iST POWER

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INSTALLATION AND MAINTENANCE MANUAL

FOR

70 kVA AUXILIARY SELF-BUNDED TRANSFORMER 3 PH 33kV ±2.5%,±5.0%,+7.5% / 433V (NL)

iST POWER Ltd SERIAL No.

102111/1-01 & 02

MANUFACTURED TO SPECIFICATIONS:
BS EN 60076-1: 2011
&
NR/SP/ELP/21020
&
EU ECO Directive No 548/2014

Manual Number: MM0704 Issue 3
19/07/2021
0105406

ISSUE 2: 1840
ISSUE 3: 1842

CONTENTS

Section 1: INTRODUCTION

i. Purpose

This installation and maintenance manual has been written to assist the user with proper procedures when handling, installing, operating and maintaining the equipment. All of the safety warnings and instructions in this book must be followed to prevent injury to personnel.

ii. General Description

The transformer is manufactured by iST POWER Ltd and is supplied as follows: -
One three phase transformer, outdoor transformer, Midel cooled, for 33000V 3 phase supply. Secondary voltage is 433 volts 3 phase.

Type	Transformer Midel 7131 cooled double wound transformer KNAN.
Cooling	Midel 7131 to BS EN/IEC 61099: 2010
Rating	70kVA
Rated Input Voltage	33000 volts
Rated Output Voltage	433 Volts
Number of Phases	3 phase
Connection	Dzn0
Frequency	50Hz
Weight of Core and Coils	430kg
Midel Quantity	295 Litres
Total Weight	1435kg
Input Termination	35kV 600A ANSI 386 Oil Bushings Euromold Series 775S1 Type ‘E’
Output Termination	4 Pole 160A Fuse Switch

Fittings	Rating and Diagram Plate Earthing Terminal Pressure Relief Valve Off Circuit Tap Selector Handle Liquid Level Gauge Envirogel Breather Auxiliary Wiring Marshalling Box Lifting Lugs Liquid Drain Valve Jacking Lugs Skid Underbase
Specification	IEC 60076:

iii. Detailed Description

The transformer is Midel 7131 immersed, naturally cooled and contained in a welded stainless-steel tank that is installed within an IP23 ventilated cooling enclosure with integral full capacity bund facility.

The transformer core is of cruciform cross section, built up from cold rolled grain oriented low loss steel laminations with interleaved and mitred joints.

The wound leg is clamped by wedges inserted between the core and the inside secondary coil insulation. The yokes are clamped by folded steel and wooden clamping frames with end clamp bolts. The yoke clamps also serve to clamp the winding assemblies axially by means of tie rods, the top clamp position being adjustable for this purpose.

The core is insulated from the clamping framework and is earthed at one point. This earth point is taken to an external earth boss via an insulated bushing and removable link. The link is removable for test purposes.

The secondary coils are placed next to the core and are layer wound spiral windings formed from paper covered rectangular copper strips wound over circular formers.

A copper foil screen is wound over the secondary winding and taken to a bushing located in the tank wall and earthed to an external boss via a removable link. The link is removable for test purposes.

The primary coils are layer wound spiral windings formed from polyester covered round copper wire wound over the primary to secondary insulation.

The assembled core and windings are thoroughly dried out in a forced air circulation oven, the windings carefully matched for length and then clamped tightly between top and bottom frames by means of the tie rods.

When assembled into the internal tank the core and winding assembly is impregnated under full vacuum with Midel at 80°C.

The externally operated off-circuit tapping switch for the primary winding has its operating hand-wheel, suitable for padlocking, mounted behind the Auxiliary Equipment cover on the external tank. The handle of the switch has the facility to be padlocked.

THIS SWITCH IS NOT SUITABLE FOR OPERATION WITH THE TRANSFORMER ENERGISED.
ENSURE THAT THE TRANSFORMER IS ISOLATED BEFORE OPERATING THE OFF-CIRCUIT TAPPING SWITCH.

The expansion space over the transformer in the Midel filled tank vents to atmosphere through a desiccant breather. This requires regular inspection as detailed in Section.10, Maintenance Recommendations.

The transformer is fitted with excess pressure relief device on the internal Midel filled tank which will open on a build-up of pressure inside the tank due to an internal fault and thereby prevent tank rupture. A cover is fitted over the pressure relief device to vent hot Midel fluid into the integral bund. An alarm switch is fitted and is wired out to a separate stainless steel marshalling box mounted behind the Auxiliary Equipment cover. In the event of an incident that causes the PRD to operate, there is a mechanical indicator that is visible through a polycarbonate window in one end of the external tank.

The transformer is fitted with a liquid level gauge mounted on the end of the internal Midel filled tank. The gauge is fitted with a switch to provide an alarm signal on falling liquid level. The switch is wired out to the marshalling box. The gauge is visible through a clear polycarbonate window in one end of the external tank.

The marshalling box contains 9-off sprung loaded terminals mounted on a din rail. The box is mounted behind the Auxiliary Equipment cover in the external tank. The marshalling box can be padlocked.

iv. Application

This manual states the requirements for 11, 22 and 33kV Oil/Synthetic Liquid filled transformers up to 500kVA for dc traction substations as detailed in Network Rail specification NR/SP/ELP/21020.

v. Reference Standards

NR/SP/ELP/21028	Network Rail Line specification for auxiliary wiring of electrical distribution equipment
RT/E/S/21033	Network Rail Line specification for the welding of transformer tanks and conservators during manufacture.
BS EN 60076 (IEC 60076)	Power transformers
BS EN 60296	Fluids for electro technical applications, Unused mineral insulating Oils for transformers and switchgear
BS EN 61099	Insulating liquids. Specification for unused synthetic organic esters for electrical purposes
BS EN 60529	Degree of protection provided by enclosures (IP Code)
BS EN 60269-1	Low voltage fuses General requirements
BS EN 60439	Low-voltage switchgear and control gear assemblies. Type-tested and partially type-tested assemblies.

Section 2: COMMERCIAL INFORMATION

i. Contact Details

iST POWER Ltd
64-66 Percy Road
Leicester
LE2 8FN
Tel: - 0116 483 3321

or

iST POWER Ltd
Sharston Industrial Estate
Longley Lane
Wythenshawe
Manchester
M22 4RU
Tel: - 0161 428 9507

ii. Commercial Conditions

Please contact iST POWER Ltd on the contact details above.

iii. Warranty Information

Please contact iST POWER Ltd on the contact details above.

iv. Repair Arrangements

For all repair arrangements please contact iST POWER Ltd on the contact details above.

Section 3: SAFETY

i. Warnings

(a) The externally operated off-circuit tapping switch for the primary winding has its operating hand-wheel, suitable for padlocking, mounted behind the Auxiliary Equipment cover on the external tank.

THIS SWITCH IS NOT SUITABLE FOR OPERATION WITH THE TRANSFORMER ENERGISED.
ENSURE THAT THE TRANSFORMER IS ISOLATED BEFORE OPERATING THE OFF-CIRCUIT TAPPING SWITCH.

(b) The transformer is delivered with the breather pipe capped. This cap must be removed and replaced with the desiccant breather supplied with the transformer.

The transformer breather is shipped as a loose item with the transformer. This will be attached to the outside of the transformer or be inside the LV switch box. There will also be a copy of the fitting instructions.

Refer to Section 8, clause (iii) Unpacking & Examination Upon Arrival

(c) Transformer is filled with Midel 7131 to BS EN/IEC 61099:2010 only. Refer to Section 12(v) for information.

ii. PPE Equipment

All PPE equipment should follow the rules and regulations for working for Network Rail.

As a minimum this should include
a) Safety Hat/Helmet
b) Safety Boots
c) High Vis overalls (Trousers and Top)
d) Safety Googles
e) Gloves

Section 4: INSULATING FLUID

i. Warning of Liquid Type

The insulating liquid is Midel 7131 synthetic ester classified non-hazardous. See Section 12(v) for the safety data sheet.

ii. Liquid Level Check

The liquid level is indicated on the level gauge at the end of the conservator tank. The level indicated will depend on the ambient temperature and the operating temperature of the transformer.
The transformer is tested for leaks before it leaves the factory so if there is any drop in the liquid level the transformer should be thoroughly inspected for leaks.

1) The liquid level gauge is located behind a polycarbonate window on the right-hand side of the transformer. See drawing 012697, reference 9. No access into the transformer enclosure is required.
2) The gauge is marked at -20°C, +20°C and + 85°C. Although the gauge markings are in °C, it is not a temperature gauge.
3) If the transformer is switched OFF and cold, the gauge will read at a level corresponding to the ambient temperature.
4) If the transformer is switched ON, the gauge will read at a level corresponding to the transformer oil temperature.

iii. Refill Arrangements

Topping up of the Midel is done through the ¾" BSP plug on the top of the conservator. This should only be carried out in good weather conditions or when the transformer can be sufficiently protected against water and debris contamination.
Any work must be carried out in compliance with Network Rail practices.

a) Remove the cap from the filler socket. Ensure that no debris can fall inside.
b) Position a clean funnel in the filler.
c) Using only new Midel from a sealed container add fluid until the level is correct.
d) Remove the funnel from the filler taking care not to spill fluid.
e) Clean the screw threads on the filler socket and filler cap.
f) Apply PTFE to the filler socket threads, screw on and fully tighten the cap.
g) Wipe clean the transformer to remove any spilt Midel.

iv. Sampling Valve

The transformer is fitted with a sampling valve fitted at the bottom of one end of the transformer. The valve is located behind a bolted cover on one end of the tank. The valve is padlocked and fitted with a blanking plate.

The sampling frequency is covered in Section 10
The sampling procedure is contained in Section 12(v).

Liquid samples should only be taken by experienced operators. Not using the correct sampling techniques can lead to false readings.

1) The sampling valve is located on the LV side, behind the Marshalling Box door. See drawing 012697, reference 11.
2) Remove the drain valve locking pin.
3) Fit a clean rubber hose to the ¼" hose tail.
4) Position the hose into a clean container, slowly open the drain valve and allow approximately 1 litre of Midel fluid to flush the valve and pipe. Do not allow the hose to become contaminated.
5) Place the hose into the neck of a clean oil sample bottle. Open the drain valve and fill with 1/3rd litre of Midel. Close the valve.
6) Seal the bottle and agitate the sample to rinse the inside of the bottle.
7) Discard this Midel into a waste container.
8) Repeat steps 5 & 6. Ensure the bottle drains completely.
9) Place the tube into the neck of the bottle with the open end against the wall of the bottle.
10) Open the valve and fill the bottle up to the neck. Allow the fluid to flow smoothly and not create bubbles. Do not let the end of the tube to become submerged in the body of the fluid.
11) Close the valve and remove the tube from the bottle. Catch any fluid drips in a clean rag.
12) Seal the sample bottle and record the transformer serial number and oil temperature.
13) Remove the hose from the hose tail and carefully wipe any free liquid with a clean dry cloth.
14) Make sure that the transformer drain valve is fully closed and re-fit the locking pin.
15) Ensure that the work area is clean and that any waste liquid is disposed of carefully in an approved manner.
16) Job complete.

v. Spill Management

Personal precautions: Spilt product can constitute a slip hazard. Avoid contact with skin and eyes.
Environmental precautions: In the event of a large spillage, clean as thoroughly as possible and contact local authority. Avoid flushing into drains.
Cleaning procedures: Use an inert absorbent material (e.g. sand, oil absorbent granules, etc.) and place in labelled containers.
Product and packaging must be disposed of in accordance with local and national regulations.
Refer to Section 12(v) for Midel 7131 Safety Data Sheet

vi. Environmental credentials

Refer to Section 12(v) for Midel fluid to BS EN/IEC 61099:2010 data sheet

vii. Midel Data sheet

Refer to Section 12(v) for Midel fluid to BS EN/IEC 61099:2010 data sheet

Section 5: EARTHING ARRANGEMENTS

i. Screen

The coil screens are internally wired to a bushing mounted on the side of the Midel filled tank. The bushing is then grounded to the tank via an earth braid taken to a welded boss inside the LV switch cabinet.

ii. Core

The core earth is internally wired to a bushing mounted on the side the Midel filled tank. The bushing is then grounded to the tank via an earth braid taken to a welded boss inside the LV switch cabinet.

iii. Neutral Earthing

The neutral of the Secondary (LV) side is grounded to the main transformer tank earth via a removable earth link arrangement located in the LV cabinet. This link can be removed to carry out relevant testing, but must be replaced prior to energisation of the transformer.

iv. External Earth Pads

The main earthing points for the transformer are two earth pads located at the base of the transformer in diagonally opposite corners.

Section 6: TERMINATIONS

i. Primary (HV) bushings

The primary bushings are Separable Connector suitable for 36kV 1250A. Oil bushings Euromold, reference 775S1, Type ‘E’ facing with 5/8” UNC 2B thread to ANSI/IEEE 386.
The bushing connectors are secured by the external tank which locks the connectors in place and conceals both the connectors and incoming cables.

Cable cleats are fitted below each bushing to support the HV incoming cables.

ii. Secondary (LV) bushings

1kV 250A Bushings DT1/250 mounted inside the LV cabinet which then feed either: -

i. LV Fuse Switch Socomec 160A Fuse switch Ref: 3841-6015

or

ii. Moulded Case Circuit Breaker (MCCB)

Access for incoming cable is via a metal gland plate fitted to the bottom of the LV cabinet.

iii. Auxiliary Wiring

The auxiliary wiring for the PRD and oil level gauge is XLPE/SWA/PVC cable and is terminated in the marshalling box. Each cable is ferruled and crimped at each end.

Section 7: DELIVERY

The units are despatched completely assembled, except for the desiccant breather, which is found either in the LV cabinet or strapped to the outside of the tank.

The transformer is suitable for HIAB off-loading to ground only. Refer to Section 8, clause iv, for handling precautions.

Jacking points are also supplied for final positioning.

Section 8: INSTALLATION

i. Introduction

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

ii. 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.

iii. 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.

The Desiccant breather is shipped as a loose item with the transformer. This will be attached to the outside of the transformer or be inside the LV switch box. There will also be a copy of the fitting instructions.

The breather is fitted to the tank breather pipe located behind the Auxiliary Equipment cover. When opened the breather pipe will be seen on the left-hand side.

