streamer
keeping the light

TRANSEC CL3A

ON-LINE MOLECULAR SIEVE DRYING FOR POWER TRANSFORMERS

PRODUCT DESCRIPTION

Streamer International AG
Masanserstrasse 17, 7000 CHUR, SWITZERLAND
office@streamer-electric.com
+41 81 250 05 25

Product Description Edition 2.

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

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.

Pic 1.

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 over a period of time, reduce the water contained within the solid insulation, and therefore reduce the rate of ageing, and extend the life of the transformer.

3.0 MODELS, SIZING, AND PERFORMANCE

There are two basic models, and two sub models for the CL3 in the TRANSEC range:

CL3A	- three cylinder designed for oil capacity greater than 10,000 litres.
CL1	- single cylinder designed for oil capaicty less than 10,000 litres.
CL3A-P1	- three cylinder as above but with PALL IDLD Stainless steel particulate filter.
CL3A-P2	- three cylinder as CL3AP1 but with PALL UR219 13" pre-filter for heavily sludged transformers. (see front cover).

The sizing of the molecular sieve is more about economics than technical considerations. 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 90 litres per hour to give maximum adsorbtion through the molecular bed. If you added more cylinders to the TRANSEC unit on a 600MVA generator transformer, it would not remove the water any quicker, it would just take longer to saturate. However, for a generator transformer with individual phase tanks, it would be normal to put a CL3A onto each phase.

A single TRANSEC cylinder will adsorb approximately 30% of the weight of the zeolite material giving a 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.

Typically a CL3A on a wet (insulation water content 4% by dry weight) hot transformer operating in a hot humid ambient climate might satuarte in 6 to 9 months.

A CL3A on a dry (insulation water content 1% by dry weight) operating at 50° C might take 24 months to saturate. A CL3A on a brand new transformer (insulation water content 0.3% by dry weight) might take 5 years before saturation.

4.0 OPERATION AND MAINTENANCE (Clyinder Saturation)

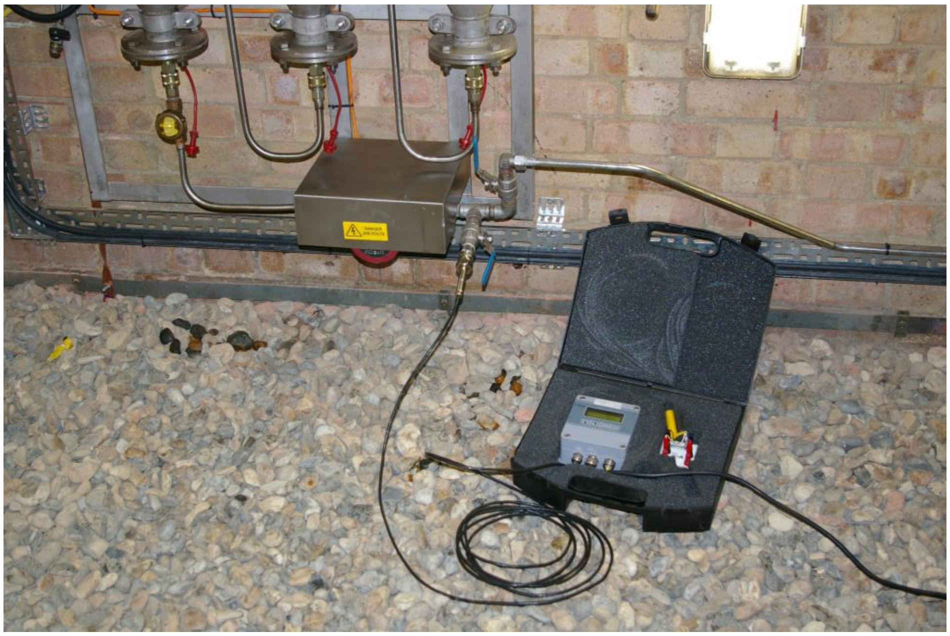
TRANSEC will operate in an external location on a continuous basis with the transformer on-line. It is constructed of stainless steel so needs no additional protection. The pump is a totally immersed canned rotor type, designed for continuous operation. Although the electrical connection box has a rating of IP45 the stainless steel cover offers total environmental protection for the pump, which increases the rating to IP65. The pump seals are all nitrile making it compatible will all transformer oils. 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)

The ppm reading at the input and output can be obtained in a number of ways. An oil sample can be taken at these two points (with reference to temperature) and through the Karl Fisher titration method, the ppm can be derived.

