenance contracts and technical support to all customers worldwide. Emergency response is available on all products and services.

About QUALITROL®

QUALITROL Company LLC manufactures substation and transformer monitoring and protection devices used by electric utilities and manufacturing companies. It is the global leader in sales and installations of transformer asset protection equipment, fault recorders and faul locators. Established in 1945, QUALITROL Company produces thousands of different types of products on demand, each customized to customers' unique requirements.

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SECTION 10

Appendix D

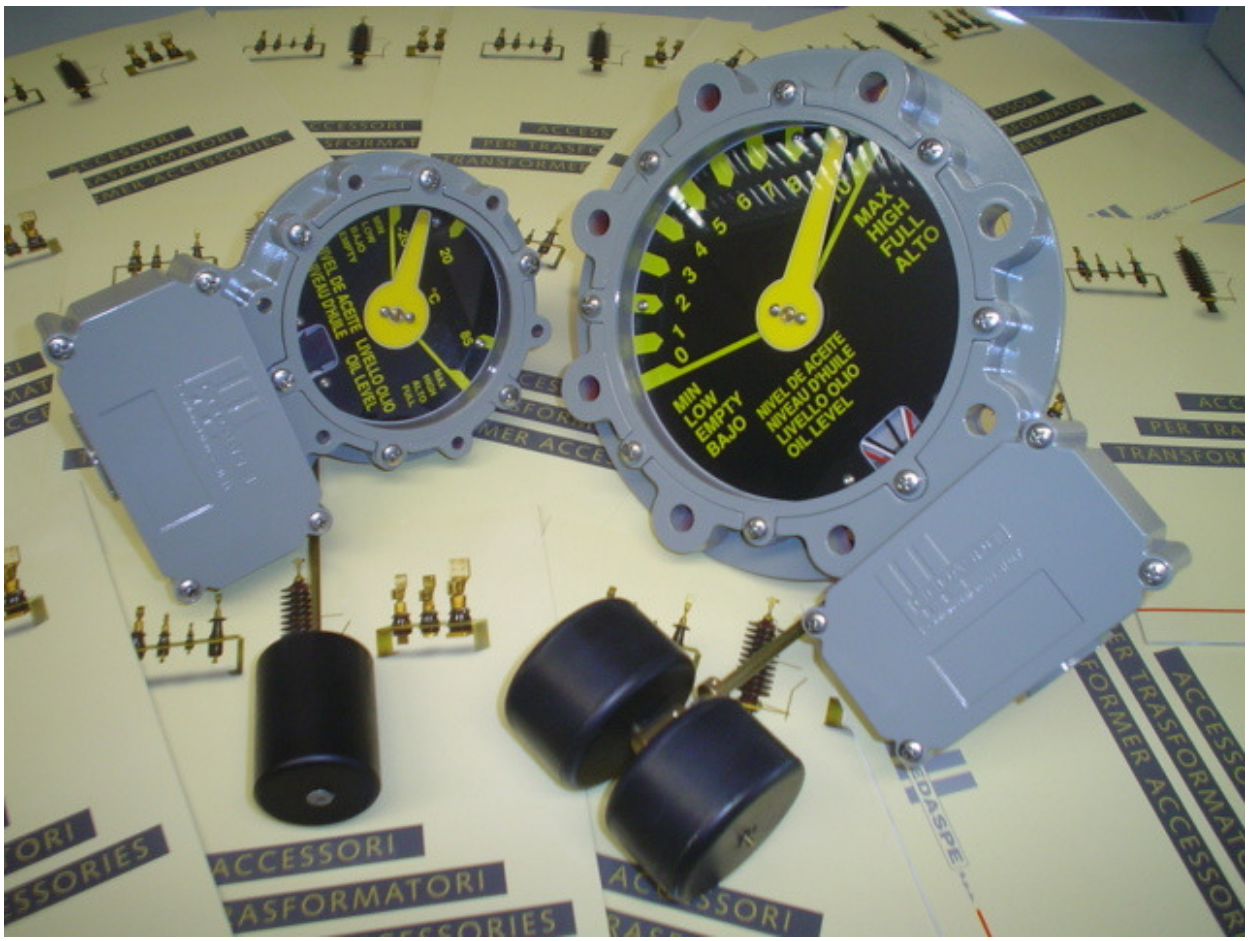
Midel Liquid Level Gauge

Cedaspe NFG Size 1 (10 pages)

I - 20098 S. GIULIANO MIL. (ITALY) - VIA COLOMBARA, 1 - FRAZ. PEDRIANO
TELEFONO +39 0298.20.44.11 - TELEFAX +39 02 98.20.44.22
E-Mail: cedaspe@cedaspe.com - InterNet Site: http://www.cedaspe.com
CAP. SOC. € 500.000 I.V. - TVA-P.I. IT 01065780155 - C.F. 01065780155
R.E.A. MI 729991 - IMPORT - EXPORT MI 142410 - REG. IMPR. 132146/3344/46 TRIB. MI

MAGNETIC OIL LEVEL INDICATOR FOR POWER TRANSFORMER NFG SERIES

(Normal Front Gauge Mounting Model year 2014)



I - 20098 S. GIULIANO MIL. (ITALY) - VIA COLOMBARA, 1 - FRAZ. PEDRIANO
TELEFONO +39 0298.20.44.11 - TELEFAX +39 02 98.20.44.22
E-Mail: cedaspe@cedaspe.com - InterNet Site: http://www.cedaspe.com
CAP. SOC. € 500.000 I.V. - TVA-P.I. IT 01065780155 - C.F. 01065780155
R.E.A. MI 729991 - IMPORT - EXPORT MI 142410 - REG. IMPR. 132146/3344/46 TRIB. MI

1.0 Features

The magnetic oil level indicators type NFG has been specially studied for use on power transformer to give an analogical indication of the oil level inside the conservator by a graduated dial with arrow plus one or more electric signal (max 4 signals) when the oil inside the conservator reaches the max or min level.

2.0 Construction features

Materials and components

The body of the gauge is made in one piece of solid compact aluminium alloy casting oil tightened proof.

The indicating system is located Inside the body and is composed by a yellow arrow, a graduated scale, one or more contacts activated by cams and a permanent magnet.

The monitoring system is located behind the fixing flange (it is fully inside the conservator, this in order to minimize the external protrusion of the gauge itself from the conservator tank) and is composed by a permanent magnet, rigidly connected (or by means of a bevel gear for form Y) to a float arm which follows the movement of the surface of the oil.

The two systems are connected by a magnetic joint through the magnetic flux of the permanent magnets.

The electric signal coming from the contacts are carried out through a waterproof terminal box (IP65) with a M25x1.5 threaded entry (see page NFG5).

Upon request we can supply adaptors M25x1.5 to M20x1.5 or to PG16.

Also upon request we can supply cable glands M25x1.5 or M20x1.5 or PG16.

Oil-tightness and resistance to pressure

The magnetic oil level indicators NFG are leak tested (routine test) and are mechanically resistant to vacuum (10 torr).

Resistance to dynamical stress

The magnetic oil level indicators NFG can operate without undue operation in following conditions:

Sinus vibrations with frequency ≤120 Hz and amplitude ≤250 µm;

Dynamical conditions causing following accelerations:

- Max 3g in all directions, sinus vibration, amplitude ≤ 20 mm;
- Shock condition with max 10 g in all directions.

Surface protection

Body, frame, terminal box and his cover are painted internally and externally with one primer coat of epoxy paint and externally with a finishing coat of polyurethane paint colour RAL 7030. The primer coat on the internal surfaces is compatible with transformer mineral oil up to temperatures of 120°C. Total thickness of two coats is 80 microns; upon request we can supply gauges with special painting for transformers located in very polluted areas.

3.0 Manufacturing program

Magnetic oil level indicator series NFG is manufactured in 3 sizes with 2 different styles:

- Size 1: flange OD 140mm; Dial ND 100mm (4 inches);
- Size 2: flange OD 220mm; Dial ND 150mm (6 inches);
- Size 3: flange OD 345mm; Dial ND 250mm (10 inches);
- Style Y: axial float arm suitable for use on traditional breathing conservator and on hermetic conservator with rubber bag
- Style R: radial float arm suitable for use on traditional breathing conservator.

All execution are fitted with 1 or more electric contacts, microswitch type, that are activated when the oil (and consequently the arrow of the instrument) reaches the presetted positions (see available wiring diagram).

The indicating arrow in type “R” moves over a 140° angle, the float arm moves over an angle of 140°.

The indicating arrow in type “Y” moves over a 140° angle, the float arm moves over an angle of 60°.

The gauge type “Y” has a special design that allow the mounting of the same gauge either in the centre of the conservator end, or the bottom of the conservator end, or inclined below the conservator, just fixing the float arm in a specific way without any special adjustment (see sketch page NFG6)

The standard Indicating dial has 10 divisions with yellow figures other dials are available (see page NFG6).

I - 20098 S. GIULIANO MIL. (ITALY) - VIA COLOMBARA, 1 - FRAZ. PEDRIANO
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E-Mail: cedaspe@cedaspe.com - InterNet Site: http://www.cedaspe.com
CAP. SOC. € 500.000 I.V. - TVA-P.I. IT 01065780155 - C.F. 01065780155
R.E.A. MI 729991 - IMPORT - EXPORT MI 142410 - REG. IMPR. 132146/3344/46 TRIB. MI

4.0 Operation, installation and maintenance

Operation

The float arm detects an increase (due to heating) or a decrease (due to an oil loss) of oil inside the conservator, giving a visible indication (analogical type) through the arrow and when the oil reaches the presetted value for alarm and/or trip a microswitch is activated and an electric signal is provided inside the terminal box.

Installation

Use one magnetic oil level indicator for the conservator of the main tank and one for OLTC conservator (if present); the oil level indicator can be fixed to the conservator using studs & nuts (type B) or screws (type V) M6 (6 pcs) or M10 (8 pcs) with washer and spring washer (see the page NFG5).

Adjusting float arm length

NFG form Y are supplied with adjustable float arm length; this in order to have an optimal calibration of the instrument. Adjustment is very easy: you need only to unloose screw A (please refer to page NFG5), adjust float arm to desired length and close screw A again.

Maintenance

Magnetic oil level gauges NFG don't need specific maintenance; we suggest to check regularly contacts during the normal maintenance of the transformer.

5.0 Electric contacts

The contacts are microswitches changeover type and are mechanically operated by a cam.
Following main characteristic of micro switches:

Lever	Stainless steel
Body and pushbutton	Thermosetting composition
Contact material	Silver
Mechanical endurance of contact	$1x10^7$ cycles
Temperature range	-40°C - +125°C
Standard interruption power AC	AC 250V-5A
Standard interruption power DC	see diagram at page NFG5
Insulation to earth at 20°C	2.000V
Protection degree of terminal box	IP 55

6.0 Wiring diagrams

Available wiring diagram are (see page NFG5):

- wiring diagram type C1 : gives a signal when oil reaches low level inside conservator
- wiring diagram type C2 : gives a signal when oil reaches low or max level inside conservator
- wiring diagram type D1 : gives an alarm signal when oil reaches low level and trip signal for very low level inside conservator
- wiring diagram type D2 : gives a double signal when oil reaches low level inside conservator
- wiring diagram type D4 : gives a double signal when oil reaches low or max level inside conservator

All contacts are operated 3/5 degrees before the arrow reaches the minimum or the maximum level of oil.

7.0 Compatibility of installation

The installation compatibility of the magnetic oil level indicator depend mainly on the climatic conditions related to ambient temperature and oil temperature (that influence choice of the material used for the flange gasket) and on environmental conditions (that influence choice of the material used for front dial and fittings) ; therefore the executions differ because of the different materials used for gaskets; front dial and fittings.

Execution related to climatic conditions:

N – O/RING made in HNBR (hydrogenated nitrile rubber)

This is standard execution on sizes 1 & 2
Admitted operating conditions are:
Environmental conditions:
Ambient temperature: -40°C to +55°C
Relative humidity: 95% to 20°C - 80% to 40°C - 50% to 50°C
Insulating liquid (transformer mineral oil):
Temperature: - 40°C to + 140°C

C – NBC Cork gasket (flat flange gasket with 6 or 8 holes instead of O-Ring gasket)
This is standard execution on size 3 and on demand on sizes 1 & 2
Admitted operating conditions are:
Environmental conditions:
Ambient temperature: -20°C to +50°C
Relative humidity: 95% to 20°C - 80% to 40°C - 50% to 50°C
Insulating liquid (transformer mineral or silicon oil):
Temperature: - 20°C to + 110°C

G – LT Cork gasket (flat flange gasket with 6 or 8 holes instead of O-Ring gasket)
This execution is on demand on all sizes for low temperature applications
Admitted operating conditions are:
Environmental conditions:
Ambient temperature: -55°C to +50°C
Relative humidity: 95% to 20°C - 80% to 40°C - 50% to 50°C
Insulating liquid (transformer mineral or silicon oil):
Temperature: - 55°C to + 160°C

Execution related to environmental conditions:

0 – For normal and tropical conditions
Front dial made in P.M.M.A.; fittings made in brass nickel plated and s/steel AISI 304

7 – For desert conditions and / or moderated corrosive conditions
Front dial made in tempered glass; fittings made in brass nickel plated and s/steel AISI 304

8 – For extremely corrosive conditions
Front dial made in tempered glass; fittings made in brass nickel plated and s/steel AISI 316

Special executions
For other environmental and/or operating conditions to be examined individually.

8.0 Ordering Instructions

When ordering must be defined following data (see order form at page 10 of catalogue):
- Style of magnetic oil level indicator : R or Y
- Size 1 (flange OD 140 mm); 2 (flange OD 220 mm); or 3 (flange OD 345 mm)
- Mounting sketch (for R style always A);
- Wiring diagram: C1; C2; D1; D2; D4;
- Climatic conditions (type of gasket: N; C; G or special);
- Environmental conditions (0; 7; 8 or special);
- Type of dial : 0; 1; 5; or special;
- Special requirement i.e. Cable Entry.

Example : to order 5 magnetic oil level indicator type NFG form Y, OD 220mm, mounting on traditional conservator, 2 contacts SPDT at min and max level, with HNBR gaskets, normal environmental conditions and dial marking Min, -20, 20, 85, Max, write:
- Nr. 5 Magnetic oil level indicator NFG Y2AC2N00.

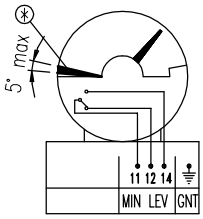
9.0 Marking on data plate

All our magnetic oil level indicator have a data plate with S/N and model of the instrument
Example : on above oil level gauge type NFG form Y, OD 220mm, mounting on traditional conservator, 2 contacts SPDT at min and max level, with HNBR gaskets, normal environmental conditions and dial marking Min, -20, 20, 85, Max, will have the following marking engraved on field Type: Y2AC2N00.

WIRING DIAGRAM

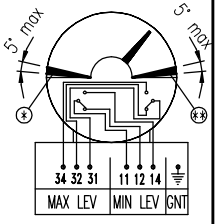
WIRING DIAGRAM C1 – (MIN CONTACT)

Only min contact
*) Min contact operates in this area



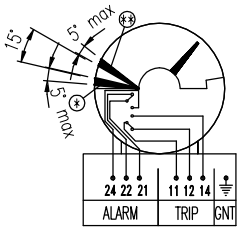
WIRING DIAGRAM C2 – (MIN & MAX CONTACT)

Min & max contact
*) Min contact operates in this area
**) Max contact operates in this area



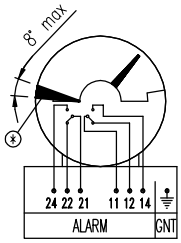
WIRING DIAGRAM D1 – TWO MIN (ALARM & TRIP CONTACT)

Alarm contact low level
Trip contact very low level
*) Trip contact operates in this area
**) Alarm contact operates in this area



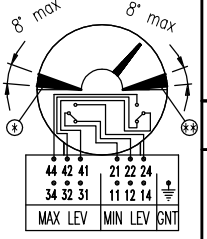
WIRING DIAGRAM D2 – (DOUBLE MIN CONTACT)

Double contact at min level
*) Both contacts operate in this area

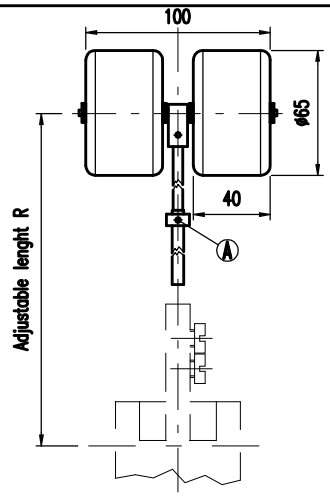


WIRING DIAGRAM D4 – (DOUBLE MIN + MAX CONTACT)

Double contact at min and max level
*) Both Min contacts operate in this area
**) Both Max contacts operate in this area



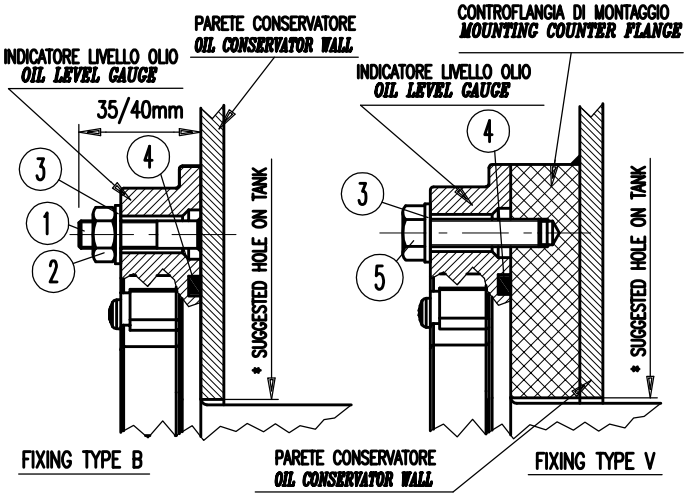
ADJUSTABLE FLOAT ARM (ROLLING FLOATS)



FOR "Y" STYLE SKETCH B, C, H & K

FIXING SKETCHS

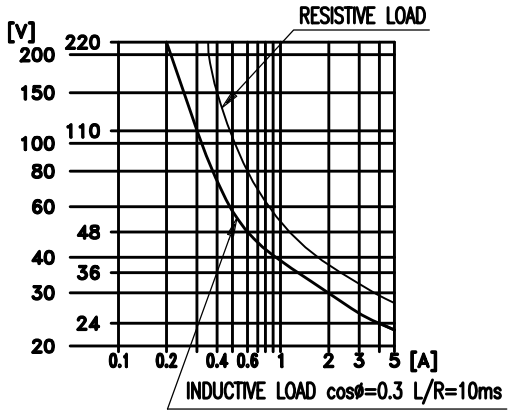
NFG 5



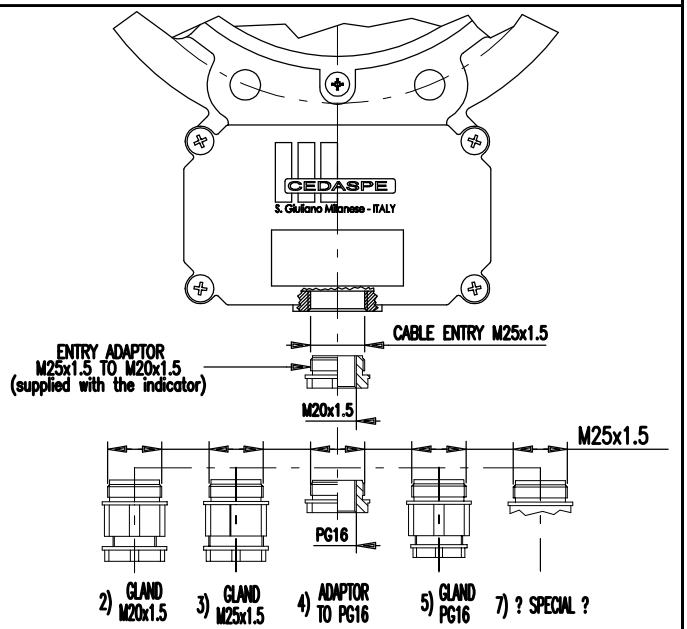
* SUGGESTED HOLE		
ø85	ø120	ø200
NFG1	NFG2	NFG3

POS.	NFG1	NFG2	NFG3
5	SCREW M6	SCREW M10	SCREW M12
4	O-RING GASKET	O-RING GASKET	FLANGE GASKET
3	WASHER M6	WASHER M10	WASHER M12
2	NUT M6	NUT M10	NUT M12
1	STUD M6	STUD M10	STUD M12

CONTACT BREAKING CAPACITY DC



OPTIONS FOR CABLE ENTRIES M25x1.5



CEDASPE

Titolo

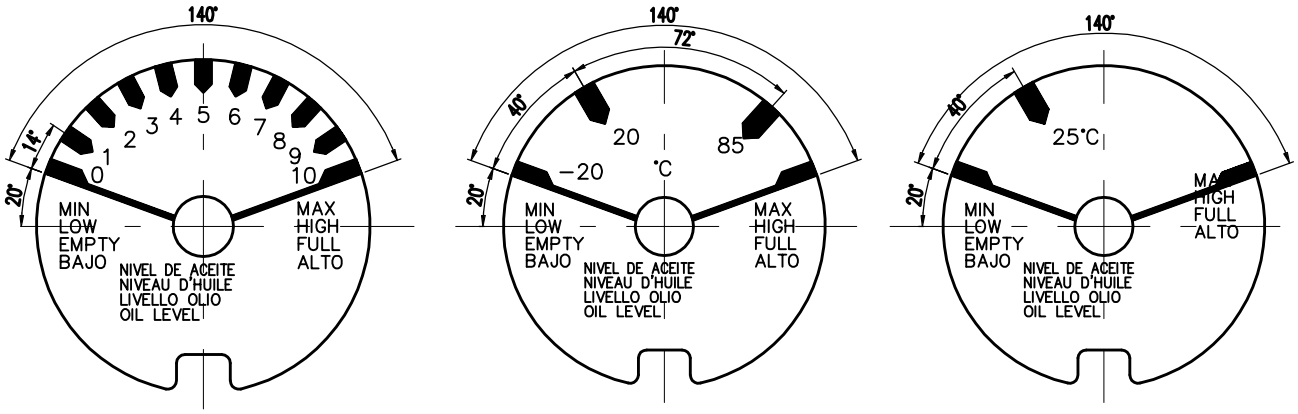
Magnetic oil level indicator NFG

Data	12/03/13
Scala	====
Dis.	
Visto	

Dis. Nr
3830

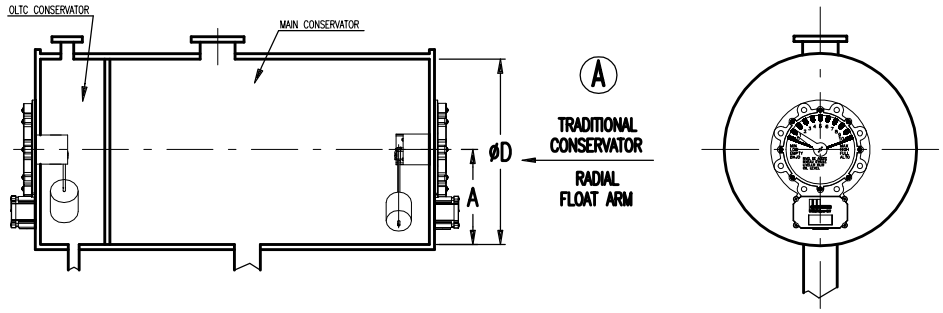
STANDARD DIALS

NFG 6

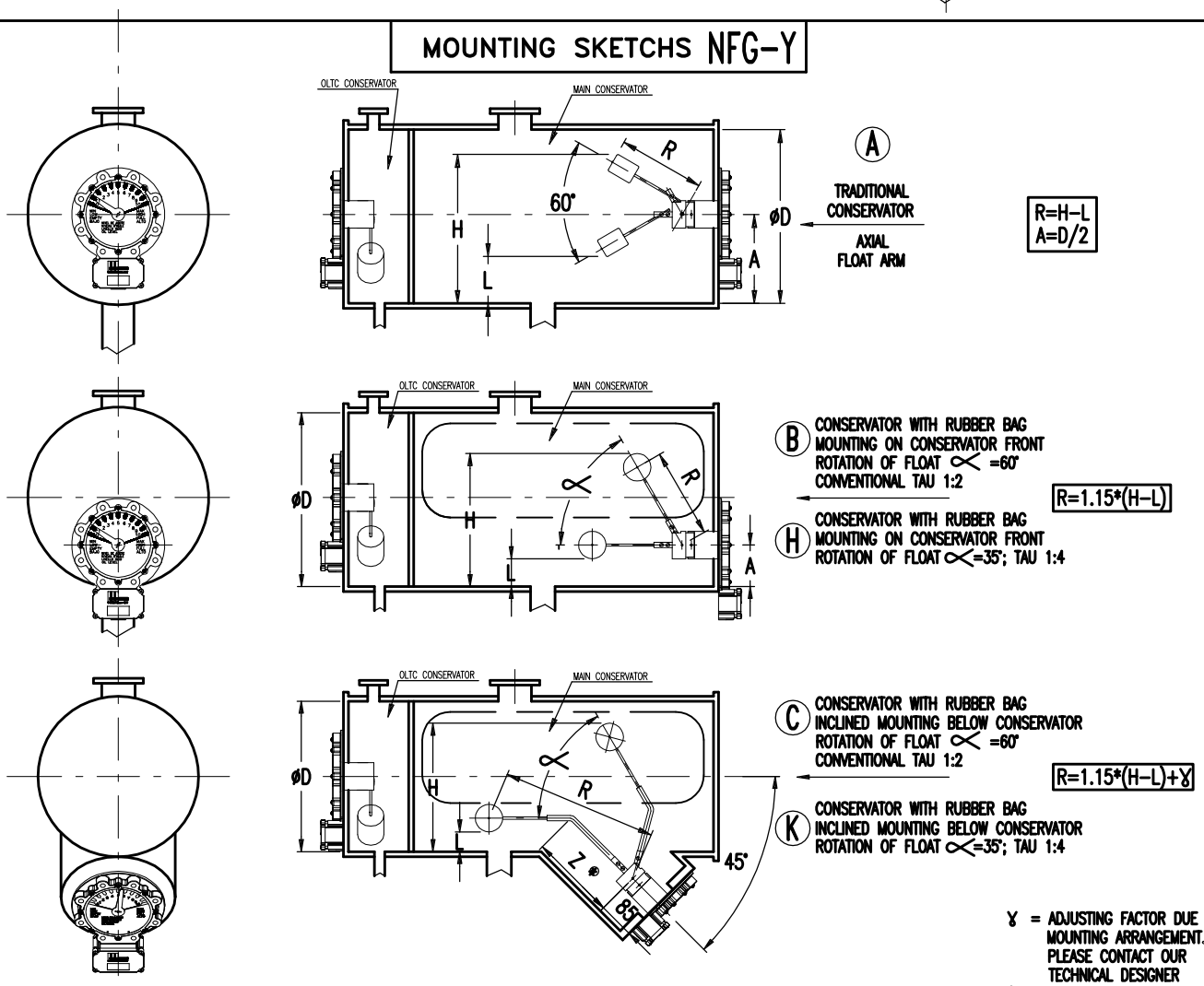


TYPE "1" TYPE "0" TYPE "5"