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 oil will 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 oil, position a 1 litre container beneath the breather tube before removing the end cap. Dispose of any Midel 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 Section12(iii) for the breather details and the fitting instruction leaflet.

iv. Handling

When lifting the equipment use the four lifting points provided with the correct lifting slings through each lifting point. If a lifting beam is not used, the sling to load angle must not be less than 60º. Great care must be taken not to knock or damage the equipment.

The lifting weight of the complete unit is 1435kg.

Jacking lugs are provided on each side.

v. Storage

The unit should be stored indoors or in a covered area, until commissioned.

vi. 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 full of Midel to operating level for use outdoors with heavy duty paint finish.

vii. Foundation and Connections

The equipment must be mounted on a suitable prepared plinth. Ensure that the plinth is flat and level.

The connection leads to the input and output should be taken through the entries provided by others and the connections fastened securely to the terminals.

Ensure that the leads are connected to the terminals marked as shown in rating and diagram drawings listed below.

Ensure that an efficient earth connection is made to the earth terminals on the tank.

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viii. Schedule of Erection Drawings

012697	Outline and General Arrangement
012698	Rating and Diagram Plate
010198	Auxiliary Wiring Diagram

Section 9: COMMISSIONING INSTRUCTION

i. General

Check the equipment for any obvious signs of damage, loose items and contamination by water or other substances. Site tests and checks are not carried out by iST POWER Ltd. Check the Transformer liquid level.

ii. Tap Changer

Before the transformer is commissioned or connected to the supply, the off-circuit tapping switch should be padlocked in the selected position.

iii. Equipment Pre-Commissioning Checks

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.

a. Ratio Measurement

With a transformer isolated, connect a transformer ratio test meter to the input and output terminals. Measure the transformer ratio. Compare the results with the values given in the test certificate.

b. Resistance Measurement

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

c. Insulation Resistance Measurement

With the transformer isolated the insulation resistance should be measured.

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

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

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

d. Reconnect all leads.

iv. Midel Sample

A Midel sample should be taken via sampling valve provided and as detailed in BS EN 60475: 2011.

Section 10: MAINTENANCE

UNIT ISOLATION

The transformer has no inherent means of input isolation. The supply to the transformer of 33000 Volts 3 phase must therefore be isolated remotely and the terminals earthed down.

ISOLATE ALL SUPPLIES PRIOR TO WORKING ON THIS EQUIPMENT

i. Transformer

The insulating liquid is transformer Midel classified non-hazardous. See section 12(v) for the safety data sheet.

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.

Note – Replace or top up with Transformer Midel 7131 to BSEN/IEC 61099

ii. Pressure Relief Valve

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 Section 12(i) for manufacturer's data.

iii. Desiccant 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 be checked as follows:

a) after 6 months
b) after 12 months
   After 12 months the period between inspections can be increased if operating experience indicates that this can be safely done.

Changing Dehydrating Breather:

1) Remove the padlock from the Auxiliary Equipment Door located on the left-hand side of the transformer.

2) Remove the two M6 dome head nuts and washer from the door retention studs and open the door.

3) The breather is located on the left-hand side of the auxiliary equipment compartment. See drawing 012697 reference 11.

4) Using a 32mm open ended spanners loosen the breather.

5) When free, undo the breather by hand using only the top flange of the breather. Do not use the bottom flange.

6) Remove the breather from the transformer.

7) Clean the threads at the end of the breather pipe and apply fresh PTFE sealing tape.

8) Un-wrap the replacement breather.

9) Screw the breather onto the breather pipe by hand using the top flange. Do not use the bottom flange.

10) Tighten the breather using a 32mm open ended spanner to 35Nm.

11) Close the Auxiliary Equipment Door and fit the two M6 dome head nuts and washers.

12) Re-fit the padlock.

13) Job complete.

c) Recommended Spares

Due to the nature of the product, there are very few items that will degrade during the lifespan of the transformer. The only item that will require replacement is the desiccant breather charge. The correct item for the transformer is listed below.

Other than the desiccant breather charge, the only other items that may require replacement are the fuses in the fuse switch (if fitted). These will only require replacing if there has been an external fault that has caused them to fail. They are not part of the routine maintenance requirements.

Transformer	Breather Charge
70 kVA	Brownell Type R1

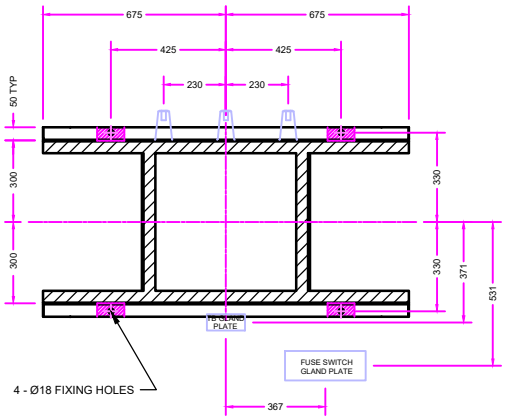
d) Disposal of Equipment

Disposal of this equipment at the end of its operational life must be in accordance with the environmental legislation in force at the time of disposal.

Section 11: TRANSFORMER DRAWINGS

i.	GENERAL ARRANGEMENT DRG	012697
ii.	RATING/DIAGRAM PLATE	012698
iii.	AUXILIARY WIRING DIAGRAM	010198

DO NOT SCALE - IF IN DOUBT ASK



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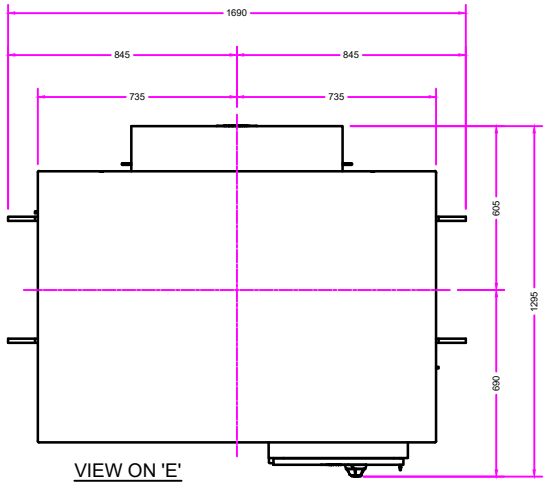


VIEW ON 'E'

TRANSFORMER RATING	
kVA	70
VOLTS	33000 / 433
AMPS	1.22 / 93.34
CONNECTION	Dzn0

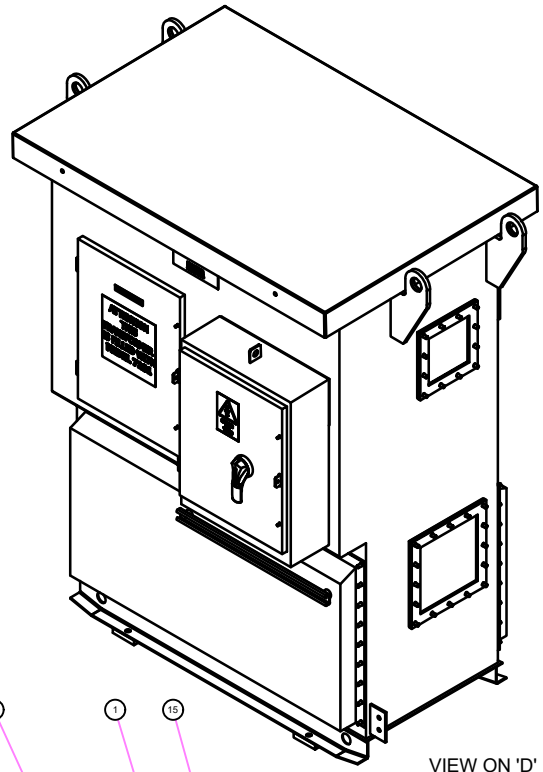
ESTIMATED WEIGHTS	
CORE AND COILS	430 KG
TOTAL WEIGHT	1435 KG
COOLING LIQUID - MIDEL 7131	295 LT

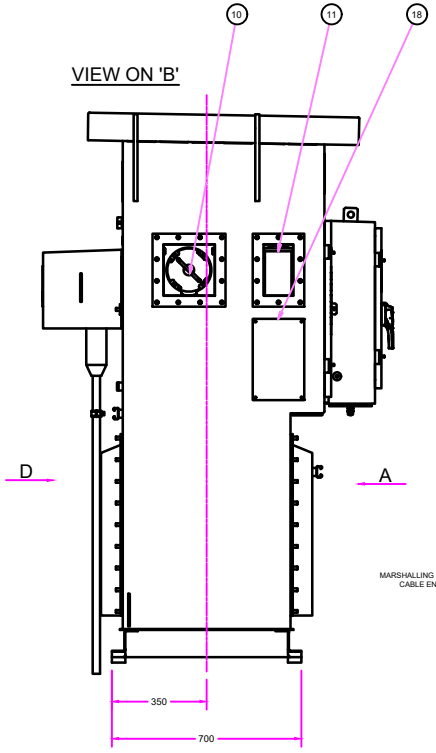
70kVA 33kV 433V SELF BUNDED AUXILIARY TRANSFORMER	
ITEM	DESCRIPTION
1	700 SERIES 36kV 800 AMP TYPE E BUSHING - 5/8" UNC THREAD
2	160 AMP 4 POLE FUSE SWITCH WITH 100 AMP FUSE LINKS & BOLTED NEUTRAL
3	AUXILIARY WIRING MARSHALLING BOX
4	OFF CIRCUIT TAP SWITCH, 6 POSITIONS, LOCKABLE
5	THERMOMETER WELL
6	MIDEL 7131 FILLING PLUG - 1" BSP
7	FILTER / SAMPLING VALVE
8	DRAIN VALVE - DN25 (BEHIND POLYCARBONATE WINDOW)
9	OIL LEVEL GAUGE (BEHIND POLYCARBONATE WINDOW)
10	P.R.D. WITH OIL DIRECTION DUCT (BEHING POLYCARBONATE WINDOW)
11	SILICA GEL BREATHER (BEHIND POLYCARBONATE WINDOW)
12	CABLE SUPPORT RAIL
13	EARTH PAD WITH 14DIA HOLE
14	MAIN LIFTER WITH 45DIA HOLE
15	SEPARABLE CONNECTORS PARKING BAY
16	SINGLE ENTRY HV TERMINALS SHROUD
17	COPPER EARTH BAR FOE 33kV CABLE SCREEN
18	RATING AND DIAGRAM PLATE
19	ANTI VIBRATION PADS

PAINT SPEC:

NETWORK RAIL SPEC. RT/CE/S/039 (RT98)
PROTECTIVE TREATMENT FOR RAIL TRACK INFRASTRUCTURE REFERENCE N1

FINAL COLOUR: SEMI-GLOSS LIGHT GREY (AGATE GREY) TO RAL 7038





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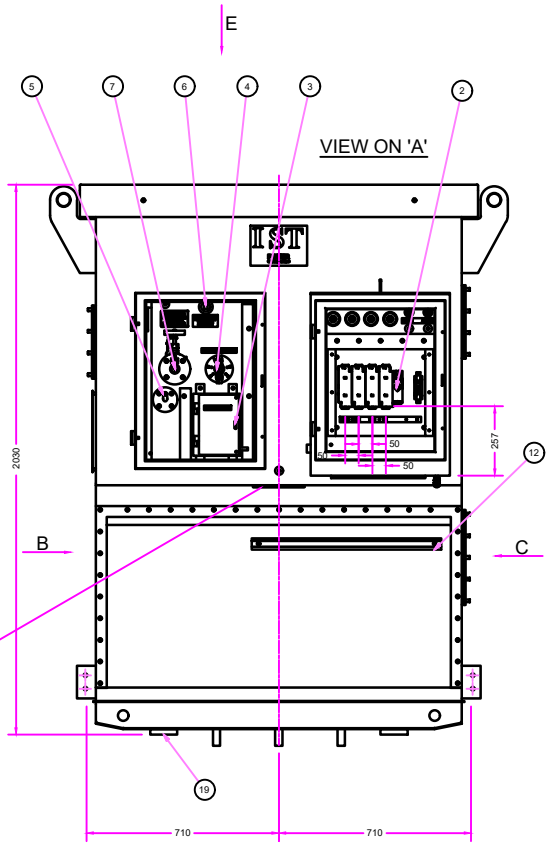

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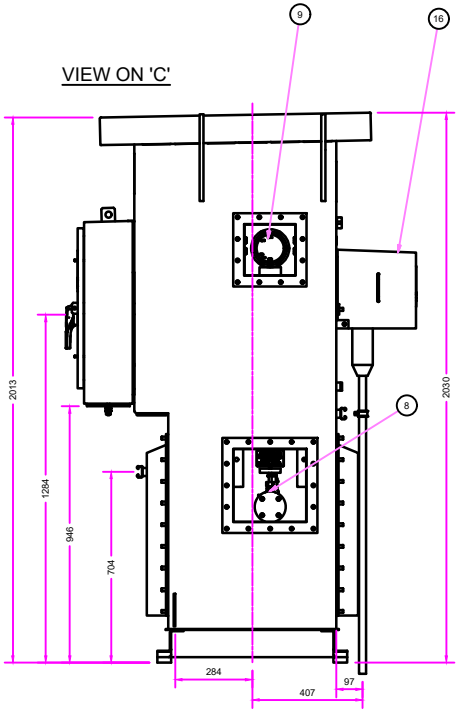

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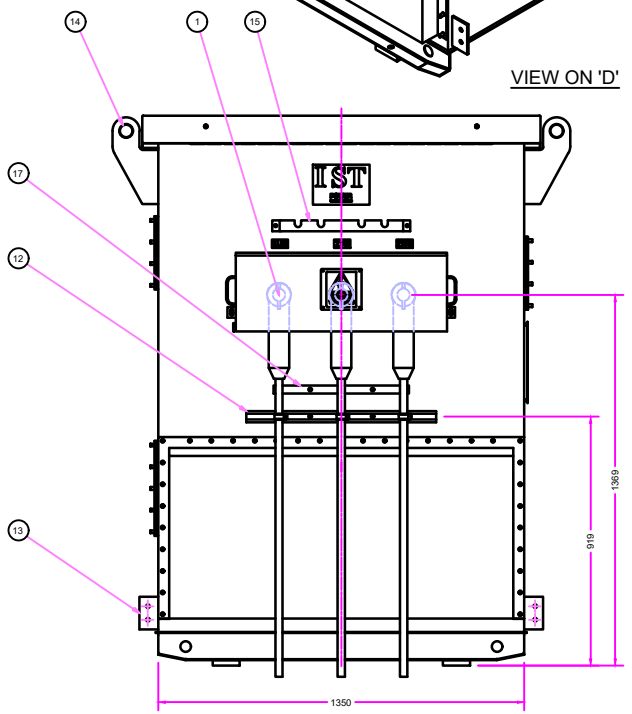