Also TRANSEC is designed that the oil sampling valves can accept a Vaisla water in oil probe and gives a number of options to take the ppm reading and temperature at these two points. (see 9.0 MONITORING)

.



Pic 2

A Vaisala HMP330 fitted to the input of a TRANSEC CL3 to monitor water activity and temperature.

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.

6.0 INSTALLATION

.

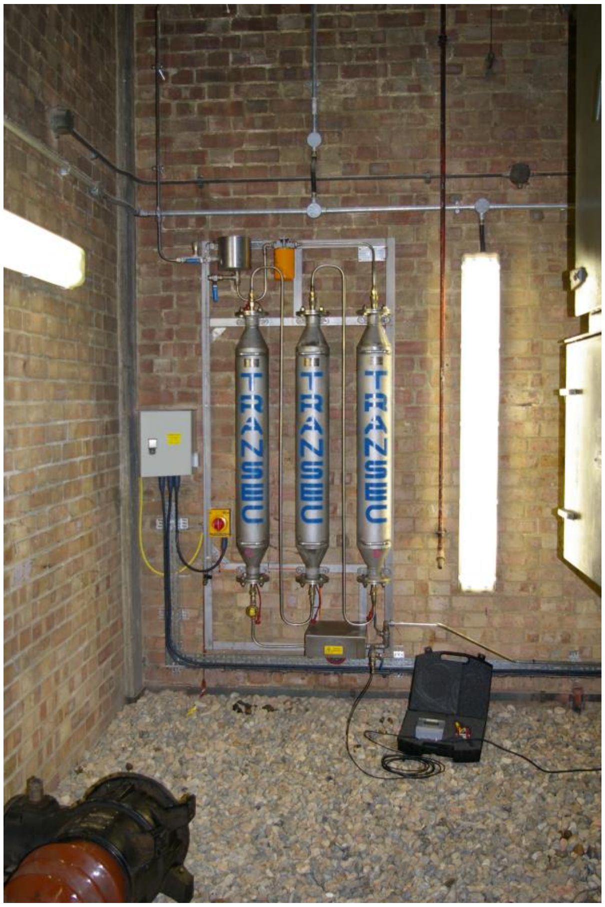
Pic 3.

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 (see pic 1 above.) 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. (Pic 3). 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.



Pic 4.

The CL3 can be fixed to a substation wall, with the pipes routed at high and low level to the take off valves, again careful consideration must be given to the pipe routing. It will be more difficult to dispel the air from the pipework for this kind of an installation, but the advantage is ease of access and cylinder change. (Pic 4)

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 (see Fig 2)

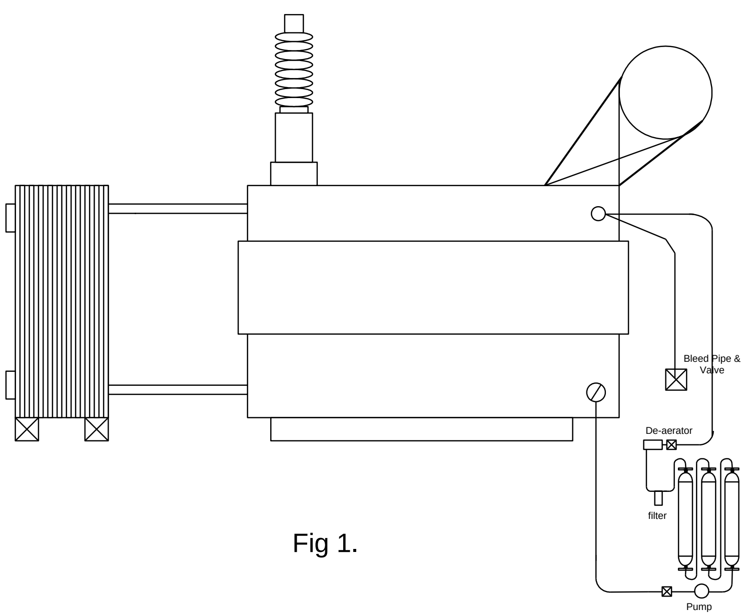


Fig 1.