MOUNTING SKETCH NFG-R



MOUNTING SKETCHS NFG-Y



CEDASPE

Titolo

Magnetic oil level indicator NFG

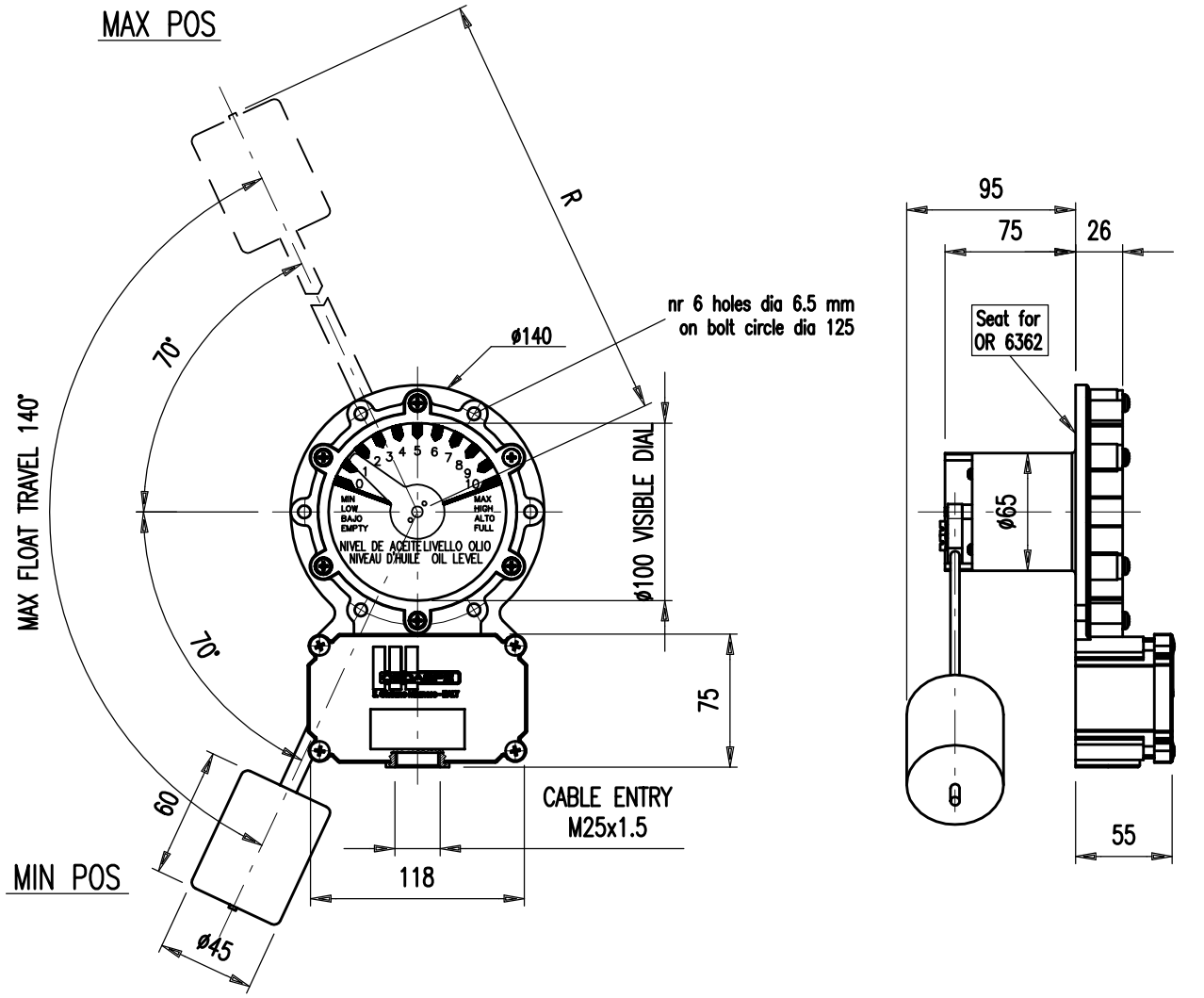
Data	12/03/13
Scala	====
Dis.	
Visto	

Dis. Nr 3831

FILE = 3831 .DWG LMT [(0,0) (196,286)] A4 (210x297)

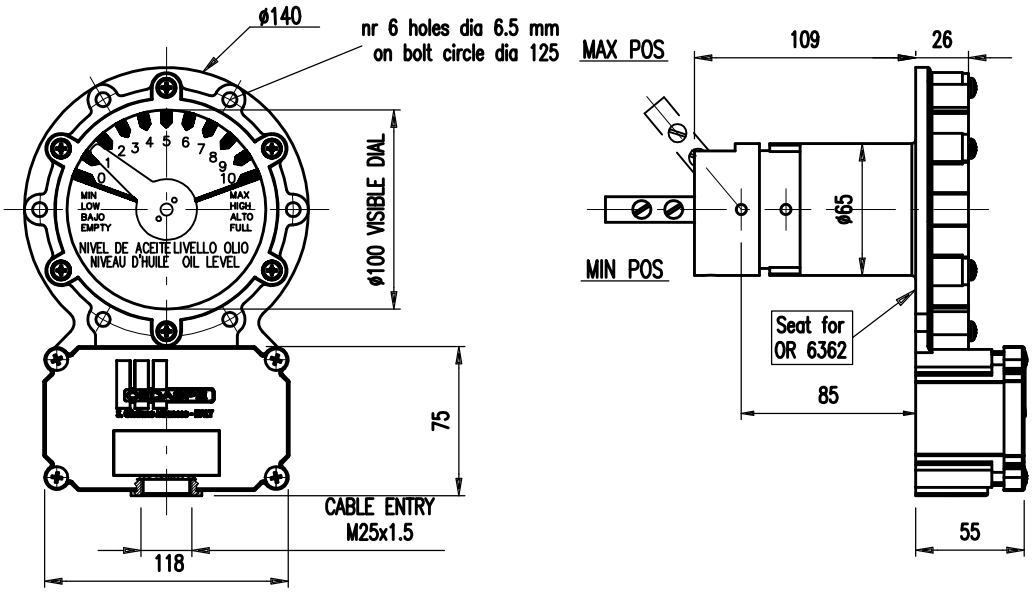
REV. 00 DTD 12/03/13

STYLE R



DIM. IN mm

STYLE Y



DIM. IN mm

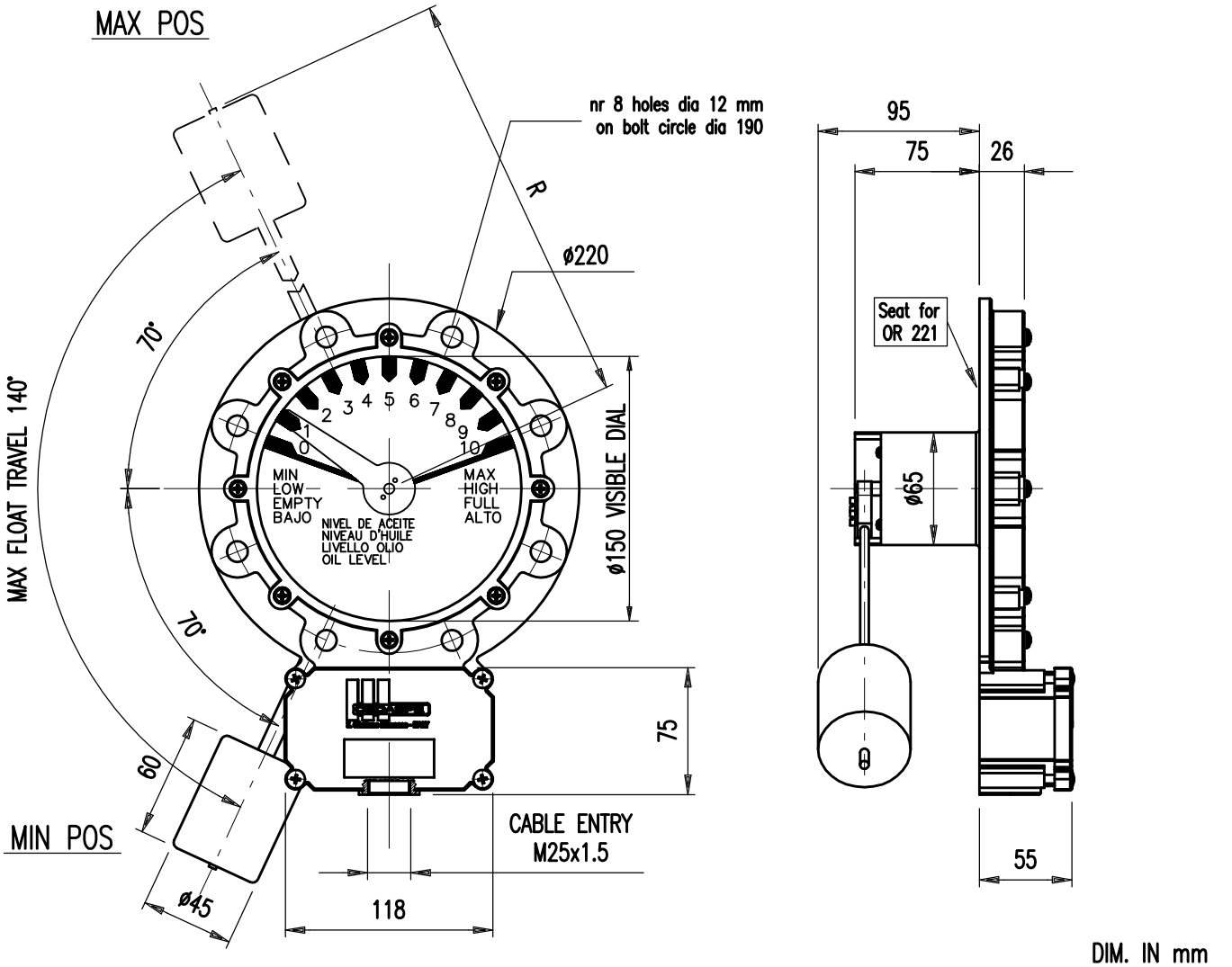
CEDASPE	Titolo: Magnetic oil level indicator NFG size 1	Data 12/03/13 Scala ==== Dis. Visto	Dis. Nr 3832

A4 (210x297) LMT [(0,0) (196,286)] FILE = 3832 .DWG REV. 00 DTD 12/03/13

REV. 00 DTD 12/03/13
FILE = 3833 .DWG
LMT [(0,0) (196,286)]
A4 (210x297)

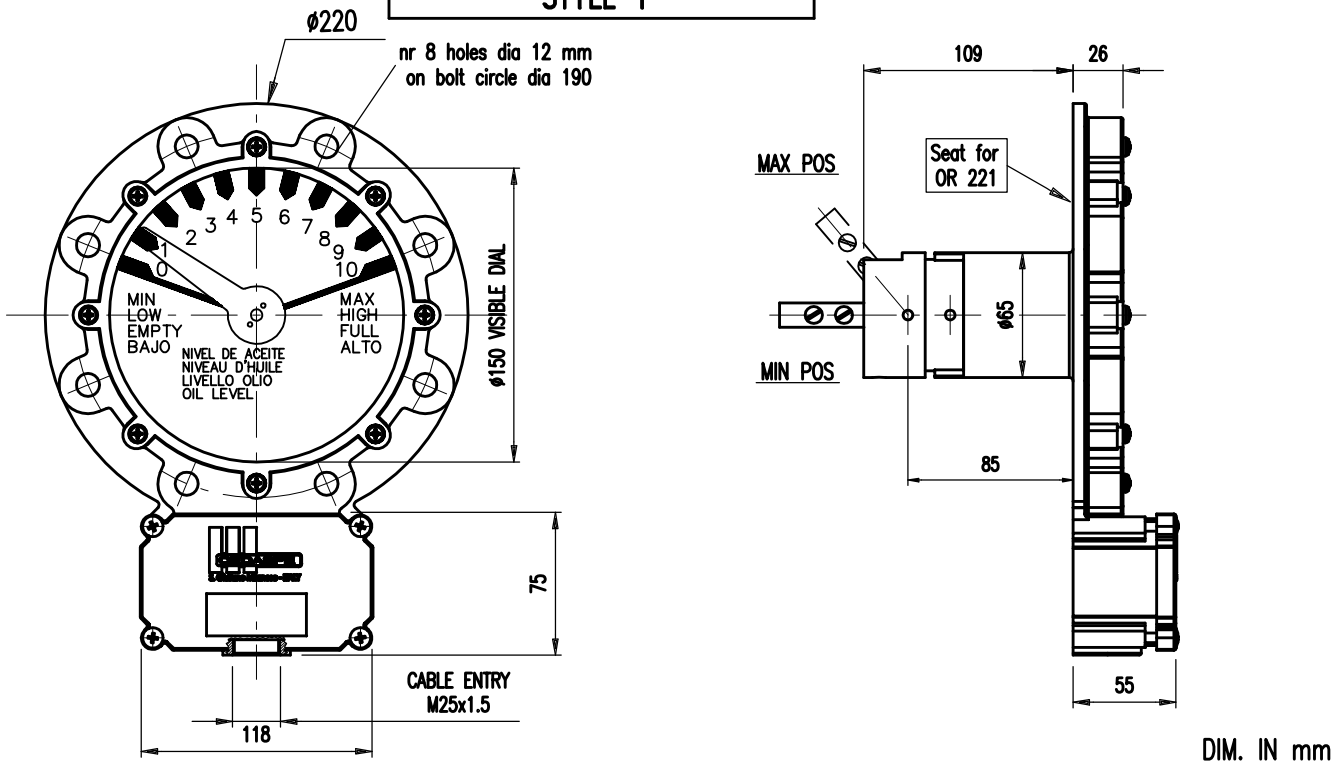
STYLE R

NFG 8



DIM. IN mm

STYLE Y



DIM. IN mm

CEDASPE

Titolo

Magnetic oil level indicator NFG size 2

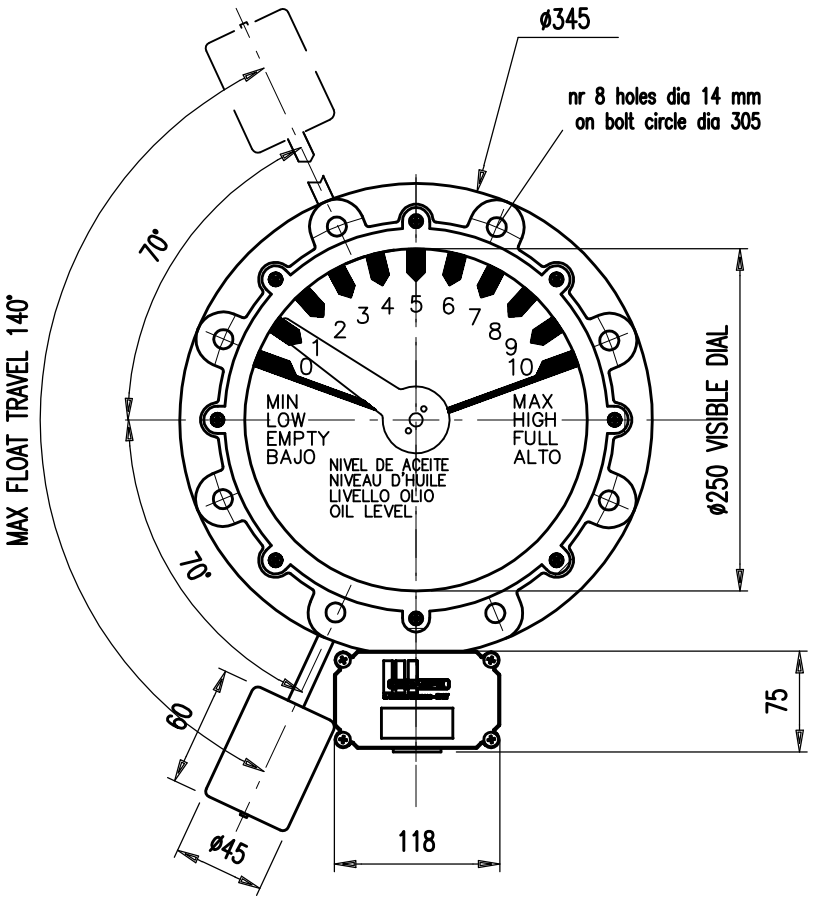
Data	12/03/13
Scala	====
Dis.	
Visto	

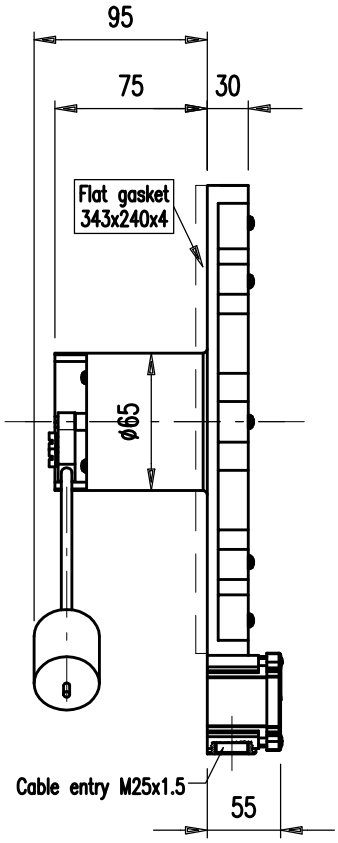
Dis. Nr

3833

STYLE R

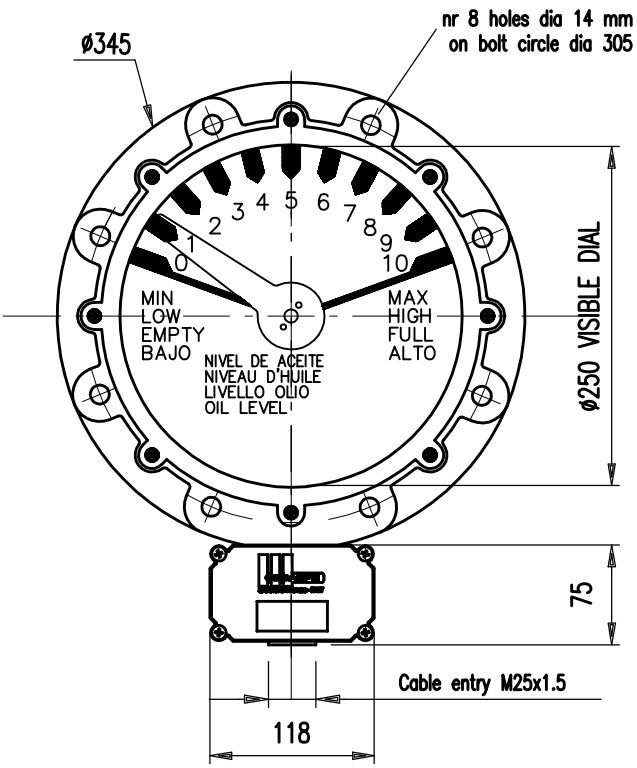
NFG 9

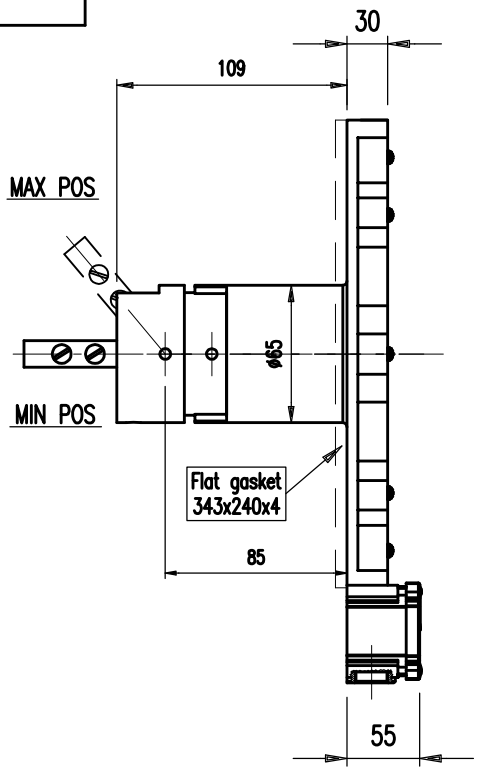




DIM. IN mm

STYLE Y

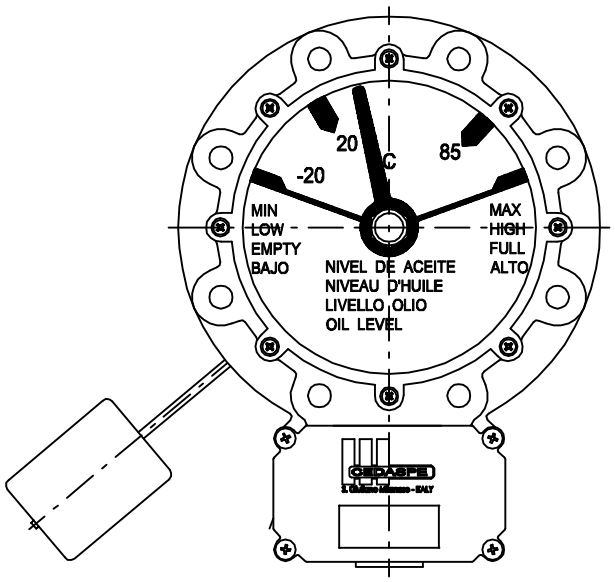


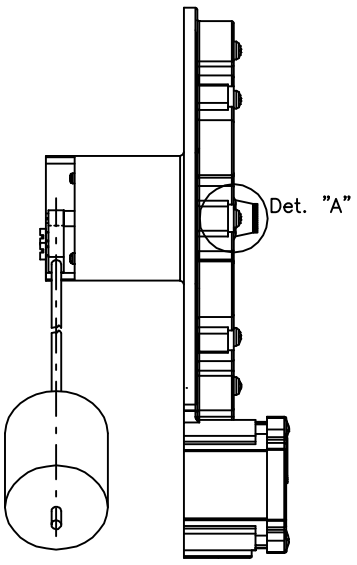


DIM. IN mm

CEDASPE	Titolo: Magnetic oil level indicator NFG size 3	Data 12/03/13 Scala ==== Dis. Visto	Dis. Nr 3834

FILE = 3834 .DWG LMT [(0,0) (196,286)] A4 (210x297)
REV. 00 DTD 12/03/13

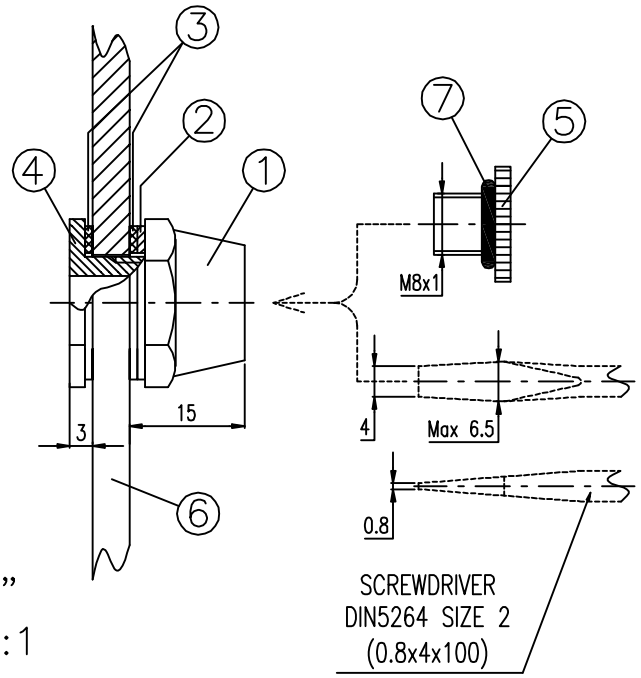




3	NFG3	50GP000300
2	NFG2	50GP000200
1	NFG1	50GP000100
Pos.	M.O.L.G.	Code

Picture shows O.L.I. type NFG R2 scale 1:4

7	OR2031		1	GGOR2031
6	Quadrante	3313	1	Vedi disegno
5	Tappo	3308	1	9TL900H0010
4	Mozzo Ch19	3310	1	9TL900H0030
3	Guarnizione	3311	2	Vedi disegno
2	Rondella Ottone	3312	1	ROT020SP01
1	Ghiera Ch19	3309	1	9TL900H0020
Pos.	Descrizione	Dwg	Q.ty	Codice



Det. "A"
Scale 1:1

			Finitura			TOLLERANZA GENERALE UNI-ISO 2768
			Trattamento			Qualità = f ☐ m ☒ c ☐
3	03/10/12	Rifatto disegno	Materiale	Unific.		EX DIS. P2256 R.1
2	25/10/10	Agg. tabella codici		Design.		Assieme =
1	21/10/10	Rifatto disegno con nuovi particolari	Peso	Grezzo	kg	Codice grezzo =
Ind.	Data	Modifica		Finito	kg	Codice =

CEDASPE

Titolo MOLG CONTACT TESTING FACILITY *(UPON REQUEST)*

Data 19/11/09
Scala ====
Dis.
Visto

Dis. Nr 3283

1 2 3

ORDER FORM NFG–Y

Type	☐ NFG–Y1	☐ NFG–Y2	☐ NFG–Y3	
Gasket type	☐ N	☐ C	☐ G	☐ SPECIAL
Wiring diagram	☐ C1	☐ C2	☐ D1	☐ D2
Dial	☐ type "0" 25°	☐ type "1" 0÷10	☐ type "5" –20/20/85	☐ SPECIAL

R: ..... L: ..... H: ..... Hmax: .....

Z*: ..... øD: ..... A: .....