VIEW ON 'D'

WHERE USED 0105406	TOLERANCES UNLESS OTHERWISE STATED : NO DECIMAL PLACE ±1mm. ONE DECIMAL PLACE ±0.4mm ANGULAR ±1°	A1 840 x 594

ISSUE	BY	ECN	DESCRIPTION	DATE
0			NEW	
1	PWJ	M1654	SEE ECN	30/09/20
2				
3				
4				
5				
6				
7				
8				

TITLE

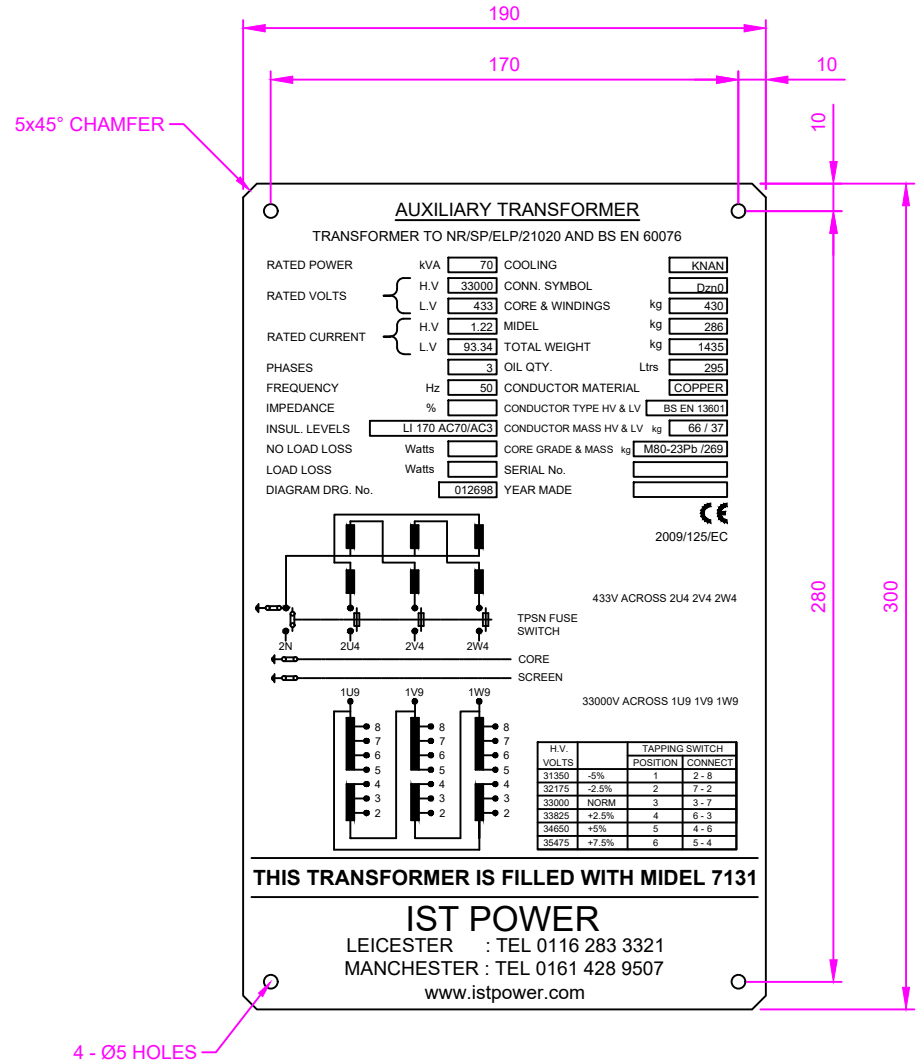
OUTLINE OF 70kVA 33kV 433V
AUXILIARY TRANSFORMER
SELF BUNDED
Dzn0

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

DRAWN BY	CHECKED	SCALE	DATE
MK	PWJ	1:10	12/08/2020

DRAWING No. 012697 SHEET No. 1

IF IN DOUBT ASK



MATERIAL : 0.8THK STAINLESS STEEL GRADE 316

NOTE : REMOVE ALL SHARP EDGES AND CORNERS

ENGRAVE OR SCREEN PRINT.
TO BE SUITABLE FOR HARSH ENVIRONMENT.

IMPEDANCE, NO LOAD LOSSES,LOAD LOSSES, SERIAL NUMBER & YEAR OF MANUFACTURE ARE TO BE ENGRAVED AFTER TEST.
ALL LETTERS TO BE BLACK

WHERE USED 0105406

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 & DIAGRAM PLATE

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

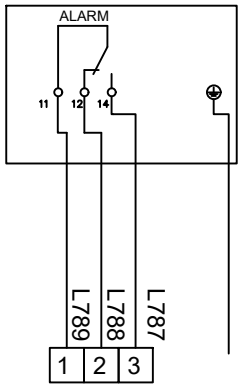
DRAWN	CHECKED	SCALE	DATE
MK	PWJ	1:2	12/08/2020

DRAWING No. 012698

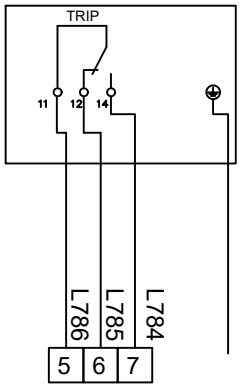
SHEET No. 1

IF IN DOUBT ASK

OIL LEVEL GAUGE
COMEM LA14



PRESSURE RELIEF DEVICE
COMEM 50M



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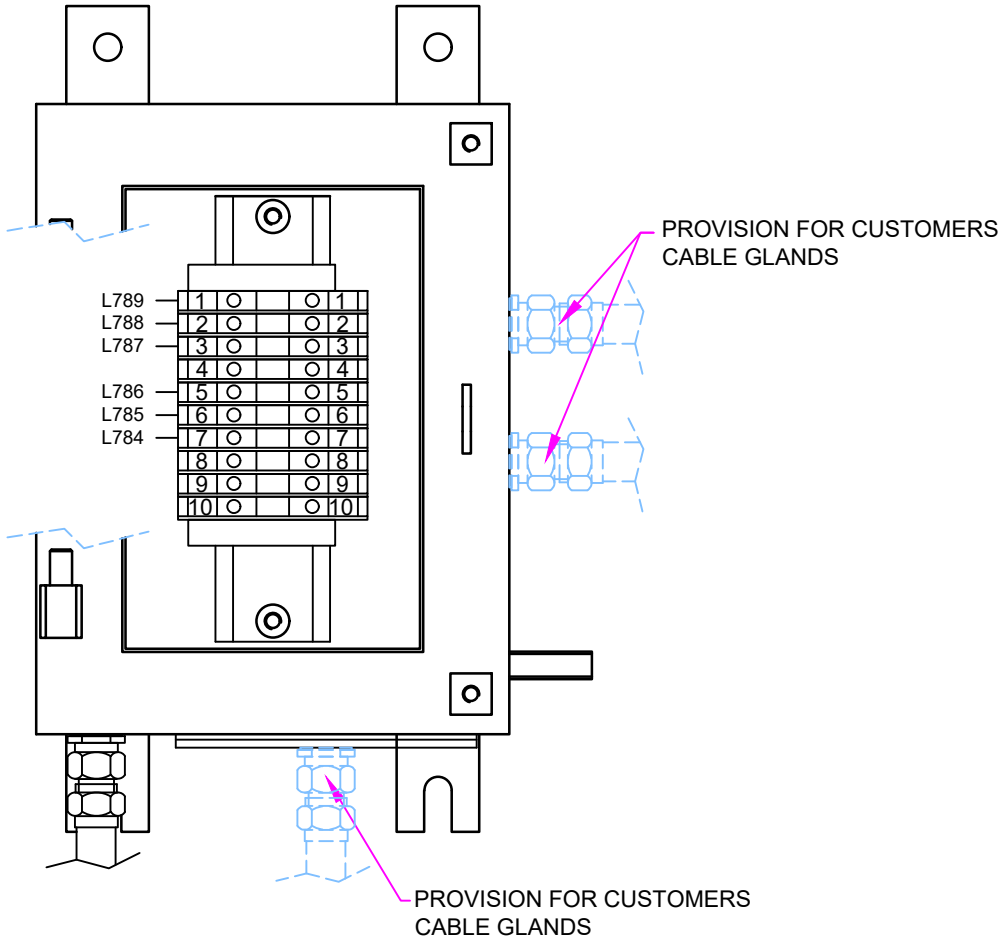


2.5mmSQ 4 CORE PVC SWA CABLE

INSTRUMENT	CONTACTS	OPERATION	COMMENTS
PRESSURE RELIEF DEVICE	1 N.O 1 N.C	CHANGE OVER ON RELEASE	RELEASE AT 5.8 P.S.I.(40kPa)
OIL LEVEL GAUGE	1 N.O 1 N.C	CHANGE OVER ON MIN OIL LEVEL	

WHERE USED

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

AUXILIARY WIRING DIAGRAM

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

DRAWN	CHECKED	SCALE	DATE
MK	PWJ	NTS	26/07/2018

DRAWING No. 010198

SHEET No. 1

Section 12: FIXTURES AND FITTINGS

i. **Pressure Relief Device**

ii. **Bushings**

iii. **Desiccant Breather**

iv. **Fuse switch**

v. **Transformer Midel**

Section 12

i. Pressure Relief Device

a) Comem/ABB 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*

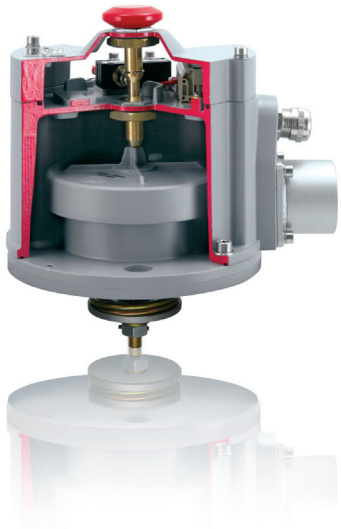
* These guideline sizes are based on experience.

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

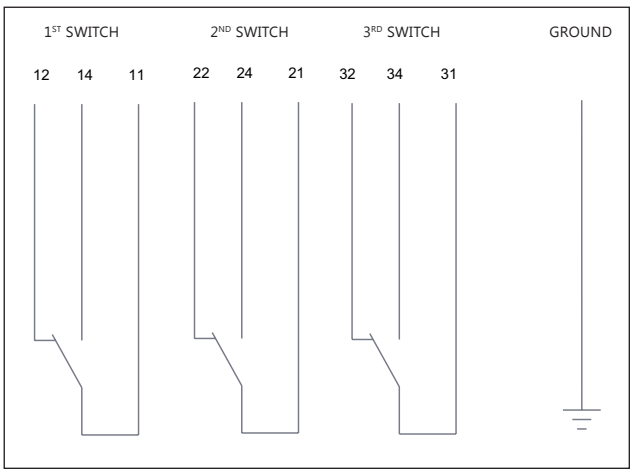
External surfaces are protected against weather corrosion. Aluminum alloy components are non-corroding and their surfaces are protected with a double layer of paint offering high level protection against all atmospheric agents and resisting temperature variations between -40 °C and +100 °C. Special painting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

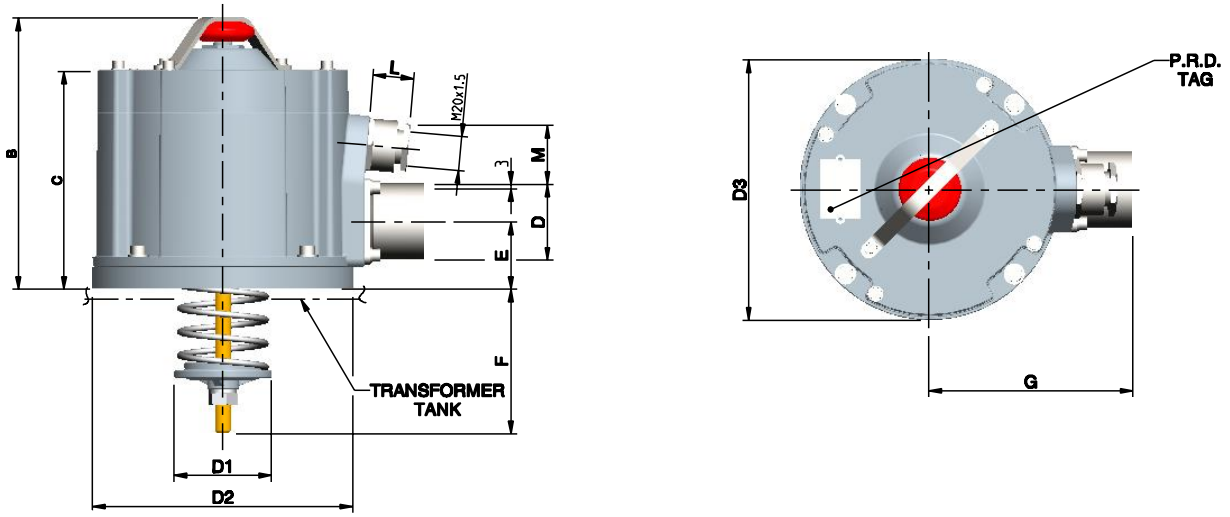
- THIRD SWITCH (terminals 32-34-31)
  change-over contact:
  – 34-31 normally open
  – 31-32 normally closed



