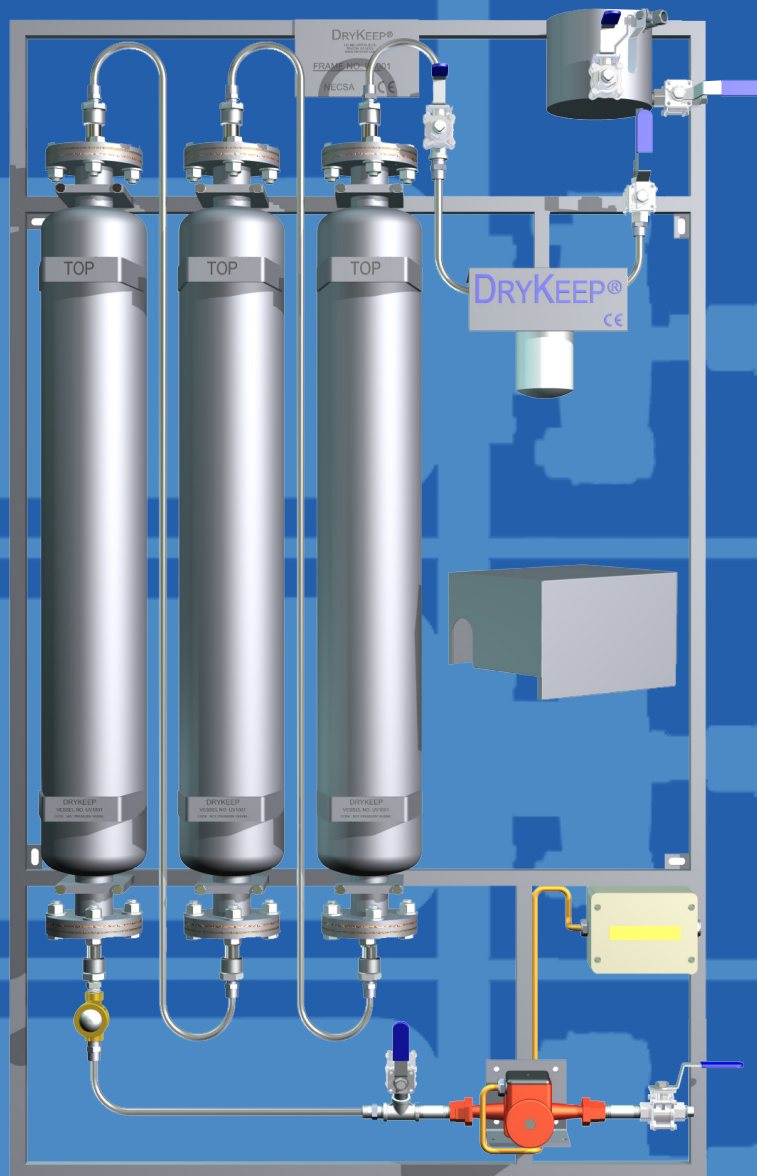


# DryKeep™

## Transformer Moisture Management System DESCRIPTIVE BROCHURE

Carries the CE mark  
ISO-9001 Certified



Complies fully with IEEE Standards C57-140-2006, 7.2  
Guide for the Evaluation and Reconditioning of  
Liquid Immersed Power Transformers

# 1.1 INTRODUCTION

Several factors shape the life expectancy of a transformer. One such factor, the moisture content within a transformer, has a significant detrimental impact on the aging of transformers. It is for this reason that the reduction of moisture or prevention of moisture increase in a transformer has captured the attention of all involved in transformer maintenance. Unlike the existing techniques, which remove moisture after it has already accumulated in the transformer, the *DRYKEEP™* unit performs this function on an ongoing, proactive basis, effectively slowing down the aging process.

The main advantage of the *DRYKEEP™* unit lies within continuous moisture management, as opposed to the very rapid traditional drying methods. By implication, the *DRYKEEP™* unit has a less dramatic impact on the transformer, as it can safely dry the oil while the transformer is still on load.

