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TRANSEC CL3AM

ON-LINE MOLECULAR SIEVE DRYING FOR POWER TRANSFORMERS WITH ON-LINE MONITORING.

PRODUCT DESCRIPTION

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CONTENTS

NOTE: THIS PRODUCT DESCRIPTION REFERS TO OTHER DETAILED DOCUMENT WHICH ARE NOT INCLUDED, BUT ARE AVAILABLE ON REQUEST FROM THE MANUFACTURER.

Method Statement TR001 – Installation
Method Statement TR002 - Commissioning
Method Statement TR003 - Regeneration

MATERIALS & PERFORMANCE SPECIFICATION

Product: TRANSEC CL3AM On-line Transformer Drying Unit with Monitoring

ADSORBTION MATERIALS & PERFORMANCE:

Zeolite - Crystalline Aluminoscilicate with binders (CAS-No. 1318-02-1; EINES-No 215-283-8) 3 Anstrom bead size. Non-flammable and bio-degradable.

Weight of beads per cylinder	- 13 kgs
Oil Volume per cylinder	- 12 litres
Oil Type	- New un-inhibited napthynic to IEC 60296 (3)
Adsorbtion capacity of water per cylinder	- Maximum 30% of bead weight (3.5 litres – approx 10 to 11 litres total for 3 cylinders per cycle)

MATERIALS IN CONSTRUCTION:

Cylinders:	304 grade stainless steel all welded construction with quick fit couplers for ease of removal.
Frame:	304 grade stainless steel all welded construction.
Pump:	Caned Rotor sealed circulation pump running at average 90l/hr -25ºC to 110ºC
Pipework:	15mm x 1mm wall Stainless Steel seamless tube with all welded joint construction wherever possible.

FITTINGS: Stainless Steel ¼ turn ball valves, flow indicator, de-aerator, non return valves etc. Lockable air bleed valve, accessible at ground level on 6mm diam. copper– up to 5 m capillary tube Non- return valve, ½" BSP, brass body construction.

MONITORS: Vaisala MMT 162 probes at input and output for SCADA signal for oil temperature and ppm water in oil, with local LCD display.

LEM monitor for incoming LV supply and pump integrity.

INSTALLATION MATERIALS: Typically for CL3AM mounted on transformer:
2 x 1.5m length of 15mm stainless steel pipe
2 x Flange Adaptors – 15mm pipe to take off valve flange size.
4 x ½" BSP M x 15mm SS male stud couplings.
3 x ½" BSP M SS hex nipples

TYPE TESTING: Random unit selected for test once every 12 months.

System pressurised to 3 bar for 1 hour at 110ºC (pump not running) to prove leak free.

ROUTINE TEST: Every production unit.

Each individual cylinder is tested under 4 bar pressure prior to TRANSEC unit assembly
Each unit is tested pressurised to 2 bar for 30 minutes at 60ºC to prove leak free.

TRANSEC JUN 2013

1.0 OVERVIEW

Power and distribution transformers are some of the most important and expensive assets in an electrical power network. Compared to other equipment, they are very reliable and require very little maintenance since they have no continuously moving parts. However, the insulating paper materials, being organic, will degrade with time in service, accelerated by a number of key factors, and will ultimately determine the end of life of the transformer. Over 95% of the moisture in a power transformer is trapped in the solid insulation, with less than 5% being held in suspension in the oil.

In a free breathing transformer water does not only enter through the conservator, or badly fitting gaskets as the temperature cycles, but water is a by-product of the decomposition of the long chain hydro- carbon glucose molecules that makes up the paper and pressboard insulation. Excessive moisture will saturate the insulation and increase its conductivity. At higher temperatures vapour, or free moisture can develop, increasing the risk of partial discharge and flash-over faults.

Moisture has a great influence on the life expectancy and the load carrying capacity of a transformer. Water is not only detrimental to the dielectric properties of the liquid and paper insulation system, it also decreases its resistance to ageing, and reduces the electrical and mechanical strength of the solid insulation. In general, the mechanical life of the insulation is halved for each doubling of the ppm water content; the rate of thermal deterioration of the paper is directly proportional to its water content.