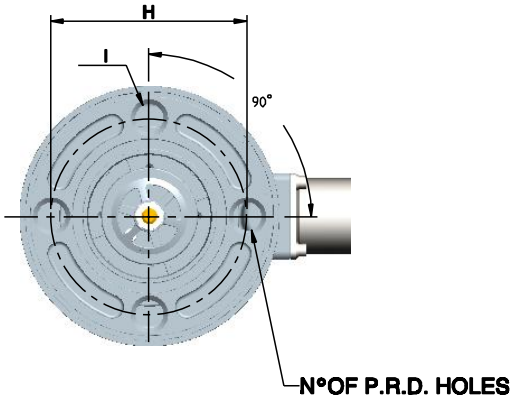
Pressure Relief Device - M

Overall dimensions

Type 50M



50M

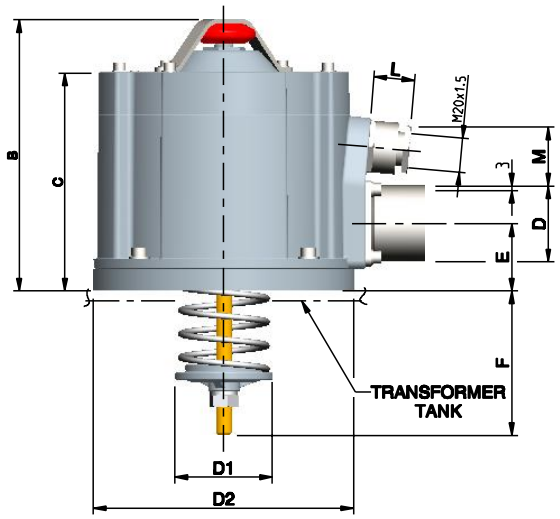


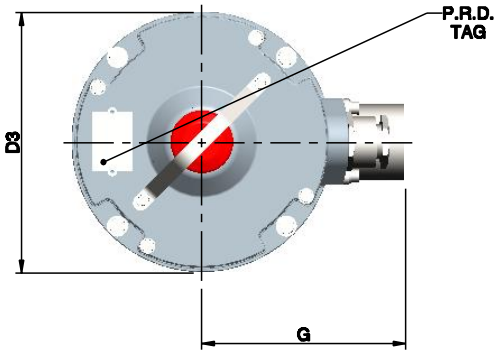
Type	B	C	D	D1	D2	D3	E	F20KPA *	F70KPA *	G	H	I	L	M	kg
50 M	170	139	Ø48.3	Ø62	Ø165	Ø166	41.5	95	60	130	Ø125	Ø18	23	38	2.1

* F = the dimension varies with set pressure

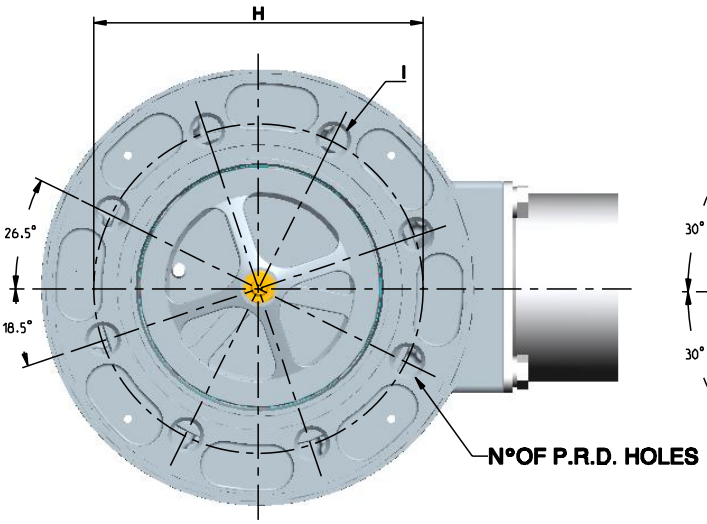
Overall dimensions

Type 125 M8 and 125 M6

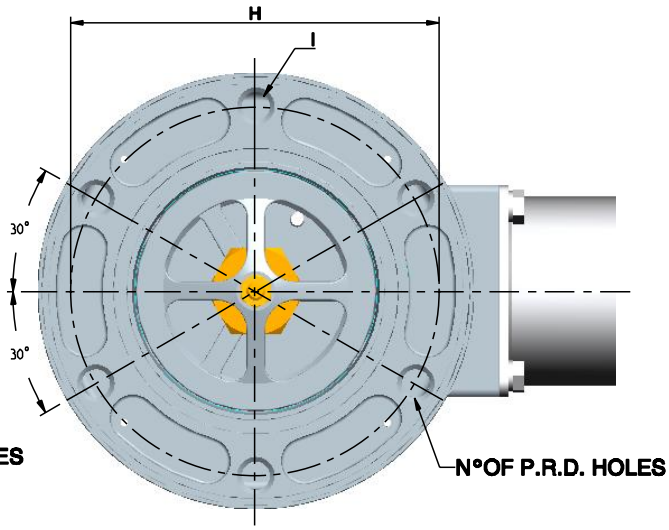




125M-8



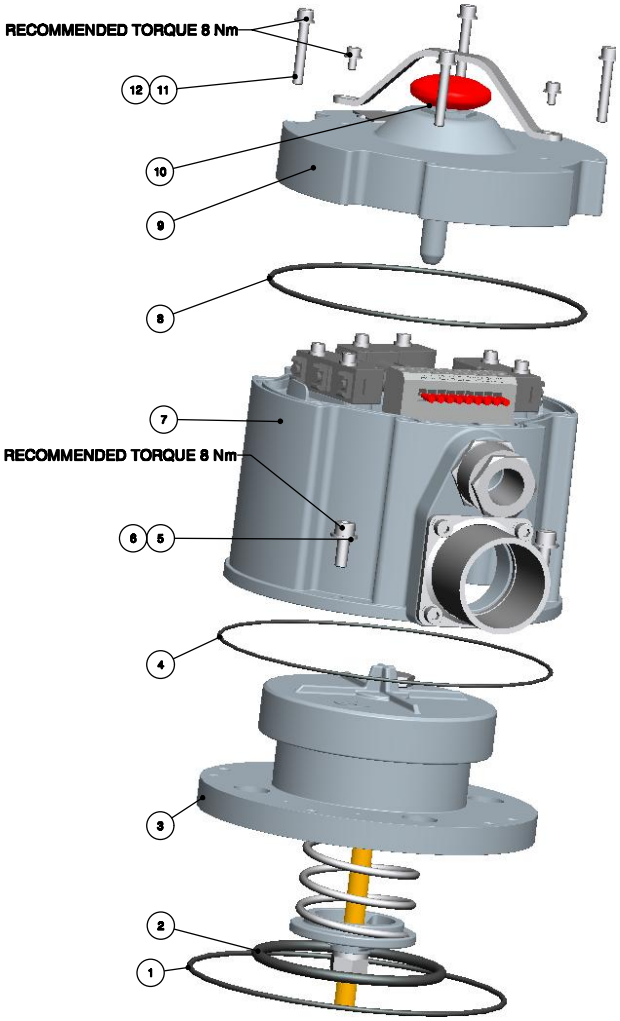
125M-6

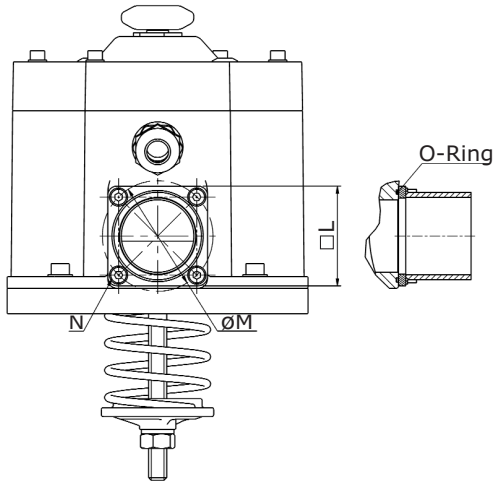


Type	B	C	D	D1	D2	D3	E	F20KPA	F70KPA	G	H	I	No. of holes
125 M-8	278	228	Ø120	Ø153	Ø278	Ø278	86	175	80	230	Ø210	Ø18	8
125 M-6	278	228	Ø120	Ø153	Ø278	Ø278	86	175	80	230	Ø235	Ø18	8

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	

ii. Bushings

a) Euromold Type E Separable Connectors. 7 pages

Euromold

a Nexans company

Medium voltage separable connectors and bushings

- Interface E -

Catalogue 2012

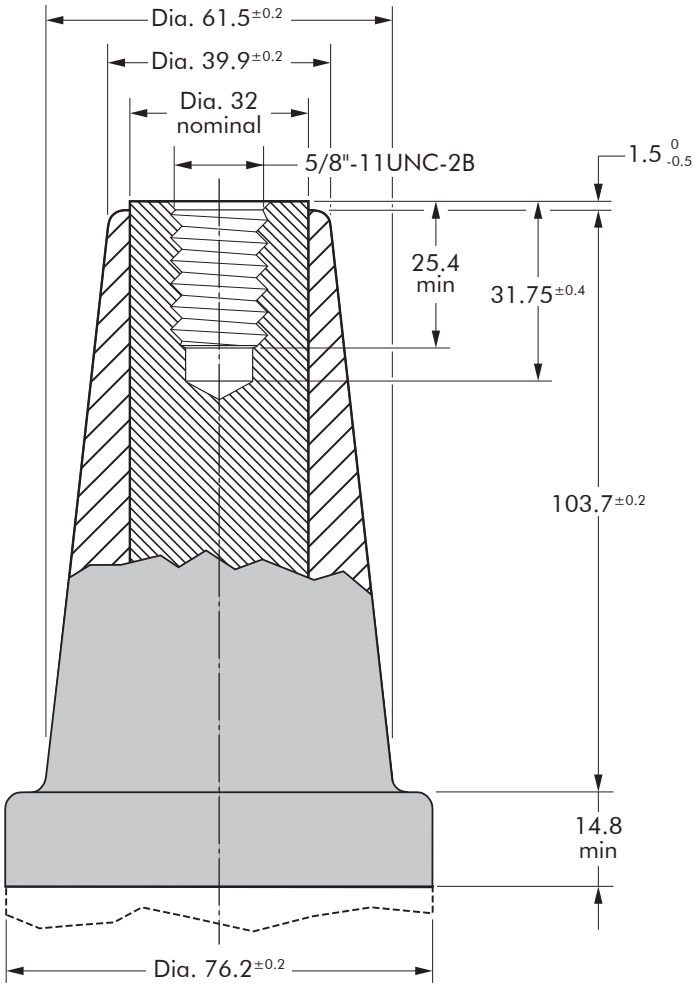
Euromold
a Nexans company

SEPARABLE CONNECTORS AND BUSHINGS
INTERFACE E - 5/8"

Table of contents

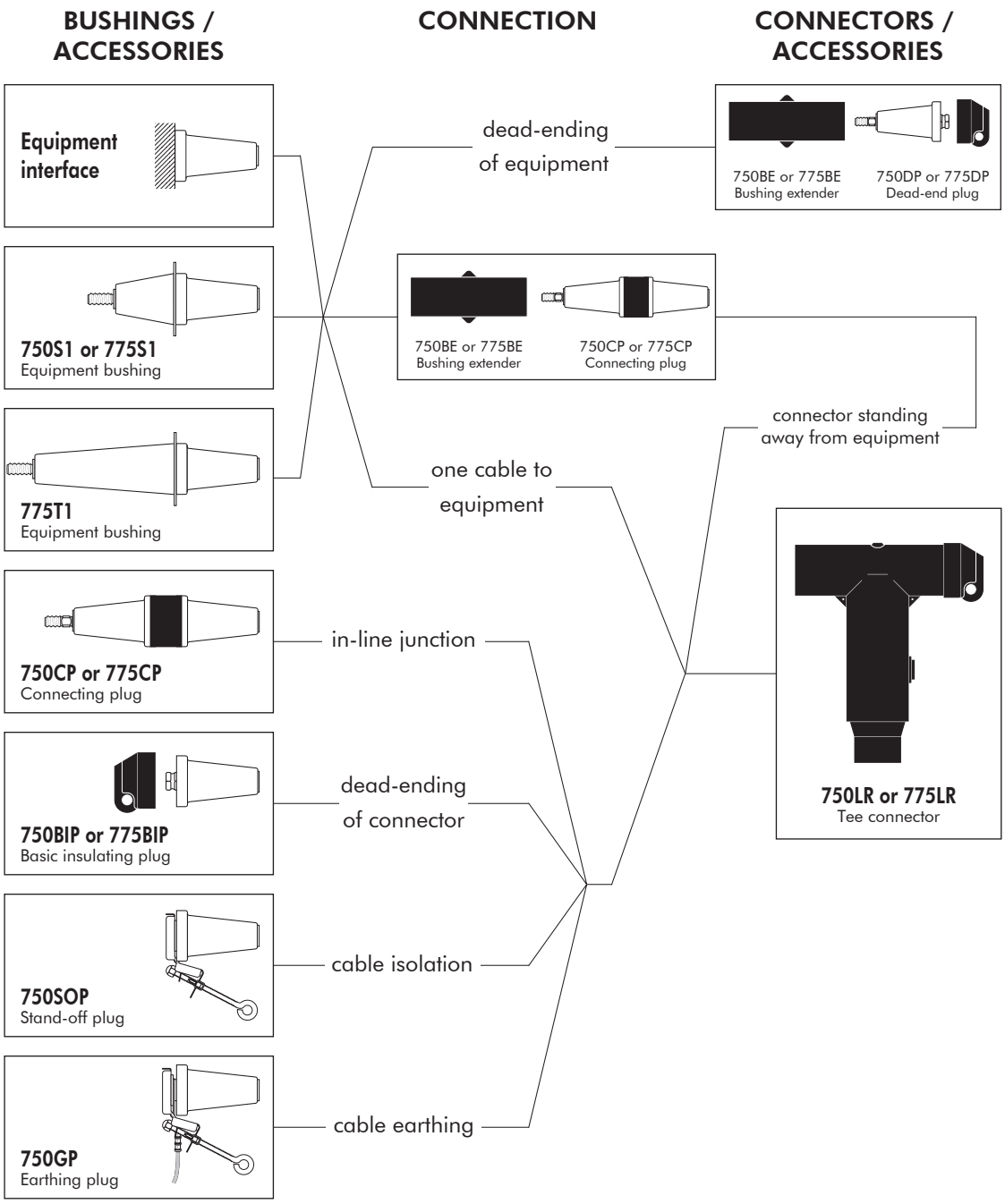
INTERFACE E - 5/8"

Dimensions according to ANSI/ IEEE std. 386 (in mm, except where noted).



04/2012

Connecting possibilities



Euromold
a Nexans company

750LR & 775LR
INTERFACE E - 5/8"
TEE CONNECTOR

Up to 36 kV
800 A & 1250 A

6/10 (12) kV
6.35/11 (12) kV
8.7/15 (17.5) kV
12/20 (24) kV
12.7/22 (24) kV
18/30 (36) kV

Application

Separable tee connector (bolted 5/8" type) designed to connect polymeric insulated cable to equipment (transformers, switchgear, motors...).
Also connects cable to cable, using the appropriate mating part.