The system is comprised of one or three (depending on the model) completely passive cylinders. Each cylinder contains a high technology adsorbent material designed to remove the dissolved water from the oil that passes through the cylinder. As moisture migrates from the transformer insulation to the oil it is gently removed by the *DRYKEEP™* system on a continuous basis as the oil passes through the cylinders. The system is unique in that, unlike similar drying techniques, the moisture that is removed cannot be released back into the oil under normal service temperature changes, nor can it freeze under severe cold ambient conditions as the adsorbent material can only release the moisture when heated to 180°C.

The RT 3 and RT 9 models are built on to a standard frame and the installation for both of these units is similar.

DRYKEEP™ CAT #	# OF CYLINDERS	SUGGESTED TRANSFORMER SIZE	WATER REMOVAL CAPACITY
RT 3	1	LESS THAN 10MVA	± 3 LITRES
RT 9	3	10 MVA AND UP	± 9 LITRES

Each cylinder can remove three liters of moisture and the saturated cylinders are changed under load.

# 1.2 APPLICATION OF THE *DRYKEEP™* SYSTEM

## 1.2.1 TRANSFORMERS

### New Transformers

After manufacture, the total moisture content in new transformers is typically less than 0.5%. The *DRYKEEP™* will maintain this moisture content and eliminate moisture buildup.

### Repaired Transformers

After a major overhaul in a workshop, and after having undergone a vapor-phase treatment, the moisture content of a repaired transformer is similar to that of a new transformer (≥ 0.5%). Therefore, the application is the same as for new transformers.

### In-Service Transformers

Transformers, irrespective of age, should be fitted with a *DRYKEEP™* to reduce the moisture in the transformer and eliminate moisture buildup. Transformers that have been in service for many years typically have high moisture content (2% and beyond). The objective is to reduce the moisture content of the paper insulation to an acceptable level and then maintain that level. This will substantially increase the life of the transformer. A transformer has to be assessed to determine its total moisture content and a moisture reduction plan must be established. Before installing *DRYKEEP™* on the transformer(s), DryKeep USA will estimate the amount of moisture in

the paper insulation. We will request certain information regarding the transformer characteristics to determine the moisture content. We will advise how many changes of saturated cylinders will be required before reaching a predetermined safe level which is about 1.3% moisture by weight remaining in the paper. The transformers are dried down to a safe level to avoid re-clamping of the core and coil assembly as it is not always possible to re-clamp in the field. The dry-out process must be monitored periodically by assessing the moisture content of the transformer. The moisture content and size of the transformer will affect the number of cylinder replacements required and the total amount of time to dry out the transformer to a safe level.

## 1.2.2 STORAGE TANKS CONTAINING TRANSFORMER OIL

Installation of *DRYKEEP™* is recommended to reduce moisture content to a sufficiently low level in storage tanks containing high levels of moisture (>2%), or to maintain moisture content and eliminate buildup in storage tanks with very little moisture content.

## 1.3 *DRYKEEP™* SYSTEM DESCRIPTION

(Refer to section 6 below, which identifies the various main components of the *DRYKEEP™* system)

The *DRYKEEP™* system complies fully with IEEE Standard C57-140- 2006, section 7.2. It carries the CE (European Conformity) marking and is manufactured under an ISO 9001 quality management system.

The system continuously circulates transformer oil and dries it through moisture adsorption by a molecular sieve granular adsorbent material contained in the cylinders. The transformer oil is circulated through the system without heating by a small electric pump and remains at the same temperature and pressure conditions as the transformer.

The system can contain either one or three cylinders, depending on transformer size. Self-sealing hydraulic quick couplers are used to connect the cylinders to the pipe-work. Pipe connections are either screwed or welded. Screwed connections are factory sealed with a sealing agent (Loctite) that can be unscrewed if required. Welds are dye-penetrated and pressure tested for leaks. The cylinders, pipe-work, valves, de-aerator, and frame are manufactured from shot blasted 300 series stainless steel, providing a matte gray finish. The material is durable and able to easily withstand extreme summer and winter temperatures (-40° C to 50° C ambient), as well as harsh coastal environmental conditions.

The flow indicator is made of gunmetal with a brass cover ring and sight-glass. The particulate, spin-on oil filter prevents particle carry-over to the transformer but is too small to act as a sludge filter for the transformer. If a transformer contains sludge this must be removed with a pre-filtration system.