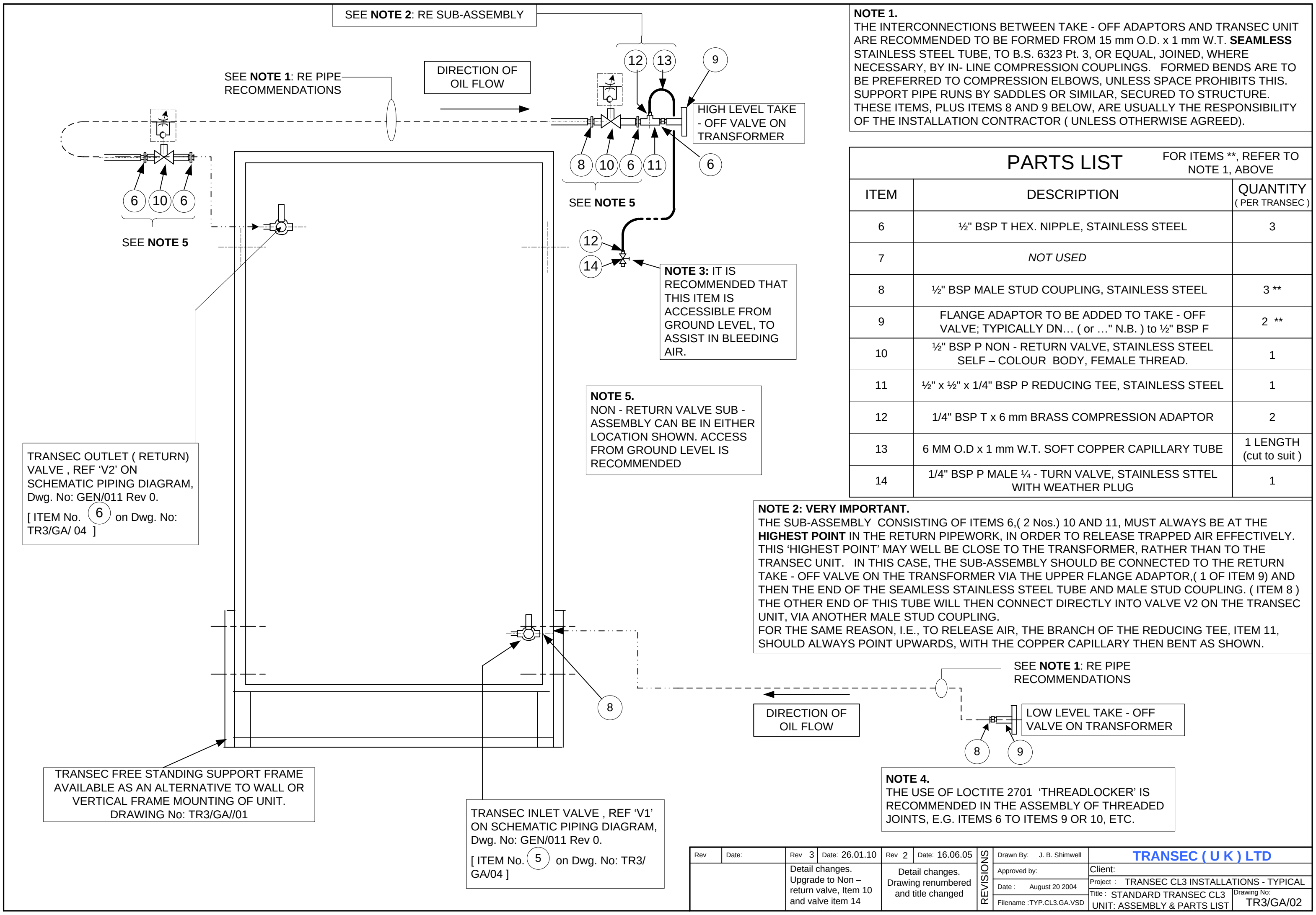
TRANSEC units may be installed with the transformer live, as provision is made to ensure that no air is introduced into the transformer during installation and commissioning. However, it will be the decision of the client as to whether he considers the risk of trip small enough to proceed with an installation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