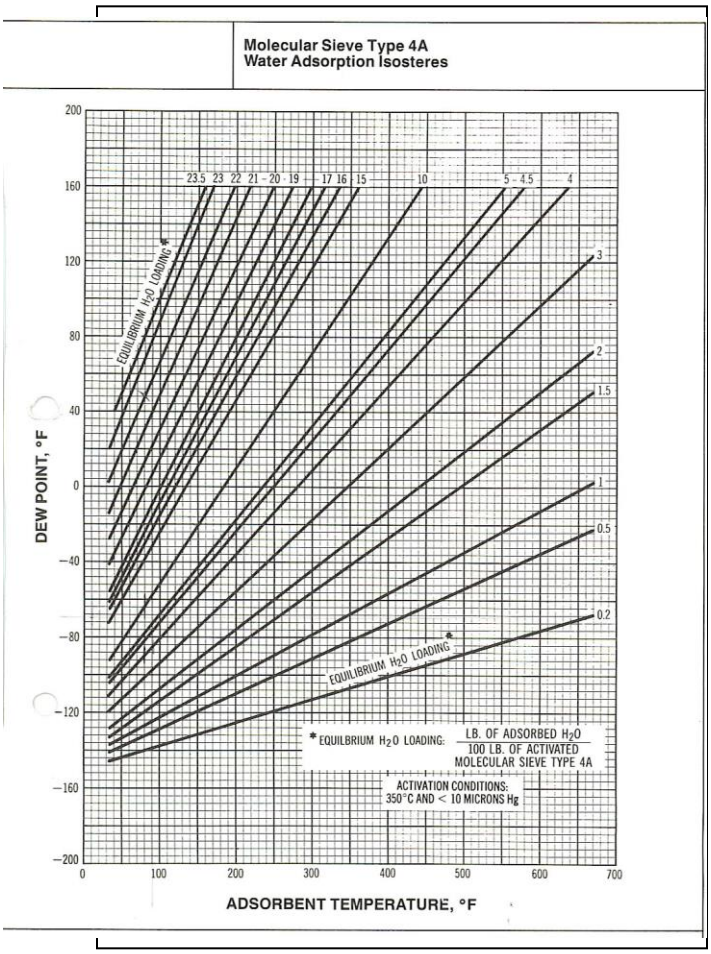
2.0 DESCRIPTION

TRANSEC is an on-line molecular sieve, developed and manufactured in the U.K., that will continuously remove water from the oil and from the paper insulation in a power transformer while it is fully operational.. This on-line process not only reduces ageing, but will improve the dielectric strength of the oil, and increase reliability. Plumbed into the oil 'circuit' of a transformer, the circulation pump will pump the oil across the molecular bed, which, through chemical bond, will attract water particles contained within the oil. By constantly reducing the level of water contained within the oil, water contained within the solid insulation, where over 95% of the water is trapped, will migrate into the oil to maintain the natural water equilibrium. In this way water gradually moves from the solid insulation, to the oil, and then trapped by the molecular sieve.

A 10 micron particulate filter will at the same time remove extraneous matter, such as fibres,
which can become ionised, being attracted to areas of high electrical stress and causing a flashover

TRANSEC is designed to be a slow, non-invasive, gradual process, that will by lowering the ppm level of water in the oil, encourage water to migrate from the solid insulation to maintain the natural hydrostatic equilibrium, and hence over a period of time, significantly reduce the water contained within the solid insulation, and therefore reduce the rate of ageing, extending the life of the transformer.

3.0 CL3AM PERFORMANCE



The TRANSEC system has the capacity to remove approximately 10 litres of water from a transformer before saturation, but the rate at which it will adsorb water will depend on many factors, mainly, how much water is available in the oil, and the temperature range through which the transformer will operate. The design flow rate of the pumped oil is nominally 60 litres per hour to give maximum adsorbtion through the molecular bed. The oil temperature does not have to be elevated to give optimum adsorbtion

A single TRANSEC cylinder will adsorb approximately 30% of the weight of the zeolite material giving a theoretical volume of 3.9 litres of water. The rate at which this adsorbtion takes place is dependant on availability of water, temperature, and the % saturation of the cylinders, the process will slow as total saturation is reached.

The Isostere graph shows that the adsorbtion performance of the zeolite improves with a reduction of temperature, whereas other dry out devices require elevated temperature to allow effective dry-out. However, we know that the higher the temperature of the transformer, the faster the rate of ageing of the paper insulation material.

Typically a CL3AM on a wet (insulation water content 4% by dry weight) hot transformer operating in a hot humid ambient climate might saturate in 6 to 9 months.

A CL3AM on a dry (insulation water content 1% by dry weight) operating at 50° C might take 24 months to saturate. A CL3AM on a brand new transformer (insulation water content 0.3% by dry weight) might take 5 years before saturation.

No specific claims for ppm levels in oil are made by TRANSEC, as the reduction of ppm will always depend on the 'wetness' of the transformer, and the dynamic operating conditions. The product is judged on the amount of water that is removed, which is reported to the client when the cylinders are replaced and regenerated.

4.0 OPERATION AND MAINTENANCE (Clyinder Saturation Monitoring)

TRANSEC will operate in an external location on a continuous basis with the transformer on-line. It is constructed of stainless steel so needs no additional protection. The pump is a totally immersed canned rotor type, designed for continuous operation with nitrile seals for compatibility with transformer oils.. Although the electrical connection box has a rating of IP45 the stainless steel cover offers total environmental protection for the pump, which increases the rating to IP65. Ambient temperature may be a consideration, and if it is likely to fall and be sustained to a degree where the temperature of the TRANSEC unit remains below minus 10° then a thermal cut off relay can be added to protect the pump motor.