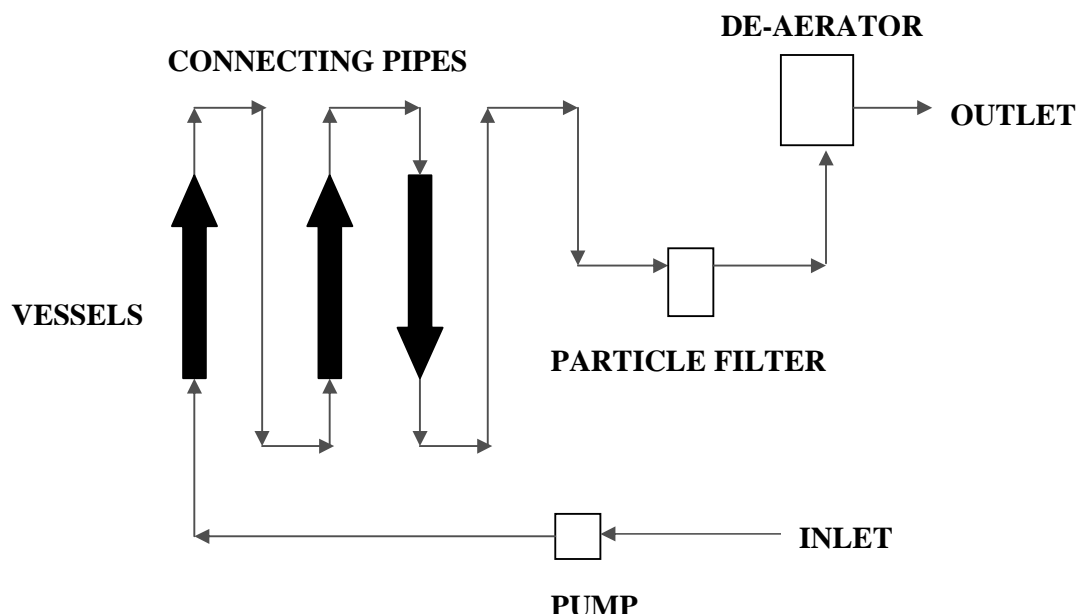
The centrifugal pump is an electrical canned rotor type. The pump and motor form an integral unit without shaft seal and requires only two gaskets for sealing. This prevents oil leaks to the environment. The pump cover is attached after installation. There are no pressure hazards as the pump is self-limiting in pressure and the system input and output are connected to the transformer, which is exposed to ambient atmospheric pressure. The *DRYKEEP™* system is completely filled with incompressible low vapor pressure oil.

The maximum operating temperature is 110° C. A typical flow rate of 24 gallons per hour has been measured depending on the viscosity of the oil.

The *DRYKEEP™* shares the same safety envelope as the transformer as it is installed onto or adjacent to the transformer. As such, safety precautions pertaining to oil contact with skin and eyes must be taken in accordance with safety data sheets and the required personal protection equipment must be used.

## 1.4 DRYKEEP™ FLOW DIAGRAM

The diagram below represents the oil flow directions of the *DRYKEEP™*.



## 1.5 FEATURES

- The cylinders are not pressure vessels
- The operating pressure of 100kPa vacuum (1.2 Bar) is compounded from:
  - A static head of 5 meters to the top of the main tank of the transformer (=50 kPa gauge)
  - Pump differential pressure (=70kPa)
- Pump is rated at 1 mPa gauge (10 Bar)
- Maximum pressure by volume ratio is 100 Bar. Liter
- The flow indicator is designed for an operation pressure of 0.7mPa (7 Bar) and is pressure-tested at 1 mPa (10 Bar)
- The quick-couplers are designed for 25mPa (250 Bar)

## 2. INSTALLATION

The *DRYKEEP™* RT 3 and RT 9 system is dispatched filled with oil and fully assembled on the framework, together with all of the components. The installation thereof is fairly easy. For detailed installation instructions, please turn to Appendix A at the end of this brochure.