* Dimension to be specified only for executions C & K

Note:

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Special request:

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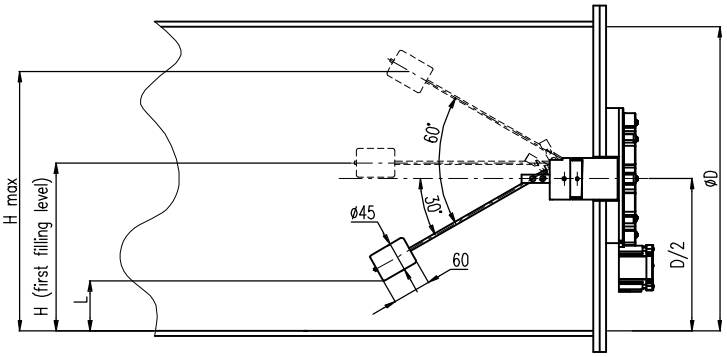
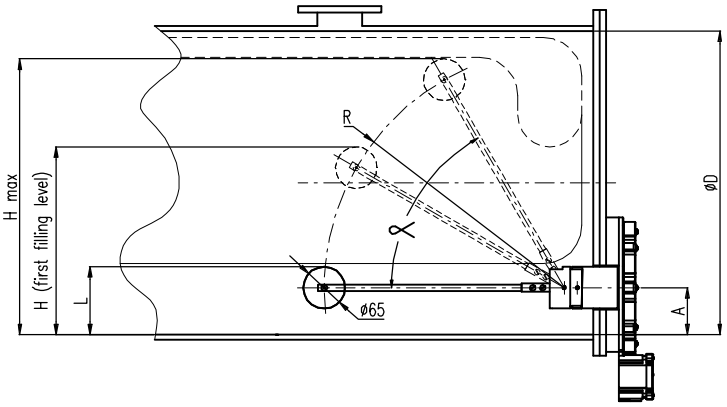


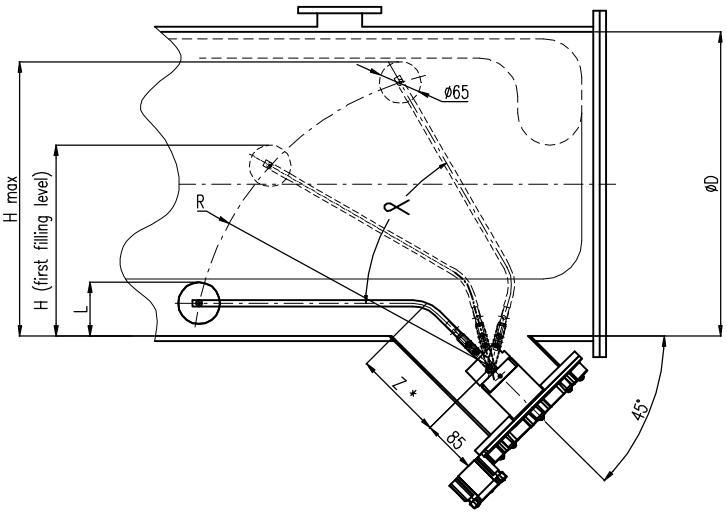
Ⓐ Traditional conservator
Axial float arm
– Float arm acc. to Drg. 5608



Ⓑ Conventional Tau 1:2 ∝ = 60°

Ⓗ Tau 1:4 ∝ = 35°

– Float arm acc. to Drg. 5607



Ⓒ Conventional Tau 1:2 ∝ = 60°

Ⓚ Tau 1:4 ∝ = 35°

* Dimension to be specified on order

– Float arm acc. to Drg. 3181

CEDASPE

Titolo

Magnetic oil level indicator NFG–Y

Data	30/09/13
Scala	====
Dis.	
Visto	

Dis. Nr 3893

1

REV. 01 DTD 28/10/13 FILE = 3893 .DWG LMT [(0,0) (196,286)] A4 (210x297)

ORDER FORM

R								RADIAL
Y								AXIAL
	1							FLANGE DIA 140 MM
	2							FLANGE DIA 220 MM
	3							FLANGE DIA 345 MM
		A						MOUNTING SKETCH A (TRADITIONAL CONSERVATOR STANDARD FOR TYPE "R")
		B						MOUNTING SKETCH "B" ON FRONT OF CONSERVATOR WITH RUBBER BAG AND CONVENTIONAL TAU1:2 (FLOAT ACC DRG 5607 & ROTATION 60°)
		H						MOUNTING SKETCH "H" ON FRONT OF CONSERVATOR WITH RUBBER BAG AND TAU1:4 (FLOAT ACC DRG 5607 & ROTATION 35°)
		C						MOUNTING SKETCH "C" BELOW CONSERVATOR WITH RUBBER BAG AND CONVENTIONAL TAU1:2 (FLOAT ACC DRG 5607 W/ARM ADAPTOR DRG 2735 & ROTATION 60°)
		K						MOUNTING SKETCH "K" BELOW CONSERVATOR WITH RUBBER BAG AND TAU1:4 (FLOAT ACC DRG 5607 W/ARM ADAPTOR DRG 2735 & ROTATION 35°)
			C1					1 MIN CONTACT
			C2					1 MIN + 1 MAX CONTACTS
			D1					2 MIN CONTACTS, ALARM + TRIP
			D2					2 MIN CONTACTS SIMULTANEOUS
			D4					2MIN + 2MAX CONTACTS SIMULTANEOUS
				N				HNBR GASKETS (AMBIENT TEMPERATURE -40/55 °C)
				C				NBC CORK GASKETS (AMBIENT TEMPERATURE -20/50°C)
				G				LT CORK GASKETS (AMBIENT TEMPERATURE -55/50°C)
				S				SPECIAL GASKETS
					0			STANDARD & TROPICAL (DIAL MADE IN P.M.M.A. AND SCREWS MADE IN AISI 304)
					7			DESERT AND / OR MODERATED CORROSIVE (DIAL MADE IN TEMPERED GLASS AND SCREWS MADE IN AISI 304)
					8			EXTREMELY CORROSIVE (DIAL MADE IN TEMPERED GLASS AND SCREWS MADE IN AISI 316)
					9			SPECIAL
						0		MIN/-20°C/20°C/85°C/MAX
						1		MIN/1;2;…8;9;10/MAX
						5		MIN / 25°C/ MAX
						9		SPECIAL
AN								LEGENDA
AN	*R*	*1*	*A*	*C*	*1*	*N*	*0*	*0*	*EXAMPLE*
	STYLE	SIZE	MOUNTING SKETCH	WIRING DIAGRAM		CLIMATIC CONDITIONS	ENVIRONMENTAL CONDITIONS	DIAL MARKING	

MARKING ON DATA PLATE

CEDASPE CODE

NOTE ON CABLE ENTRY :
OIL LEVEL INDICATOR IS SUPPLIED WITH CABLE ENTRY M25X1.5 AND ADAPTOR TO M20x1,5.
DIFFERENT CABLE ENTRIES AND CABLE GLAND ARE AVALAIBLE ON DEMAND (SEE PAGE 5 OF CATALOGUE)

SPECIAL REQUIREMENTS / NOTE / OPTIONALS
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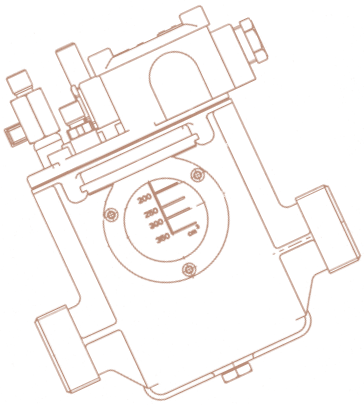
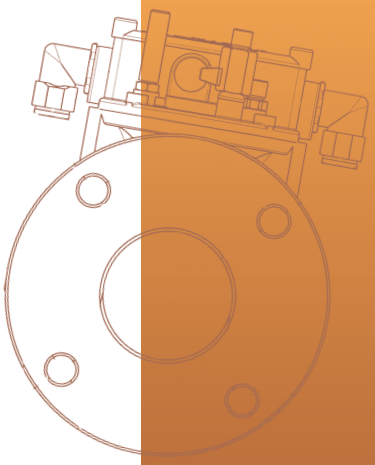
SECTION 11

Appendix E

Buchholz Relay Gas Relay

ABB/Comem BS50 (18 pages)