Figures 1 above and 2 below show a typical installation for a TRANSEC CL3A



ITEM	DESCRIPTION	QUANTITY (PER TRANSEC)
6	½" BSP T HEX. NIPPLE, STAINLESS STEEL	3
7	*NOT USED*	
8	½" BSP MALE STUD COUPLING, STAINLESS STEEL	3 **
9	FLANGE ADAPTOR TO BE ADDED TO TAKE - OFF VALVE; TYPICALLY DN… (or …" N.B.) to ½" BSP F	2 **
10	½" BSP P NON - RETURN VALVE, STAINLESS STEEL SELF – COLOUR BODY, FEMALE THREAD.	1
11	½" x ½" x 1/4" BSP P REDUCING TEE, STAINLESS STEEL	1
12	1/4" BSP T x 6 mm BRASS COMPRESSION ADAPTOR	2
13	6 MM O.D x 1 mm W.T. SOFT COPPER CAPILLARY TUBE	1 LENGTH (cut to suit)
14	1/4" BSP P MALE ¼ - TURN VALVE, STAINLESS STTEL WITH WEATHER PLUG	1

Fig 2.

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.

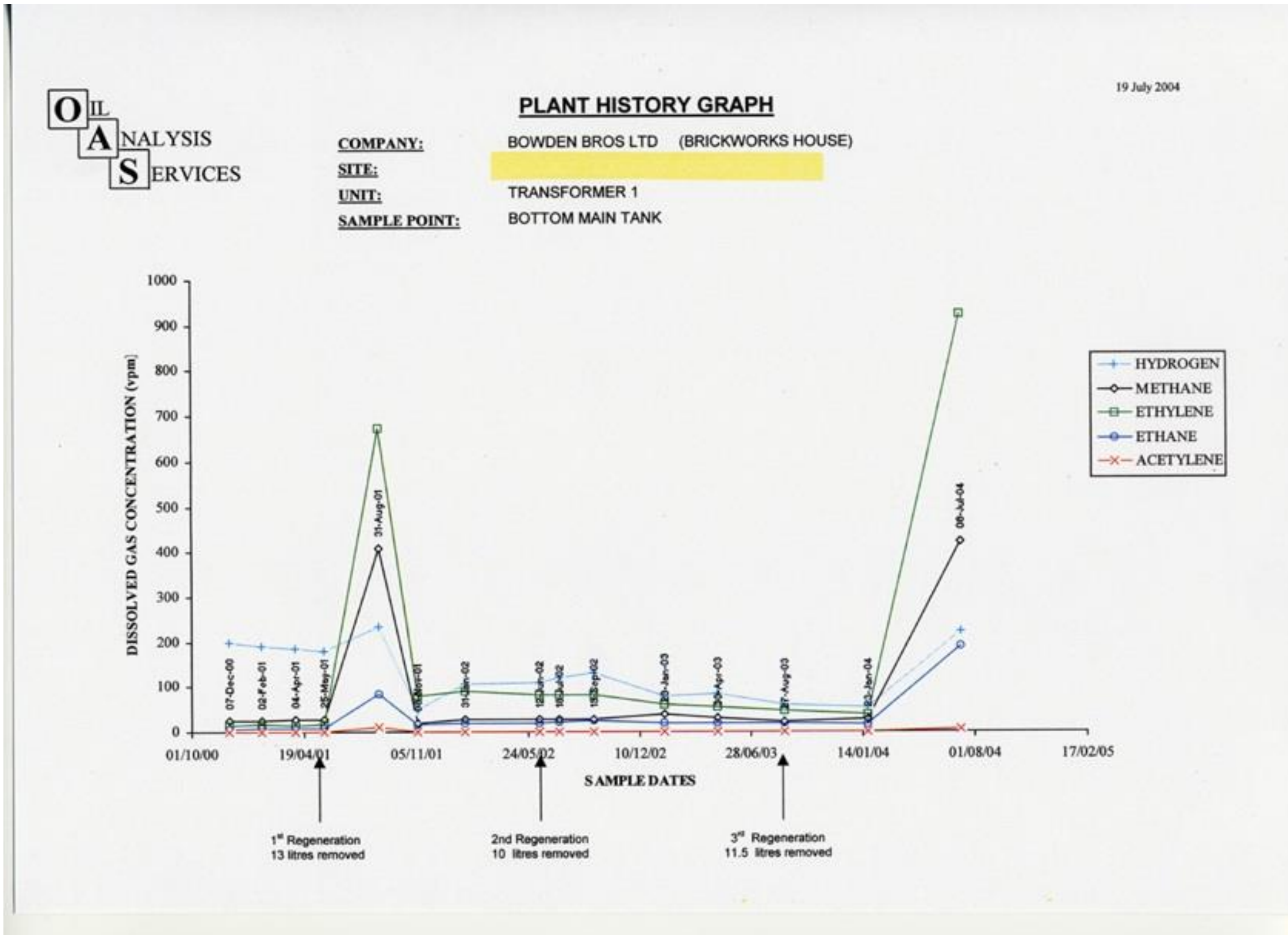


Fig 3

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.