The TRANSEC cylinders will continue to adsorb water from the oil until saturation occurs. To measure the degree of saturation a reading of ppm water in oil must be taken from both the input to the molecular bed and also the output, and the two readings compared. When the zeolite is new and dry, the reading at the output will be far less than the reading at the input, because the oil will have had its water removed during the pass over the molecular bed. However, when the zeolite can adsorb no more water, the reading at the output will be very similar to that at the input. In this way we can tell that the zeolite will adsorb no more water, and requires changing (see Regeneration) In the TRANSEC CL3AM two Vaisala MMT 162 probes are mounted at the input and at the output to the TRANSEC unit. These probes will give an output signal to SCADA which can be read on the control computer giving real time temperature and water activity which is converted to ppm. (see monitoring) There is also a local display mounted within the monitor enclosure

The MMT 162 probe leads are terminated in the Monitor enclosure, where the LCD display gives the local reading. SCADA connections are made using two analogue channel outputs for current and voltage giving readings for temperature and water in oil in ppm. The probes are fitted into stainless steel tee fittings which introduce the sensing head directly into the oil flow. The client must request the format in which the SCADA signals are to be presented.

4.1 PUMP & SUPPLY MONITORING

The continuous operation of the pump and the integrity of the incoming LV supply is monitored via the LEM monitor. The LEM monitor is a C/T through which the live core of the cable which supplies the pump passes. If current above a pre-set threshold is present then the incoming 240V 50Hz supply is healthy, and the pump is operating. If either of these fails an alarm will trigger in the form of a volts free relay change of state. This can then be brought out hard wired to control, or connected to a remote monitoring facility.

The picture shows the CL3AM monitoring enclosure in stainless steel, rated at IP65 with electrical isolator, mounted on the TRANSEC frame. The two MMT162 probe cables are terminated within the enclosure, from where the SCADA and alarm signals can be taken. The local LCD display is housed within the cabinet

For Technical Specification of MMT 162 probe see page 12.

For Technical Drawing of LEM Monitor see page 13.

TRANSEC CL3AM also has a visual indicator to show oil flow through the unit.

5.0 REGENERATION

When the cylinders are found to be saturated they must be replaced. TRANSEC (UK) offers a cylinder exchange where we supply three previously 'regenerated cylinders' for either the client, or TRANSEC to fit in place of the existing ones. This is done by simply using the quick fit couplers on the top and bottom of each cylinder, and removing each cylinder in turn. The couplers self seal, so there is no oil loss. The three replacement cylinders are then fitted and the quick couplers snapped shut. At the same time the particulate filter should also be changed. The 'wet' cylinders removed are then returned to TRANSEC (UK) or local regeneration agent, who will carry out the regeneration process. Method statement TR003 must be observed for the cylinder change process. (available on request)

5.1 Regeneration Process

The cylinders will have the top flange removed, and they will be topped up with oil to the point of refusal (i.e. the same state as when they were first commissioned) the cylinder is then accurately weighed with the removed flange. Each cylinder has a unique serial number which is referenced in our database to its original starting weight when newly supplied. The difference between the two weights is the amount of water adsorbed by the zeolite, and can be reported to the client in terms of litres of water removed. (see Regeneration Spreadsheet Figs). The wet beads and oil are removed, and disposed of through a licensed authority (although the zeoliate beads are totally bio-degradable), the cylinder is cleaned with a solvent, before being dried, and refilled with new beads and oil in a controlled dry environment. The cylinder is weighed, and noted on the data base which will be used as the reference for the next regeneration.

REGENERATION REPORT SHEET

Project Ref:	**4049**	Client:	**XXXXXXXXXXXXXXXXXXXX**		
Site:	**XXXXXXXXXX**	Transformer I.D.:		**T 2A**	
Date removed from transformer site:		**14.12.05**			
Date processed on Regeneration Plant:		**12.01.06**	Plant Operator:		**P.BECKETT**

Cylinder Serial Nos:	**R398/85**	**R398/81**	**R398/80**
1 Initial weight on receipt. (Full with 'dirty, wet'oil) **Kg**	**51.9**	**51.5**	**49.9**
2 Drained weight before recycling (i.e., drained of 'free'oil) **Kg**	**46.1**	**45.5**	**46.4**
3 Dry weight after recycling (i.e., 'cleaned' cylinders, no fluid contents) **Kg**	**36.2**	**35.6**	**36.2**
4 Final weight, after refilling with clean, 'dry' oil (for putting back into service) **Kg**	**47.5**	**47.6**	**47.5**
5 Calculations Drained fluid (**1. - 2.**) **Kg**	**5.8**	**6**	**3.5**
Fluid removed by Regeneration (**2. - 3**.) **Kg**	**9.9**	**9.9**	**10.2**
Oil volume refilled. (**{ 4. - 3. } / 0.88**) **Litres.**	**12.84**	**13.64**	**12.84**
Water removed from transformer (**1 - 4**) Kg = Litres	**4.40**	**3.90**	**2.40**

Comments

Total volume of moisture adsorbed amounts to approximately 11 litres (= Kg), which although unevenly distributed across the 3 series connected cylinders, at least is logical in that the 1st. Cylinder became saturated first.

6.0 INSTALLATION

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A choice of installation exists for TRANSEC.