GAS-ACTUATED RELAYS

BUCHHOLZ TYPE

ACCORDING TO

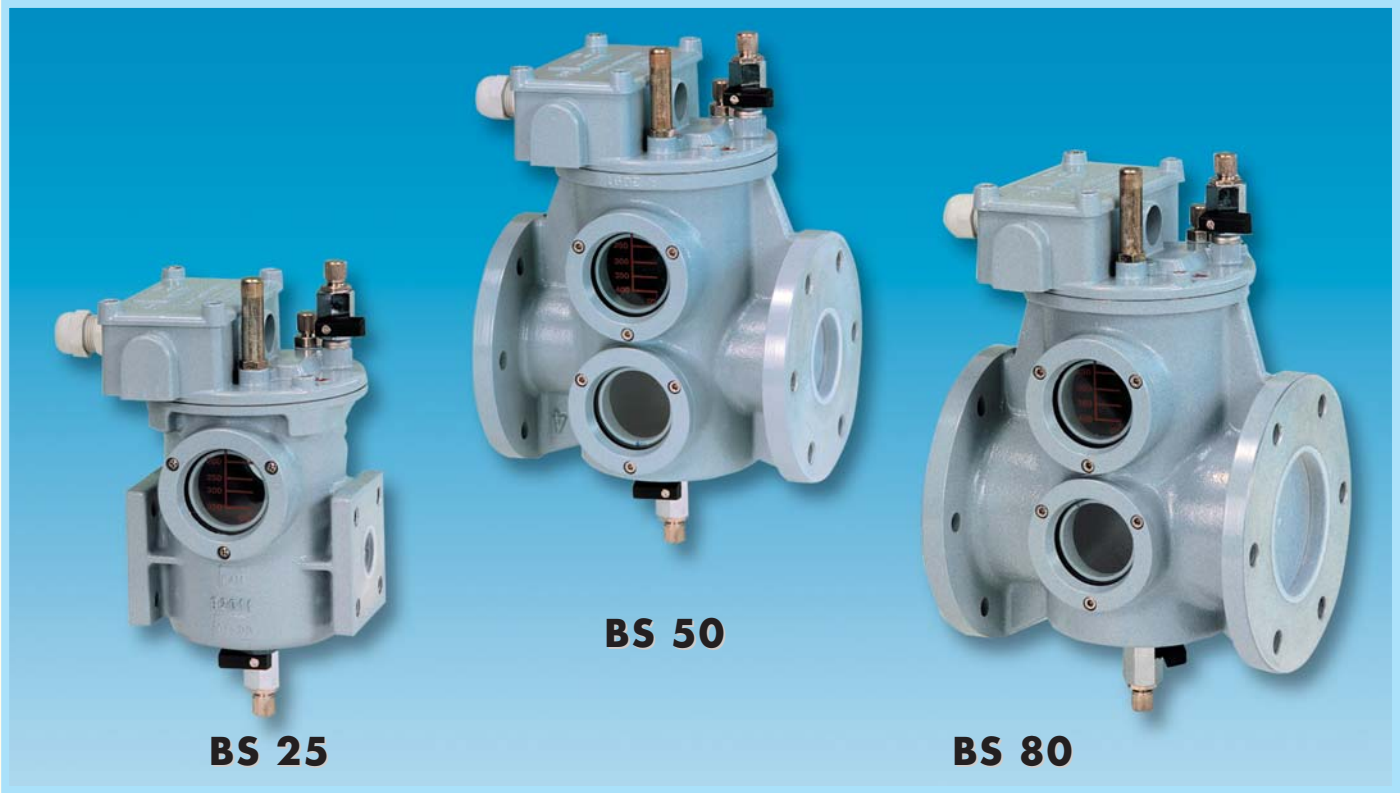
CENELEC EN 50216-2 STANDARD

AND

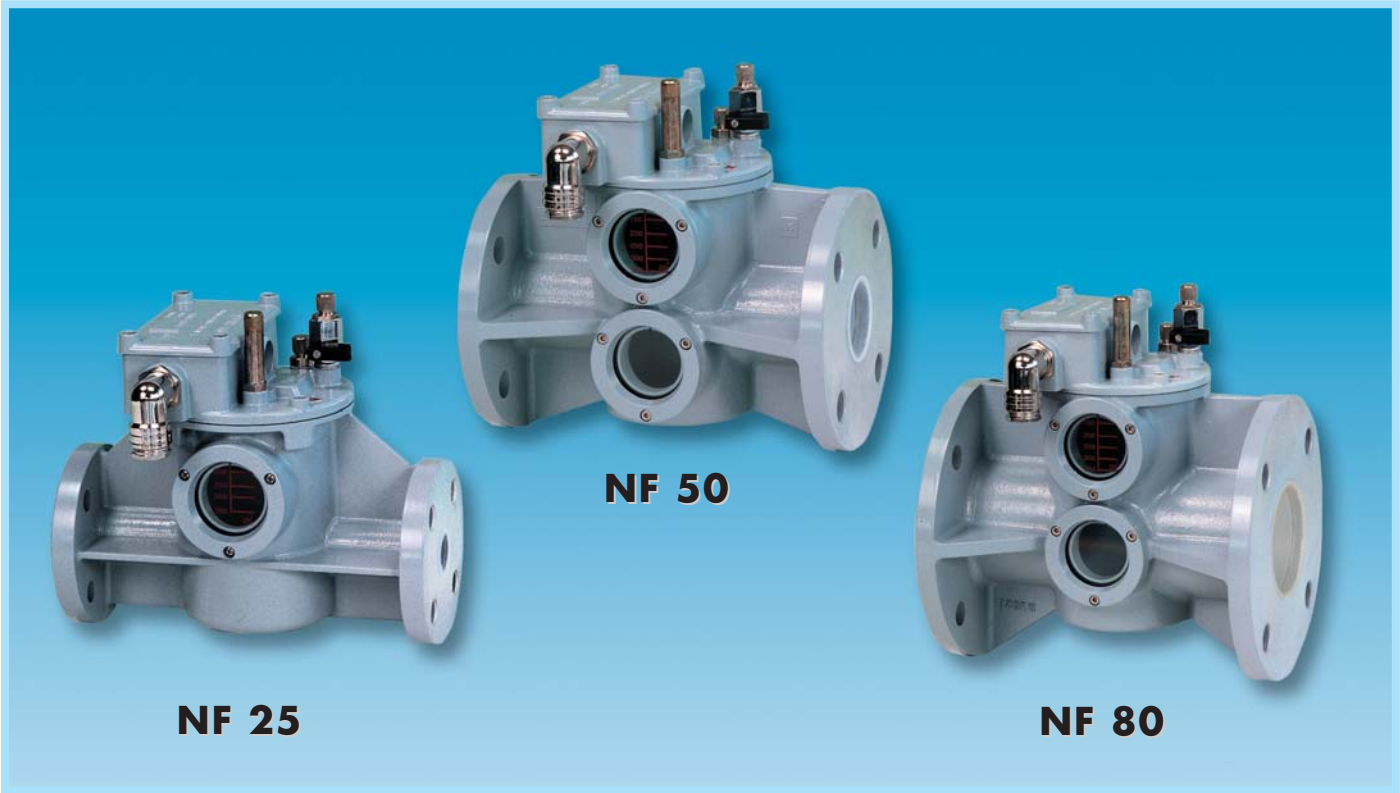
GAS SAMPLING DEVICE

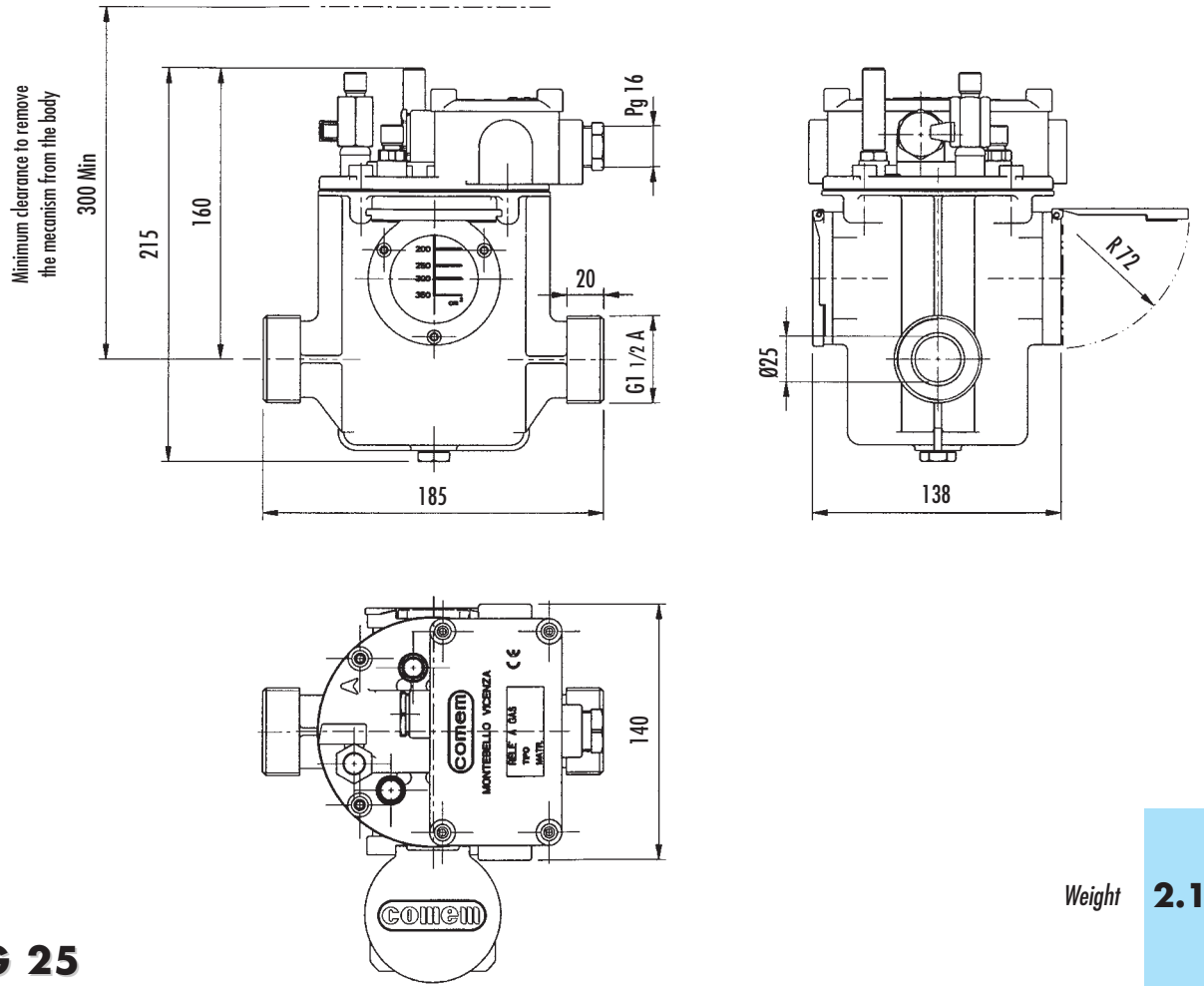
comem®

GAS-ACTUATED RELAYS BUCHHOLZ TYPE



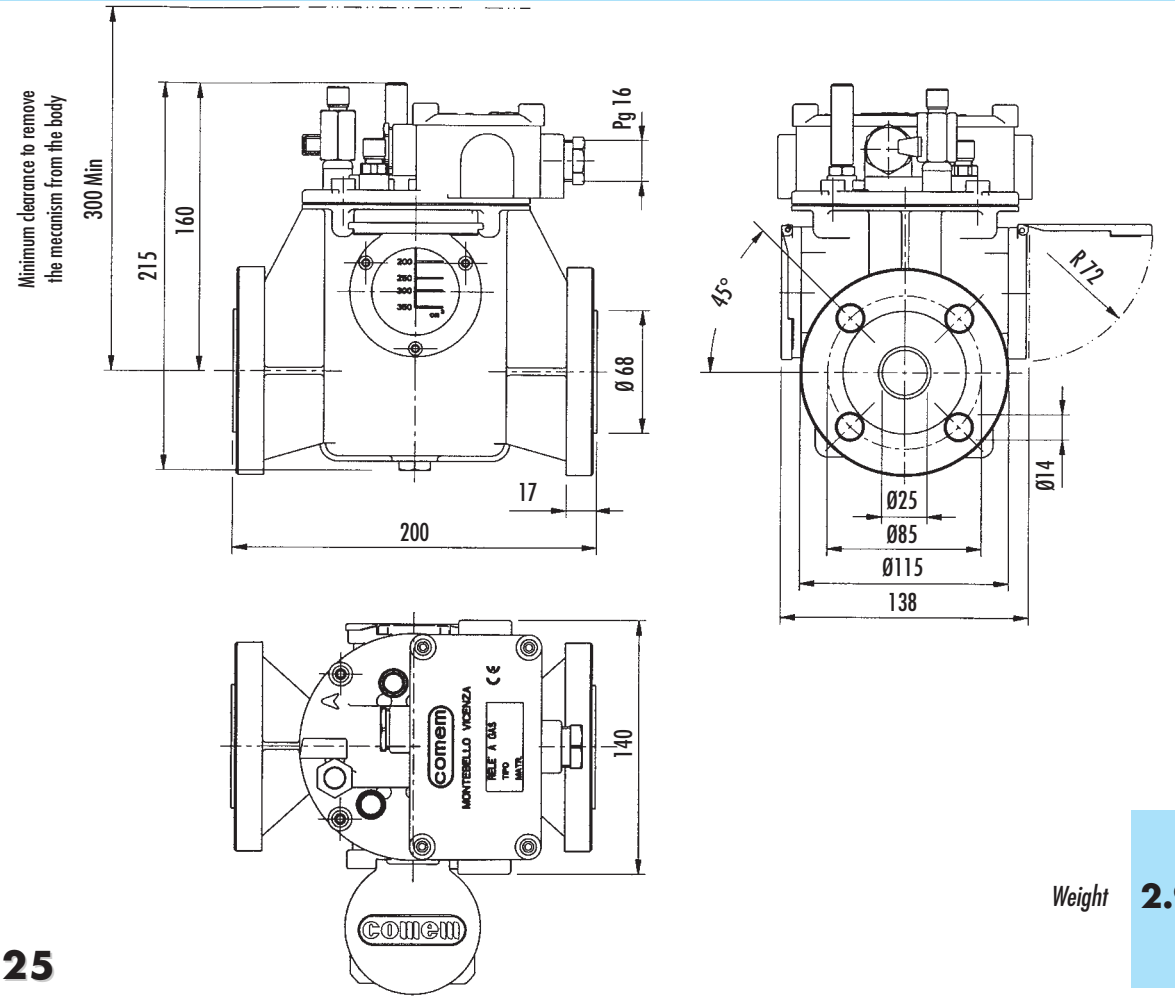
GAS-ACTUATED RELAYS BUCHHOLZ TYPE





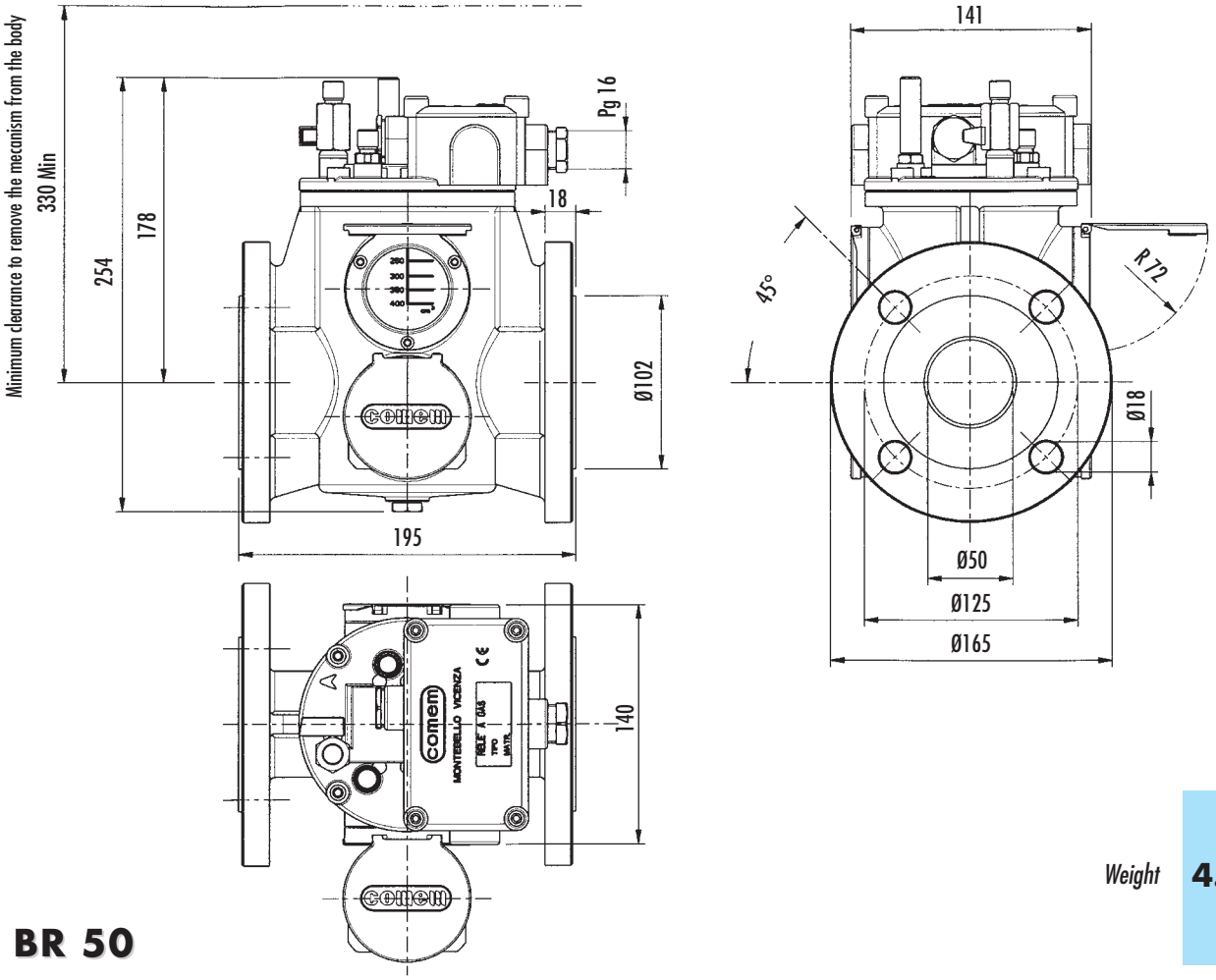
BG 25

Weight **2.1 kg**



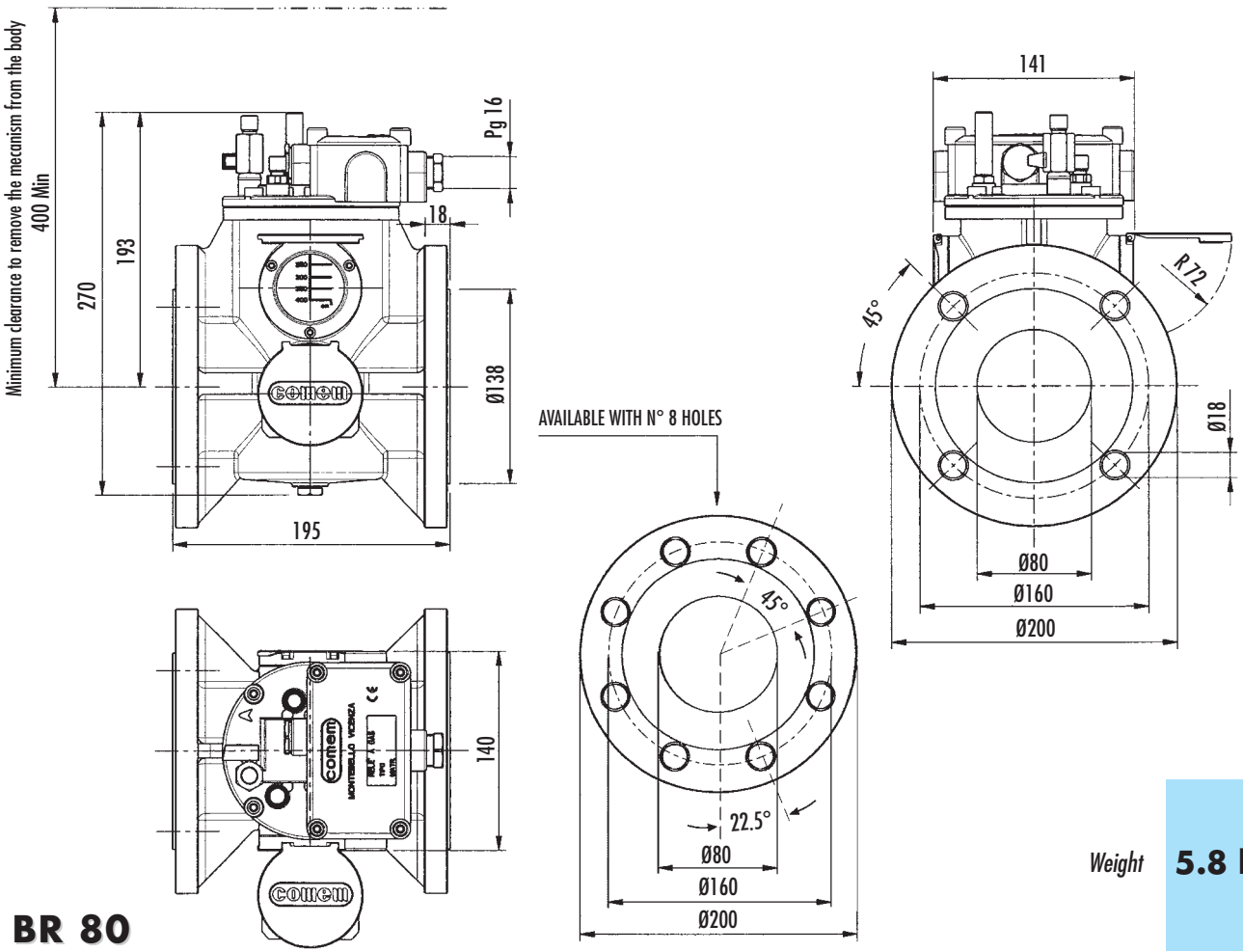
BR 25

Weight **2.9 kg**



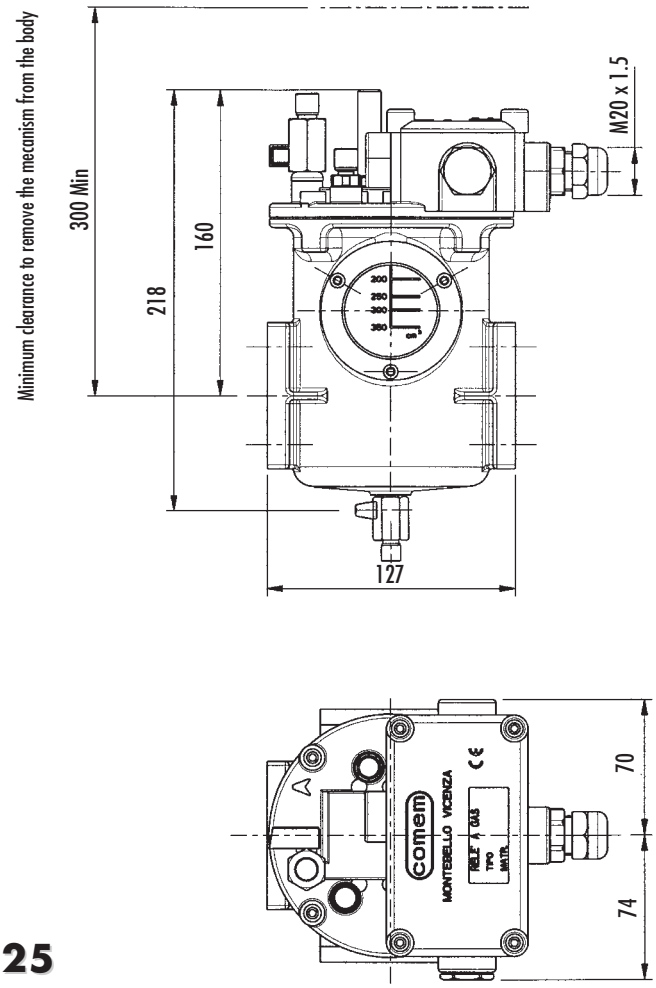
BR 50

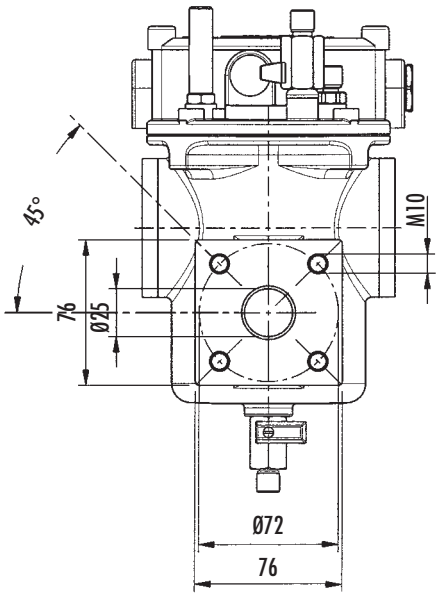
Weight **4.9 kg**



BR 80

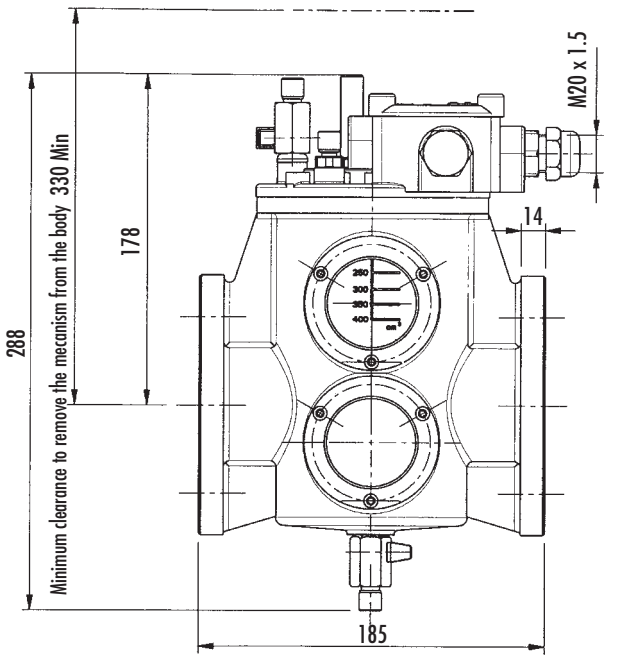
Weight **5.8 kg**

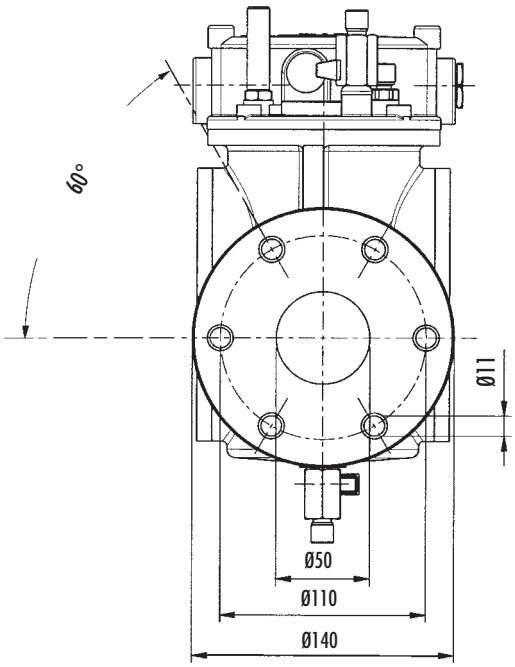




BS 25

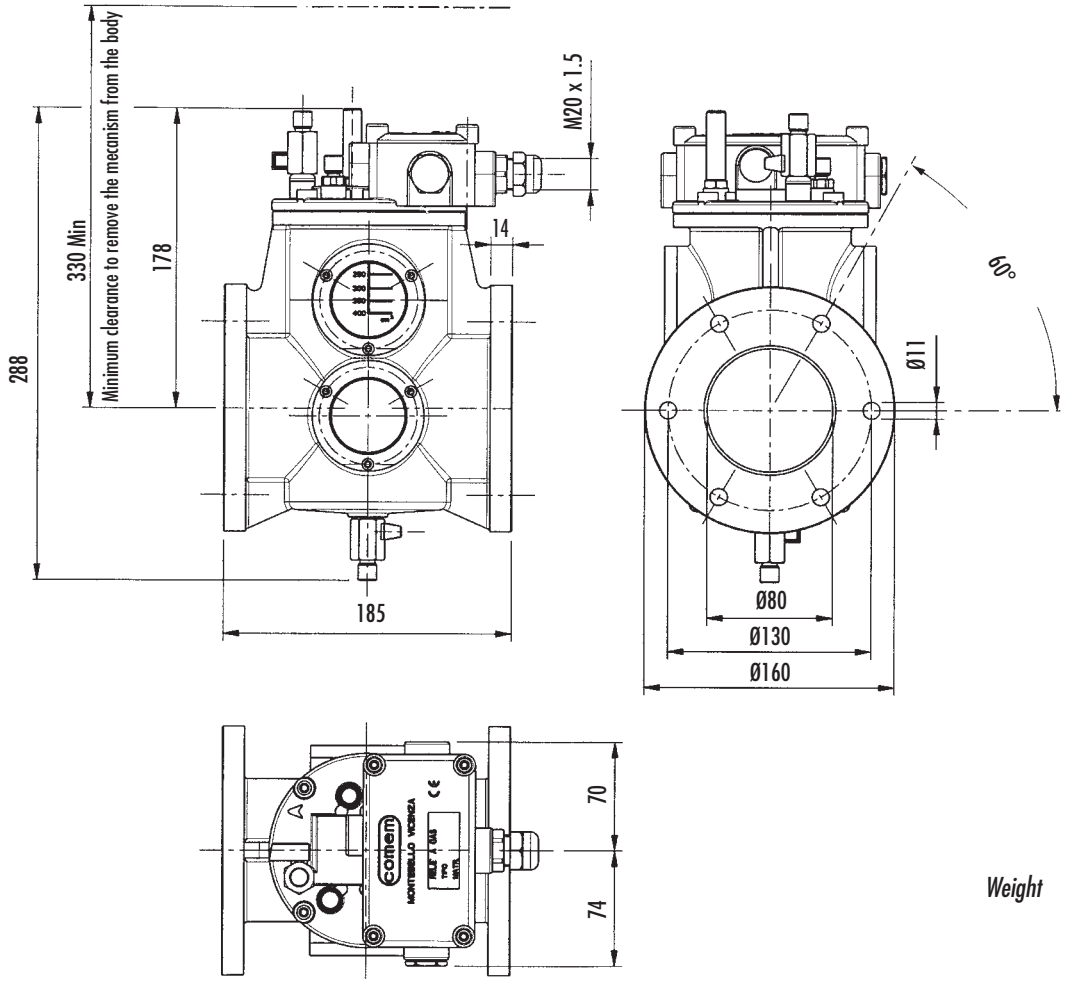
Weight **2.2 kg**





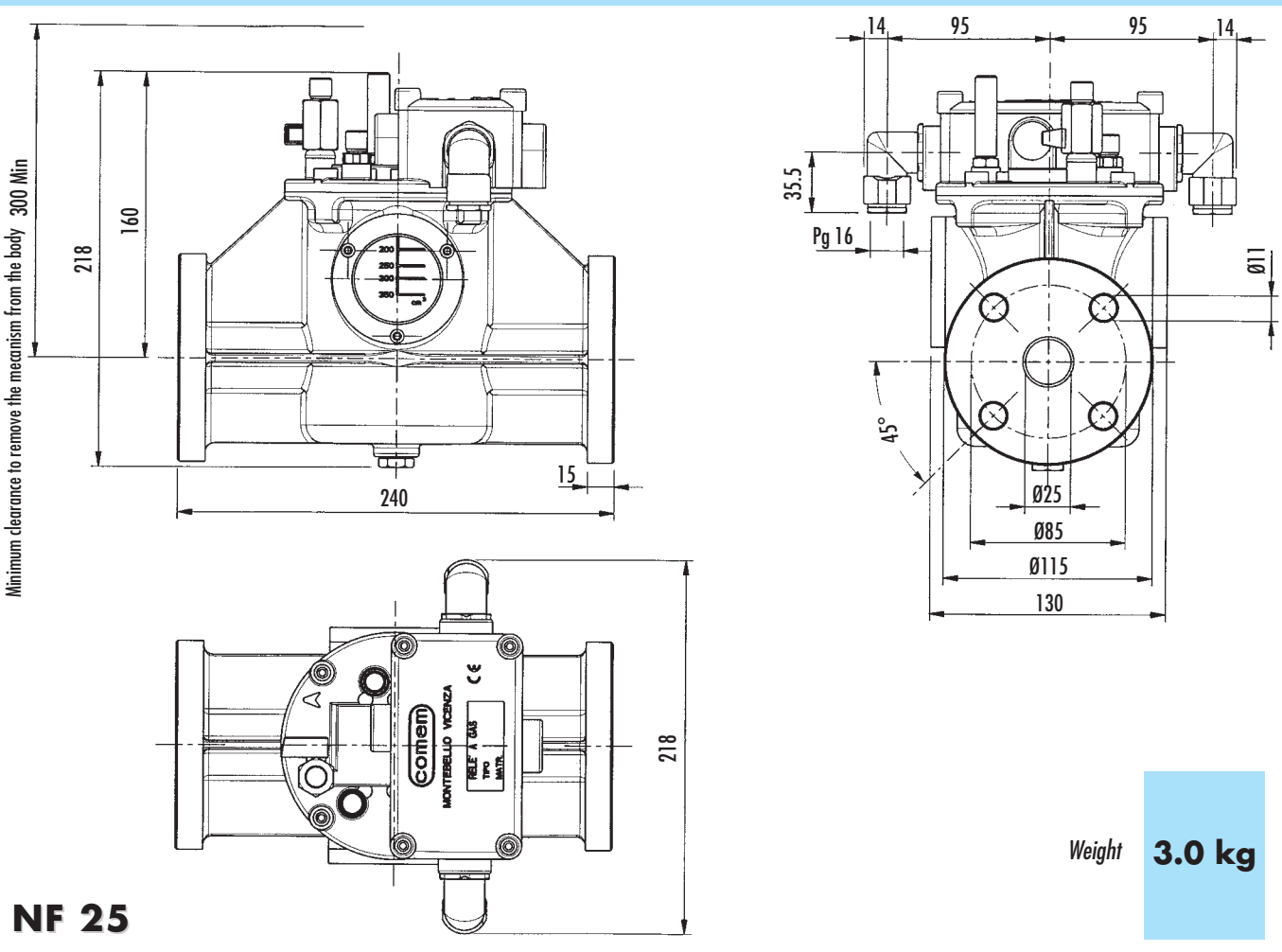
BS 50

Weight **4.1 kg**



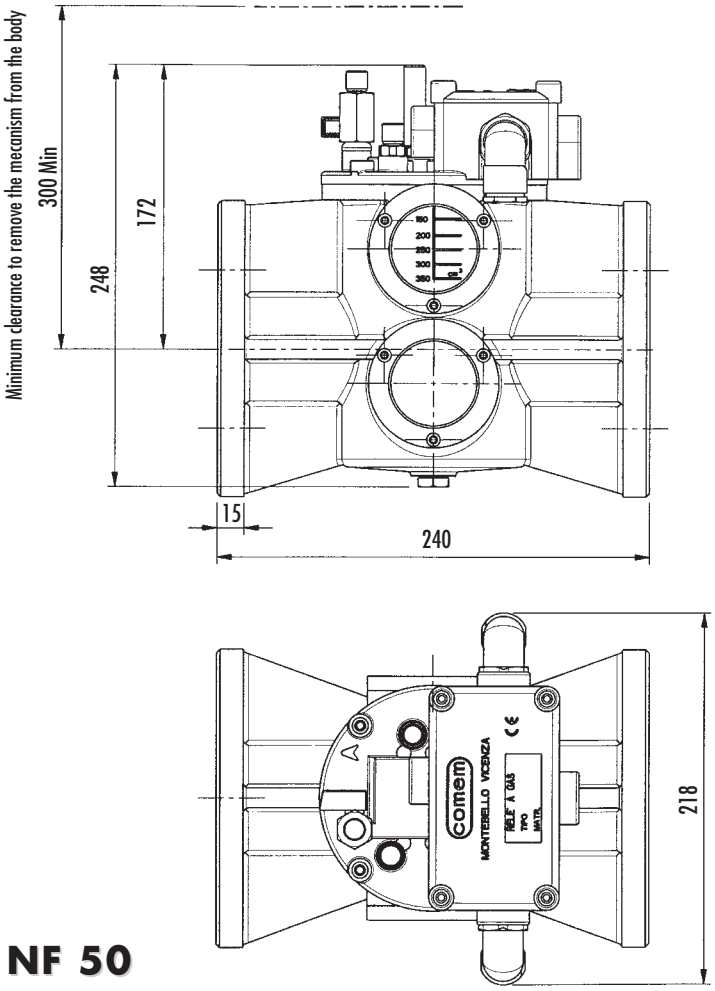
BS 80

Weight **4.3 kg**



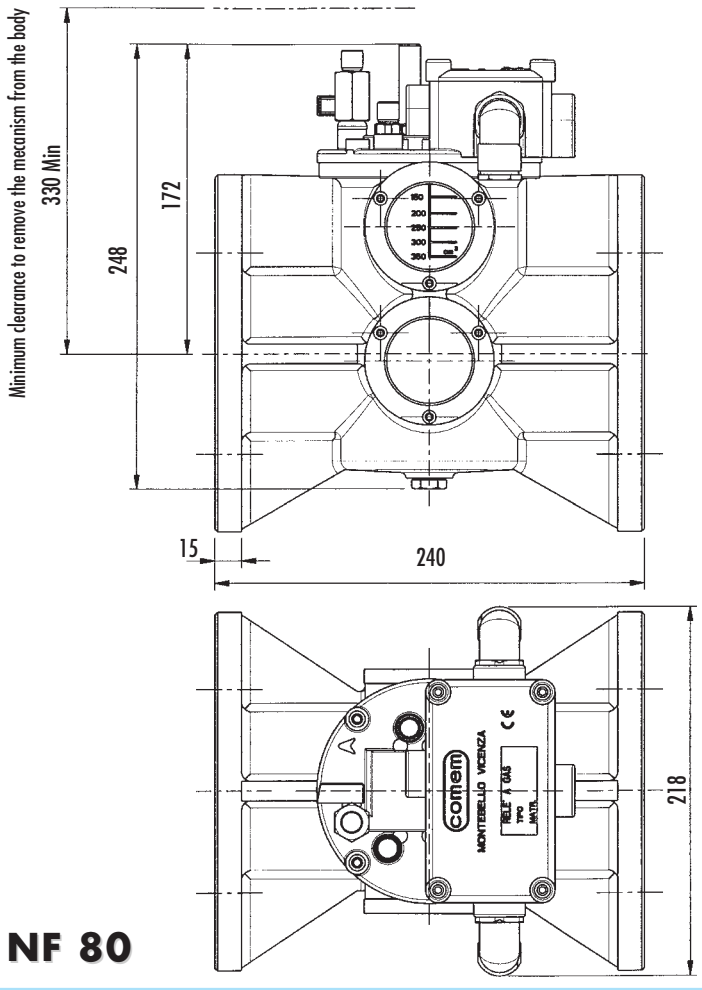
NF 25

Weight **3.0 kg**



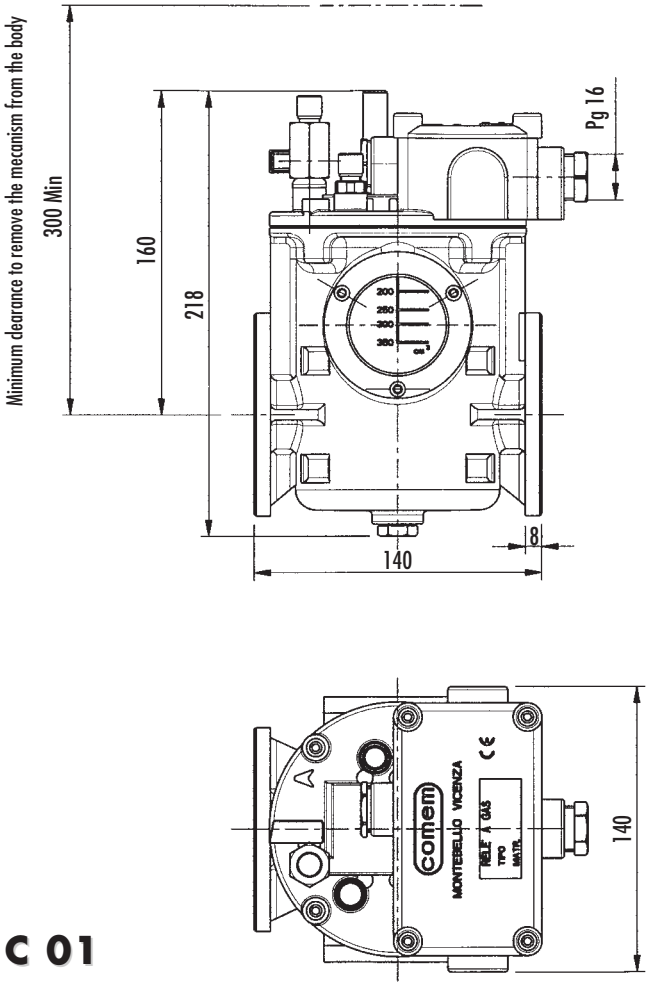
NF 50

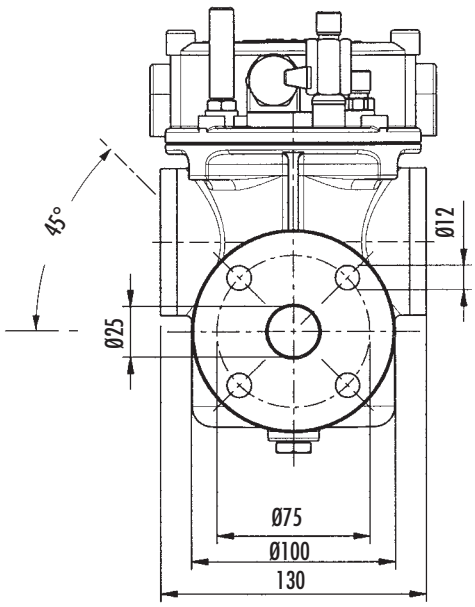
Weight **4.8 kg**



NF 80

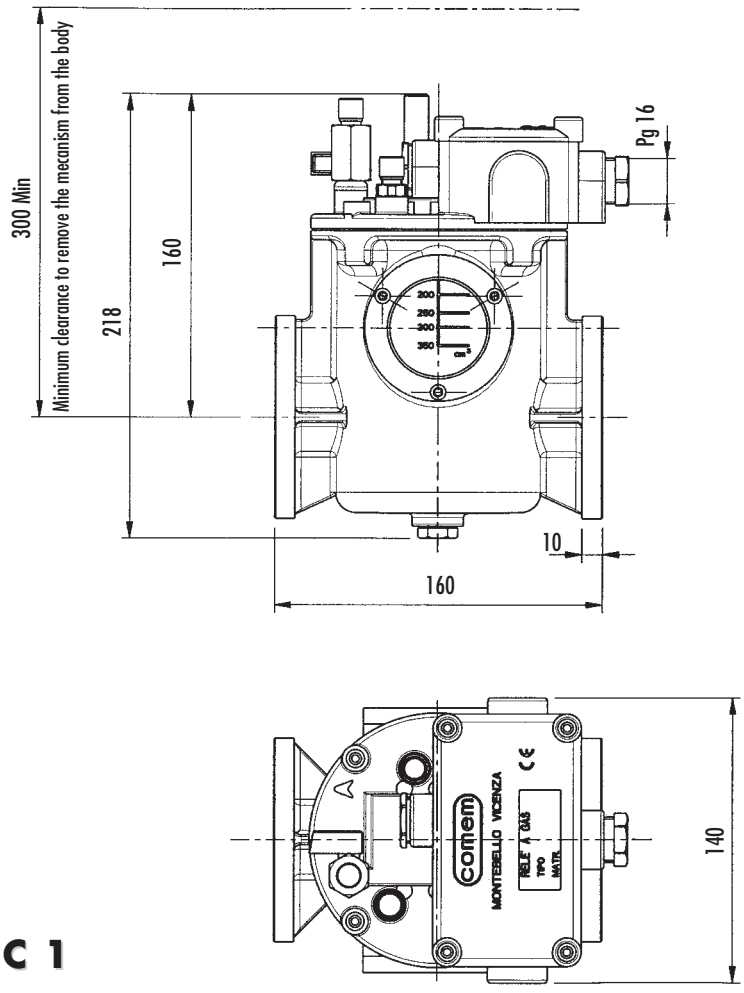
Weight **5.5 kg**

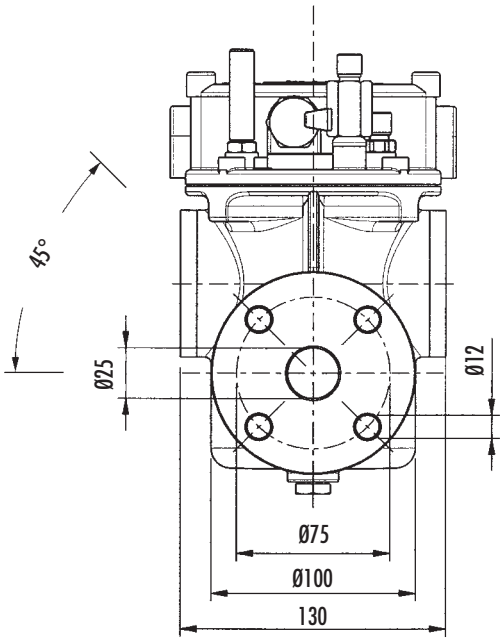




C 01

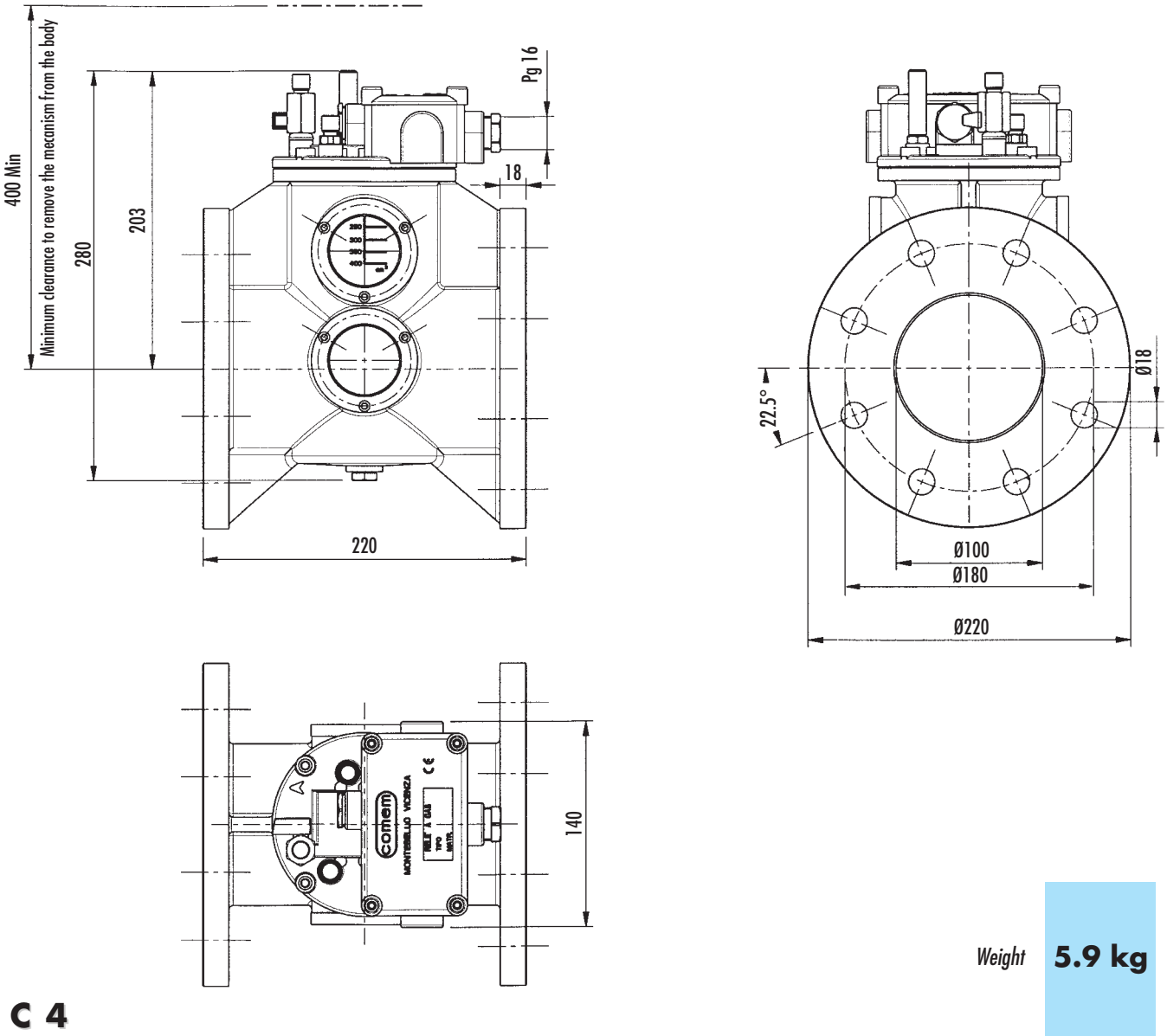
Weight **2.2 kg**





C 1

Weight **2.3 kg**



C 4

Weight **5.9 kg**

BUCHHOLZ GAS-ACTUATED RELAY
to CENELEC EN 50216-2 standard

The generation of gas in an oil filled trasformer is a clear indication of a problem. The gas may be a result of the following:

• Decomposition/degradation of solid, or liquid insulation inside the transformer due to overheating, or arcing.