**SAFETY NOTE:** It is recommended that the transformer be de-energized when installing the *DRYKEEP™* system. Once in operation, the replacement of the saturated cylinders can be done with the transformer energized.



### 3. OPERATION AND MAINTENANCE

The *DRYKEEP*™ frame, cylinders and pipe-work are 300 series stainless steel which requires minimal maintenance.

Once the system is in operation, only periodic inspection is required to check for unforeseen oil leaks and normal operation of the system.

Oil sampling and saturation assessments with moisture sensors are used to determine the condition of the molecular sieve in the cylinders. The frequency of sampling is recommended as follows:

- The first sample should be taken prior to commissioning;
- Thereafter, sampling should be taken after 1, 3, and 6 months have passed;
- Thereafter, sampling should be done as dictated by normal company maintenance standards and policies.

For detailed operations and maintenance, please refer to Appendix B at the end of this brochure.

### 4. SATURATION OF CYLINDERS AND REPLACEMENT

There are several methods of determining whether the cylinders are saturated and need to be replaced.

- Karl Fischer titration testing comparing oil samples taken from the inlet bypass valve (BP1) and the outlet bypass valve (BP2) or the bleed valve (V5), all as shown in Section 6 below.
- Portable moisture sensors such as the Doble Domino USS or Vaisala MM70 at the inlet and outlet bypass valves.
- Permanently mounted moisture monitors taking readings from the inlet and outlet bypass valves.

Normally, the moisture values between the inlet and outlet will largely differ. As the cylinder approaches saturation, the inlet and outlet moisture values will converge indicating it is time for cylinder replacement.

For detailed instructions on cylinder replacement, please refer to Appendix C at the end of this brochure.

### 5. THE EFFECT OF THE *DRYKEEP*™ ON THE RESULTS OF DISSOLVED GAS ANALYSIS (DGA)

Dissolved Gas Analysis (DGA) is widely used as one of the tools to carry out condition monitoring on transformers and has become a useful early warning system to eliminate catastrophic failure.

To ensure the integrity of DGA trending, the molecular sieve beads in the *DRYKEEP*™ cylinders are carefully selected for their preferential bonding with water molecules while excluding bonding with gas molecules.

During the development of the *DRYKEEP*™ system, Eskom Research Institution (TSI) carried out an investigation on transformers ranging in size from 40 MVA to 500 MVA to determine if *DRYKEEP*™ had any appreciable effect on the interpretation of the DGA. Their conclusion stated that for a continuously gassing transformer, the action of the *DRYKEEP*™ can never mask the generation of gas and will not significantly affect a trending analysis of gas production rates.