New Transformers will generally provide fixing points for TRANSEC to be installed on the side of the tank which allows the pipe runs to remain short.

Existing transfomers may have TRANSEC installed with a stand alone frame, possibly supported by a bund wall or channel struts on some convenient point on the transformer. The pipe route to the top take off valve (the TRANSEC Output) and the low level take off valve (the TRANSEC Input) must be carefully considered to ensure no trip hazard, or damage is likely to be caused. In this installation flexible pipes have been used.

The support frame attaches to the TRANSEC frame and allows the assembly to be bolted down onto a plinth.

TRANSEC units may be installed with the transformer live, as provision is made to ensure that no air is introduced into the transformer during installation and commissioning. However, it will be the decision of the client as to whether he considers the risk of trip small enough to proceed with an installation on an energized transformer.

If this is the case care must be taken and a full risk assessment undertaken to take into account the proximity of the high level connection to any part of the H.V. equipment.

Health and Safety must take first priority for any installation. Access may require the use of scaffolding, and manual handling must be considered when planning the installation.

An isolated 240V 50 Hz supply will be required and fused at 6 amps. Nominal operational current is 1.1 amps. The supply will be brought into the isolator on the TRANSEC frame to enable local control of the pump.

The input to TRANSEC CL3 is from the low level take off valve on the transformer tank or cooling circuit. The output from the CL3 is to the high level take off valve on the transformer tank or cooling circuit, but the return must be below the oil level in the conservator, it must not be allowed to return into the air space above the oil level. It is important to have a top to bottom gradient between input and output, and across the transformer tank is ideal, but not essential.

In common with all installations of TRANSEC equipment Method Statement TR001 must be followed precisely, and the correct materials used in all cases. It is imperative that all joints are sealed using a Loctite sealant, and that no leaks exist on leaving the installation.

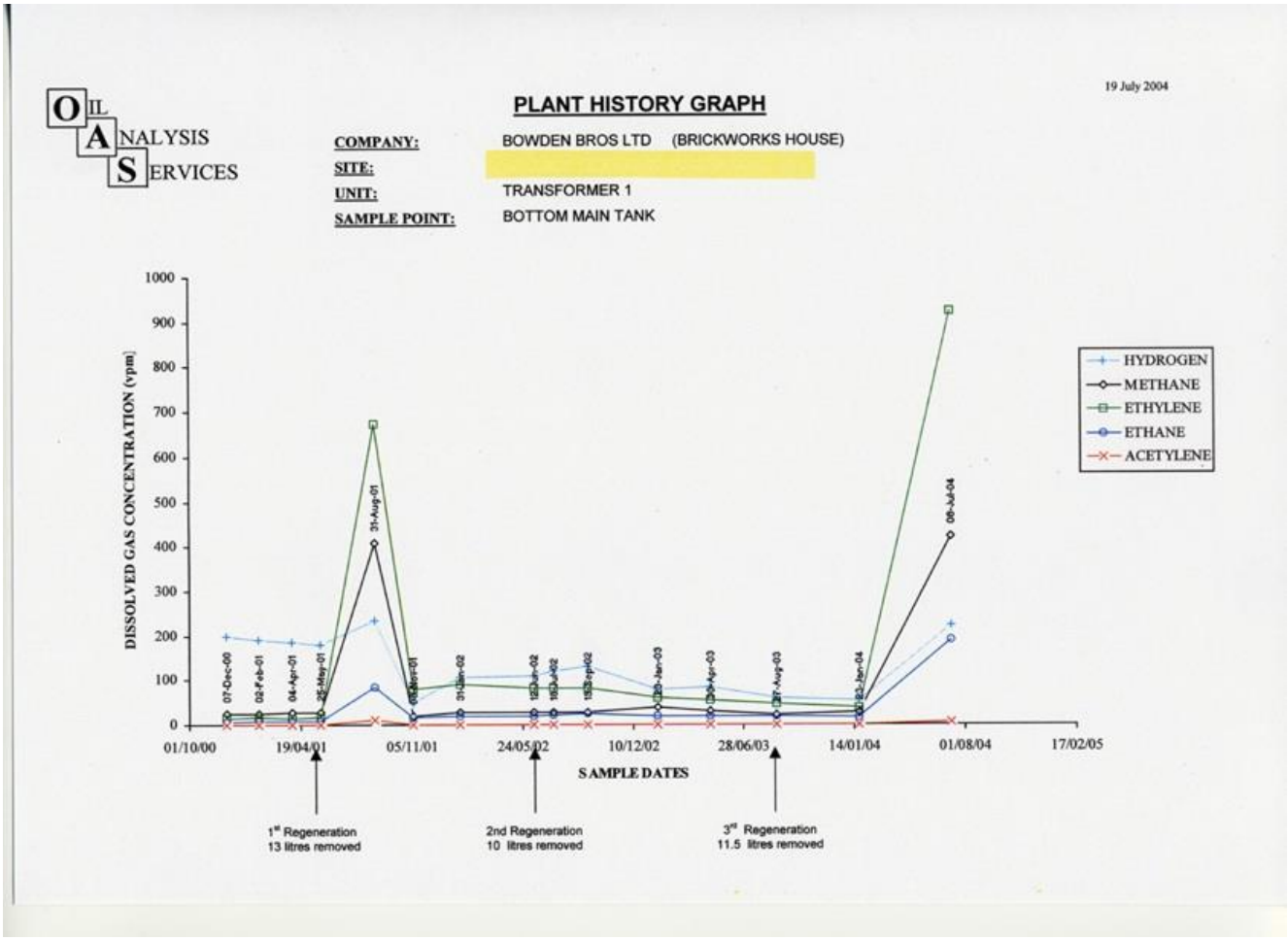
A high level bleed pipe is supplied to be fitted in the oil line adjacent to the top take off valve, so that when the air is purged from the pipework it is bleed to atmosphere from the highest point of the system before returning to the transformer