• From the outside towards the pipeline.

• From the oil itself due to unsatisfactory de-gassing prior to filling.

Rapid oil movement in the pipeline towards the conservator is caused by an internal arc, short circuit, or hot spot which must be correctely addressed.

Oil leaks from the transformer are environmentally unacceptable and a fire hazard will lead to transformer failure.

To indicate any of the above malfunctions Comem as the result of 40 years experience with these products has developed a new "Buchholz" relay to comply fully with the latest CENELEC EN 50216-1 and EN 50216-2 standards.

The new relay incorporates the very latest technology in its construction.

PRINCIPLE OF OPERATION

The Buchholz relay is sited in the pipework between the transformer and its conservator and it is filled with oil during normal transformer operation. When gas is generated in the transformer it rises towards the conservator and collects in the upper chamber of the relay.

The oil level drops and the top float triggers alarm switch.

Gas shall not freely pass from the relay body and escape into the pipewoek before the alarm contact has operated.

The trip contact shall operate at a steady oil flow as indicated in Table 3.

This operation shall not be adversely affected when the alarm contact has already closed and gas is escaping freely.

In the event of an oil leak the Buchholz relay will only operate after the conservator has exhausted all of its oil. In order to check this eventuality it is recommended that an RDR MK II automatic shutter valve is fitted between the Buchholz and the conservator.

Specific information on this product are available on request.

CONSTRUCTION

The new Comem Buchholz relay is an assembly of two machined aluminium alloy castings that effect a perfect oil seal.

1) The main body of the relay is fitted with tempered glass inspection windows with graduated scale markings in cubic centimetres to indicate the internal volume. The oil drain plug is located at the bottom of the main body.

2) The top cover carries the frame which contains the moving parts of the relay. These comprise the two floats and their associated switches encapsulated in glass bulbs, one calibrated flow valve and two permanent magnets.

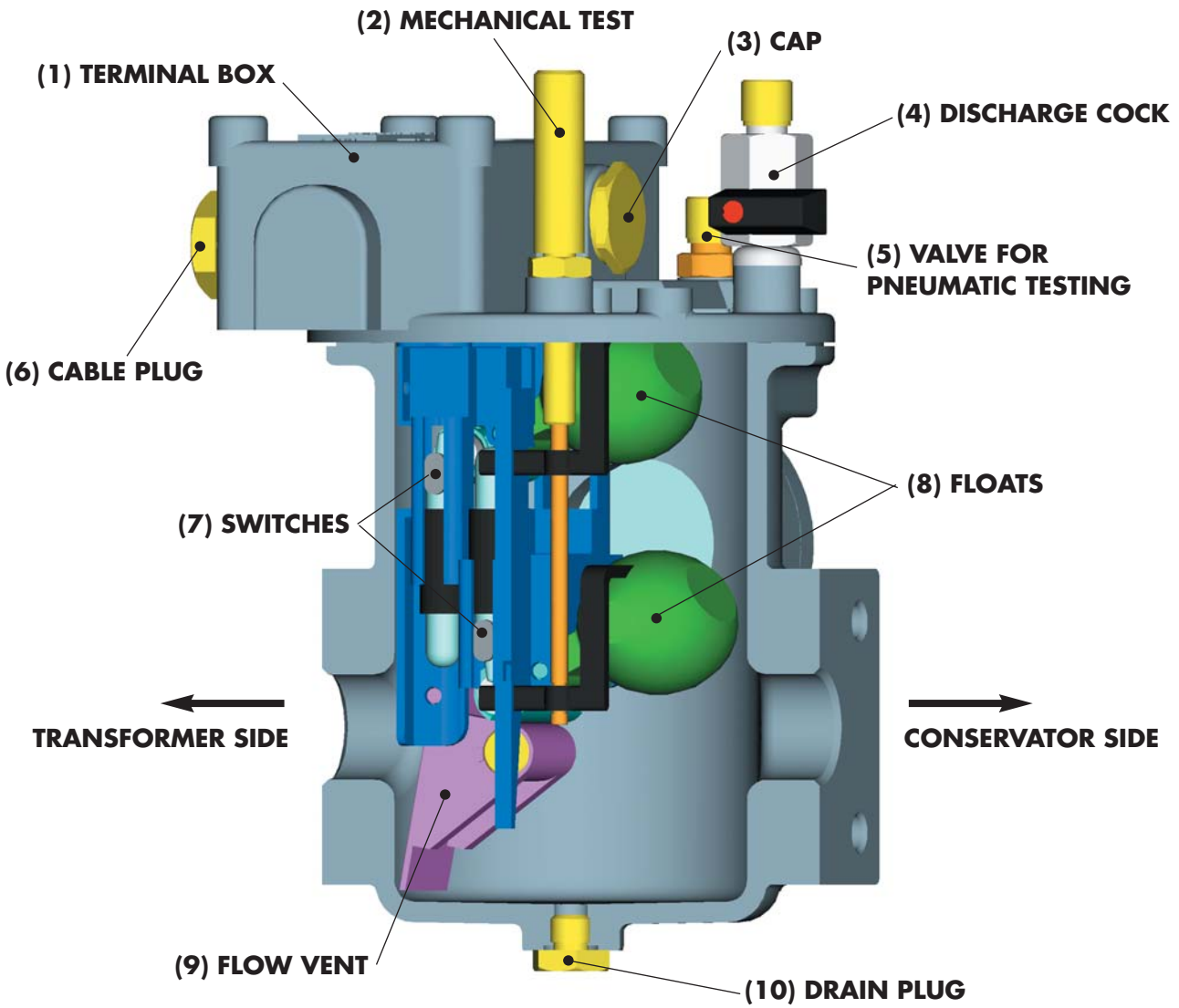
The cover also carries:

(4) a gas discharge valve with G1/8" in male thread with protective cap.

(5) A valve for pneumatically testing the alarm and insulation circuits, with protective cap.

(2) A push rod for mechanically tripping the alarm and the insulation circuits, with protective cap.

A terminal box which as standard contains 4 numbered M6 terminals and one earth terminal.



EXTERNAL COATING AND PROTECTION

To the external aluminium alloy parts is given a phosphate treatment prior to applying one coat of vinyl enamel, colour RAL 7001. This treatment has proved more than satisfactory over the years for the majority of applications including desert and tropical situations. However, in particularly severe applications (>500h salt fog) such as applications in corrosive atmospheres (acids) a suitable epoxy primer is recommended. (This should be discussed at the time of selection).

All external brass fittings are plated and all nuts are made in stainless steel.

RELAY SELECTION

The size and type of relay to be used will depend on the transformer rating and oil volume. Suggestions are given in the following table but the final choice is often as a result of the transformer manufacturers experience.

MVA TRANSFORMER POWER	NOMINAL DIAMETER
Up to 5	25
From 5 up to 20	50
From 20 up to 50	80
Over 50	100

tab. 1

TECHNICAL DATA

- The relay pipework is typically mounted at 2,5 degrees to the horizontal. A positive inclination of up to 5 degrees to the horizontal axis is admissible.
- Operating pressure - 1 bar, tested to 2,5 bar for 2 minutes at 100 deg C.
- Gas volume to trip alarm:

BUCHHOLZ RELAY TYPE	GAS VOLUME NECESSARY TO TRIP THE ALARM
BG 25, BR 25, NF 25, C 01 , C 1	100÷200
NF 50, NF 80	100÷200
BR 50 , BR 80, C 4	150÷250
BS 25	170÷230
BS 50, BS 80	250÷300

tab. 2

- Rate of oil flow in m/s to trip insulation. In the following table standard values are highlighted with an '**O**' available, on request with an '**X**' and not available with a '**//**'. +/- 15% tolerance at 20°C with oil viscosity according to IEC296.

INSIDE PIPE DIAMETER	1,0 m/s	1,5 m/s	2,0 m/s
25	**O**	**X**	**X**
50	**O**	**X**	**X**
80	**O**	**X**	**X**
100	//	**O**	**X**

tab. 3

- The relay operates within 0,5 seconds.
- Oil temperature between -25 and +115 deg C.
- Ambient temperature between -25 and +60 deg C.
- Degree of Protection IP65 to EN 60529.

SWITCH ELECTRICAL DATA

Rated switch current is **2 A r.m.s**. with max. **10 A r.m.s.** as short term 30 ms current value.
Breaking power is specified in the following table:

VOLTAGE	CURRENT	BREAKING POWER	
220 V d.c. (min. 12 V)	2 A for 10000 maneuvers	250 W	L/R < 40 ms
230 V a.c. (min. 12 V)	6 A for 1000 maneuvers	400 VA	cos φ > 0,5

tab. 4

Dielectric contact voltage as specified in the following table:

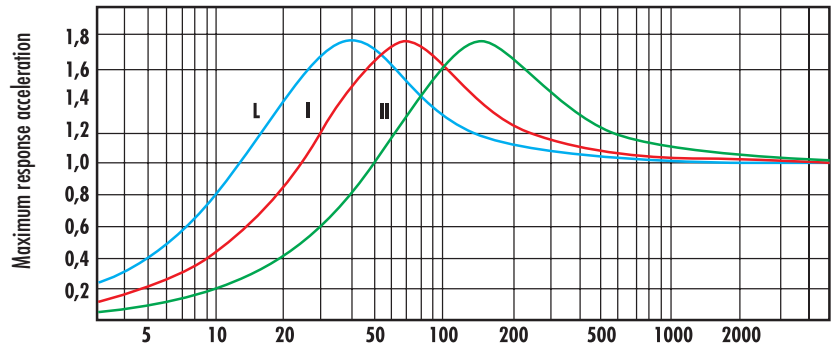
	SHORT TERM INDUSTRIAL FREQUENCY LEAKAGE TEST kV/1 min. (r.m.s)	RESISTANCE VOLTAGE PER PULSE kV (peak)
Between circuits and ground	2.5	5
Across open contacts	1	3

tab. 5

TESTING

The following Type Tests have been performed on the relay.

- Measurement of the volume of gas necessary to trip the alarm.
- 500 hr salt fog.
- Electromagnetic Field Test. Relay does not trip in field strength up to **25 mT** (ref EN 50216-2).
- Stationary sinusoidal mechanical vibrations. Tests according to EN 60721-3-4 standards have been performed.
  a) class **4M4** (4M6 on request) vibration test applied in sites where vibrations are transmitted from machinery and vehicles. Not suitable for machines exposed to high vibration and shock levels. Three-axis movement was impressed to the relay using special equipment with stationary sinusoidal vibrations from **2** to **200 Hz.** Movement had a constant **3 mm** (6 mm peak-peak) amplitude in the range from **2** to **9 Hz** whereas above this frequency it had constant **10 m/s²** acceleration. The alarm and release switches did not trip.
  b) non-stationary vibration tests with vertical shock with **100 m/s²** acceleration with type I spectrum (duration 11 ms) as shown in the graph below. Alarm and release contacts did not trip. On demand we are able to manufacture Buchholz relays with special features and test values higher than the ones stated above.



Example duration of a sinusoidal half pulse:

Type L spectrum: 22 ms duration

Type I spectrum: 11 ms duration

Type II spectrum: 6 ms duration

- A seismic test was also performed according to EN 50216-1 standards that refers to EN 60068-3-3 class 0, level 2 standards. The test consists of application of a **9 m/s²** horizontal acceleration and a **4.5 m/s²** vertical acceleration, increasing frequency one octave per minute. No activation of alarm or release switches was encountered.
- Pressure Withstand Test 2.5 bar for 2 minutes with oil at 100 deg C.
- Vacuum Withstand Test of 2500 Pa for 24 hrs.
- Rate of oil flow test to operate trip contcts, (as shown in table 3).
- Test to show the relay is insensitive to oil flow from conservator to transformer.
- Electrical tests per table 5.

ROUTINE TESTS

The following Routine Tests are applied to all relays.

- Hydraulic seal test in mineral oil at 90 deg C and 100 kpa pressure for 30 minutes.
- Contact operation via mechanical push rod.
- Contact operation by lowering the oil.
- Rate of oil flow to trip contacts.
- Electrical withstand test between contacts (as table 5).
- Electrical withstand test between contacts and earth (as table 5).

An individual routine Test Report is shipped with each relay

RELAY OPERATING TEST

The following site Tests can be performed when the relay is installed on the transformer
The Alarm and Trip contacts can be tested manually by the push rod (2) - mechanical test, or (only for alarm contact) by the introduction of air into the relay through valve (5) - pneumatic test.
A bicycle pump can be utilised for this test or a kit article n° **5400806002** is available from Comem.
To effectively test the rate of flow of oil is a complex test requiring specialised equipment. Should this test be required other than as a type test then Comem can perform this on request at the time of the order.

INSTALLATION INSTRUCTIONS

The following installation procedures must be observed for proper relay operation:

- The red arrow on the relay must point towards the conservator.
- The relay must always be full of oil, which means that the minimun oil level in the conservator must be higher than the relays breather valve.
- The recommended inclination of the relay pipework is 2.5 degrees from the horizontal.
- The pipe from the transformer to the relay must exit the transformer at the highest point.
- The pipeline upstream from the relay has to be straight and with a length equal to **5-10 times** the pipeline diameter, at least. Down stream from the relay, pipeline length has to be **3 times** the pipeline diameter, only. It must rise up towards the conservator.

RELAY ORDER FORM

Chosen size and model (see drawings and table 1):

BG 25	BR 25	BR 50	BR 80	BR 80 8 holes	BS 25	BS 50	BS 80	NF 25	NF 50	NF 80	C 01	C 1	C 4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Electric contact layout (meaning with relay filled with oil and operating):

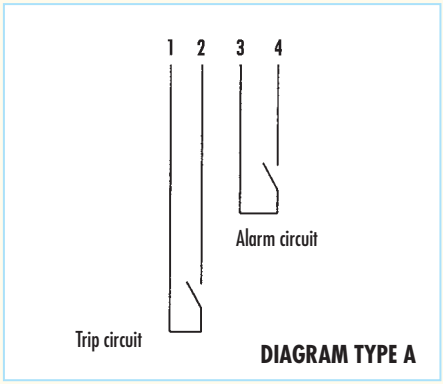


DIAGRAM TYPE A

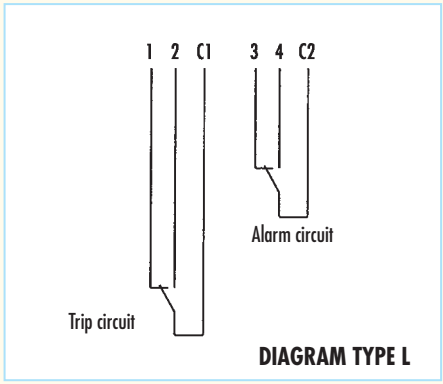


DIAGRAM TYPE L

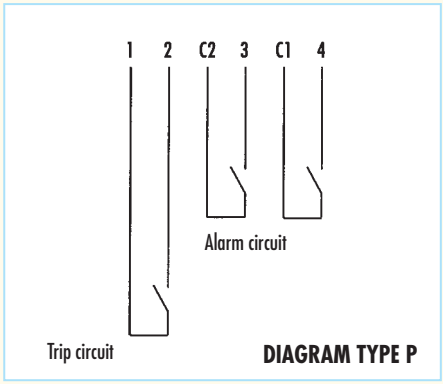


DIAGRAM TYPE P

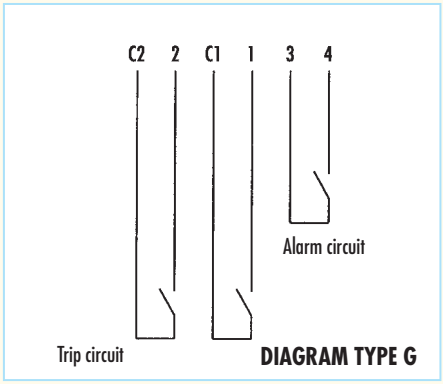


DIAGRAM TYPE G

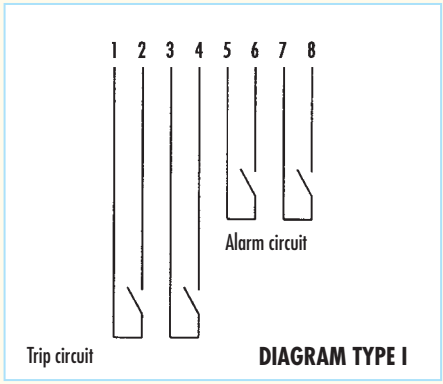


DIAGRAM TYPE I

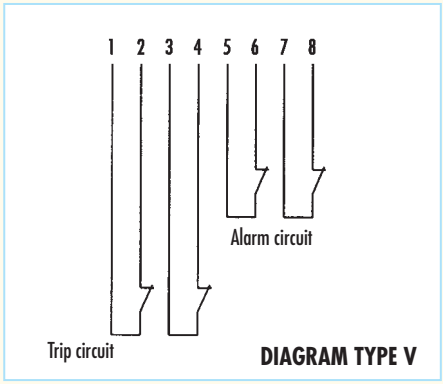


DIAGRAM TYPE V

A	L	P	G	I	V	Other
☐	☐	☐	☐	☐	☐	☐ _____

Chosen seals:

A	B	C	Other
☐	☐	☐	☐

	TYPE OF DIELECTRIC / AMBIENT TEMPERATURE/OIL		MINERAL	SILICONE	ESTERIZED
A	Ambient -25° ÷ 60° C Oil -25° ÷ 115° C	Standard version	NBR	VITON/NBR	//
B	Ambient -10 ÷ 60° C Oil -10° ÷ 115° C	Special version	//	VITON	VITON
C	Ambient -40° ÷ 60° C Oil -40° ÷ 115° C	Special version	NBR/VITON	NBR/VITON	NBR/VITON

(NBR/VITON: meaning: parts in contact with oil in VITON, parts not in contact with oil in NBR) tab. 6

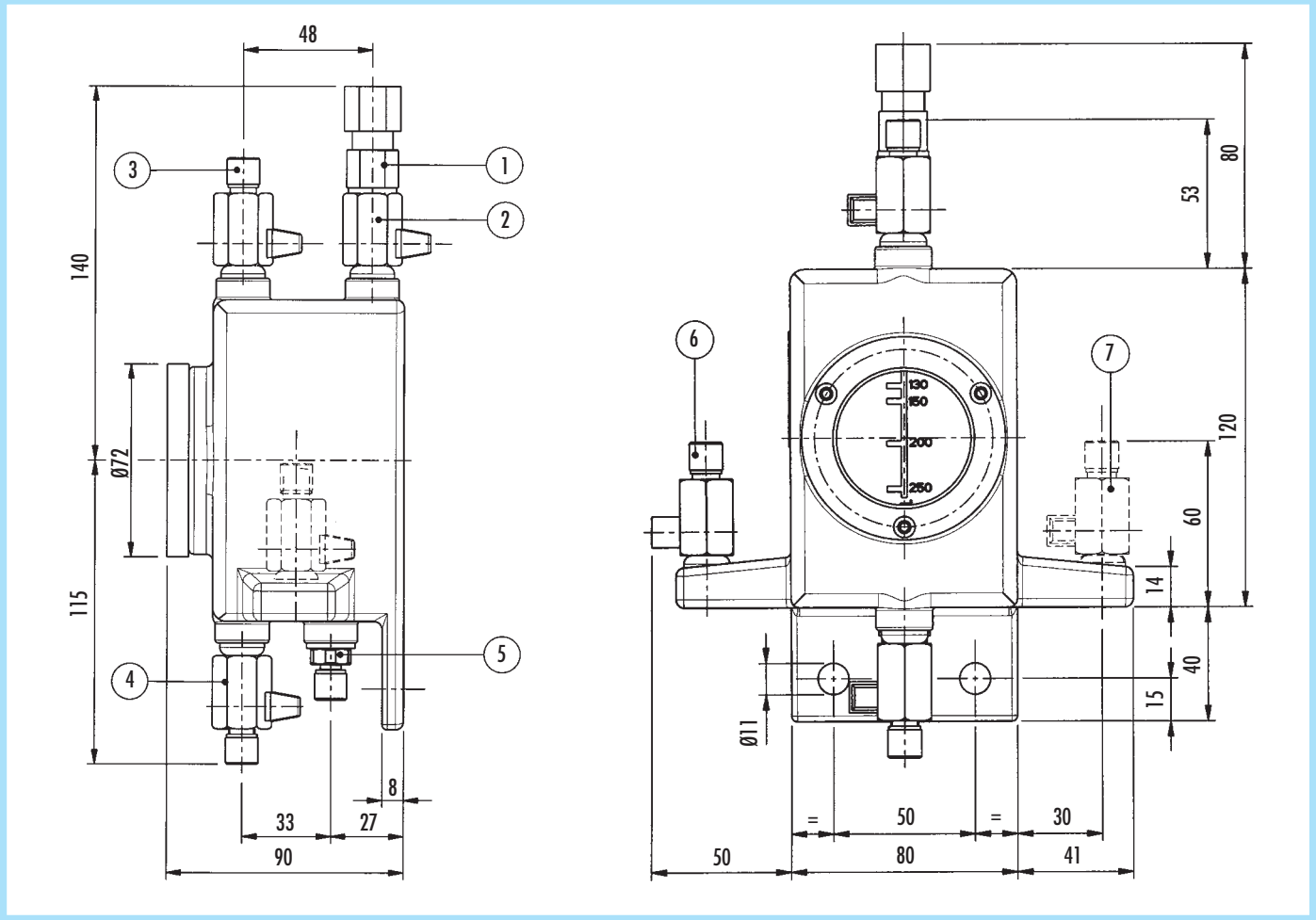
Paint finish:

Standard	Corrosive environments	Other special finishes
☐	☐	☐ _____

GAS SAMPLING DEVICE WITH APPLICATION OF THE BUCHHOLZ RELAY OIL DRAIN COCK

PRINCIPLE OF OPERATION

The presence of gas inside an oil filled transformer is always a sign of malfunction and one of the tasks of the Buchholz relay is to signal this presence. Analysis of the evolved gas can often give good indication of the type of malfunction but accessing the Buchholz relay during live operation of the transformer can be hazardous.
The gas sampling device has been designed to overcome this problem by siting the unit remote from the Buchholz and in a readily accessible position typically on the side of the transformer.

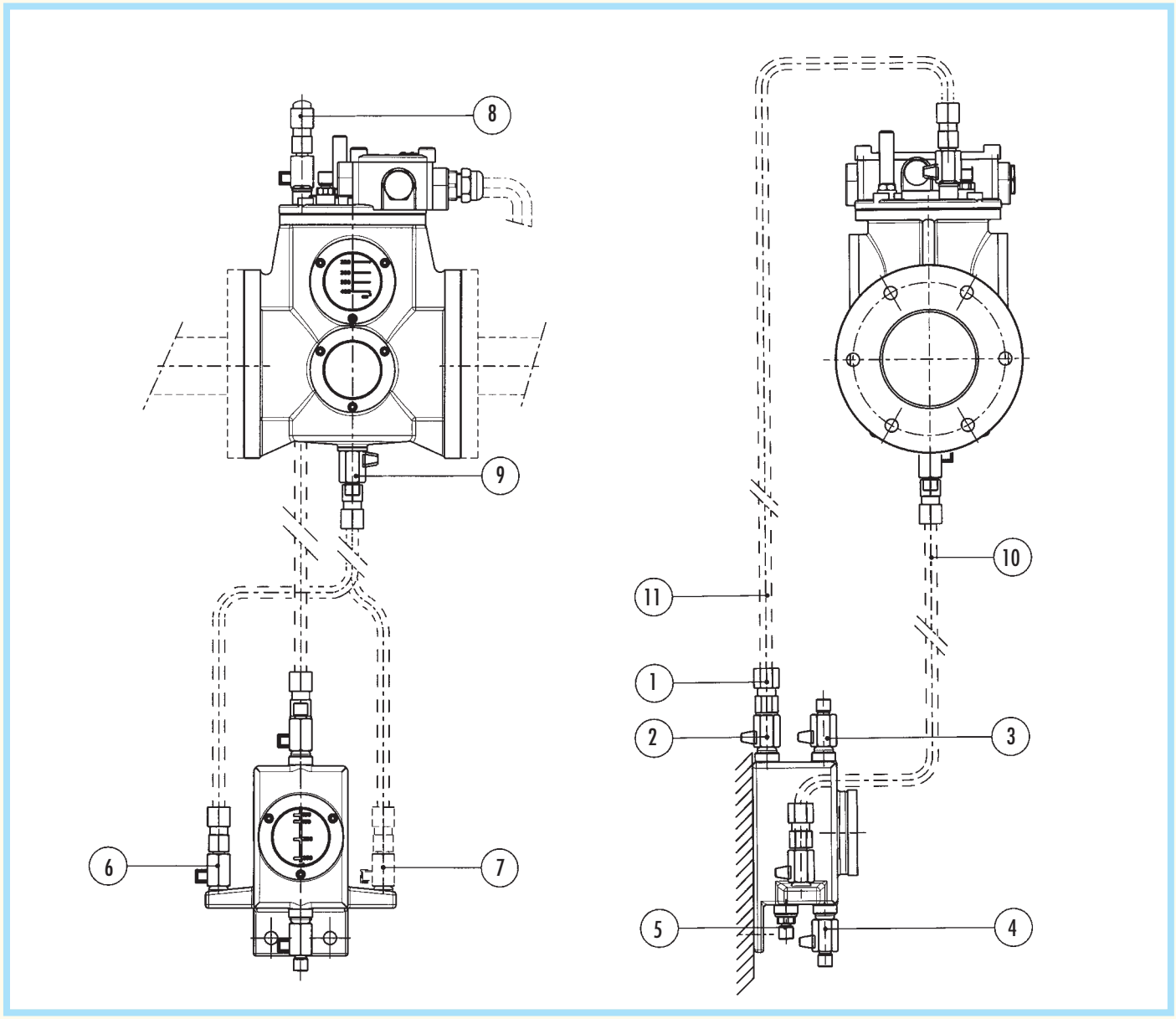


CONSTRUCTION

The Comem gas sampling device is manufactured from an aluminium alloy casting with the following fittings:
- A tempered glass inspection window with graded markings for volume indication.
- A gas sampling valve (2).
- A bleed valve (3).
- A gas inlet valve for pneumatic testing (5).
- A valve for draining oil from the relay (this can be mounted on the right or left hand side of the body (6) or (7).

As a routine test all castings are tested by injecting ambient air at 2.5 bar for 2 minutes.
A certificate to this effect is supplied with the unit.

For the sake of standardisation the device is fitted with the left and right hand valve supports but only one valve.
Customer can then choose which side he prefers.
- With fittings for outside dia. 10 tubes, code **1RDPG00005** (standard);
- with fittings for outside dia. 6 tubes, code **1RDPG00006** (on request);
- with fittings for outside dia. 8 tubes, code **1RDPG00007** (on request).