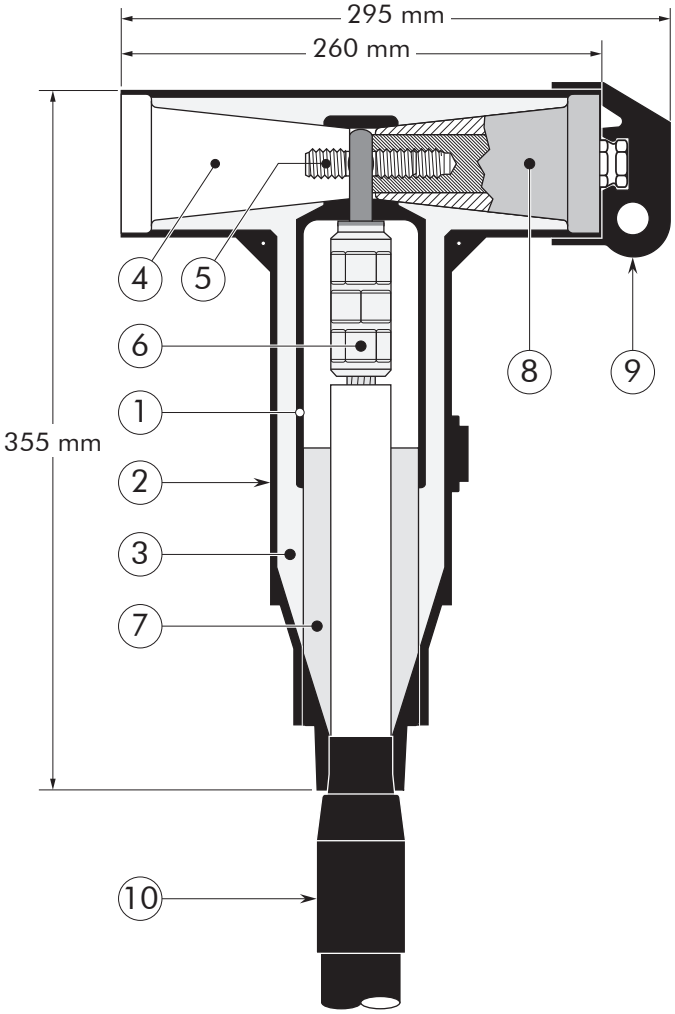
Technical characteristics

- A thick conductive EPDM jacket provides a total safe to touch screen.
- Each separable connector is tested for AC withstand and partial discharge prior to leaving the factory.

Design

Separable connector comprising:

1. Conductive EPDM insert.
2. Conductive EPDM jacket.
3. Insulating EPDM layer moulded between the insert and the jacket.
4. Type E interface as described in ANSI/IEEE std. 386.
5. Threaded stud 5/8".
6. Conductor connector.
7. Cable reducer.
8. Dead-end plug (with VD point).
9. Conductive rubber cap.
10. Cable adaptor.



Specifications and standards

The separable connectors 750LR and 775LR meet the requirements of CENELEC HD 629.1.

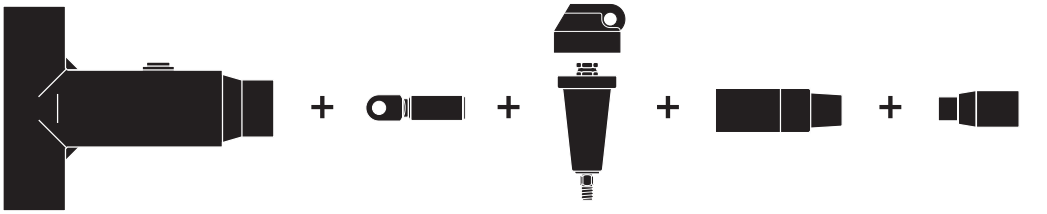
Separable connector type	Voltage Um (kV)	Current Ir (A)	Conductor sizes (mm^2)	
			min.	max.
750LR	36	800	35	630
775LR	36	1250	35	630

04/2012

Kit contents

The complete 750LR or 775LR tee connector kit comprises the following components:

The kit also comprises lubricant, wipers, installation instructions and crimp chart.



Connector housing 750BLR

Conductor contact TBC-**X1** or TBC-**X2**

Dead-end plug + rubber cap 750DP or 775DP

Cable reducer 755CA-**W**

Cable adaptor 11TL

= 750LR-**W-X1**+11TL or 775LR-**W-X2**+11TL connector kit

Ordering instructions

Select the part number which gives the best centring to the cable core insulation diameter.

Example:

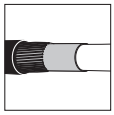
The copper wire screened cable is 36 kV, 300 mm^2 stranded aluminium with a diameter over core insulation of 38.8 mm. Order a 750LR-M-300KM-10-2+11TL tee connector kit for 800 A application.

Table W

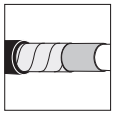
Ordering part number - 800 A	Ordering part number - 1250 A	Dia. over core insulation (mm)	
		min.	max.
750LR-G-**X1**+11TL	775LR-G-**X2**+11TL	19.3	24.1
750LR-H-**X1**+11TL	775LR-H-**X2**+11TL	21.6	26.7
750LR-J-**X1**+11TL	775LR-J-**X2**+11TL	24.9	30.0
750LR-K-**X1**+11TL	775LR-K-**X2**+11TL	27.7	33.3
750LR-L-**X1**+11TL	775LR-L-**X2**+11TL	30.0	37.2
750LR-M-**X1**+11TL	775LR-M-**X2**+11TL	34.8	41.1
750LR-N-**X1**+11TL	775LR-N-**X2**+11TL	38.5	45.2
750LR-P-**X1**+11TL	775LR-P-**X2**+11TL	43.8	49.1
750LR-Q-**X1**+11TL	775LR-Q-**X2**+11TL	48.3	53.9

Table X

Conductor sizes (mm^2)	Table X1: 800 A			Table X2: 1250 A		
	Aluminium conductor		Copper conductor	Aluminium conductor		Copper conductor
	DIN hexagonal	Deep indent	DIN hexagonal	DIN hexagonal	Deep indent	DIN hexagonal
35	35(K)M-10-2	35KM-10-1	35(K)M-14	35(K)M-12-2	35KM-12-1	35(K)M-11-2
50	50(K)M-10-2	50(K)M-10-1	50(K)M-14	50(K)M-12-2	50(K)M-12-1	50(K)M-11-2
70	70(K)M-10-2	70(K)M-10-1	70(K)M-14	70(K)M-12-2	70(K)M-12-1	70(K)M-11-2
95	95(K)M-10-2	95(K)M-10-1	95(K)M-14	95(K)M-12-2	95(K)M-12-1	95(K)M-11-2
120	120(K)M-10-2	120(K)M-10-1	120(K)M-14	120(K)M-12-2	120(K)M-12-1	120(K)M-11-2
150	150(K)M-10-2	150(K)M-10-1	150(K)M-14	150(K)M-12-2	150(K)M-12-1	150(K)M-11-2
185	185(K)M-10-2	185(K)M-10-1	185(K)M-14	185(K)M-12-2	185(K)M-12-1	185(K)M-11-2
240	240(K)M-10-2	240(K)M-10-1	240(K)M-14	240(K)M-12-2	240(K)M-12-1	240(K)M-11-2
300	300(K)M-10-2	300(K)M-10-1	300(K)M-14	300(K)M-12-2	300(K)M-12-1	300(K)M-11-2
400	400(K)M-10-2	400(K)M-10-1	400(K)M-14	400(K)M-12-2	400(K)M-12-1	400(K)M-11-2
500	500(K)M-10-2	500(K)M-10-1	500(K)M-14	500(K)M-12-2	500(K)M-12-1	500(K)M-11-2
630	630(K)M-10-2	630(K)M-10-1	630(K)M-14	-	630(K)M-12-1	630(K)M-11-2



For use with copper wire screened cables. No earthing device is necessary.



For use with copper tape screened cables. Order: Kit MT.

For use with fabric tape (graphite) screened cables. Order additional semi-conductive tape (type TSC).

For use with other cable types. Please contact our representative.

For outdoor applications. Order: +MWS.

Components can be ordered individually.

Euromold
a Nexans company

750S1, 775S1 & 775T1
INTERFACE E - 5/8" EQUIPMENT BUSHING

Application
For use in equipment insulated with oil fluid, typically for transformers, switchgear, capacitors...

Technical characteristics
Each bushing is tested for AC withstand and partial discharge prior to leaving the factory.

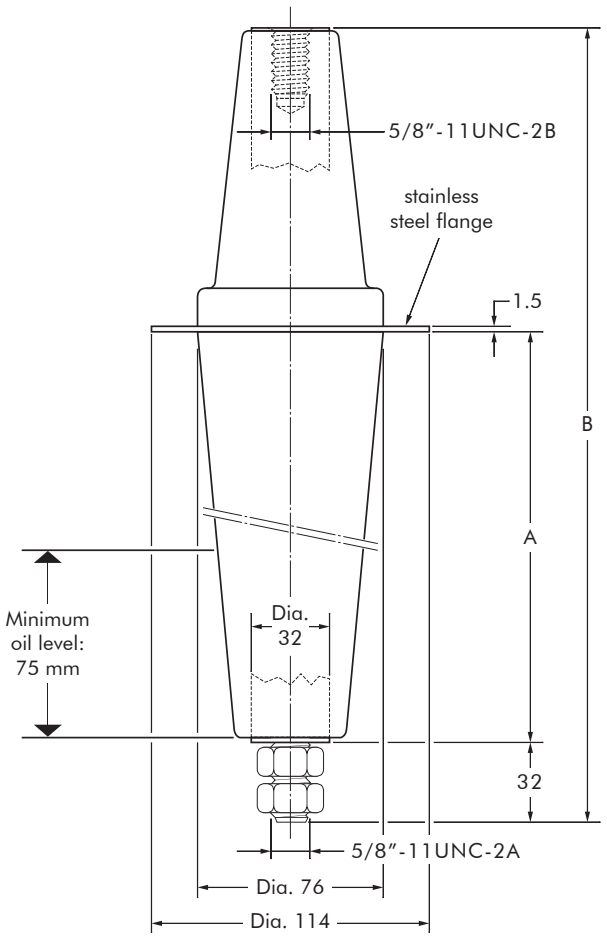
Up to 36 kV
800 A & 1250 A

6/10 (12) kV
6.35/11 (12) kV
8.7/15 (17.5) kV
12/20 (24) kV
12.7/22 (24) kV
18/30 (36) kV

Design
The equipment bushing is a moulded epoxy insulated part in accordance with ANSI/IEEE 386 std. (5/8" threading system).

Specifications and standards
The bolted type equipment bushings 750S1, 775S1 and 775T1 meet the requirements of IEC 60137.

Ordering instructions
To order the equipment bushing, specify the type.

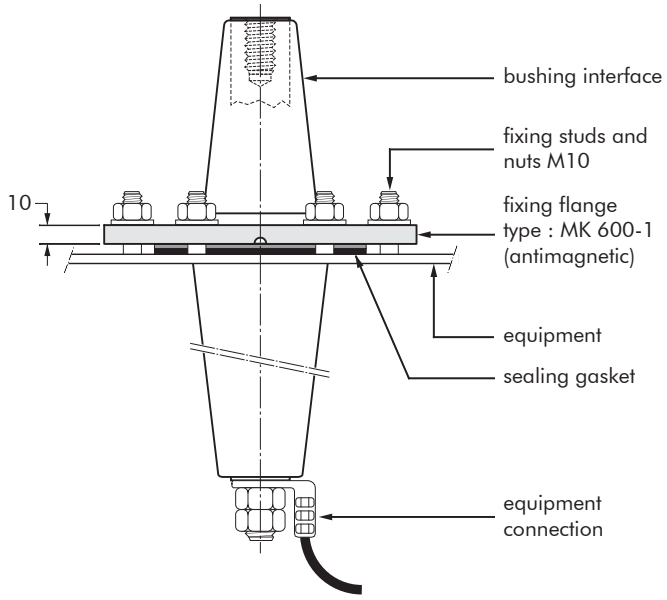


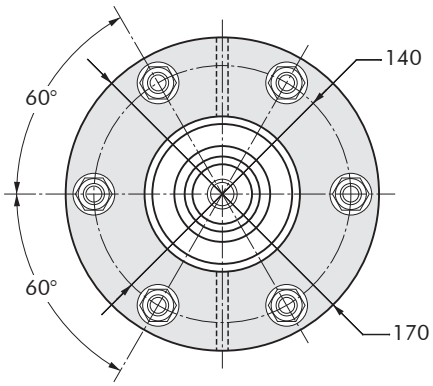
In mm, except where noted.