## 6. LAYOUT OF THE DRYKEEP™ RT 9

V1-Inlet Valve

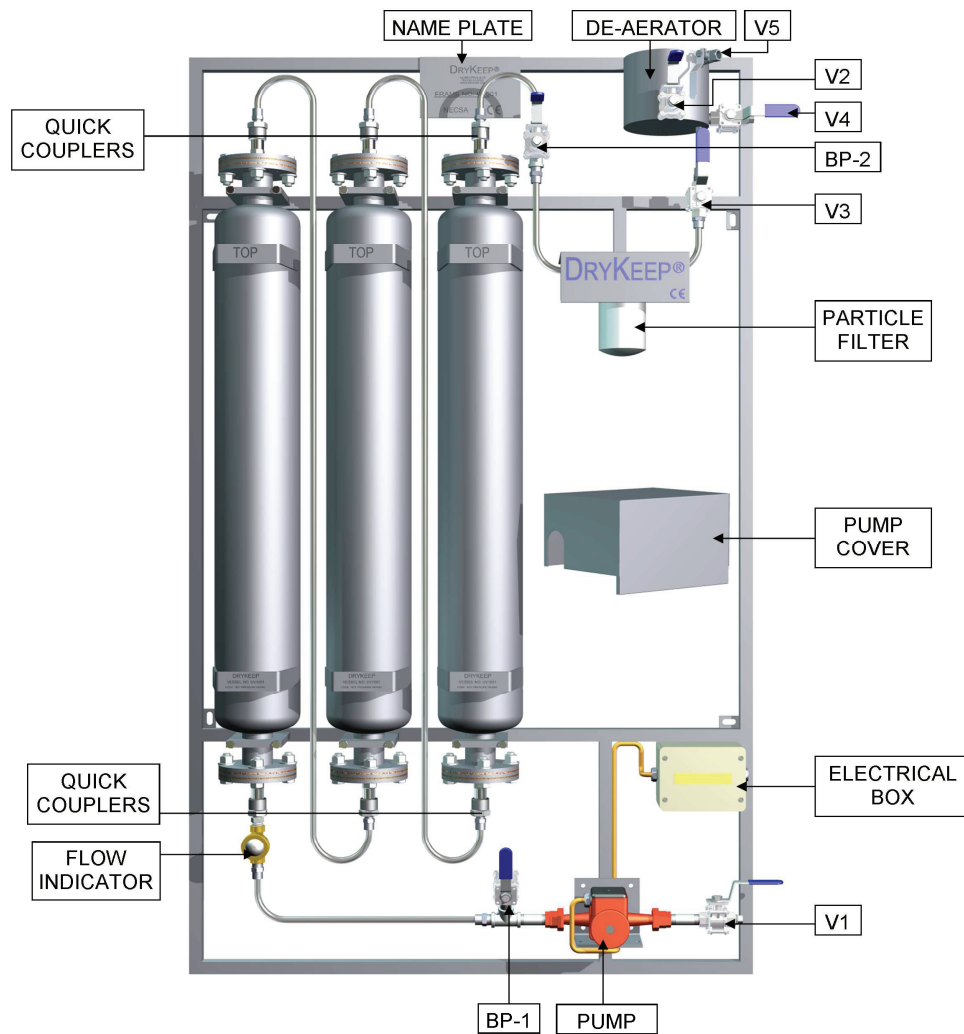
V2- Outlet Valve

V3-Particle Filter Valve

V4-Alternative Outlet Valve

V5 -Bleed Valve

BP1 & BP2-Bypass Valves (for moisture content sampling)



## 7. DRYKEEP™ RT9 SPECIFICATION

ITEM	SPECIFICATION	MATERIAL	MASS/VOLUME
Complete system (filled)	45" wide x 75" tall x 12" deep	Stainless steel 304 and 316	392 lbs 178 kg
Frame	1" x 1" square tubing	Stainless steel 316	
Cylinder (filled)	48" x 6.6" OD x 0.08" wall Cylinder handles have cylinder number engraved	Stainless steel 304	101 lbs 46-kg
Dry mass of adsorbent per cylinder	0.8 gal (3-litre) moisture removal capacity per cylinder	Aluminium silicate	35 lbs 16 kg
Oil per cylinder	Transformer oil	BS 148 (ASTM D3487)	1.8 gals 6.8 litres
Pump	Grundfos UPS-25-62-180 (60 Hz, single phase, 220 V.) 120 V 60Hz also available Grundfos UPS-25-80-180 (50 Hz, single phase, 230 V, 0.2 kW) 10 Bar static pressure rating 145 psi	Cast iron pump housing Nebar gaskets	10 lbs 4.5 kg
Pump cover		Stainless steel 316	
Pump recycling rate	1.5 litres/minute/ 24 gal/hr		
De-aerator	Stainless steel 304		0.8 gal-3 litres
Flow indicator	Impeller	Gunmetal	
Valves	Full bore	Stainless steel 316	½" three-piece and ¼" one-piece
Oil wetted materials		Transformer oil compatible	
Temperature operating range	-40°C to 110°C		
Piping		Stainless steel 316	½"
Flanges	6-mm and 8-mm x 152-mm OD	Stainless steel 304 Gaskets: Cork-elastomeric (Nebar)	
Quick couplers		Zinc passivated	
Oil filter	Parker or equal spin-on automobile type		
Oil filter cover		Stainless steel 316	
Electrical cable		Polyurethane sheathed (oil resistant)	
Electrical junction box		Plastic, compression glands	
Fittings	½", 1", 3/8"	Stainless steel 316	
Nameplate	Contains frame number	Stainless steel 316	
Manufacturing standards	CE Mark, ISO 9001: 2000 IEEE C57-140, 7.2		

## **8 WARRANTY**

The warranty is valid for a period of twelve months from the date of installation or eighteen months from the date of shipment, whichever is the earlier.