7.0 COMMISSIONING

TRANSEC CL3 will be full of oil to IEC 60296 unless otherwise advised (other compatible oils are available by special order). When the unit is commissioned the air from the empty pipework must be dispelled in rotation, starting from the bottom take off valve on the transformer. Method Statement TR002 gives details of the Commissioning process. (available on request)

8.0 GAS ADSORPTION (DGA)

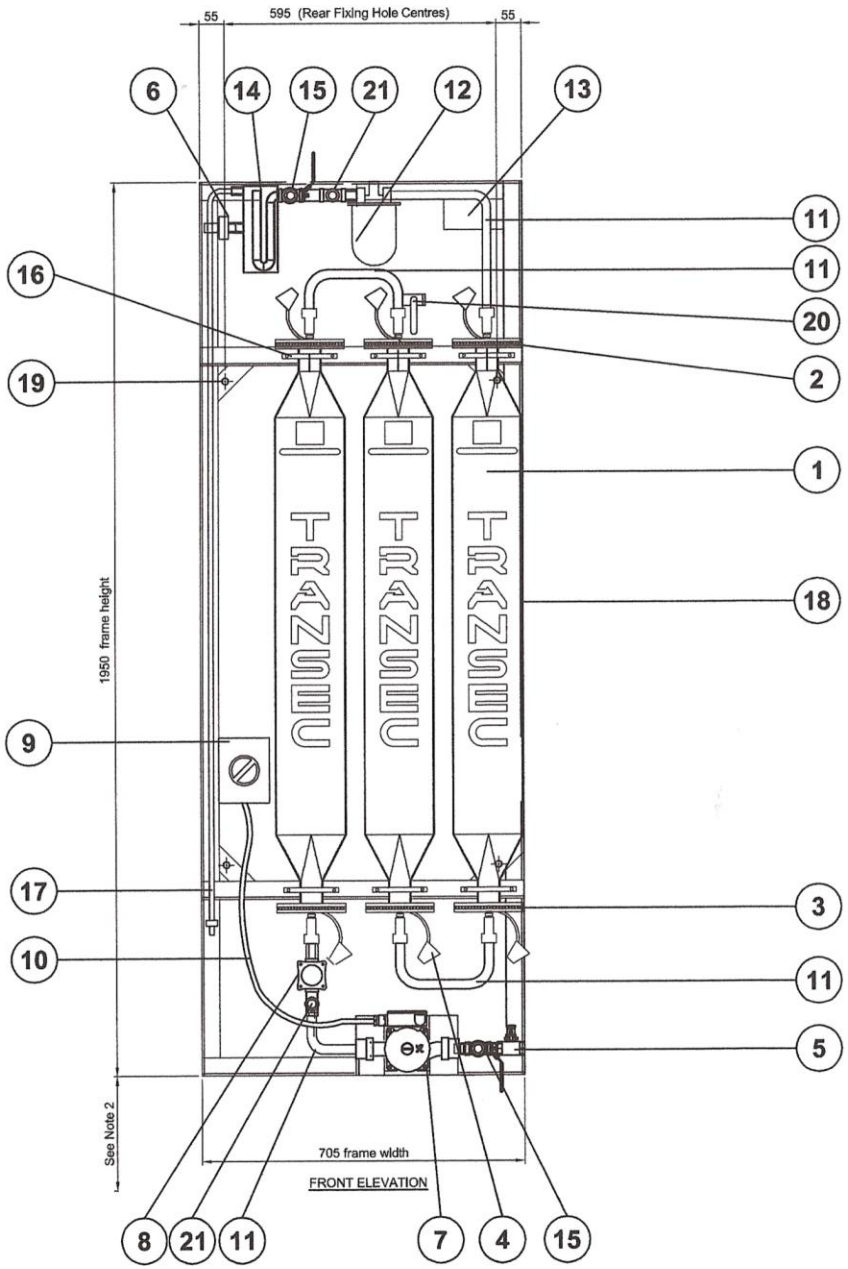
TRANSEC contains a zeolite with a 'pore' size of 3 Å. This allows a molecule of water to be adsorbed into the 'pore' of the hydroscopic bead, but the molecular size of the key gases within the transformer are larger than 3 Å and therefore will not be adsorbed by the zeolite. Small quantities of hydrogen may be adsorbed if water molecules are not available, but Fig 3 shows the DGA graph of a 132/33KV grid transformer with a TRANSEC unit fitted, which suffered two through faults, which can clearly be detected by the DGA analysis. No special provision is required to read or understand the DGA when taken on a transformer that has a TRANSEC molecular sieve fitted.