Equipment bushing type	Voltage Ur (kV)	Current Ir (A)	Dimensions (mm)	
			A	B
750S1	36	800	75	235
775S1	36	1250	75	235
775T1	36	1250	221	378

04/2012

750S1, 775S1 and 775T1 bushings





Bushing fixing flange

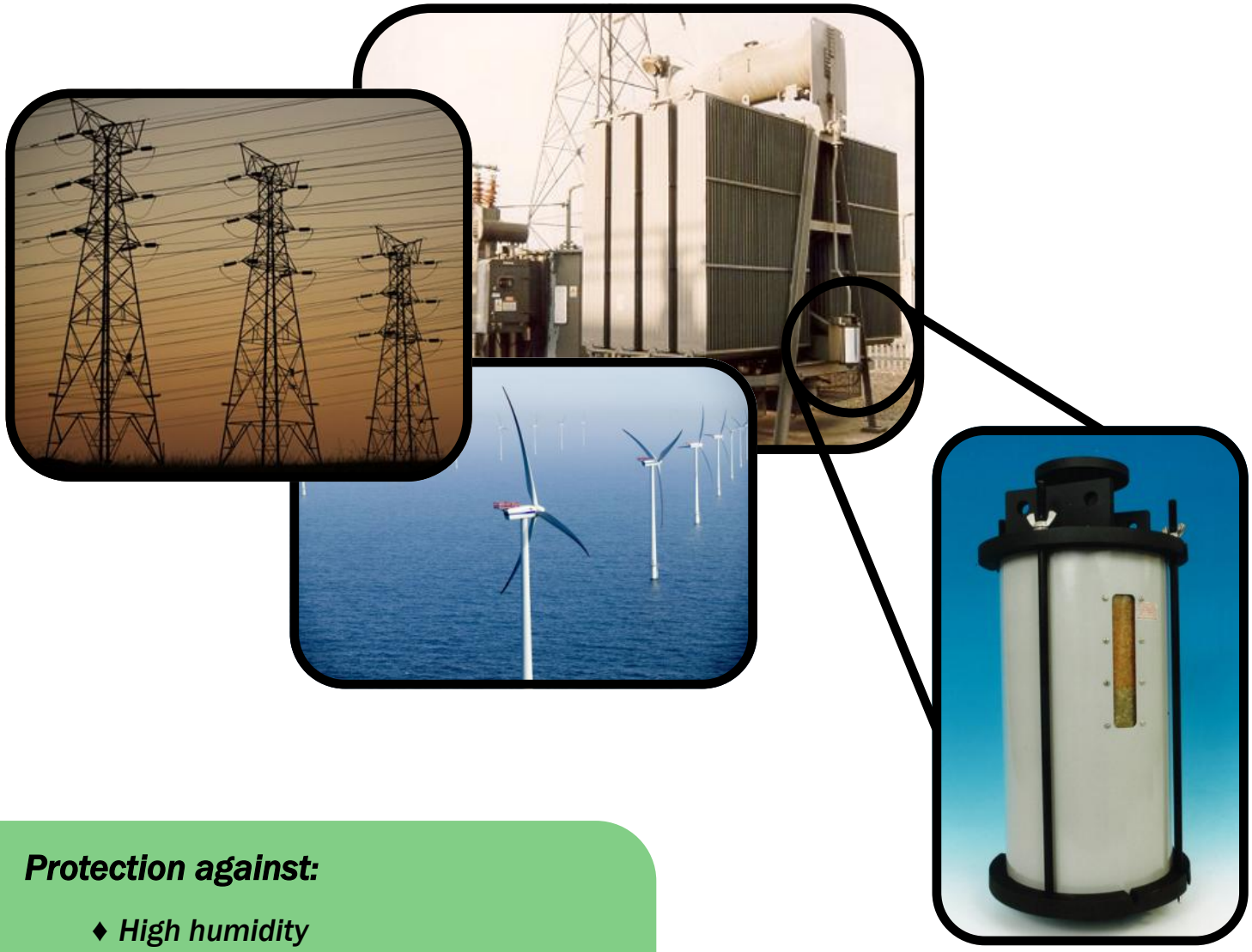
To order the bushing fixing flange, simply specify MK600-1.

In mm.

iii. Desiccant Breather

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

Transformer Breathers



Protection against:

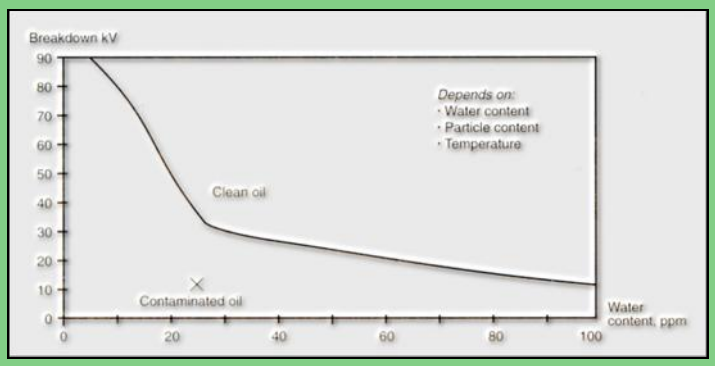
- *High humidity*
- *Water condensation*
- *Pressure variations*
- *Dielectric loss*
- *Mould growth*
- *Outgassing*

Key Technical Features

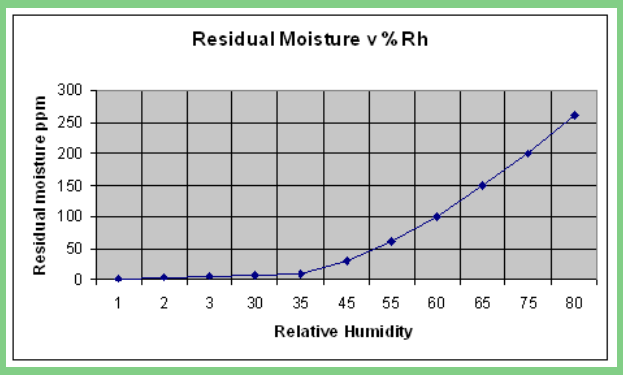
- High performance plastic or metal construction
- Simple installation
- ISO9001/2008 design approved
- Suitable for 1250 kVA to 750 mVA Transformers
- Low dusting beaded ENVIROGEL adsorbent
- Up to 25% adsorption capacity
- Definitive colour change saturation indication
- IP 65 rating
- Operating temperature 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

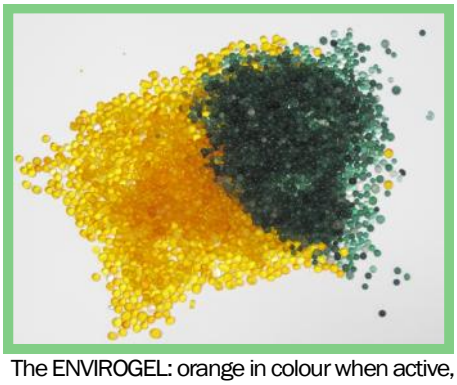
Robust construction Transformer Breathers

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.



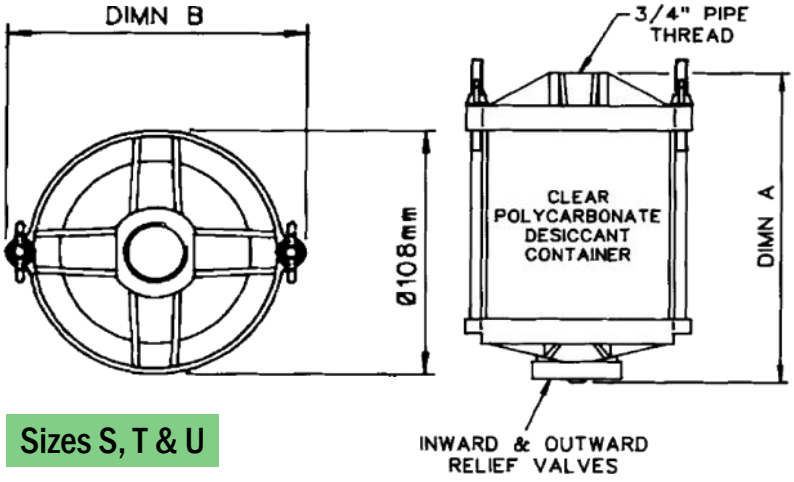
The ENVIROGEL: orange in colour when active, turning green when saturated

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.

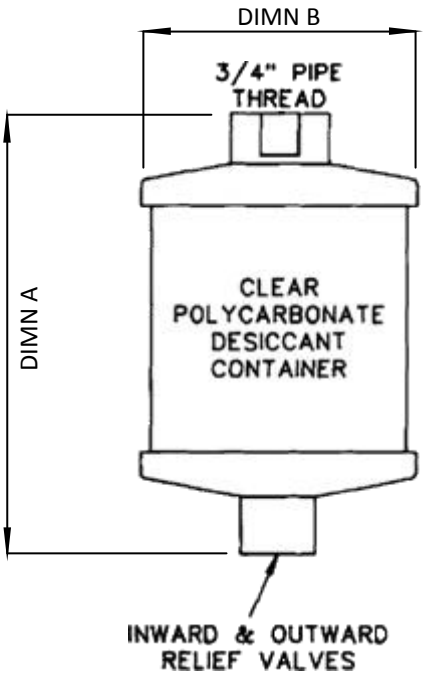
Sizes R, R1, R2, S, T & U

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) Hazard label(s)	Not applicable.
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.

iv. Fuse Switch

a) Socomec Fuse Switch Data. 5 pages

FUSERBLOC

Fuse combination switches
for industrial fuses up to 1250 A


fuser_548_a_1_cat

FUSERBLOC
630 to 1250 A


fuser_532_a_1_cat

FUSERBLOC
32 to 400 A


fuser_539_a_1_cat

FUSERBLOC
20 to 32 A

Function

FUSERBLOC are manually operated multipolar fuse combination switches. They make and break on load and provide safety isolation and protection against overcurrent for any low voltage electrical circuit.

Advantages

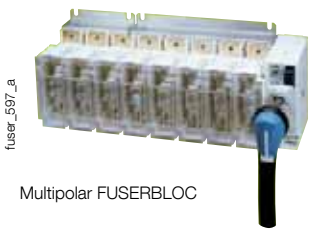
Improved safety
- Complete isolation of the fuse with double breaking per pole (top and bottom of fuse).
- Positive break indication.
- IP2X protection with terminal shrouds front panel.

High breaking capacity

Protection against overloads and short-circuits thanks to high breaking capacity fuses (100 kA rms).

Specific functionalities for simplified use
- TEST position for testing control circuits without power using U-type auxiliary contacts. In TEST position, the enclosure door can be opened.
- Mechanical or electronic fuse melting detection system (see DDMM or FMD).

Customised solutions


fuser_597_a

Multipolar FUSERBLOC


fuser_552_a

Centred operation

The solution for
- Motor load break
- Protection of industrial cabinet

Strong points
- Improved safety
- High breaking capacity
- Specific functionalities for simplified use

A complete range.
- Centred or left side operation, rear connections, plug-in connections. Please consult us.

Conformity to standards
- IEC 60947-3
- EN 60947-3
- BS EN 60947-3
- NBN EN 60947-3
- IEC 60269-1
- DIN EN 60269-1
- NF EN 60269-1
- IEC 60269-2
- VDE 0636-1
- VDE 0660-107
- Standards UL: see FUSERBLOC UL

Approvals and certifications(1)

(1) *Product reference on request.*

What you need to know

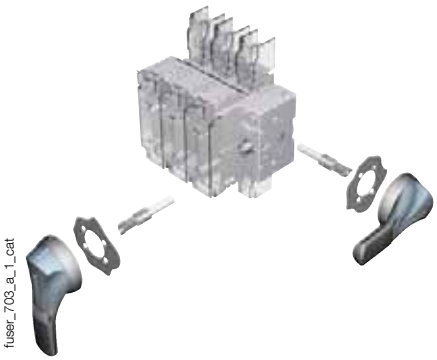
- In addition to the FUSERBLOC rating, product selection also depends on the fuse characteristics and functional specifications, which need to be in accordance with the application.
  SOCOMEC FUSERBLOC are available for utilisation with **NFC, DIN or BS88 fuses.**

- Whether it is 3 pole + switched neutral or 3 pole + solid neutral, the **FUSERBLOC** 20 to 32 A with **direct front operation** and **external operation** is the best suited solution in compact design.

- From 32 to 400 A, the FUSERBLOC is available in 2, 3 or 4 poles with **direct right side operation**.

- From 630 to 1250 A, the FUSERBLOC allows **direct** and **external front left** or **right** side operation in 2, 3 or 4 poles.

- With external operation, it is possible to operate the device in 3 ways:
  - **Front** operation
  - **Right side** operation
  - **Left side** operation.



- For ratings 20 to 400 A, the **flat mounting kit** provides a compact solution ideally suited to withdrawable applications.

- Maintenance of outputs from the DC common bus. The **FUSERBLOC LMDC** is the most compact solution and the most economical for your maintenance requirements (please consult us).

BS 88 - External front and side operation - 200 to 1250 A

Rating (A) Fuse size Frame size	Number of poles	Reference Switch I-0	Reference Changeover I - 0 - II	External front handle I-0	TEST External front handle I-0 TEST	External right side handle I -0	Changeover external front handle I - 0 - II	Shaft extensions for handle	Terminal shrouds(3)	U type A/C (2)	Integrated solid neutral link
CD 200 A A3-A4 (5) 13 A	2 P	3841 **2019**		Black S2 type IP55 1421 **2111**(1) Red/Yellow S2 type IP65 1424 **2111**	Black S2 type IP65 1423 **2115**(1) Red/Yellow S2 type IP65 1424 **2115**	Black S2 type IP55 1425 **2111**(1) Red/Yellow S2 type IP65 1428 **2111**	Black S2 type IP55 1421 **2113**(1) Red/Yellow S2 type IP65 1424 **2113**	320 mm 1400 **1032**	2 P 3998 **2016** 3 P 3998 **3016** 4 P 3998 **4016**	1 contact NO 3999 **0701** 1 contact NC 3999 **0702**	3829 **9320**
	3 P	3841 **3019**	3880 **3019**								
	4 P	3841 **6019**	3880 **6019**								
200 A B1-B2 15	2 P	3841 **2021**							2 P 3998 **2025** 3 P 3998 **3025** 4 P 3998 **4025**		3829 **9325**
	3 P	3841 **3021**	3880 **3021**								
	4 P	3841 **6021**	3880 **6021**								
250 A B1-B2-B3 15	2 P	3841 **2024**									
	3 P	3841 **3024**	3880 **3024**								
	4 P	3841 **6024**	3880 **6024**								
315 A B1-B2-B3 16	2 P	3841 **2031**							2 P 3898 **2040** 3 P 3898 **3040** 4 P 3898 **4040**		3829 **9339**
	3 P	3841 **3031**	3880 **3032**(6)								
	4 P	3841 **6031**	3880 **6032**(6)								
400 A B1-B2-B3-B4 16	2 P	3841 **2038**									
	3 P	3841 **3038**									
	4 P	3841 **6038**									
630 A C1-C2 17	2 P	3821 **2063**		Black S3 type IP65 1433 **3111**(1) Red/Yellow S3 type IP65 1434 **3111**		Black S3 type IP65 1437 **3111**(1) Red/Yellow S3 type IP65 1438 **3111**		320 mm 1400 **1232**	2 P 3898 **2080** 3 P 3898 **3080** 4 P 3898 **4080**		3829 **9308**
	3 P	3821 **3063**									
	4 P	3821 **6063**									
800 A C1-C2-C3 17	2 P	3821 **2080**									
	3 P	3821 **3080**									
	4 P	3821 **6080**									
1250 A D1 18	2 P	3821 **2120**		Black S4 type IP65 1443 **3111**(1)					3898 **2120**		3829 **9312**
	3 P	3821 **3120**							3898 **3120**		
	4 P	3821 **6120**							3898 **4120**		

(1) Standard.
(2) 4 auxiliary contacts as standard without additional contact holder.
(3) Top/bottom.
(4) 8 AC as standard without support (the support is for 8 additional auxiliary contacts).
(5) For fuse size A4: max diameter 31 mm.
(6) Terminal shrouds: 3 P - 3998 3025, 4 P - 3998 4025.