Pic 5

10.0 MONITORING

10.1 OIL FLOW OR PUMP MONITOR

To monitor the continuous flow of oil through the TRANSEC unit two options exist

10.1.1 The LEM monitor is a C/T through which the live core of the cable which supplies the pump passes. If current is present then the incoming 240V 50Hz supply is healthy, and the pump is drawing current and therefore spinning. 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. (see Pic 4 – LEM monitor is installed on wall next to TRANSEC)

10.1.2 Alternatively a Flow-Mon flow monitor can replace the visual flow indicator. This will monitor the rate of oil through the TRANSEC, and if it falls below a set flow rate (user adjustable) then an alarm will be triggered as above. (see Pic 5 – Flow-Mon monitor is shown next to pump with control box mounted on frame)

10.2 WATER IN OIL PPM & TEMPERATURE

There are a number of options for monitoring ppm and temperature with TRANSEC. In its simplest form a re-chargeable battery powered Vaisala can be carried between TRANSEC installations for a spot check at input and output using the LCD display. Alternatively a permenantly installed Vaisala unit can give data in real time back to SCADA via wireless connection.

10.2.1 Vaisala MMT330 can be 24V d.c. powered and packaged as a portable unit (see Pic 6)

Pic 6

Alternatively a 240V 50 Hz MMT330 can be permanently installed, although to monitor both Input and Output to TRANSEC, two instruments will be required. The option then exist to use the data live via RS232 or RS485 link to SCADA.

10.2.2 A preferred option is to permanently install two Vaisala MMT162 probes (Pic 7) at input and output and use a M170 hand held (Pic 8) to plug in and interrogate the probes. This offers an economic and practical solution to monitoring the saturation level of the cylinders, and gives a trending pattern to the water in oil ppm level in the transformer tank.

Pic 7.

Pic 8.

APPENDIX

REGENERATION REPORT SHEET

Project Ref:	4049	Client:	XXXXXXXXXXXXXXXXXXXXX
Site:	XXXXXXXXXXX	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. (left- hand) cylinder had adsorbed most moisture. Whether more in total would have been adsorbed over time cannot be known with certainty.

FIG 3.

MATERIALS & PERFORMANCE SPECIFICATION

Product: TRANSEC CL3A On-line Transformer Drying Unit.

ADSORBTION MATERIALS & PERFORMANCE:

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

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

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

INSTALLATION MATERIALS: Typically for CL3A 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