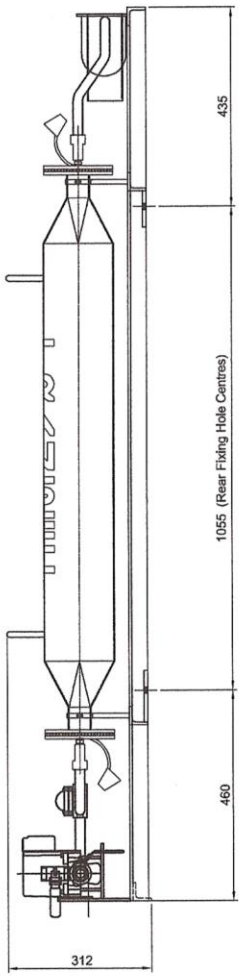
9.0 ROUTINE & TYPE TESTING.

Each TRANSEC Unit produced is individually tested for leaks on the test rig (Pic 5). The oil temperature is elevated to 60°C and a pressure equal to 2 bar applied for 30 minutes with the pump turned off. All joints and interfaces are inspected. Test results are noted and a certificate of conformity is signed and issued against that frame number and cylinder serial numbers.

Every 12 months a unit is picked from random and type tested on the test rig with oil elevated to 110°C with a pressure applied of 3 bar fpr 60 minutes. All joints and interfaces are inspected, and is satisfactory a type test certificate is issued for that TRANSEC frame number and cylinder serial numbers.



FRONT ELEVATION



SIDE ELEVATION

NB: DO NOT SCALE THIS DRAWING

ITEM No.	QUANTITY PER FRAME	DESCRIPTION OF ITEM
1	3 No.	CYLINDER
2	6 No.	FLANGE & PIPE CONNECTOR
3	6 No.	CORK GASKET
4	6 No.	WEATHER CAP TO PIPE CONNECTOR (SEE NOTE 1)
5	1 No.	½" BSP F INLET PIPE & VALVE (V1) (LOCKABLE)
6	1 No.	½" BSP F OUTLET PIPE & VALVE (V2) (LOCKABLE)
7	1 No.	PUMP & COVER
8	1 No.	ST/STEEL FLOW INDICATOR
9	1 No.	LOCKABLE , IP65 ISOLATOR SWITCH
10	1 No.	PUMP WIRING, SPECIFICATION H05
11	4 No.	1/2" O/D PIPEWORK
12	1 No.	FILTER, 10 µ PARTICLE FILTER
13	1 No.	NAME PLATE, WITH FRAME NUMBER
14	1 No.	100mm OD DE-AERATOR
15	2 No.	1/2" SAMPLING VALVE
16	6 No.	SUPPORT CLIP
17	1 No.	DE-AERATOR BLEED PIPE & 1/4 TURN VALVE WITH CAP
18	1 No.	MAIN FRAME
19	4 No.	14Ø FRAME FIXING POINTS
20	1 No.	1/4 " BALL VALVE WITH PLUG (USED ON COMMISSIONING OR CYLINDER CHANGE)
21	2 No.	SAMPLING TEE

PARTS LIST

NOTES

1.	Weather caps to be used for transport of cylinders when removed from Frame
2.	Increase in height when used with floor frame see drg: TR3-GA-01
3.	Rear fixing hole positions shown.
REVA	2 No. sampling tee added item 21 and new version pump

FINISH

Frame - St/st, grade 304
Components - St/st, plated & plastic

BASED ON DRAWING

-

SURVEY DATE

-

DRAWING TITLE

Transec CL3A Unit Assembly
New General Arrangement
Standard Filter.

CLIENT

TRANSEC

DRAWN BY	DATE
R.BROWN	03-04-09
	SCALE: -
JOB No.: -	DATA CARD No.: -

DRAWING No.: TR3/GA/04 REV.: A

Makesmetalwork

GMC General Metal Constructions Limited

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51 Hollands Rd, Haverhill, Suffolk, CB9 8PL
Telephone (01440) 703537 Facsimile (01440) 703375

☐ Area Office
Unit 7, Orbital One, Green St, Green Rd, Dartford, Kent, DA1 1QG
Telephone (01322) 285777 Facsimile (01322) 285577

Technical Data

Measured Values

Water activity

Measurement range	0 ... 1 aw
Accuracy (including non-linearity, hysteresis and repeatability)	
0 ... 0.9	± 0.02
0.9 ... 1.0	± 0.03
Response time in oil flow (typical)	<1 min (dry-wet)

Moisture

Calculated moisture content in ppm for mineral transformer oil

Temperature

Accuracy at +20 °C (+68 °F)	± 0.2 °C (0.36 °F)