DESCRIPTION OF OPERATION

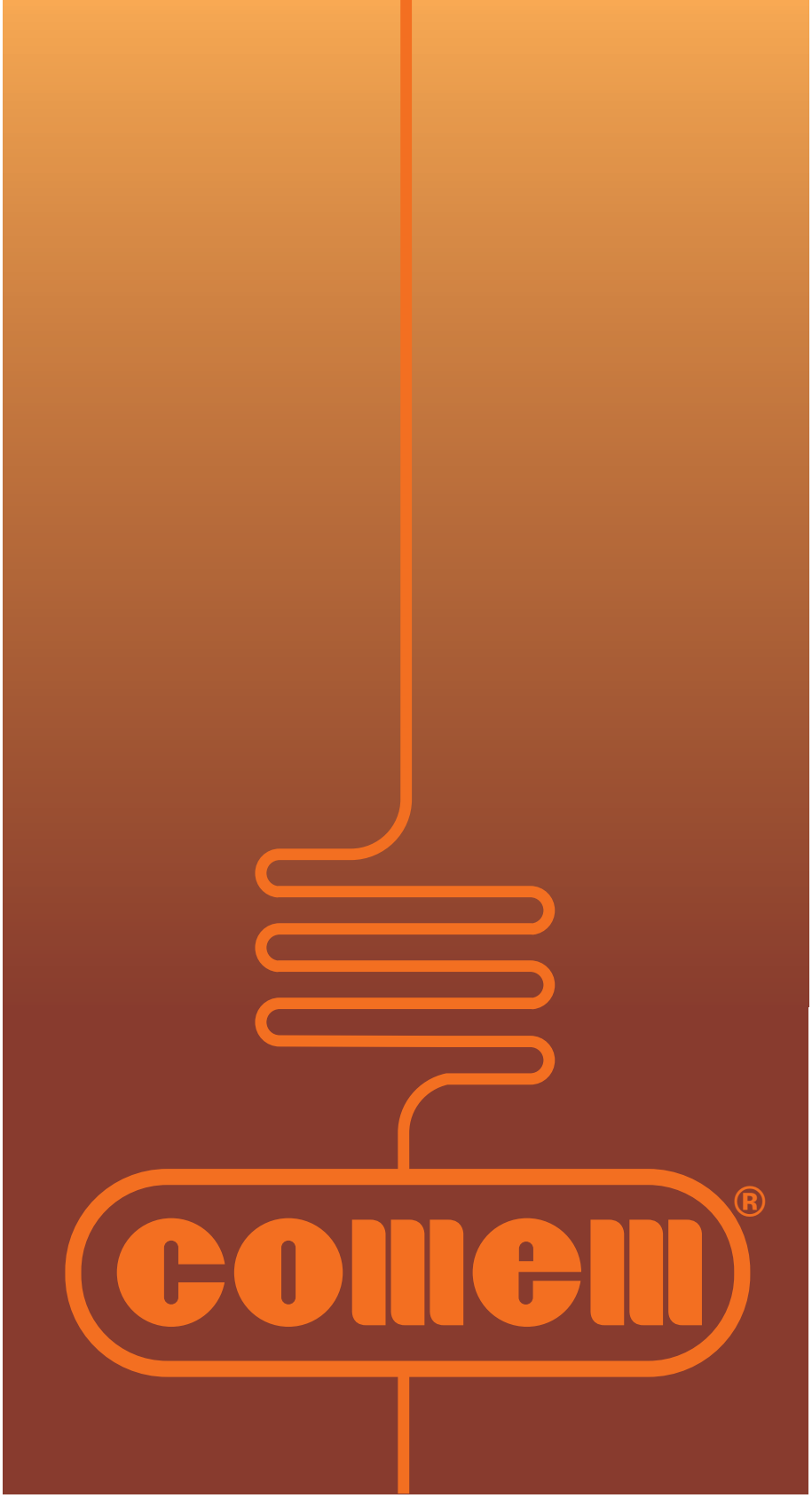
During normal operation the Buchholz relay is full of oil and is connected to the gas sampling device via pipelines 10 and 11.
Valves (8), (2) and (9) are open.
Valves (3), (4), (6) or (7) are closed.
The gas sampling device is consequently also full of oil.
Sampling procedures are as follows:
A- To sample oil: open valve (6) or (4).

B- To sample gas if the relay has signalled alarm or tripped the transformer:
Open valve 4 and let the oil in the device flow out. This draws any gas from the relay via valve (8), tube (11) and valve (2) into the body of the gas. The progress of this operation can be checked through the inspection window. When the desired amount of gas has been collected close valves (2) and (4) and open valve (3) to take the sample.

C- To test satisfactory operation of the alarm and trip circuits proceed as follows:
Close valve (2) then drain all the oil from the device by opening valves (3) and (4). Attach an air pump (bicycle pump) or kit from Comem 5400806002) to valve (5). Close valves (3) and (4) and pump fast whilst simultaneously opening valve (2). The air will then pass into the upper chamber of the Buchholz relay via pipeline (11) lowering the floats and consequently closing their contacts. If you wish to test the lower float then first the valve between the relay and the conservator must be closed to prevent air from flowing directly into the conservator.

OPERATION STARTING

Caution: After commissioning ensure the Buchholz relay and the sampling device are both filled with oil.



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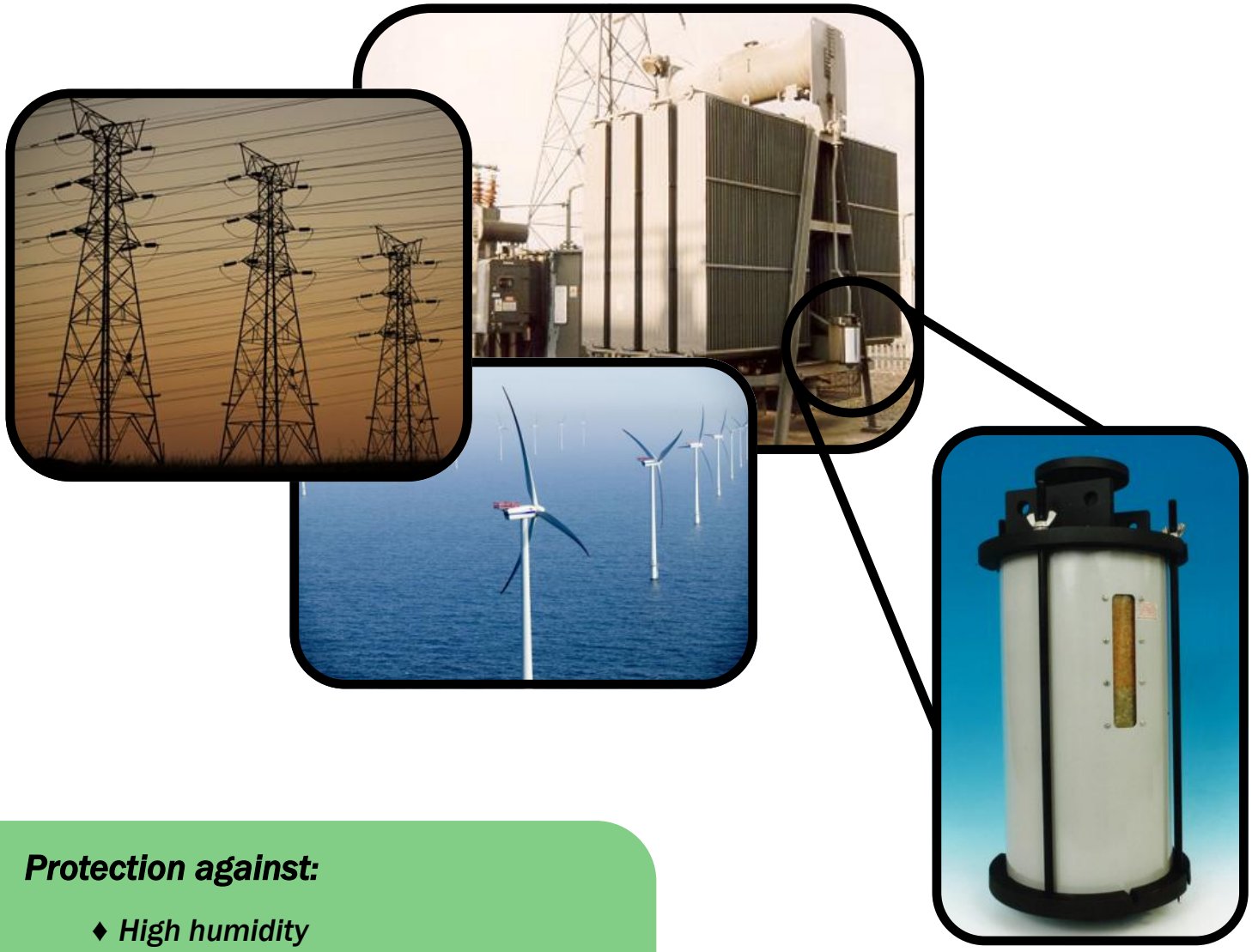
SECTION 12

Appendix F

Dehydrating Breather – Brownell Type R1

a) Brownell Transformer Breathers Brochure (5 pages)
b) Envirogel MSDS (11 pages)
c) TB Instructions BLD 9662 (2 pages)

Transformer Breathers



Protection against:

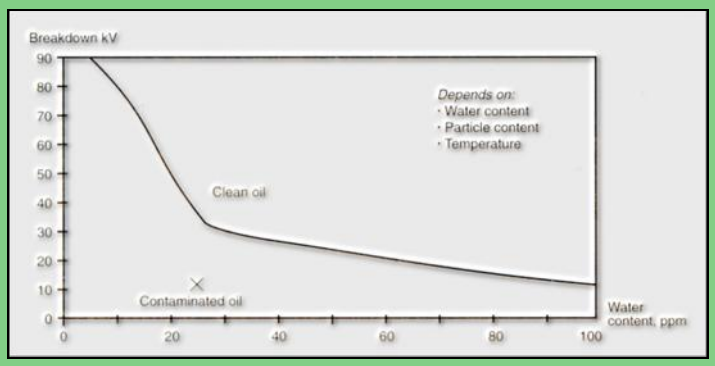
- *High humidity*
- *Water condensation*
- *Pressure variations*
- *Dielectric loss*
- *Mould growth*
- *Outgassing*

Key Technical Features

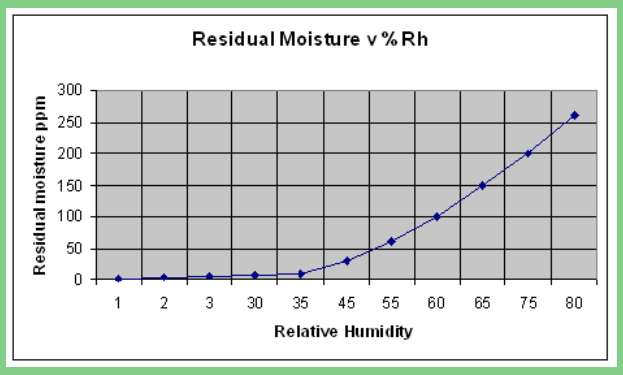
- High performance plastic or metal construction
- Simple installation
- ISO9001/2008 design approved
- Suitable for 1250 kVA to 750 mVA Transformers
- Low dusting beaded ENVIROGEL adsorbent
- Up to 25% adsorption capacity
- Definitive colour change saturation indication
- IP 65 rating
- Operating temperature range –50°C to +70°C
- Vandal proof
- Weather resistant
- All round visual saturation indicator

Size R Transformer Breather

Typical Electrical Breakdown in Transformers



The insulation value of oil can deteriorate dramatically as it becomes contaminated with water.



Water content of oil increases as it is exposed to high relative humidity

Rechargeable Transformer Breathers

V, W Transformer Breathers

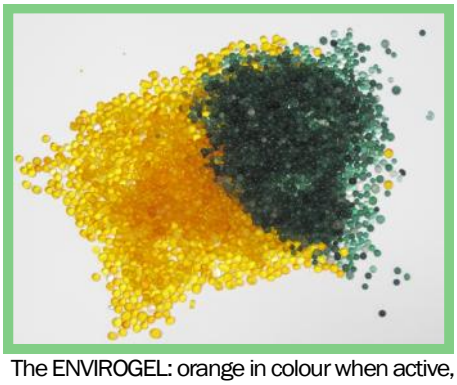
Robust construction Transformer Breathers

BROWNELL Transformer Breathers provide clear visibility of the ENVIROGEL through a shatter-proof, UV stabilised polycarbonate cylinder or window.

Two-way, low pressure valves are fitted in the base of the breather, to ensure that atmospheric air enters the desiccant charge when a negative pressure differential occurs within the transformer being protected.

BROWNELL Transformer Breathers are filled with ENVIROGEL, self-indicating desiccant.

The ENVIROGEL is orange in colour when active, turning green when saturated. This allows a visible assessment of the condition of the ENVIROGEL. Various sizes and packs of ENVIROGEL are available for refilling the Transformer Breathers.



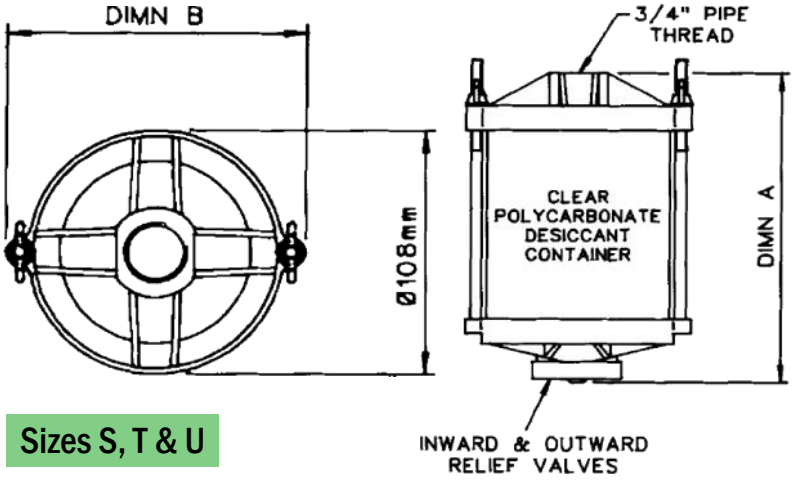
The ENVIROGEL: orange in colour when active, turning green when saturated

BROWNELL have more than 40 years experience in the design, manufacture and testing of types of humidity control equipment and moisture measuring instruments.
Please contact our Technical Services Division for further information.

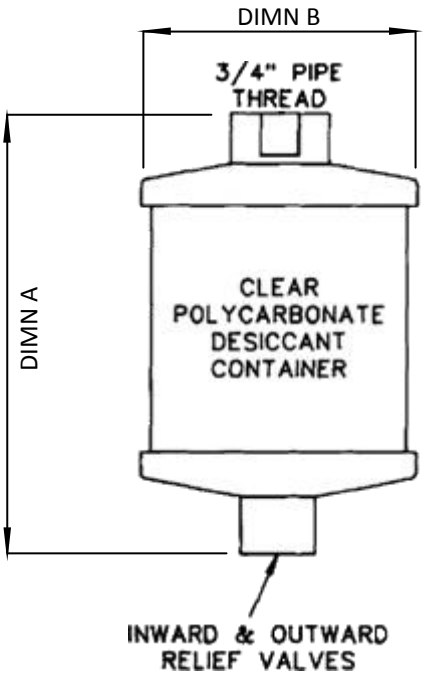
Sizes R, R1, R2, S, T & U

The top pipe connector (3/4" Female Pipe Thread) is also the filling and emptying point. The beaded, self-indicating ENVIROGEL should be replaced once the colour has changed from orange to green, as indicated on the label attached to the breather. All threads conform to BS21 and ISO7-1. Full installation and maintenance instructions are supplied with each BROWNELL Transformer Breather.

Size	Max. Oil Contents	Weight of Desiccant	Overall Length (A)	Overall Diameter (B)
R	1500 Litres	0.60 Kg	158mm	108mm
R1	3000 Litres	1.20 Kg	260mm	108mm
R2	4750 Litres	1.90 Kg	362mm	108mm
S	1130 Litres	0.45 Kg	170mm	127mm
T	2250 Litres	0.90 Kg	270mm	127mm
U	4500 Litres	1.80 Kg	470mm	127mm



Sizes S, T & U



Sizes R, R1 & R2

Quick Change

- ENVIROGEL cartridges can be refilled, replaced or reactivated
- Rapid cartridge replacement
- No special tools required
- Minimum downtime and maintenance
- Ideal for planned maintenance cycles

Transformer Breathers can be changed in a matter of minutes with Brownell's replacement cartridges. (Size W illustrated)

FAQs

Q: Can I fit a Transformer Breather, which has a larger ENVIROGEL capacity than my existing Transformer Breather?
A: Yes, for example you can use a Size R1 Transformer Breather to replace an R type which will significantly increase the time between ENVIROGEL maintenance.

Q: Are there any specific safety considerations when handling Transformer Breathers and ENVIROGEL?
A: We recommend when handling ENVIROGEL, suitable precautions are taken (as with any potentiality dust generating material) an approved respiratory mask is used.

Q: What is the recommended method for disposing of used ENVIROGEL?
A: We suggest that used ENVIROGEL is disposed of at a registered landfill site in accordance with local authority regulations.

Q: How can I reactive saturated ENVIROGEL?
A: Following the safety procedures for handling ENVIROGEL. Heating the ENVIROGEL for 3-4 hours at 95°C will recover 95% of the adsorption capacity.

INSTALLATION, OPERATING & MAINTENANCE INSTRUCTIONS

FOR BLD9662/01-3 TRANSFORMER BREATHERS

Description

The S, T & U Transformer Breathers consist of a top moulding with metal adaptor, a refillable desiccant container with stainless steel guard and a bottom moulded assembly which houses the inlet and outlet relief valve. All items are clamped together by two-threaded tie rods.

Installation

The Breather is supplied with a threaded sealing plug, which is fitted into the atmosphere air inlet on the top moulding. This is to prevent any water vapour ingress whilst in store. This plug should be removed immediately prior to the top moulding (with adaptor) being screwed to the air vent pipe of the equipment. The thread size of the metal adaptor on the top moulding of the breather is ¾ inch BSPP Female. When fitting the breather to the transformers pipe it should only be fitted by the metal adaptor, the transformer breather must not be twisted from the body or the supporting tie rods as this will damage the end mouldings.

The breather is now ready to use.

Since the change from oil seal bowls to relief valves no other work is involved in the installation as the valves prevent any water vapour ingress from the atmosphere.

Operation

Periodic inspection should be carried out to monitor the condition of the desiccant charge. The breathers are charged with ENVIROGEL desiccant. This material changes in colour from orange to green as it becomes saturated with water vapour. When the colour change reaches the indicator line on the label on the desiccant container, it should be re-charged with fresh ENVIROGEL.

Desiccant

All Brownell transformer breathers are filled with non carcinogenic silica gel called ENVIROGEL. For more information about ENVIROGEL go to www.envirogel.co.uk

Maintenance

The only maintenance necessary to keep the breather in a fully active condition is the replacement of the spent desiccant as follows:

1. Loosen the wing nuts on the tie rods until the desiccant container and guard can be removed from between the top and bottom mouldings.
2. Remove the top perforated cover and empty the spent desiccant from the container. This material may be disposed of in a normal landfill site.

3. Fill the container with active Envirogel desiccant (Refills of the correct grade and quantity are available from Brownell Limited). Lightly tap the container to settle the desiccant and top up if necessary.

4. Replace the perforated cover and refit the container between the top and bottom mouldings and guard ensuring that it is correctly fitted between the sealing gaskets.

5. Screw the wing nuts home, being careful not to over tighten as this can distort the moulding.

NOTE: If it is necessary to replace the complete desiccant container, instead of re-charging the existing unit, ensure that the self-adhesive aluminum foil vapour barriers are removed from the top and bottom of the container before installation.

DESICCANT REFILLS

	Size S	**Size T**	**Size U**
Refill Part No.	BL/D6750/01	BL/D6750/02	BL/D6750/03
Complete Desiccant Container Part No.	BL/D6437/01	BL/D6437/02	BL/D6437/03

As indicated above, individual refills containing sufficient Envirogel desiccant of the correct grade and volume are available. This method of supply is recommended to users who have a limited requirement.

As an alternative to individual refills for users who have a regular requirement, 25, 50 & 125kg sealed drums of the correct grade and size of desiccant are available.

It must be emphasised, however, that careful housekeeping is necessary when dispensing desiccant from bulk containers.

Ensure that the container is open for the minimum time necessary to remove the required quantity and that is properly sealed immediately after use.

Please contact our technical Support Division on 020 838 8408 or 020 8965 9281 for further information and guidance if required.

BROWNELL
LIMITED

Unit 2, Abbey Rd Industrial Park
Commercial Way, Park Royal
London, NW10 7XF

Tel**: 020 8965 9281** Fax: **020 8965 3239**

E-Mail: info@brownell.co.uk
Website: www.envirogel.co.uk
Website: www.tankventdryer.com

The Friendly ENVIROGEL Adsorbent

Safety Data Sheet

According to Regulation (EC) No 1907/2006 (REACH)

Trade Name: Brownell Limited
Product: Self-Indicating Silica Gel, Orange to Green
Version No: MCS/101/01/MSDS - 06 / EN

Revision Date: 03.01.2017
Print Date: 03.01.2017

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name or designation of the mixture	Self-Indicating Silica Gel, Orange to Green
Registered number	Not available
Synonyms Issue	Silica, amorphous, silica, precipitated and gel
Date Version	12th May 2014
Number Revision	06
Date Supersedes	03rd January 2017

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses	Desiccant. For adsorption of moisture and prevention of corrosion and mould growth
Uses advised against	No other uses are advised

1.3 Details of the supplier of the safety data sheet

Supplier Name	Brownell Limited
Address	Unit 2, Abbey Road Industrial Park, Commercial Way Park Royal London NW10 7XF
Country	UK
Telephone	+44 (0) 208 965 9281
Fax	+44 (0) 208 965 3239
Email	info@brownell.co.uk
Contact	Robert Beasley
Website	www.brownell.co.uk

1.4 Emergency telephone number

+44 (0) 20 8838 8408 – (08:00 – 17:00) office hours

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

The mixture has been assessed and/or tested for its physical, health and environmental hazards and the following classification applies.

Classification according to Regulation (EC) No. 1272/2008 as amended
This substance does not meet the criteria for classification according to the Regulation (EC) 1272/2008 as amended.

Physical hazard	Not classified as a physical hazard.
Human health hazard	Not classified as a health hazard.
Environmental hazard	Not classified as an environmental hazard.

Addition information Repeated exposure may cause skin dryness or cracking.
Exposure to powder or dusts may be irritating to eyes, nose and throat.

2.2 Label elements

Labelling according to Regulation (EC) No 1272/2008 [CLP/GHS]

Product identifier Not applicable
Hazard statements Not applicable
Precautionary statements Not applicable
Supplemental hazard information Not applicable
Special rules for supplemental label elements for certain mixtures Not applicable
Additional labeling Not applicable

2.3 Other hazards Not applicable

SECTION 3: Compostition/information on ingredients

3.1 Substances

Substance name	Silica Gel (Silicon Dioxide) >98%	Methyl Violet <0.2%	Water <2%
Index No	-	-	-
EC No	231-545-4	208-953-6	231-791-2
REACH No	JT211170-39	-	-
CAS No	(12926-00-8) 7631-86-9	548-62-9	7732-18-5

Purity Not Applicable
Synonyms Silica, amorphous; silica, precipitated and gel.
Stabilisers Not Applicable
Hazard Impurities Not Applicable

3.2 Mixtures Not applicable
Additional information This mixture does not contain further substances fulfilling the criteria of hazard class “acute toxicity” according to CLP regulation.

SECTION 4: First Aid measures

General information If exposed or concerned, get medical advice/attention. Show this safety data sheet to the doctor in attendance.

4.1 Description of first aid measures

Inhalation If dust from the material is inhaled, remove the affected person immediately from the source of exposure to fresh air, seek medical attention if symptoms develop or persist.

Skin contact	Wash spillage from skin with soap and water, seek medication attention if irritation develops and persists.
Eye Contact	Do not rub eyes. Rinse with water, seek medical attention if irritation develops and persists.
Ingestion	Rinse out mouth with water thoroughly; seek medical attention if symptoms occur. If ingestion of a large amount does occur, seek medical attention.

4.2 Most important symptoms and effects, both acute and delayed

Symptoms	Dust may irritate the respiratory tract, skin and eyes.

4.3 Indication of any immediate medical attention and special treatment needed

Notes for the doctor	Provide general supportive measures and treat symptomatically. Keep victim under observation. Symptoms may be delayed.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media	Any media suitable for the surrounding fire.
Unsuitable extinguishing media	Not applicable and unused material will not burn.

5.2 Special hazards arising from the substance or mixture

Hazardous combustion products	Inorganic compound, not combustible and is not considered to be a fire hazard.

5.3 Advice for firefighters

Additional information	Special protective equipment for fire-fighters - Full protective clothing must be worn in case of fire and appropriate breathing equipment for surrounding fire.

SECTION 6: Accidental release measure

6.1 Personal precautions, protective equipment and emergency procedures.

For non-emergency personnel

Protective equipment	Avoid inhalation of dust from the spilled material. Wear a dust mask if dust is generated above exposure limits. Wear appropriate protective equipment and clothing during clean-up. Ensure adequate ventilation.
Emergency procedures	Keep unnecessary personnel away.

6.2 Environmental precautions No special precautions.

6.3 Methods and materials for containment and cleaning up

For containment	Contain spillage, collect material using a vacuum cleaner equipped with HEPA filter and collect in suitable container for disposal.
For cleaning up	Large Spills: Wet down with water and pile for later disposal. Shovel the material into waste container. Following product recovery, flush area with water. Small Spills: Sweep up or vacuum up spillage to avoid the generation of dust during clean-up and collect in suitable container for disposal.

6.4 Reference of other sections

Additional information	For personal protection, see section 8 of the SDS. For waste disposal, see section 13.

SECTION 7: Handling and Storage

7.1 Precautions for safe handling

Protective measures	
Advice on safe handling	Wear appropriate personal protective equipment. Do not breathe dust from this material, avoid creating any dust and contact with skin and eyes as this may cause irritation.
Fire preventions	During handling electrostatic charges can accumulate, therefore static electricity and formation of sparks must be prevented, use proper bonding and/or grounding procedures.
Aerosol and dust generation preventions	Keep formation of airborne dusts to a minimum. Provide appropriate exhaust ventilation at places where dust is formed.
Environment precautions	No special environmental precautions required.
Advice on general occupational hygiene	Observe good industrial hygiene practices.

7.2 Conditions for safe storage, including any incompatibilities

Technical measures and storage conditions	Suitable for any general chemical storage area. Provide appropriate exhaust ventilation at places where dust is formed.
Packaging materials	Keep all material in an air-tight container, material is hygroscopic.
Requirements for storage rooms and vessels	All containers must be kept in a dry, cool place. Store in a well-ventilated place.
Hints on storage assembly:	
Storage class	Not Available
Materials to avoid	Not Applicable

7.3 Specific end uses

Recommendations	Not applicable
Specific end uses	The specified uses for this material are shown in section 1 of the document.

SECTION 8: Exposure controls/personal protection

8.1 Control Parameters

8.1.1 Occupational exposure limits**:**

UK. EH40 Workplace Exposure Limits (WELs)

Substance Name	EC-No.	CAS-No.	Type	Value	Occupational exposure limit value	
					Long Term	Short Term
Silica, Amorphous – Inhalable dust	231-545-4	(12926-00-8) 7631-86-9	TWA	OES 6mg/m^3	8 Hours	-
Silica, Amorphous – Respirable dust	231-545-4	(12926-00-8) 7631-86-9	TWA	OES 2.4mg/m^3	8 Hours	-
Silica gel	231-545-4	(12926-00-8) 7631-86-9	TWA	ACGIH: TLV 10mg/m^3	8 Hours	-
Methyl Violet	208-953-6	548-62-9	TWA	ACGIH: 0.5mg/m^3	8 Hours	-

8.1.2 Biological limits values No biological exposure limits noted for the ingredient(s).

8.1.3 Exposure limits at intended use Not applicable

8.1.4 DNEL/PNEC-values DNEL / PNEC < 1 = No immediate concern

8.1.5 Risk management measures according to used control banding approach Not applicable

8.2 Exposure controls

8.2.1 Appropriate engineering controls: Engineering methods to prevent or control exposure are preferred. Methods include process or personnel enclosure, mechanical ventilation (dilution and local exhaust) and control of process conditions.