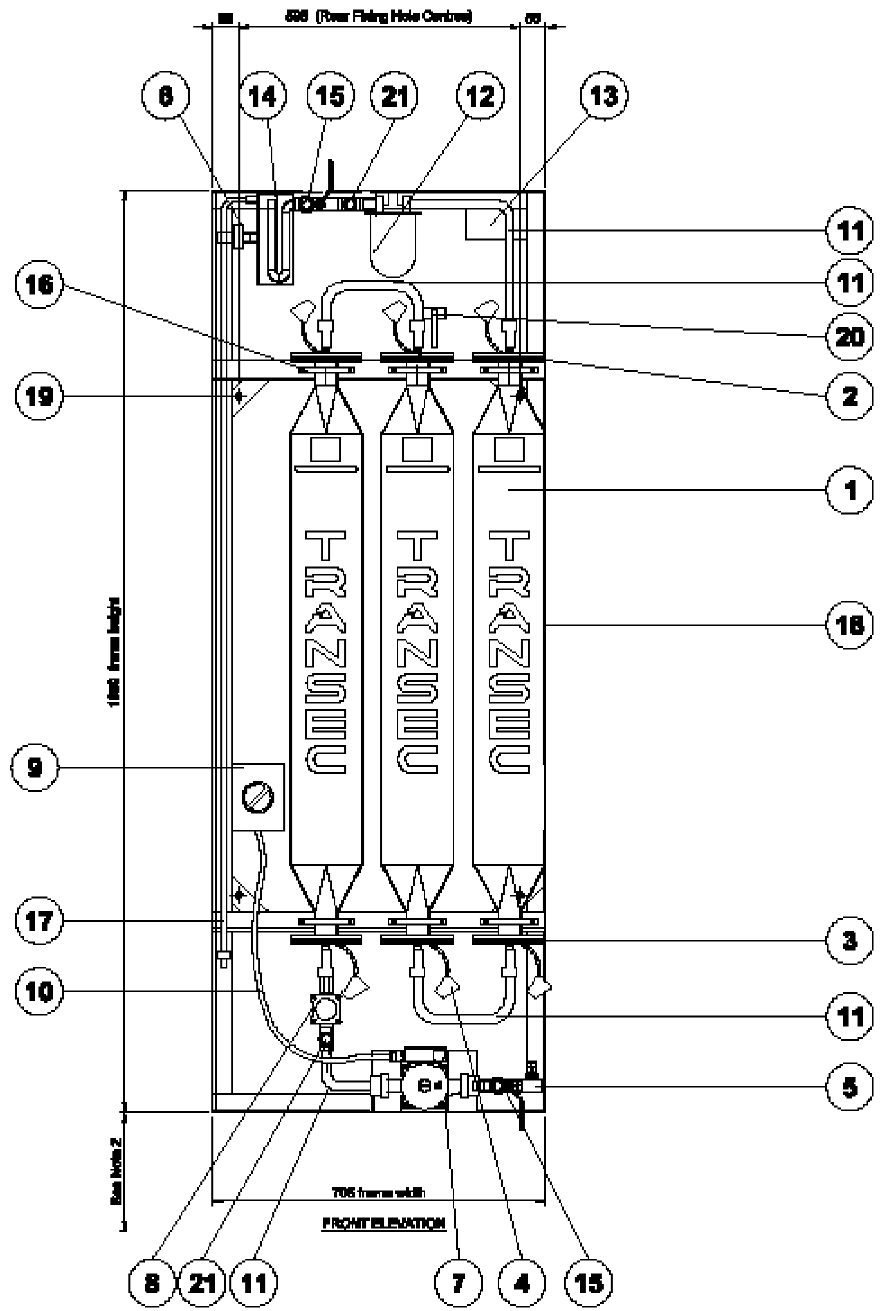
TYPE TESTING:

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

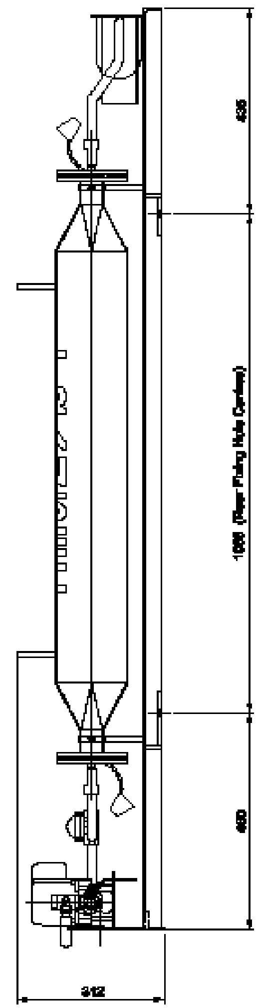
ROUTINE TEST:

Each unit is tested pressurised to 2 bar for 30 minutes at 60ºC to prove leak free.

TRANSEC 12.01.09



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.	BSP F INLET PIPE & VALVE (V1) (LOCKABLE)
6	1 No.	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
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.

REV A: 2 No. sampling tee added item 21 and new version pump

FINISH: Frame - Stst, grade 304; Components - Stst, plated & plastic

BASED ON DRAWING: -

SURVEY DATE: -

DRAWING TITLE: Transec CL3A Unit Assembly New General Arrangement Standard Filter.

CLIENT: TRANSEC

DRAWN BY: R.BROWN

DATE: 03-04-09

SCALE: -

JOB No.: -

DATA CARD No.: -

DRAWING No.: TR3/GA/04

REV.: A

Makesmetalwork

GMC General Metal Constructions Limited

☒ Head Office

☐ Area Office