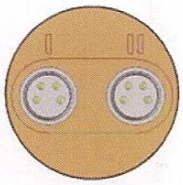
Operating Environment

Operating temperature	-40 ... +60 °C (-40 ... +140 °F)
Oil temperature	-40 ... +80 °C (-40 ... +176 °F)
Pressure range	
metal version	up to 200 bar
plastic version	up to 40 bar
Oil flow	some flow recommended

Outputs

Analog outputs (two channels)	
current output	0 ... 20 mA, 4 ... 20 mA
voltage output	0 ... 1 V, 0 ... 5 V, 0 ... 10 V
Alarm level indication by analog signal	user selectable
Digital outputs	RS-485

Pin	I	II
1	Vsupply	Vsupply
2	Ch 1	RS-485 - / B
3	GND	GND
4	Ch 2	RS-485 + / A



General

Sensor	HUMICAP®
Cable connections (2 ports)	M8, 4 pin
Minimum operating voltage with	
RS-485 output	14 ... 28 VDC
voltage output	16 ... 28 VDC
current output	22 ... 28 VDC
Supply current	
normal measurement	20 mA + load current
External load for	
voltage output	min. 10 kOhm
current output	max. 500 Ohm
Housing material	
metal	AISI 316L
plastic	PPS + 40% GF
Mechanical connections with bonded seal ring (washer)	
metal version	G 1/2" ISO or NPT 1/2"
plastic version	G 1/2" ISO
Housing classification	IP65 (NEMA 4)
Storage temperature range	-40 ... +80 °C (-40 ... +176 °F)
Weight	
with plastic housing	65 g (2.3 oz)
with metal housing	200 g (7 oz)

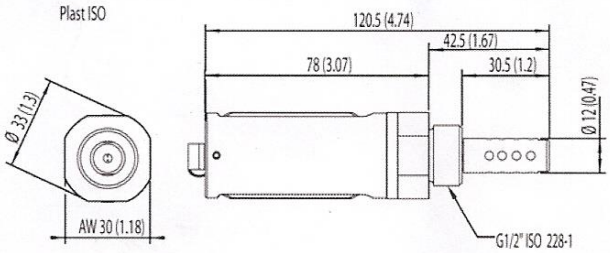
Complies with EMC standard EN61326-1, Electrical equipment for measurement control and laboratory use - EMC requirements; Industrial environment

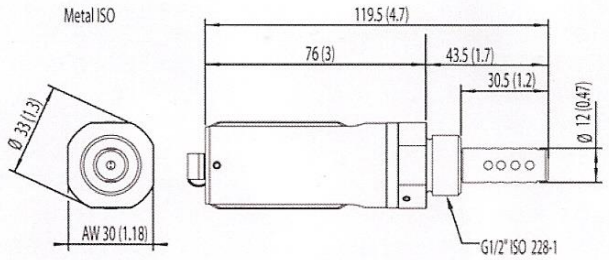
Options and accessories

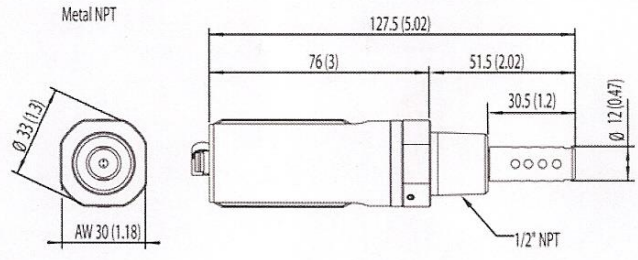
Stainless steel filter (standard)	221494SP
Stainless steel filter for high flow (>1 m/s)	221493SP
Connection cable for MM70 hand-held meter	219980
USB serial interface cable	219690
Sealing ring set (U-seal) ISO G1/2, 3 pcs	221525SP
Sealing ring set (copper) ISO G1/2, 3 pcs	221524SP
ISO 1/2" plug	218773
NPT 1/2" plug	222507
Sampling cell	DMT242SC
Sampling cell w. Swagelok connectors	DMT242SC2
100 ... 240 VAC external power supply (not IP65)	POWER-1
Connection cable	
2 m (6.5 ft), M8 snap-on	211598
0.32 m (1 ft) Shielded, M8 threaded	HMP50Z032
3.0 m (9.8 ft), Shielded, M8 threaded	HMP50Z300
5.0 m (16.4 ft), Shielded, M8 threaded	HMP50Z500
10 m (32.8 ft), Shielded, M8 threaded	HMP50Z1000
3 m, Shielded, connector 90° angle	221739
5 m, Shielded, connector 90° angle	221740
M8 threaded, Ch1 signal + Ch2 LED	MP300LEDCBL