Accessories

Direct operation handle

For front operation

Rating (A)	Frame size	Figure no.	Handle colour	Reference
20 ... 32	0	1	Black	3629 **4012**
20 ... 32	0	1	Red	3629 **4013**
32 ... 400	11 ... 16	2	Black	3629 **7910**
630 ... 800	17	2	Black	3899 **6011**
800 ... 1250	18	3	Black	3899 **7011**

For right side operation

Rating (A)	Frame size	Figure no.	Handle colour	Reference
32 ... 63	1/2	4	Black	3629 **7900**
100 ... 400	3 ... 6	4	Black	3629 **7901**
630 ... 1250	17 ... 18	5	Black	1437 **7911**

Fig. 1

Fig.2

Fig. 3

Fig.4

Fig. 5

External front operation handle

Padlockable handle in position 0

Rating (A)	Frame size	Handle type	Handle colour	Operation	External IP(1)	Defeatable handle	Reference
CD 25 ... 63	0/11/12	S1	Black	I - 0	IP55	Yes	1411 **2111**
CD 25 ... 63	0/11/12	S1	Black	I - 0	IP65	Yes	1413 **2111**
CD 25 ... 63	0/11/12	S1	Red/Yellow	I - 0	IP65	Yes	1414 **2111**
CD 25 ... 63	0/11/12	S1	Black	I - 0 - Test	IP65	Yes	1413 **2115**
CD 25 ... 63	0/11/12	S1	Red/Yellow	I - 0 - Test	IP65	Yes	1414 **2115**
100 ... 400	13 ... 16	S2	Black	I - 0	IP55	Yes	1421 **2111**
100 ... 400	13 ... 16	S2	Black	I - 0	IP65	Yes	1423 **2111**
100 ... 400	13 ... 16	S2	Red/Yellow	I - 0	IP65	Yes	1424 **2111**
100 ... 400	13 ... 16	S2	Black	I - 0 - Test	IP55	Yes	1423 **2115**
100 ... 400	13 ... 16	S2	Red/Yellow	I - 0 - Test	IP65	Yes	1424 **2115**
630 ... 800	17	S3	Black	I - 0	IP65	Yes	1433 **3111**
630 ... 800	17	S3	Red/Yellow	I - 0	IP65	Yes	1434 **3111**
800 ... 1250	18	S4	Black	I - 0	IP65	Yes	1443 **3111**
800 ... 1250	18	S4	Red/Yellow	I - 0	IP65	Yes	1444 **3111**

(1) IP: protection degree according to IEC 60529 standard.

Padlockable handle in position 0 and I

Rating (A)	Frame size	Handle type	Handle colour	External IP(1)	Reference
CD 25 ... 63	0/11/12	S1	Black	IP65	1413 **2311**
100 ... 400	13 ... 16	S2	Black	IP65	1423 **2311**

(1) IP: protection degree according to IEC 60529 standard.

S1 type handle

S2 type handle

S3 type handle

S4 type handle

External right side operation handle

Rating (A)	Frame size	Handle type	Handle colour	External IP(1)	Reference
CD 25 ... 63	0/11/12	S1	Black	IP55	1415 **2111**
CD 25 ... 63	0/11/12	S1	Black	IP65	1417 **2111**
CD 25 ... 63	0/11/12	S1	Red/Yellow	IP65	1418 **2111**
100 ... 400	13 ... 16	S2	Black	IP55	1425 **2111**
100 ... 400	13 ... 16	S2	Black	IP65	1427 **2111**
100 ... 400	13 ... 16	S2	Red/Yellow	IP65	1428 **2111**
630 ... 1250	17/18	S3	Black	IP65	1437 **3111**
630 ... 1250	17/18	S3	Red/Yellow	IP65	1438 **3111**

(1) IP: protection degree according to IEC 60529 standard.

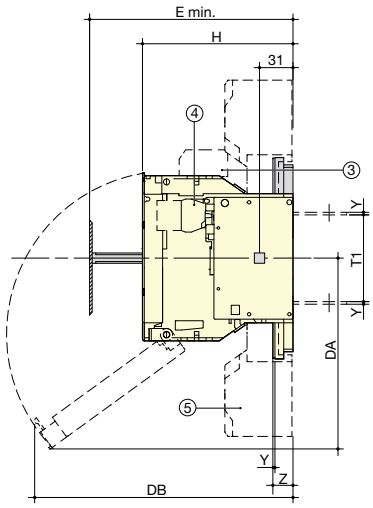

S1 type handle

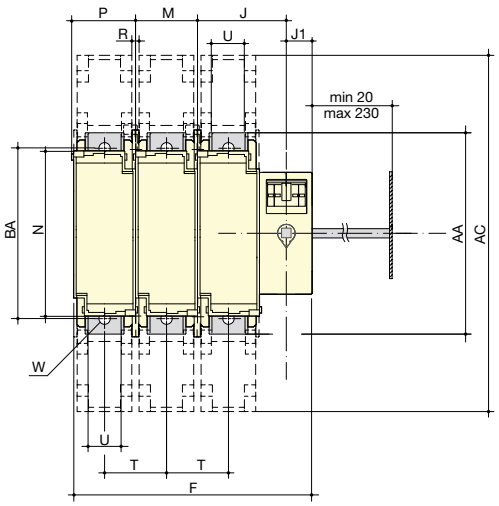
S3 type handle

Dimensions (continued)

External operation

BS88 32 to 250 A - NFC and DIN 50 to 250 A





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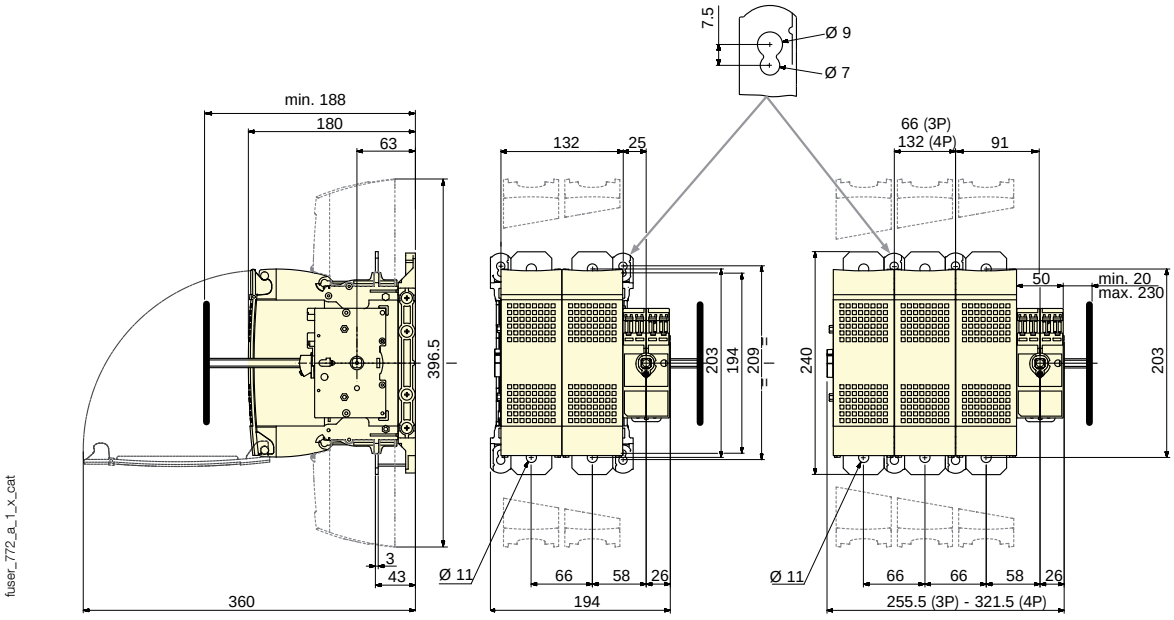
1. Position TEST.
2. Rear connection (option)
3. 1 or 2 CA type DDMM
4. 1 or 8 CA NO/NC pre-break.
5. Terminal shrouds.

Rating (A)	NFC/DIN Fuse size	BS88 Fuse size	Frame size	Overall dimensions E min	Terminal shrouds AC	Switch body								Switch mounting				Connection							
						F 3p.	F 4p.	H	J	J1	BC	DA	DB	M	N	P	R	T	T1	U	W	Y	Z	AA	BA
32		A1	11	100	-	121	148	87	45	18	70	85	153	27	106	31	6	27	59	12	-	2	-	118	-
50	14 x 51	-	11	100	-	121	148	87	45	18	70	85	153	27	106	31	6	27	59	12	-	2	-	118	-
63	00C	A2-A3	12	125	-	136	168	116	50	18	70	159	145	32	106	36	5.4	32	59	12	-	2	-	118	-
100	22x58	A4	13	135	268	148	184	116	54	18	125	141	187	36	127	40	5.4	36	62	20	8.5	2.5	19.5	162	141
125	22x58	-	13	135	268	148	184	116	54	18	125	141	179	36	127	40	5.4	36	62	20	8.5	2.5	19.5	162	141
125	00	-	13	135	268	148	184	126	54	18	125	141	193	36	127	40	5.4	36	62	20	8.5	2.5	19.5	162	141
160	00	-	13	135	268	148	184	126	54	18	125	141	193	36	127	40	5.4	36	62	20	8.5	2.5	19.5	162	141
CD 160 CD 200	-	A3-A4	13A	145	268	148	184	139	54	18	125	141	-	36	130	40	5.4	36	78	18	8.5	3	20	162	141
160	0	A4-B1-B2	14	145	268	190	240	136	64	18	125	174	229	50	140	54	5.4	50	62	20	8.5	2.5	19.5	162	141
200	-	B1-B2	15	154	345	234	294	146	86	25	125	185	251	60	162	64	6.4	60	84	32	11	2.5	19.5	195	166
250	1	B1-B2-B3	15	154	345	234	294	146	86	25	125	185	251	60	162	64	6.4	60	84	32	11	2.5	19.5	195	166

BS88 315 to 400 A (size B1-B2-B3-B4) - DIN 400 A (size 2)



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socomec
Innovative Power Solutions

v. Transformer Midel

a) Midel technical Information Pack. 18 pages
b) Oil Sampling procedure. 4 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

December 2010 Page 1 of 2

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.

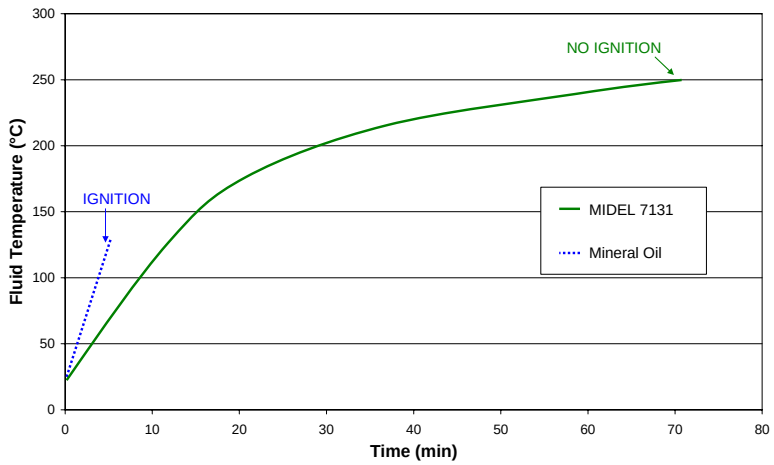
Smoke and Combustion Products

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



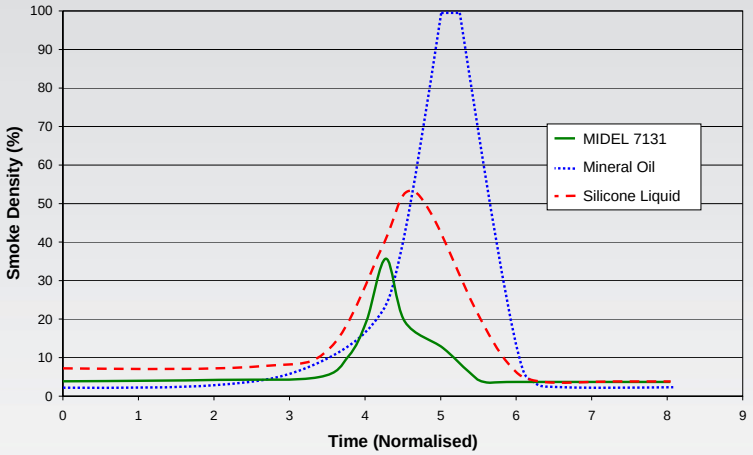
Increased Fire Safety

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

December 2010 Page 1 of 2

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.