8.2.2 Personal protective equipment

Eye / Face protection:

Suitable eye protection Wear suitable eye protection (safety glasses with side shields).

Skin protection:

Hand protection Suitable gloves can be recommended by the glove supplier.

Body protection Wear lab coat over normal work clothing (long sleeved shirts and long pants) is recommended.

	Respiratory protection	Avoid inhalation of dust. Wear suitable respiratory protection equipment if working in confined spaces with inadequate ventilation or whenever there is any risk of the exposure limits being exceeded.
	Thermal hazards	None known
8.2.3	**Environmental exposure controls**	None known

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance:
Physical state: Solid beads **Colour:** Dry: Yellow/Orange Saturated: Green **Odour:** Odourless

pH	2-10 (5% Aqueous Solution)
Melting Point	>1000°C
Boiling Point	Not Applicable
Flash Point	Not Applicable
Evaporation rate	Not available
Flammability (solid, gas)	Non-flammable
Upper/lower flammability or explosive limits	
Upper explosive limits	Not Applicable
Lower explosive limits	Not Applicable
Vapour pressure	Not available
Vapour density	Not available
Relative density	2.1 (water = 1)
Solubility(ies)	Less 1.0% in weight
Partition coefficient: n-octanol/water	Not available
Auto-ignition temperature	Not available
Decomposition temperature	Not available
Viscosity	Not available
Viscosity, dynamic	Not available
Viscosity, cinematic	Not available
Explosive properties	Not available
Oxidising properties	Not available

9.2 Other information:

Physical hazards	
Explosives:	Not available
Flammable gases:	Not applicable
Flammable aerosols:	Not applicable
Oxidising gases:	Not available
Gases under pressure:	Not available

Flammable liquids:	Not applicable
Flammable solids:	Not applicable
Self-reactive substances and mixtures	Not available
Pyrophoric liquids	Not available
Pyrophoric solids	Not available
Self-heating substances and mixtures	Not available
Substances or mixtures which, in contact with water emit flammable gases	Not available
Oxidising liquids	Not available
Oxidising solids	Not available
Organic peroxides	Not available
Metal corrosion	Not available

SECTION 10: Stability and reactivity

10.1 Reactivity — The product is stable and non-reactive under normal conditions of use, storage and transport

10.2 Chemical stability — Material is stable under normal conditions and hygroscopic

10.3 Possibility of hazardous reactions — No dangerous reaction known under conditions of normal use

10.4 Conditions to avoid — Not available

10.5 Incompatible materials — Not available

10.6 Hazardous decomposition products — No hazardous decomposition products are known

SECTION 11: Toxicological information

11.1 Information on toxicological effects
11.1.1 Substances
Acute toxicity: Animal data

Substance	Effect dose / concentration	Value	Species
Acute oral toxicity	LD50	>15,000mg/kg	Rat
Acute dermal toxicity	LD50	>5,000mg/kg	Rabbit
Acute inhalation	LC50	>0.139mg/1/14h	Rat

Skin corrosion/irritation	No data available
Eye damage/irritation	No data available

Sensitisation to the respiratory tract/skin	No data available
Germ cell mutagenicity	No data available
Carcinogenicity	Amorphous silica is not classifiable as to its carcinogenicity to humans (Group 3).
Reproductive toxicity	No data available
Specific target organ toxicity (single exposure)	No data available
Specific target organ toxicity (repeated exposure)	No data available
Aspiration hazard	Dust may irritate lungs. Amorphous silica is not known to cause silicosis.
Physical, chemical and toxicological characteristics	
In case of ingestion	No data available
In case of skin contact	Dust may have a drying effect on the skin.
In case of inhalation	Synthetic amorphous silica gel has little adverse effect on lungs and does not produce significant disease or toxic effect when exposure is kept below the permitted limits. However existing medical conditions (eg asthma, bronchitis) may be aggravated by exposure to dust. Effects of dust may be greater and occur at lower levels of exposure in smokers compared to non-smokers.
In case of eye contact	Dust may cause discomfort and mild irritation.

11.1.2 Mixtures No data available

SECTION 12: Ecological information

12.1 Toxicity Synthetic amorphous silica is virtually inert and has no known adverse effect on the environment and not toxic to aquatic life

12.2 Persistence and degradability The product solely consists of inorganic compounds which are not biodegradable. The methods for determining the biological degradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential Does not bioaccumulate.

12.4 Mobility in soil Insoluble and thus presents a low mobility in most soils.

12.5 Results of PBT and vPvB assessment This substance is not classified as PBT or vPvB according to current EU criteria.

12.6 Other adverse effects No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product / packaging disposal Product can be reactivated in an oven for re-use.

Waste codes / waste designations according to EWC/AVV	The Waste code should be assigned in discussion between the user, the producer and the waste disposal company. This material is not classified as hazardous waste under EEC Directive 91/689/EEC.
Packaging	No data available
Waste treatment options	Disposal of in accordance with all applicable local and national regulations. This material is not classified as special waste under UK Special Waste Regulations 1996 and can be disposed of by landfill at an approved site.
Other disposal recommendations	Dispose in accordance with all applicable regulations.

SECTION 14: Transport information

14.1 UN No.	Not classified as dangerous goods under the United Nations Transport Recommendations.
14.2 UN Proper Shipping name	Not applicable.
14.3 Transport hazard class(es)	Not applicable.
Hazard label(s)	
14.4 Packing group	Not applicable.
14.5 Environmental hazards	Not applicable.
14.6 Special precautions for user	Not applicable.
14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not applicable.
Land transport (ADR/RID)	Not regarded as dangerous goods
Inland Waterway transport (ADN)	Not regarded as dangerous goods
Sea transport (IMDG)	Not regarded as dangerous goods
Air transport (ICAO-TI / IATA-DGR)	Not regarded as dangerous goods

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

15.1.1 EU regulations

Authorisations:	Not applicable
Restrictions on use:	Not applicable

Other EU Regulations:
Directive 2010/75/EC on industrial emissions
Not listed

Directive 2004/42/CE on the limitation of emissions of volatile organic compounds
Not listed

Regulation (EC) No. 842/2006 on certain fluorinated greenhouse gases
Not listed

Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, Annex I
Not Listed

Regulation (EC) No. 1005/2009 on substances that deplete the ozone layer, Annex II
Not Listed

Regulation (EC) No. 649/2012 concerning the export and import of dangerous chemicals, Annex I, Part 1 as amended
Not Listed

Regulation (EC) No. 649/2012 concerning the export and import of dangerous chemicals, Annex I, Part 2 as amended
Not Listed

Regulation (EC) No. 649/2012 concerning the export and import of dangerous chemicals, Annex I, Part 3 as amended
Not Listed

Regulation (EC) No. 649/2012 concerning the export and import of dangerous chemicals, Annex V as amended
Not Listed

15.1.2 National regulations Not Available

15.2 Chemical safety assessment No Chemical Safety Assessment has been carried out.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of New and Existing Chemicals (EINECS)	Yes

Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

SECTION 16: Other information

16.1 Indication of changes

MSDS first issued	18th April 2000
MSDS revision	20th November 2002
MSDS Revised	10th December 2008
MSDS Revised	11th October 2011
MSDS Revised	12th May 2014

16.2 Abbreviations and acronyms

Not applicable

16.3 Key literature references and sources for data

ECHA European Chemicals agency

16.4 Classification for mixtures and used evaluation method according to regulation (EC) 1272/2008 [CLP]

Regulation (EU) No. 1272/2008.
Classification, labelling and packaging of substances and mixtures.
The product does not need to be labelled in accordance with Directive 67/548/EEC.
Not classified as a hazardous substance or mixture according to Directive 1999/45/EC.

16.5 Relevant R-, H- and EUH-phrases (number and full text)

Not applicable

16.6 Training advice

Follow training instructions when handling this material.

16.7 Further information

Not available.

Disclaimer

The information provided in the SDS is correct to the best of our knowledge at the date of publication. This document is intended as a guide for safe handling, storage and use in known industrial applications. The manufacturer makes no representation, warranty or guarantee as to its accuracy, reliability or completeness nor assumes any liability for its use. It is the users responsibility to confirm in advance that the information is current, applicable and suitable to their circumstances for each particular use. No representative of ours has authority to waive this provision.

Appendix G

Paint Specification 704-80180 (15 pages)

IST POWER LTD

PAINT APPLICATION AND PREPARATION PROCEDURE FOR

LIQUID FILLED TRANSFORMERS FOR C5M (VH) PROTECTION (>25 years)

Quality Process Instruction

Quick Guide

a) **All sharp edges and corners must be removed; welds dressed smooth, all welding spatter should be removed.**
b) **All areas are to be thoroughly cleaned of any contamination before metal spraying or painting.**
c) **The manufacturers paint datasheets form part of this specification and must be adhered to.**

d) **Paint records must be taken.**

Circulation/storage
REFER TO "ISSUED DOCUMENT REGISTER" HELD BY QUALITY MANAGER

Ref: 704-60180 Issue: 4	Author: Peter Jones Approved for Issue: Peter Jones Date: 30/3/20	Change Ref: G312

Safety

1. Review and adhere to all instructions contained in the company HSE Policies ref.GHI-001 & 002 (see company notice boards).
2. Review and adhere to all paint safety data sheet instructions referenced in this instruction (copies in COSHH folders)
3. PPE required: Full face respiratory mask, gloves, coveralls and safety footwear. Ensure no loose items of clothing or accessories.
4. Maintain a clean & tidy work area – remove potential trip hazards
5. Near Miss and HSE concerns must be reported by the "ARF" system, or directly to the Health & Safety Representative/Manager

Background

The transformers being supplied will probably be installed in a marine, coastal or severely polluted environment. The painting/corrosion protection is therefore to be to a minimum of C5M (VH) to EN ISO 12944.

Summary of corrosion protection system

The corrosion protection of the steel components of the transformers will be as follows:

Interior

- Blast clean
- 2 pack Epoxy paint

Exterior

- Blast clean
- Zinc Spray
- 2 pack Epoxy Primer
- 2 pack Epoxy MIO
- 2 pack Acrylic Polyurethane Finish

The manufacturers paint datasheets form part of this specification.

During the painting process the manufacturer guidelines for mixing, spraying, curing/drying & over coating are to be followed.

Pre-blast clean inspection

All sharp edges and corners must be removed; welds dressed smooth, all welding spatter should be removed.

All welds are to be dressed smooth in accordance with the 'good' standard of ISO 12944-3. All welds must be inspected for undercuts/irregularities and made good where necessary.

Exterior

Blast clean

The exterior of the transformer tanks and conservators to be grit blasted to SA 3 of ISO 8501-1. Particular attention is to be made in hard to reach areas.

Mask stainless steel earth pads before blasting.

All areas are to be thoroughly cleaned of any contamination before metal spraying.

Zinc spraying is to take place as quickly as possible after grit blasting

Zinc spray

The exterior of the tank is to be zinc sprayed in accordance with ISO 2063. Thickness of the zinc coating must not be less than 100 µm.

Exterior Painting

A stripe coat is required on all edges, welds and hard to reach areas for all layers of paint.

Primer/Sealer

Paint Manufacturer: International
Paint Type: Two component epoxy primer
Paint Description: Intergard 269
No of coats: One
Coat thickness: 20 µm (thinned to reach this thickness) (minimum DFT)
Colour: Red
Drying Time:

Temperature	Touch Dry	Hard Dry	Minimum
10°C	40 min	16 hours	16 hours
15°C	35 min	12 hours	12 hours
25°C	30 min	8 hours	8 hours
40°C	15 min	1 hour	4 hours

Intermediate coat

Paint Manufacturer: International
Paint Type: Two component, epoxy micaceous iron oxide
Paint Description: Intercure 384
No of coats: One
Coat thickness: 150 µm (minimum DFT)
Colour: Silver grey
Drying Time:

Temperature	Touch Dry	Hard Dry	Minimum
5°C	4 hours	14 hours	7 hours
15°C	2.5 hours	8 hours	4 hours
25°C	2.5 hours	3.5 hours	3.5 hours
40°C	45 min	1.5 hours	1 hour

Finish coat

Paint Manufacturer: International
Paint Type: Two component acrylic polyurethane
Paint Description: Interthane 990
No of coats: One
Coat thickness: 50 µm (minimum DFT)
Colour: Refer to tank fabrication drawing for Final Colour
Drying Time:

Temperature	Touch Dry	Hard Dry	Minimum
5°C	5 hours	24 hours	24 hours
15°C	150 min	10 hours	10 hours
25°C	90 min	6 hours	6 hours
40°C	60 min	3 hours	3 hours

Note: Minimum external dry film thickness is 320 microns including zinc spray coating.

Interior

Blast Clean

The interior of the transformer tanks and conservators it to be grit blast to SA 2 ½ of IS 8501-1. All surplus grit and residue must be removed before painting.

Painting is to be carried out within four hours of grit blasting.

Interior Painting

All of the transformer interior should be painted with Valspar 39,0009-50.

Interior paint

Paint Manufacturer: Valspar
Paint Type: Two component epoxy primer
Paint Description: Valspar
No of coats: One
Coat thickness: 40 µm (minimum DFT)
Colour: White

Temperature	Touch Dry	Hard Dry	Minimum
20°C		6 hours	6 hours

Paint Repair Procedure

If the paint coating is damaged in any way, repairs must be done to the following procedure.

Using hand or mechanical means, rub down the affected area so that all paint coats are feathered towards the damaged area.

Clean down and thoroughly degrease.

Each coat of paint is to overlap the previous coat. Minimum film thicknesses are to be maintained.

All coats of paint are to be applied by brush.

Primer/Sealer

Paint Manufacturer: International
Paint Type: Two component zinc rich epoxy primer
Paint Description: Interzinc 52
No of coats: One
Coat thickness: 60 µm (minimum DFT)
Colour: Grey
Drying Time:

Temperature	Touch Dry	Hard Dry	Minimum
5°C	2 hours	10 hours	8 hours
15°C	90 min	6 hours	4 hours
25°C	75 min	4 hours	3 hours
40°C	45 min	2 hours	2 hours

Intermediate coat

Paint Manufacturer: International
Paint Type: Two component, epoxy micaceous iron oxide
Paint Description: Intercure 384
No of coats: One
Coat thickness: 200 µm (minimum DFT)
Colour: Silver grey
Drying Time:

Temperature	Touch Dry	Hard Dry	Minimum
5°C	4 hours	14 hours	7 hours
15°C	2.5 hours	8 hours	4 hours
25°C	2.5 hours	3.5 hours	3.5 hours
40°C	45 mins	1.5 hours	1 hour

Finish coat

Paint Manufacturer: International
Paint Type: Two component acrylic polyurethane
Paint Description: Interthane 990
No of coats: One
Coat thickness: 60 µm (minimum DFT)
Colour: Refer to tank fabrication drawing for Final Colour
Drying Time:

Temperature	Touch Dry	Hard Dry	Minimum
5°C	5 hours	24 hours	24 hours
15°C	150 min	10 hours	10 hours
25°C	90 min	6 hours	6 hours
40°C	60 min	3 hours	3 hours

Paint process stages for the tank

Item	Process Description	Standard	Hold Point (I = IST) A = ABB
1	Visual inspection of structure	ISO 8501-3	
2	Visual inspection – Oil / Grease removal	SSPC-SP1	
3	Grit Blast standard	ISO 8501-1 Sa 3	
4	Surface profile	ISO 8503-5	
5	Environmental Conditions	Product Data	
6	Apply coat 1		
7	Apply coat 2		
8	Apply coat 3		
9	Total Thickness DFT		IST to witness
12	Visual appearance		
13	Adhesion Test on Test plate		
14	Approval of completed treatment		
15	Approval of Inspection documents		IST to review

Intercure® 384

Epoxy

PRODUCT DESCRIPTION

A two component, high solids, low VOC epoxy micaceous iron oxide intermediate coating offering excellent barrier protection, low temperature cure and rapid overcoating properties.

Pigmented with micaceous iron oxide to comply with the requirements of BS5493:1977

INTENDED USES

As a high build intermediate to provide excellent barrier protection as part of a high performance system in aggressive environments including offshore structures, bridges, chemical and petrochemical plants and power stations.

The incorporation of plate-like micaceous iron oxide pigment both increases the barrier effect and improves long term overcoating properties of the system making this material ideally suitable for application in the fabrication shop, prior to shipping, with final overcoating at site.

The rapid curing and overcoating properties of Intercure 384 provide production flexibility, making this product suitable for use both in new construction and on site as a maintenance coating.

PRACTICAL INFORMATION FOR INTERCURE 384

Colour	Silver Grey MIO
Gloss Level	Matt
Volume Solids	72%
Typical Thickness	125-175 microns (5-7 mils) dry equivalent to 174-243 microns (7-9.7 mils) wet
Theoretical Coverage	5.80 m²/litre at 125 microns d.f.t and stated volume solids 231 sq.ft/US gallon at 5 mils d.f.t and stated volume solids
Practical Coverage	Allow appropriate loss factors
Method of Application	Airless Spray, Air Spray, Brush, Roller

Drying Time

			Overcoating Interval with recommended topcoats	
Temperature	**Touch Dry**	**Hard Dry**	*Minimum*	*Maximum*
5°C (41°F)	4 hours	14 hours	7 hours	Extended[1]
15°C (59°F)	2.5 hours	8 hours	4 hours	Extended[1]
25°C (77°F)	2.5 hours	3.5 hours	3.5 hours	Extended[1]
40°C (104°F)	45 minutes	1.5 hours	1 hour	Extended[1]

[1] See International Protective Coatings Definitions and Abbreviations

REGULATORY DATA

Flash Point (Typical)	Part A 37°C (99°F); Part B 27°C (81°F); Mixed 33°C (91°F)	
Product Weight	1.79 kg/l (14.9 lb/gal)	
VOC	169 g/kg	EU Solvent Emissions Directive (Council Directive 1999/13/EC)

See Product Characteristics section for further details

SURFACE PREPARATION

All surfaces to be coated should be clean, dry and free from contamination. Prior to paint application all surfaces should be assessed and treated in accordance with ISO 8504:2000.

Oil or grease should be removed in accordance with SSPC-SP1 solvent cleaning.

Abrasive Blast Cleaning

Abrasive blast clean to Sa2½ (ISO 8501-1:2007) or SSPC-SP6. If oxidation has occurred between blasting and application of Intercure 384, the surface should be reblasted to the specified visual standard.

Surface defects revealed by the blast cleaning process should be ground, filled, or treated in the appropriate manner.

Shop Primed Steel

Weld seams and damaged areas should be blast cleaned to Sa2½ (ISO 8501-1:2007) or SSPC-SP6.

If the shop primer shows extensive or widely scattered breakdown overall sweep blasting may be necessary.

Metallic Zinc Primed Surfaces

Ensure that the surface of the primer is clean, dry and free from contamination and zinc salts before application of Intercure 384. Ensure zinc primers are fully cured before overcoating.

APPLICATION

Mixing

Material is supplied in two containers as a unit. Always mix a complete unit in the proportions supplied. Once the unit has been mixed it must be used within the working pot life specified.

(1) Agitate Base (Part A) with a power agitator.

(2) Combine entire contents of Curing Agent (Part B) with Base (Part A) and mix thoroughly with power agitator.

Mix Ratio

3.00 part(s) : 1.00 part(s) by volume

Working Pot Life

5°C (41°F)	15°C (59°F)	25°C (77°F)	40°C (104°F)
90 minutes	90 minutes	60 minutes	30 minutes

Airless Spray	Recommended	Tip Range 0.38-0.58 mm (15-23 thou) Total output fluid pressure at spray tip not less than 176 kg/cm² (2503 p.s.i.)
Air Spray (Pressure Pot)	Recommended (5% thinning required)	Gun: DeVilbiss MBC or JGA Air Cap: 704 or 765 Fluid Tip: E
Brush	Suitable - small areas only	Typically 75 microns (3.0 mils) can be achieved
Roller	Suitable - small areas only	Typically 75 microns (3.0 mils) can be achieved
Thinner	International GTA220	Do not thin more than allowed by local environmental legislation
Cleaner	International GTA822	

Work Stoppages

Do not allow material to remain in hoses, gun or spray equipment. Thoroughly flush all equipment with International GTA822. Once units of paint have been mixed they should not be resealed and it is advised that after prolonged stoppages work recommences with freshly mixed units.

Clean Up

Clean all equipment immediately after use with International GTA822. It is good working practice to periodically flush out spray equipment during the course of the working day. Frequency of cleaning will depend upon amount sprayed, temperature and elapsed time, including any delays.

All surplus materials and empty containers should be disposed of in accordance with appropriate regional regulations/legislation.

PRODUCT CHARACTERISTICS

Intercure 384 is capable of curing at temperatures below 0°C (32°F). However, this product should not be applied at temperatures below 0°C (32°F) where there is a possibility of ice formation on the substrate.

This product must only be thinned using recommended International GTA220 thinners. The use of alternative thinners, particularly those containing ketones, can severely inhibit the curing mechanism of the coating.

Surface temperature must always be a minimum of 3°C (5°F) above dew point.

Over-application of Intercure 384 will extend both the minimum overcoating periods and handling times, and may be detrimental to long term overcoating properties.

Absolute measured adhesion of topcoats to aged Intercure 384 is less than that to fresh material, however, it is adequate for the specified end use.

This product is frequently used as a 'travel coat' prior to final overcoating on site. To ensure best extended overcoating properties ensure over-application does not occur and that the surface is fully cleaned of any contamination which may be present in the surface texture due to the coarse nature of the micaceous iron oxide pigmentation.

In common with all epoxies Intercure 384 will chalk and discolour on exterior exposure. However, these phenomena are not detrimental to anti-corrosive performance.

As with all products with high micaceous iron oxide levels, only relatively dark colours can be formulated, consequently with some colours of thin film finishes two coats may be needed to give good coverage.

Intercure 384 is not designed for continuous water immersion.

This product has the following specification approvals:
- BS5493:1977 KUID & KF1F
- UK Department of Transport Item No.112

Note: VOC values are typical and are provided for guidance purpose only. These may be subject to variation depending on factors such as differences in colour and normal manufacturing tolerances.

SYSTEMS COMPATIBILITY

Please consult International Protective Coatings for specific information regarding application to prefabrication primers.

The following primers are recommended for Intercure 384:

Intercure 200HS	Interzinc 12 - mist coat may be required
Intercure 324	Interzinc 22 - mist coat may be required
Intercure 202	Interzinc 42
Intergard 251	Interzinc 52
Intergard 269	Interzinc 135
	Interzinc 315

The following topcoats are recommended for Intercure 384:

Interfine 629HS
Intergard 740
Interthane 990

For other suitable topcoats/intermediates, consult International Protective Coatings.

ADDITIONAL INFORMATION

Further information regarding industry standards, terms and abbreviations used in this data sheet can be found in the following documents available at www.international-pc.com:

- Definitions & Abbreviations
- Surface Preparation
- Paint Application
- Theoretical & Practical Coverage

Individual copies of these information sections are available upon request.

SAFETY PRECAUTIONS

This product is intended for use only by professional applicators in industrial situations in accordance with the advice given on this sheet, the Material Safety Data Sheet and the container(s), and should not be used without reference to the Material Safety Data Sheet (MSDS) which International Protective Coatings has provided to its customers.

All work involving the application and use of this product should be performed in compliance with all relevant national, Health, Safety & Environmental standards and regulations.

In the event welding or flame cutting is performed on metal coated with this product, dust and fumes will be emitted which will require the use of appropriate personal protective equipment and adequate local exhaust ventilation.

If in doubt regarding the suitability of use of this product, consult International Protective Coatings for further advice.

PACK SIZE	Unit Size	Part A		Part B	
		Vol	Pack	Vol	Pack
	20 litre	15 litre	20 litre	5 litre	5 litre
	For availability of other pack sizes, contact International Protective Coatings.				
SHIPPING WEIGHT (TYPICAL)	Unit Size	Part A		Part B	
	20 litre	32.8 kg		5.36 kg	
STORAGE	Shelf Life	12 months minimum at 25°C (77°F). Subject to re-inspection thereafter. Store in dry, shaded conditions away from sources of heat and ignition.			

Important Note

Issue date: 12/12/2014

www.international-pc.com

Intergard® 269
Epoxy

PRODUCT DESCRIPTION

A quick drying two component epoxy primer.

Suitable for overcoating after prolonged periods of weathering.

INTENDED USES

As a blast holding primer suitable for use in immersed and exposed conditions and overcoatable with a wide range of high performance systems.

For use at both new construction and maintenance.

Also for use as a tie coat on zinc silicate to prevent zinc salt formation on weathering and pinholing of subsequent high build topcoats.

PRACTICAL INFORMATION FOR INTERGARD 269

Colour	Red (See Product Characteristics section for further details)
Gloss Level	Matt
Volume Solids	47%
Typical Thickness	40 microns (1.6 mils) dry equivalent to 85 microns (3.4 mils) wet
Theoretical Coverage	11.80 m²/litre at 40 microns d.f.t and stated volume solids 471 sq.ft/US gallon at 1.6 mils d.f.t and stated volume solids
Practical Coverage	Allow appropriate loss factors
Method of Application	Airless Spray, Air Spray, Brush, Roller

Drying Time

			Overcoating Interval with recommended topcoats	
Temperature	**Touch Dry**	**Hard Dry**	*Minimum*	*Maximum*
10°C (50°F)	40 minutes	16 hours	16 hours	Extended[1]
15°C (59°F)	35 minutes	12 hours	12 hours	Extended[1]
25°C (77°F)	30 minutes	8 hours	8 hours	Extended[1]
40°C (104°F)	15 minutes	1 hour	4 hours	Extended[1]

[1] Maximum overcoating intervals are shorter when using polysiloxane topcoats. Consult International Protective Coatings for further details.

REGULATORY DATA

Flash Point	Part A 26°C (79°F); Part B 25°C (77°F); Mixed 26°C (79°F)	
Product Weight	1.53 kg/l (12.8 lb/gal)	
VOC	3.75 lb/gal (450 g/lt)	EPA Method 24
	293 g/kg	EU Solvent Emissions Directive (Council Directive 1999/13/EC)

See Product Characteristics section for further details

SURFACE PREPARATION

All surfaces to be coated should be clean, dry and free from contamination. Prior to paint application all surfaces should be assessed and treated in accordance with ISO 8504:2000.

Oil or grease should be removed in accordance with SSPC-SP1 solvent cleaning.

Abrasive Blast Cleaning

For immersion service, Intergard 269 must be applied to surfaces blast cleaned to Sa2½ (ISO 8501-1:2007) or SSPC-SP10. However, for atmospheric exposure Intergard 269 may be applied to surfaces prepared to a minimum of Sa2½ (ISO 8501-1:2007) or SSPC-SP6.

Surface defects revealed by the blast cleaning process should be ground, filled, or treated in the appropriate manner.

Ultra High Pressure Hydroblasting / (non-immersed service only)

May be applied to surfaces prepared to Sa2 (ISO 8501-1:2007) or SSPC-SP6 which have flash rusted to no worse than Grade HB2M (refer to International Hydroblasting Standards). Further information is available from International Protective Coatings.