Dimensions

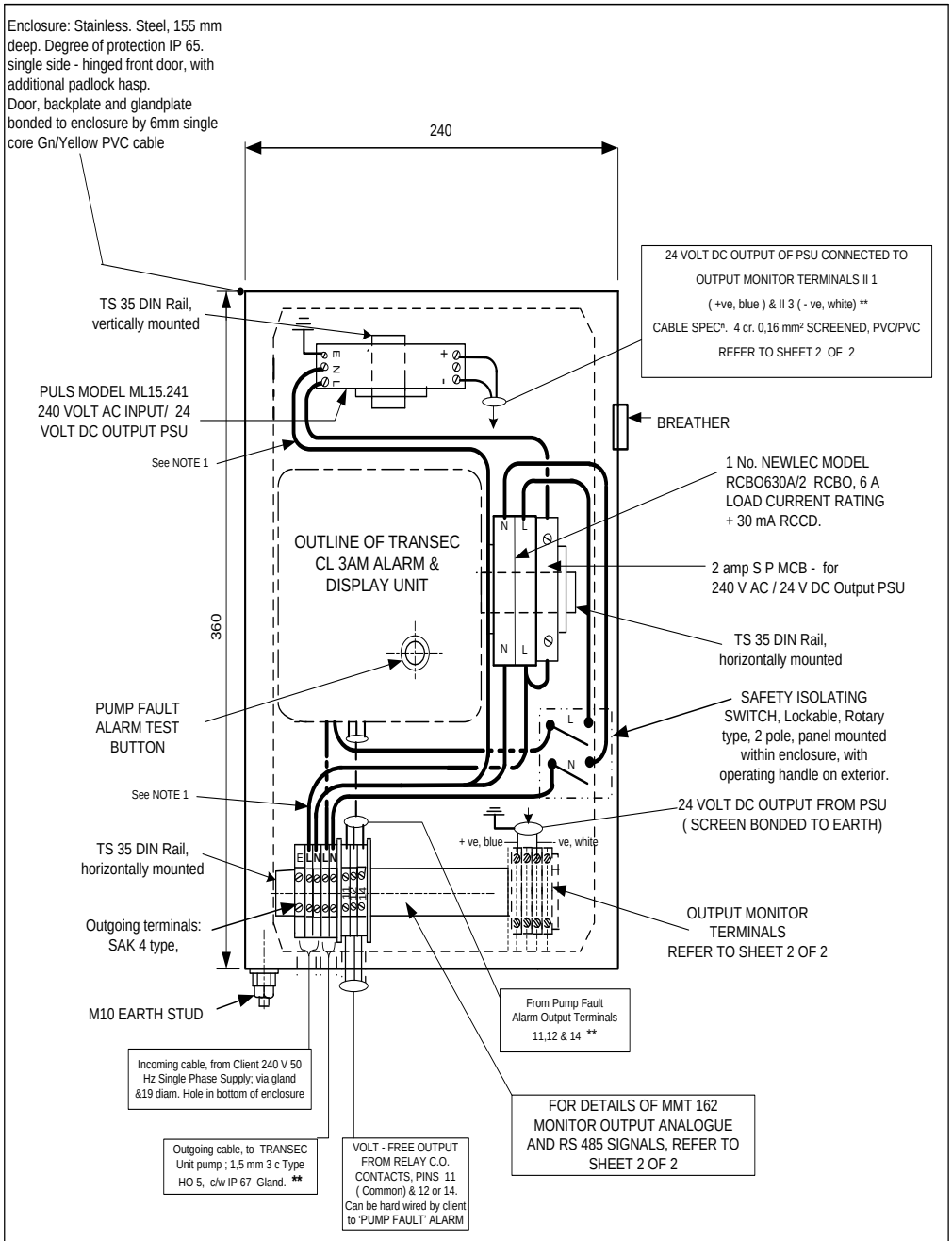
Dimensions in mm (inches)







Ref. B210755EN rev. A 2008 - 09



NOTES:

1. Interconnecting wiring within enclosure between:
   i) Incoming terminals and line terminals of RCBO and
   ii) Load terminals of RCBO and line terminals of other devices will be pre-wired off site using 2,5 mm (7/ 0,67) single core LSZH insulated cable 600/1 000 volt grade, in phase & neutral colours.
   iii) Interconnecting internal wiring from Pump Fault Alarm Relay to remote alarm terminals will be pre-wired using 1,5 mm single core LSZH insulated cable, 600/1 000 volt grade, with black insulation,

   All these are shown as solid lines.
   Note: ** indicates pre- wired interconnections, completed in Works and included in functional tests. Earth connections are not shown, for clarity
2. Second breather in base of enclosure also not shown

SHEET 1 OF 2 SHEETS

Rev	Date	Detail changes
Rev 2	Date: 06.10.10	Detail changes
Rev 4	Date: 23.09.11	Panel layout updated Component changes, with resultant wiring and terminal changes
Rev 3	Date: 22.10.10	As built Notes updated

REVISIONS

Drawn By: J. B. Shimwell
Approved by:
Date : September 29 2010
Filename CL3A M.ALARM.VSD

TRANSEC (U K) LTD

Client: STANDARD
Project : TRANSEC CL3 AM ALARM & MONITOR
Title CL3AM CURRENT MONITOR & ALARM UNIT ARRANGEMENT
Drawing No: 4300/WD/01