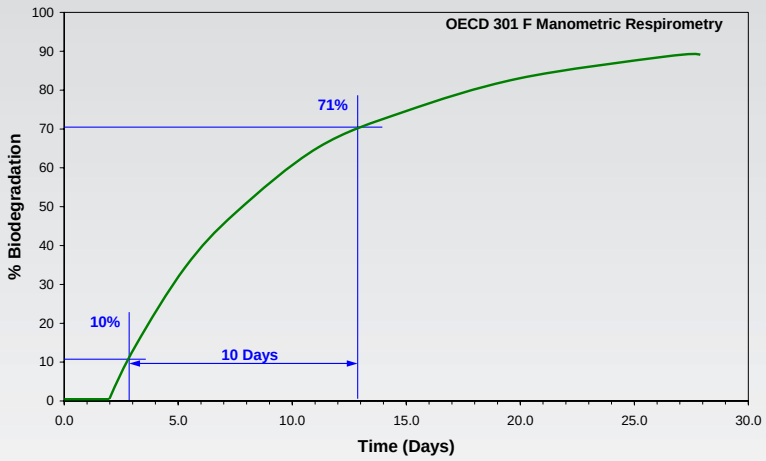
Biodegradation

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

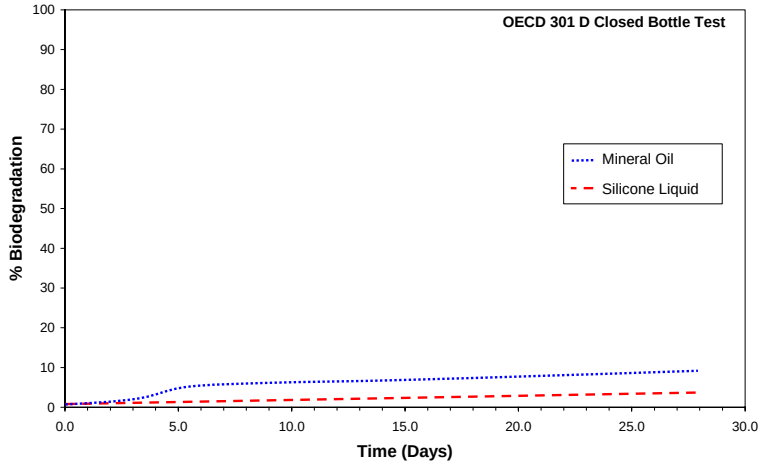
Figure 1 demonstrates that MIDEL 7131 achieved 10% degradation by day 3 and 10 days later it was 71% degraded. On the 28th day MIDEL 7131 reached 89% degradation, putting it comfortably in the Readily Biodegradable OECD and the Fully Biodegradable IEC 61039 categories.

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.

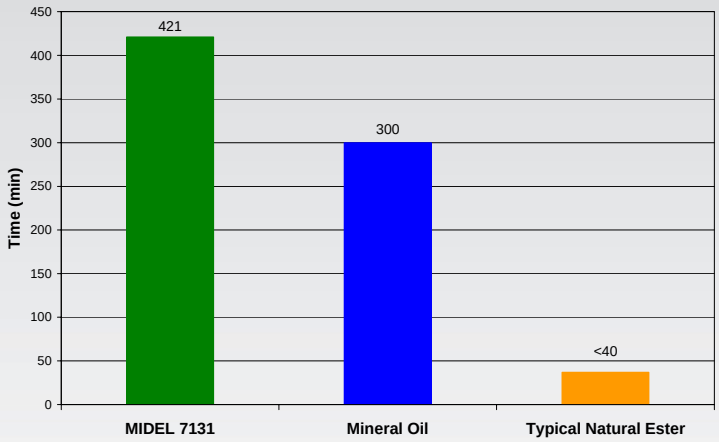
Oxidation Resistance

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



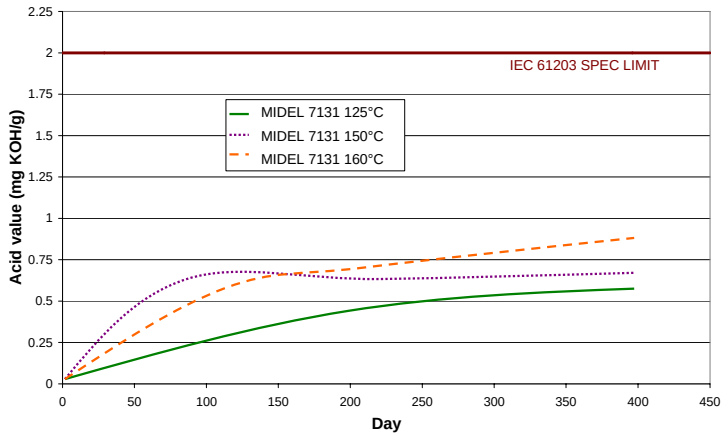
High Temperature Performance

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



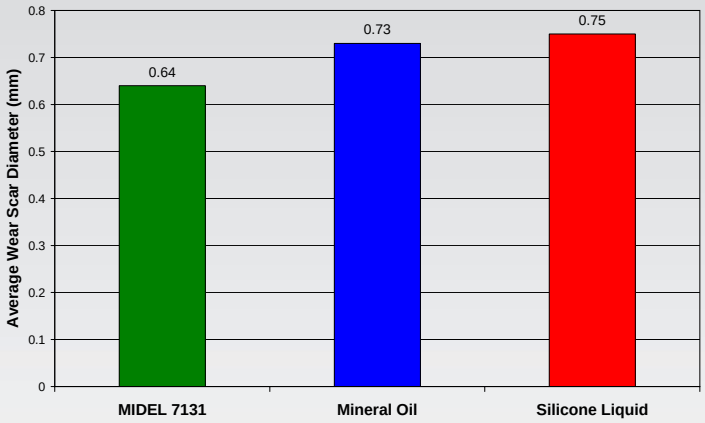
High Performance

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.

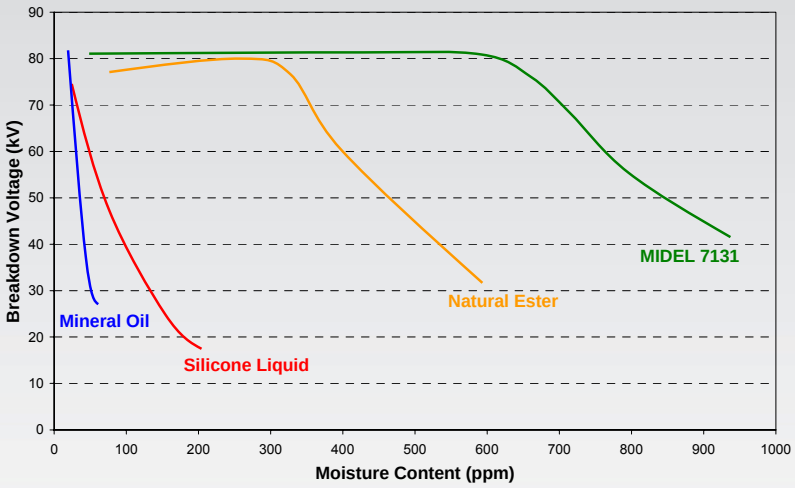
Why Moisture Tolerance Is Important in Transformers:

- 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.

IST POWER LTD

Oil Procedure: On Site Oil/Midel Sampling

Quality Process Instruction

Quick Guide

1. **Oil/Midel samples must be taken from transformer at the intervals specified in the O & M Manual unless operational experience allows this to be changed.**
2. **Drain oil/Midel for 20 seconds into container to clean the valve.**
   Rinse sample bottle 3 times to clean before taking final sample.

Ref: 704-60240 **Issue: 1**	**Author: Peter Jones** **Approved for Issue: Judith Clark** **Date: 3/4/19**	**Change Ref: new**

Samples should be taken from each transformer or reactor every 12 months this period has been extended or reduced based on operational experience.

1) Remove the protective guard from over the bottom drain/sampling valve.

2) With a lint-free, dry cloth wipe down the external surface of the valve to remove any contamination or moisture. Place a drip tray below the valve to collect any dripping oil/Midel.

3) Clean and fit the sampling valve making sure to tighten it securely as shown below. (This step is omitted for transformer where the sampling valve is permanently fitted).

4) With a receptacle (bucket or tray) below the tap, open the valve fully open for about 20 seconds. The object is to flush through about 1 litre of Midel. This action flushes out the insides of the valve.

5) Fill a clean and new sample bottle to about a 3/4 full and seal it. Vigorously shake the bottle for 30 seconds to unsettle any debris in the bottle & inside the lid. Dispose of the contents.

6) Fill the bottle for the second time, but this time ½ full and gently turn the bottle over and shake slowly to rinse the inside. Dispose of the contents.

7) Fill the bottle for the third time, but this time ⅓ full and gently turn the bottle over and shake slowly to rinse the inside. Dispose of the contents.

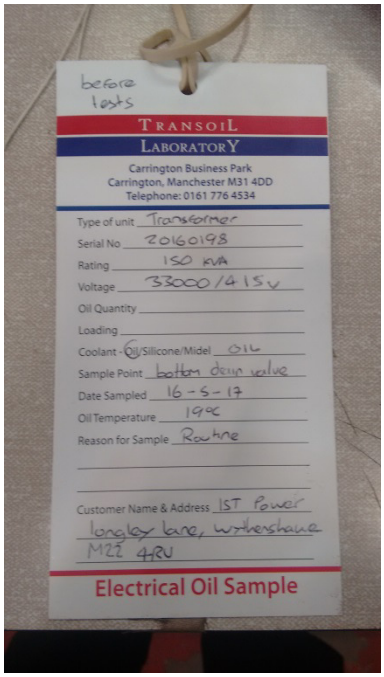
8) Slightly close the valve to lower the pressure and fill the bottle slowly. Avoid splashing and bubbling or any aeration of the oil/Midel during this process. FILL TO VERY TOP OF THE BOTTLE. Note: When sampling at site and storing in very hot conditions, a small gap can be left for heat expansion.

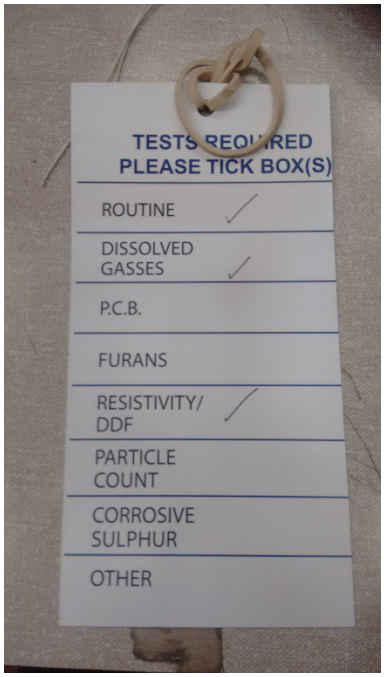
9) Place the bottle into the anti UV envelope provided and then put into the hard container.

10) Seal the valve and shut the tap making sure it is a tight as can be managed. Remove the valve fitting, if necessary, and wipe down the surfaces. Replace the valve guard.

11) Dispose of the waste oil/Midel using a waste oil container in a safe same way.

12) Fill out the identifications tags (put name of sampler on the purchase requisition for traceability) and attach them to the container specifying what stage of testing the sample represents and which tests are required. Standard tests are: - Routine, Dissolved Gasses and Resistivity/DDF.





Section 13: TEST CERTIFICATE

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 : Osbourne Infrastructure **ELECTRICAL SPEC :** 0105406 REV. 1

RATING kVA : 70 3 **PHASE** 50 **Hz** **SERIAL No :** 102111/1-01

	PRIMARY	SECONDARY
RATED VOLTS :	33000	433
RATED AMPS :	1.22	93.3

TEMPERATURE CLASS : A **COOLING :** KNAN **VECTOR GROUP :** DZn0

REFERENCE TEMP. °C : 75

THIS TRANSFORMER HAS BEEN TESTED IN ACCORDANCE WITH SPECIFICATION

BS EN 60076-1 2011

AND HAS SATISFACTORILY PASSED THE FOLLOWING TESTS

VOLTAGE RATIO AT NO LOAD : AS RATED VOLTS

WINDING RESISTANCE AT 20 DEGREES C :

	PRIMARY Ohms	SECONDARY milli Ohms
U - V	280.27	40.24
V - W	284.20	40.24
W - U	284.79	40.98

TEST RESULTS

SHORT CIRCUIT IMPEDANCE :	**%**	4.69
LOAD LOSS :	**Watts**	1442
NO LOAD LOSS :	**Watts**	122
NO LOAD CURRENT :	**%**	1.28
ZERO SEQUENCE IMPEDANCE :	**Ohms per ph.**	

INDUCED OVERVOLTS : 200% AT 100Hz FOR 60 Seconds

SEPARATE SOURCE VOLTS PRIMARY : 70kV AT 50Hz FOR 60 Seconds

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

INSULATION RESISTANCE PRIMARY TO SEC AND EARTH : 5.27 G Ohms

INSULATION RESISTANCE SECONDARY TO EARTH : 8.42 G Ohms

REMARKS :

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

WITNESSED : Liam Green **DATE :** 25/01/2021

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CERTIFICATE OF CONFORMANCE

CUSTOMER : Osbourne Infrastructure

IST ELECTRICAL SPEC : 0105406 REV. 1

SPECIFICATION : BS EN 60076-1 2011

SERIAL No : 102111/1-01

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 : Mark Jackson TEST ENGINEER

DATE : 25/01/2021

iST POWER

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TRANSFORMER TEST CERTIFICATE

CUSTOMER : Osbourne Infrastructure **ELECTRICAL SPEC :** 0105406 REV. 1

RATING kVA : 70 3 **PHASE** 50 **Hz** **SERIAL No :** 102111/1-02

	PRIMARY	SECONDARY
RATED VOLTS :	33000	433
RATED AMPS :	1.22	93.3

TEMPERATURE CLASS : A **COOLING :** KNAN **VECTOR GROUP :** DZn0

REFERENCE TEMP. °C : 75

THIS TRANSFORMER HAS BEEN TESTED IN ACCORDANCE WITH SPECIFICATION

BS EN 60076-1 2011

AND HAS SATISFACTORILY PASSED THE FOLLOWING TESTS

VOLTAGE RATIO AT NO LOAD : AS RATED VOLTS

WINDING RESISTANCE AT 20 DEGREES C :

	PRIMARY Ohms	SECONDARY milli Ohms
A - B	283.29	39.48
B - C	280.94	39.46
C - A	280.36	39.75

TEST RESULTS

SHORT CIRCUIT IMPEDANCE :	**%**	4.75
LOAD LOSS :	**Watts**	1428
NO LOAD LOSS :	**Watts**	128
NO LOAD CURRENT :	**%**	1.37
ZERO SEQUENCE IMPEDANCE :	**Ohms per ph.**	

INDUCED OVERVOLTS : 200% AT 200Hz FOR 30 Seconds

SEPARATE SOURCE VOLTS PRIMARY : 70kV AT 50Hz FOR 60 Seconds

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

INSULATION RESISTANCE PRIMARY TO SEC AND EARTH : 5.37 G Ohms

INSULATION RESISTANCE SECONDARY TO EARTH : 3.42 G Ohms

REMARKS :

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

WITNESSED : _____ **DATE :** 25/01/2021

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CERTIFICATE OF CONFORMANCE

CUSTOMER : Osbourne Infrastructure

IST ELECTRICAL SPEC : 0105406 REV. 1

SPECIFICATION : BS EN 60076-1 2011

SERIAL No : 102111/1-02

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 : 25/01/2021

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0105406

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