Tie Coat Applications (see Product Characteristics)

In the case of zinc primers, where necessary, remove weld spatter, smooth weld seams and sharp edges and blast clean welds and damaged primer to Sa2½ (ISO 8501-1:2007) or SSPC-SP6. The shop primer or other primer surface should be dry and free of all contamination (oil, grease, salt etc) and overcoated with Intergard 269 within the overcoating intervals specified for the primer (consult the relevant product data sheet).

Ensure that the zinc primer has fully cured and is clean, dry and free from zinc salts prior to overcoating.

APPLICATION

Mixing

Material is supplied in two containers as a unit. Always mix a complete unit in the proportions supplied. Once the unit has been mixed it must be used within the working pot life specified.

(1) Agitate Base (Part A) with a power agitator.
(2) Combine entire contents of Curing Agent (Part B) with Base (Part A) and mix thoroughly with power agitator.

Mix Ratio

4 part(s) : 1 part(s) by volume

Working Pot Life

10°C (50°F)	15°C (59°F)	25°C (77°F)	40°C (104°F)
17 hours	12 hours	8 hours	3 hours

Airless Spray	Recommended	Tip Range 0.38-0.53 mm (15-21 thou) Total output fluid pressure at spray tip not less than 141 kg/cm² (2005 p.s.i.)
Air Spray (Pressure Pot)	Recommended	Gun DeVilbiss MBC or JGA Air Cap 704 or 765 Fluid Tip E
Brush	Suitable - small areas only	Typically 25-30 microns (1.0-1.2 mils) can be achieved
Roller	Suitable - small areas only	Typically 25-30 microns (1.0-1.2 mils) can be achieved
Thinner	International GTA220 (or International GTA415)	Do not thin
Cleaner	International GTA822 or International GTA415	

Work Stoppages

Do not allow material to remain in hoses, gun or spray equipment. Thoroughly flush all equipment with International GTA822. Once units of paint have been mixed they should not be resealed and it is advised that after prolonged stoppages work recommences with freshly mixed units.

Clean Up

Clean all equipment immediately after use with International GTA822. It is good working practice to periodically flush out spray equipment during the course of the working day. Frequency of cleaning will depend upon amount sprayed, temperature and elapsed time, including any delays.

All surplus materials and empty containers should be disposed of in accordance with appropriate regional regulations/legislation.

PRODUCT CHARACTERISTICS

Use as a Holding Primer

Intergard 269 is suitable for use as a blast holding primer for steelwork intended for exposure in both immersed and atmospheric exposure conditions. Apply Intergard 269 at the recommended thickness as over-application will result in a glossy surface which may not be suitable for overcoating after ageing.

When coating steel in high ambient temperatures thinning with International thinners may be necessary to prevent dry spray and control film thickness.

This product will not cure adequately below 5°C (41°F). For maximum performance ambient curing temperatures should be above 10°C (50°F).

Intergard 269 is also suitable for application to degreased and abraded stainless steel and galvanised steel. Abrasion can be carried out by light blasting using a non-ferrous abrasive or by carborondum disking on small areas.

Use as a Tie Coat

To ensure good penetration of zinc silicate coatings Intergard 269 should be thinned by 15-25% with International thinners. Intergard 269 should be allowed to cure before topcoating with high builds otherwise the effectiveness in preventing pinholing is reduced.

Excessive film thickness may lead to splitting of the film when overcoated with high build systems.

For application at temperatures below 10°C (50°F) alternative tie coats are available. For information contact International Protective Coatings.

When used in a marine environment the schemes and overcoating intervals utilised may differ.

Intergard 269 is globally available in Red; alternative shades may be available upon request. Consult International Protective Coatings for further details.

Note: VOC values quoted are based on maximum possible for the product taking into account variations due to colour differences and normal manufacturing tolerances.

Low molecular weight reactive additives, which will form part of the film during normal ambient cure conditions, will also affect VOC values determined using EPA Method 24.

SYSTEMS COMPATIBILITY

Intergard 269 is suitable for use over the following primers:

Interzinc 22
Interzinc 52

The following topcoats/intermediates are recommended for Intergard 269:

Intercure 200HS	Intergard 740
Intercure 420	Interseal 670HS
Interfine 629HS	Interthane 870
Interfine 878	Interthane 990
Interfine 979	Interzone 505
Intergard 251	Interzone 954
Intergard 345	Interzone 1000
Intergard 475HS	

For details of other systems, consult International Protective Coatings.

ADDITIONAL INFORMATION

Further information regarding industry standards, terms and abbreviations used in this data sheet can be found in the following documents available at www.international-pc.com:

- Definitions & Abbreviations
- Surface Preparation
- Paint Application
- Theoretical & Practical Coverage

Individual copies of these information sections are available upon request.

SAFETY PRECAUTIONS

This product is intended for use only by professional applicators in industrial situations in accordance with the advice given on this sheet, the Material Safety Data Sheet and the container(s), and should not be used without reference to the Material Safety Data Sheet (MSDS) which International Protective Coatings has provided to its customers.

All work involving the application and use of this product should be performed in compliance with all relevant national, Health, Safety & Environmental standards and regulations.

In the event welding or flame cutting is performed on metal coated with this product, dust and fumes will be emitted which will require the use of appropriate personal protective equipment and adequate local exhaust ventilation.

If in doubt regarding the suitability of use of this product, consult International Protective Coatings for further advice.

PACK SIZE

Unit Size	Part A		Part B	
	Vol	Pack	Vol	Pack
20 litre	16 litre	20 litre	4 litre	5 litre
5 US gal	4 US gal	5 US gal	1 US gal	1 US gal

For availability of other pack sizes, contact International Protective Coatings.

SHIPPING WEIGHT

Unit Size	Part A	Part B
20 litre	28.9 kg	4.1 kg
5 US gal	59.7 lb	8.4 lb

STORAGE

Shelf Life	12 months minimum at 25°C (77°F). Subject to re-inspection thereafter. Store in dry, shaded conditions away from sources of heat and ignition.

Important Note

Issue date: 05/10/2009

www.international-pc.com

Interthane® 990
Polyurethane

PRODUCT DESCRIPTION

A two component acrylic polyurethane finish giving excellent durability and long term recoatability.

INTENDED USES

Suitable for use in both new construction and as a maintenance finish which can be used in a wide variety of environments including offshore structures, chemical and petrochemical plants, bridges, pulp and paper mills, and in the power industry.

PRACTICAL INFORMATION FOR INTERTHANE 990

Colour	Wide range via the Chromascan system
Gloss Level	High Gloss
Volume Solids	57% ± 3% (depends on colour)
Typical Thickness	50-75 microns (2-3 mils) dry equivalent to 88-132 microns (3.5-5.3 mils) wet
Theoretical Coverage	11.40 m²/litre at 50 microns d.f.t and stated volume solids 457 sq.ft/US gallon at 2 mils d.f.t and stated volume solids
Practical Coverage	Allow appropriate loss factors
Method of Application	Airless Spray, Air Spray, Brush, Roller

Drying Time

			Overcoating Interval with recommended topcoats	
Temperature	**Touch Dry**	**Hard Dry**	*Minimum*	*Maximum*
5°C (41°F)	5 hours	24 hours	24 hours	Extended[1]
15°C (59°F)	150 minutes	10 hours	10 hours	Extended[1]
25°C (77°F)	90 minutes	6 hours	6 hours	Extended[1]
40°C (104°F)	60 minutes	3 hours	3 hours	Extended[1]

[1] See International Protective Coatings Definitions and Abbreviations

REGULATORY DATA

Flash Point	Part A 34°C (93°F); Part B 49°C (120°F); Mixed 35°C (95°F)	
Product Weight	1.21 kg/l (10.1 lb/gal)	
VOC	3.50 lb/gal (420 g/lt) 341 g/kg	EPA Method 24 EU Solvent Emissions Directive (Council Directive 1999/13/EC)

See Product Characteristics section for further details

SURFACE PREPARATION

All surfaces to be coated should be clean, dry and free from contamination. Prior to paint application all surfaces should be assessed and treated in accordance with ISO 8504:2000.

Primed Surfaces

Interthane 990 should always be applied over a recommended anti-corrosive coating scheme. The primer surface should be dry and free from all contamination and Interthane 990 must be applied within the overcoating intervals specified (consult the relevant product data sheet).

Areas of breakdown, damage etc., should be prepared to the specified standard (e.g. Sa2½ (ISO 8501-1:2007) or SSPC-SP6, Abrasive Blasting, or SSPC-SP11, Power Tool Cleaning) and patch primed prior to the application of Interthane 990.

APPLICATION

Mixing

Material is supplied in two containers as a unit. Always mix a complete unit in the proportions supplied. Once the unit has been mixed it must be used within the working pot life specified.

(1) Agitate Base (Part A) with a power agitator.
(2) Combine entire contents of Curing Agent (Part B) with Base (Part A) and mix thoroughly with power agitator

Mix Ratio

6 part(s): 1part(s) by volume

Working Pot Life

5°C (41°F)	15°C (59°F)	25°C (77°F)	40°C (104°F)
12 hours	4 hours	2 hours	45 minutes

Airless Spray	Recommended	Tip Range 0.33-0.45 mm (13-18 thou) Total output fluid pressure at spray tip not less than 155 kg/cm² (2204 p.s.i.)	
Air Spray (Pressure Pot)	Recommended	Gun Air Cap Fluid Tip	DeVilbiss MBC or JGA 704 or 765 E
Air Spray (Conventional)	Suitable	Use suitable proprietary equipment	
Brush	Suitable	Typically 40-50 microns (1.6-2.0 mils) can be achieved	
Roller	Suitable	Typically 40-50 microns (1.6-2.0 mils) can be achieved	
Thinner	International GTA713 (or International GTA733 or GTA056)	Do not thin more than allowed by local environmental legislation.	

Cleaner

International GTA713 (or International GTA733 or GTA056)

Work Stoppages

Do not allow material to remain in hoses, gun or spray equipment. Thoroughly flush all equipment with International GTA713. Once units of paint have been mixed they should not be resealed and it is advised that after prolonged stoppages work recommences with freshly mixed units.

Clean Up

Clean all equipment immediately after use with International GTA713. It is good working practice to periodically flush out spray equipment during the course of the working day. Frequency of cleaning will depend upon amount sprayed, temperature and elapsed time, including any delays.

All surplus materials and empty containers should be disposed of in accordance with appropriate regional regulations/legislation.

PRODUCT CHARACTERISTICS

Interthane 990 is available in a range of metallic finishes - please consult the separate Interthane 990 Metallic Working Procedures document for further information.

Level of sheen and surface finish are dependent on application method. Avoid using a mixture of application methods whenever possible.

Best results in terms of gloss and appearance will always be obtained by conventional air spray application.

For brush and roller application, and in some colours, two or more coats of Interthane 990 may be required to give uniform coverage, especially when applying Interthane 990 over dark undercoats, and when using certain lead free bright colours such as yellows and oranges. Best practice is to use a colour compatible intermediate or anticorrosive coating under the Interthane 990.

When overcoating after weathering or ageing, ensure the coating is fully cleaned to remove all surface contamination such as oil, grease, salt crystals and traffic fumes, before application of a further coat of Interthane 990.

Absolute measured adhesion of topcoats to aged Interthane 990 is less than that to fresh material, however, it is adequate for the specified end use.

This product must only be thinned using the recommended International thinners. The use of alternative thinners, particularly those containing alcohols, can severely inhibit the curing mechanism of the coating.

Surface temperature must always be a minimum of 3°C (5°F) above dew point.

When applying Interthane 990 in confined spaces ensure adequate ventilation.

Condensation occurring during or immediately after application may result in a matt finish and an inferior film.

Premature exposure to ponding water will cause colour change, especially in dark colours and at low temperatures.

This product is not recommended for use in immersion conditions. When severe chemical or solvent splashing is likely to occur contact International Protective Coatings for information regarding suitability.

A modified version of Interthane 990 is available for use within the Korean marketplace in order to provide improved workability.

Note: VOC values quoted are based on maximum possible for the product taking into account variations due to colour differences and normal manufacturing tolerances.

Low molecular weight reactive additives, which will form part of the film during normal ambient cure conditions, will also affect VOC values determined using EPA Method 24.

SYSTEMS COMPATIBILITY

The following primers/intermediates are recommended for Interthane 990:

Intercure 200	Interseal 670HS
Intercure 200HS	Interzinc 315
Intercure 420	Interzinc 52
Intergard 251	Interzinc 52HS
Intergard 269	Interzone 505
Intergard 345	Interzone 954
Intergard 475HS	Interzone 1000

Interthane 990 is designed only to be topcoated with itself.

For other suitable primers/intermediates consult International Protective Coatings.

ADDITIONAL INFORMATION

Further information regarding industry standards, terms and abbreviations used in this data sheet can be found in the following documents available at www.international-pc.com:

- Definitions & Abbreviations
- Surface Preparation
- Paint Application
- Theoretical & Practical Coverage
- Interthane 990 Metallic Finish Working Procedures

Individual copies of these information sections are available upon request.

SAFETY PRECAUTIONS

This product is intended for use only by professional applicators in industrial situations in accordance with the advice given on this sheet, the Material Safety Data Sheet and the container(s), and should not be used without reference to the Material Safety Data Sheet (MSDS) which International Protective Coatings has provided to its customers.

All work involving the application and use of this product should be performed in compliance with all relevant national, Health, Safety & Environmental standards and regulations.

In the event welding or flame cutting is performed on metal coated with this product, dust and fumes will be emitted which will require the use of appropriate personal protective equipment and adequate local exhaust ventilation.

If in doubt regarding the suitability of use of this product, consult International Protective Coatings for further advice.

Warning: Contains isocyanate. Wear air-fed hood for spray application.

PACK SIZE	Unit Size	Part A		Part B	
		Vol	Pack	Vol	Pack
	20 litre	17.14 litre	20 litre	2.86 litre	3.7 litre
	5 US gal	4.29 US gal	5 US gal	0.71 US gal	1 US gal
	For availability of other pack sizes, contact International Protective Coatings.				

SHIPPING WEIGHT	Unit Size	Part A	Part B
	20 litre	23.1 kg	3.5 kg
	5 US gal	47.6 lb	7.1 lb

STORAGE	Shelf Life	24 months (Part A) & 12 months (Part B) minimum at 25°C (77°F) Subject to re-inspection thereafter. Store in dry, shaded conditions away from sources of heat and ignition.

Important Note

www.international-pc.com

Valspar Industries GmbH

Informacja techniczna

EP-farba do gruntowania
Nr art. 39,0009-50
Nr art. 588.33.99 utwardzacz

Ausgabe 06/04 Rev. 2
390009-50 Sch

Charakterystyka: Dwuskładnikowa farba epoksydowa, zawierająca rozcieńczalnik organiczny, schnąca na powietrzu i w suszarce. Nie zawiera chromu i ołowiu..

Zastosowanie: Farba gruntująca dla konstrukcji żelaznych i stalowych, dla odpowiedzialnych systemów antykorozyjnych oraz jako warstwa gruntująca dla powierzchni ocynkowanych takich jak: kadzie transformatorów, pokrywy, konserwatory i radiatory.
Farba EP Art. nr. 39,009 – 50 została dopuszczona przez Firmy ABB i ALSTOM do malowania powierzchni wewnętrznych transformatorów.

Dane techniczne:

Wszystkie dane dotyczą farby zmieszanej z utwardzaczem (art. nr. 588.33.99) w stosunku wagowym 5:1. Dane określone zostały dla warunków znormalizowanych, 20°C i 65% wilgotności względnej.

Nr art.			**39,0009-50**
Kolor			biały
Stosunek mieszania, wagowy			5:1
		Prüfnormen nach DIN	
Gęstość	(g/cm^3)	53217	1,45
Zawartość części stałych	(%)	53216	ca. 68
Objętość części stałych	(cm^3 / kg)	53219	ca. 330
Objętość części stałych	(%)	53219	ca. 48
Wydajność teoretyczna przy 40 µm	(m^2 / kg)	55945	ca. 8,5
Lepkość		53219	strukturalna
Czas schnięcia przy 20 °C i 40 µm grubości warstwy suchej:			
Stopień 1		53150	po 20 minutach
Stopień 4		53150	po 5 godzinach
Stopień 6		53150	po 6 godzinach
Do zestawów z farbami **„Valspar“:**			EP, EPW, PUR, ACN
Osągalna grubość powłoki:	polewanie		40 µm
	natrysk		80 µm
Odporność na temp. -suche powietrze			do 150 °C
Max. czas magazynowania			12
Rozcieńczalnik specjalny : Art. nr.			39.0410

Wskazówki dotyczące przygotowania:

Powierzchni: Najlepiej metodą strumienio-ścierną wg. DIN 55928 część 4, stopień czystości Sa 2,5 - 3. Należy zachować uśrednioną wysokość nierówności R_z , zgodnie z normą DIN 4768 część 1 lub DIN ISO 8503 część 1. Im większa jest wysokość nierówności, tym grubsza musi być warstwa powłoki malarskiej, tak aby osiągnąć tzw. „wystarczające pokrycie wierzchołków nierówności powierzchni". Trwałość ochrona warstwy malarskiej zależy w znacznej mierze od dokładności przygotowania podłoża przed malowaniem.

Farby: w razie potrzeby należy używać rozcieńczalnika art.-nr. 39.0410:

Nakładanie pędzlem	Bez rozcieńczania. Tylko w wyjątkowych przypadkach
Natrysk metodą powietrzną	Ustawić odpowiednią lepkość farby przez dodanie 10- 20 % rozcieńczalnika. Dysza 1,5 - 1,8 mm / ciśnienie powietrza 4-5 bar
Natrysk Airless	Lepkość dostawcza. Rozcieńczać tylko w wyjątkowych przypadkach. Dysza 0,43-0,55 mm / kąt natrysku 40° (w zależności od wielkości obiektu), ciśnienie natrysku 150-200 bar.
Natrysk Airmix, Air-Coat	Lepkość dostawcza, ewentualnie ustawić odpowiednią lepkość farby przez dodanie 3 – 10 % rozcieńczalnika, dysza 0,28 - 0,45 mm / kąt natrysku 20 - 65° (w zależności od wielkości obiektu), ciśnienie natrysku 50 - 100 bar; ciśnienie powietrza wspomagającego 1-4 bar.
Czas przydatności zmieszanych składników przy 20 °C	około 12 godzin, w zbiorniku do polewania max. 8 godzin!
Temperatura pracy	min +5 °C!
Temp.obiektu / wilg.wzgl.	min +3 °C powyżej punktu rosy / max. 85 %!

Uwagi: Minimalny czas konieczny do nałożenia farby nawierzchniowej na bazie PUR lub ACN wynosi:
16 godz przy 20 ^{0}C temp. obiektu 2 godz. przy 40 ^{0}C temp. obiektu, 1 godz. przy 60 ^{0}C temp. obiektu.
Nałożenie farby nawierzchniowej EP, przy temp. obiektu 20 ^{0}C, możliwe jest najwcześniej :
-przy grubości warstwy suchej 40µm po 4 godz, -przy grubości warstwy suchej 80µm po 8 godz.
Przy temperaturach +5,+10 ^{0}C należy stosować "szybki" utwardzacz Art.nr. 39,0809
Grubość powłoki suchej przy malowaniu wnętrza transformatora nie może przekraczać 80 m

Przykładowy zestaw warstw malarskich:
Farbą EP można kilkakrotnie przemalowywać powierzchnię gruntowaną.

np.:	farba do gruntowania EP biała	nr art. 39,0009-50	
	farba międzywarstwowa EP	nr art. 39,0075 -50	
	farba nawierzchniowa ACN	nr art. 41, 7633	lub
	farba do gruntowania EP biała	nr art. 39,0009-50	
	farba międzywarstwowa EP z miką	nr art. 39,0915-F	
	farba nawierzchniowa ACN	nr art. 41,7633	

Do malowania nawierzchniowego można stosować wszystkie farby - wymienione w pozycji na stronie pierwszej - Do zestawów z farbami **„Valspar"-**
Dane techn. dot. farby międzywarstwowej i nawierzchniowej zawarte są w odrębnych informacjach.

Dane bezpieczeństwa:	**farba bazowa: 39,0009-50**	**utwardzacz:588.33.99**
Temperatura zapłonu	24°C	24 °C
Klasa zagrożenia wg VbF	nie dotyczy	A II
Przepisy transportowe wg ADR/RID	patrz nadruk na opakowaniu lub „Karta danych bezpieczeństwa"	
Znakowanie wg EWG 88/379	patrz nadruk na opakowaniu lub „Karta danych bezpieczeństwa"	

Środki bezpieczeństwa: Przy stosowaniu produktu należy zachować wszelkie środki ostrożności obowiązujące w odniesieniu do materiałów malarskich, wynikające z „Karty danych bezpieczeństwa". Są to np.: „Przepisy dot. zapo-biegania nieszczęśliwym wypadkom" VBG 23, Branżowego Stowarzyszenia Przemysłu Chemicznego.

Niniejsza publikacja unieważnia wszystkie wcześniejsze wersje Informacji Technicznej dot. w/w farby.

UWAGA:
Pisemne lub ustne zalecenia techniczno-aplikacyjne dot. naszych produktów, przekazywane jako pomoc naszym Klientom, nie są zobowiązujące i nie stanowią podstawy do jakichkolwiek dodatkowych roszczeń z tytułu zawarcia umowy kupna. Zalecenia te opracowane zostały zgodnie z naszymi doświadczeniami i zgodnie z aktualnym stanem wiedzy naukowej i praktycznej. Nie zwalniają one Kupującego od samodzielnej kontroli przydatności naszego produktu do przewidzianego zastosowania. Ponadto obowiązują nasze ogólne warunki dostaw i płatności.

SECTION 14

Appendix H

Test Certificate (4 pages)

iST POWER

IST POWER LTD

64/66 Percy Road, Leicester, LE2 8FN (reg'd office) Tel: +44 (0)116 283 3321

Longley Lane, Sharston Industrial Estate, Wythenshawe, Manchester, M22 4RU Tel: +44 (0)161 428 9507

Email:- sales@istpower.com Web: www.istpower.com

TRANSFORMER TEST CERTIFICATE

CUSTOMER : SES **ELECTRICAL SPEC :** 0105275 REV. 1

RATING kVA : 2000 3 **PHASE** 50 **Hz** **SERIAL No :** 20190195

	PRIMARY	SECONDARY
RATED VOLTS :	11000	433
RATED AMPS :	105	2667

TEMPERATURE CLASS : A **COOLING :** KNAN **VECTOR GROUP :** Dyn11

REFERENCE TEMP. °C : 75

THIS TRANSFORMER HAS BEEN TESTED IN ACCORDANCE WITH SPECIFICATION

BS EN 60076

AND HAS SATISFACTORILY PASSED THE FOLLOWING TESTS

VOLTAGE RATIO AT NO LOAD : AS RATED VOLTS

WINDING RESISTANCE AT 20 DEGREES C :

	PRIMARY milli Ohms	SECONDARY milli Ohms
A - B	299.35	0.62
B - C	299.35	0.62
C - A	299.75	0.62

TEST RESULTS

SHORT CIRCUIT IMPEDANCE :	**%**	6.59
LOAD LOSS :	**Watts**	17388
NO LOAD LOSS :	**Watts**	1478
NO LOAD CURRENT :	**%**	0.19
ZERO SEQUENCE IMPEDANCE :	**Ohms per ph.**	

INDUCED OVERVOLTS : 200% AT 100Hz FOR 60 Seconds

SEPARATE SOURCE VOLTS PRIMARY : 28kV AT 50Hz FOR 60 Seconds

SEPARATE SOURCE VOLTS SECONDARY : 3kV AT 50Hz FOR 60 Seconds

INSULATION RESISTANCE PRIMARY TO SEC AND EARTH : 1.4 G Ohms

INSULATION RESISTANCE SECONDARY TO EARTH : 2.09 M Ohms

REMARKS :

TESTED : Michael Harry **APPROVED :** Mark Jackson

WITNESSED : Peter Holt **DATE :** 08/01/2020

iST POWER

IST POWER LTD

64/66 Percy Road, Leicester, LE2 8FN (reg'd office) Tel: +44 (0)116 283 3321

Longley Lane, Sharston Industrial Estate, Wythenshawe, Manchester, M22 4RU Tel: +44 (0)161 428 9507

Email:- sales@istpower.com Web: www.istpower.com

CERTIFICATE OF CONFORMANCE

CUSTOMER : SES

IST ELECTRICAL SPEC : 0105275 REV. 1

SPECIFICATION : BS EN 60076

SERIAL No : 20190195

CUSTOMER PART No : **ISSUE :**
(If Applicable)

The goods identified by the above unique serial number have been tested and inspected to the above specification and have been proved to conform in all respects with your order.

APPROVED : Michael Harry TEST ENGINEER

DATE : 08/01/2020

iST POWER

IST POWER LTD

64/66 Percy Road, Leicester, LE2 8FN (reg'd office) Tel: +44 (0)116 283 3321

Longley Lane, Sharston Industrial Estate, Wythenshawe, Manchester, M22 4RU Tel: +44 (0)161 428 9507

Email:- sales@istpower.com Web: www.istpower.com

TRANSFORMER TEST CERTIFICATE

CUSTOMER : SES **ELECTRICAL SPEC :** 0105275 REV. 1

RATING kVA : 2000 3 **PHASE** 50 **Hz** **SERIAL No :** 20190196

	PRIMARY	SECONDARY
RATED VOLTS :	11000	433
RATED AMPS :	105	2667

TEMPERATURE CLASS : A **COOLING :** KNAN **VECTOR GROUP :** Dyn11

REFERENCE TEMP. °C : 75

THIS TRANSFORMER HAS BEEN TESTED IN ACCORDANCE WITH SPECIFICATION

BS EN 60076

AND HAS SATISFACTORILY PASSED THE FOLLOWING TESTS

VOLTAGE RATIO AT NO LOAD : AS RATED VOLTS

WINDING RESISTANCE AT 20 DEGREES C :

	PRIMARY milli Ohms	SECONDARY milli Ohms
A - B	302.74	0.63
B - C	300.12	0.66
C - A	299.92	0.67

TEST RESULTS

SHORT CIRCUIT IMPEDANCE :	**%**	6.60
LOAD LOSS :	**Watts**	17368
NO LOAD LOSS :	**Watts**	1494
NO LOAD CURRENT :	**%**	0.22
ZERO SEQUENCE IMPEDANCE :	**Ohms per ph.**	

INDUCED OVERVOLTS : 200% AT 100Hz FOR 60 Seconds

SEPARATE SOURCE VOLTS PRIMARY : 28kV AT 50Hz FOR 60 Seconds

SEPARATE SOURCE VOLTS SECONDARY : 3kV AT 50Hz FOR 60 Seconds

INSULATION RESISTANCE PRIMARY TO SEC AND EARTH : 1.4 G Ohms

INSULATION RESISTANCE SECONDARY TO EARTH : 2 M Ohms

REMARKS :

TESTED : Michael Harry **APPROVED :** Mark Jackson

WITNESSED : Peter Holt **DATE :** 08/01/2020

iST POWER

IST POWER LTD

64/66 Percy Road, Leicester, LE2 8FN (reg'd office) Tel: +44 (0)116 283 3321

Longley Lane, Sharston Industrial Estate, Wythenshawe, Manchester, M22 4RU Tel: +44 (0)161 428 9507

Email:- sales@istpower.com Web: www.istpower.com

CERTIFICATE OF CONFORMANCE

CUSTOMER : SES

IST ELECTRICAL SPEC : 0105275 REV. 1

SPECIFICATION : BS EN 60076

SERIAL No : 20190196

CUSTOMER PART No : **ISSUE :**
(If Applicable)

The goods identified by the above unique serial number have been tested and inspected to the above specification and have been proved to conform in all respects with your order.

APPROVED : Michael Harry TEST ENGINEER

DATE : 08/01/2020

iST

POWER