## **9. CONTACT US**

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## **APPENDIX A**

### **INSTALLATION INSTRUCTIONS**

The DRYKEEP™ system is dispatched from the factory as a fully assembled system on its frame as shown in the Section 6 layout. It comes filled with transformer oil and the molecular sieve adsorbent beads. The unit can be mounted as received, or the cylinders can be removed prior to mounting to lighten the weight of the unit while the rest of the components are to be left on the framework.

Mount unit at least 20" (500mm) above ground level.

Mounting position should preferably be on the side of the main tank or the coolers / radiators.

The DRYKEEP™ system must be mounted vertically (inlet valve and pump located at the bottom and de-aerator at the top).

Fastening of the DRYKEEP™ frame to the transformer can be done by welding or bolting to the transformer.

The system can also be mounted onto another structure close to the transformer such as a building wall or steel structure.

**NOTE:** When installing the DRYKEEP™ system on a reactor, DRYKEEP™ should be mounted on a free standing frame or an adjacent structure due to excessive vibration interference from the reactor with the DRYKEEP™ pipe work and connections. If mounted directly to the reactor tank, we suggest using vibration dampers. Contact us for further details.

### **FOR TRANSFORMERS THAT ARE IN SERVICE:**

(Refer to the DRYKEEP™ layout in Section 6 above and sample installation photos below)

Transformer should be switched off and made safe before installation commences.

Installation is flexible depending on the transformer design, however the simplest way to install the DRYKEEP™ system is to connect the bottom drain valve of the transformer to the DRYKEEP™ pump inlet valve V1 (as shown in the layout in Section 6). For added flexibility, DRYKEEP™ has two outlet valves that can be selected by the user. Whichever outlet valve is selected (either V2 or V4 as shown in Section 6) will then be connected to the transformer fill valve. The required piping shall be ½" NPT stainless steel and/or flexible hose (not supplied).

### **FOR TRANSFORMERS THAT ARE NOT IN SERVICE:**

For transformers under repair and/or not containing oil, and thus completely accessible, modifications can be made to the transformer tank to add an entry and exit fitting for the DRYKEEP™ system. The entry and exit fittings need to be diagonally apart from each other (i.e. if top left, then bottom right) to avoid re-circulating the just-dried oil. If this is not an option, DRYKEEP™ can still be installed on a transformer that is not in service the same way as described above for a transformer in service.

### **ELECTRICAL CONNECTIONS:**

The installer must connect the chosen power supply to the supplied electrical junction box. The junction box is equipped with terminal blocks and a circuit breaker. The pump is a single phase 120 V, 0.94A max or 220 V, 0.51A max, 60 Hz., or a 230 V, 50 Hz. 1.04A max at speed position three.

The brown lead is the "source" or live line. The blue wire is the neutral and the yellow/green wire is the ground.

## **MECHANICAL CHECKS:**

The installer should check the tightness of all cylinder bolts (torque value of 65 lb-ft. or 88 Newton/meters), and check that the quick couplers are secured.

## **COMMISSIONING:**

Once the system is mounted, piped to the transformer, and an available power supply has been provided to the pump motor via the electrical junction box, the system is ready for commissioning.

The following procedure must be adhered to in order to prevent air from entering the transformer:

1. Ensure that the active outlet valve (either V2 or V4 as shown in the layout in Section 6) on the DRYKEEP™ system is closed.
2. Open the inlet valve (V1) of the DRYKEEP™ system and start the pump.
3. Slowly open the bleed valve (V5) on the de-aerator tank. It is recommended that the installer has a vessel on hand at this step to capture any oil that may come out of the bleed valve while it is open.
4. Ensure that all the trapped air in the system escapes through the bleed valve.
5. Close the bleed valve on the de-aerator tank (V5).
6. Slowly open the active outlet valve (V2 or V4) of the DRYKEEP™ system.
7. Open the bleed valve (V5) intermittently to remove air from the system that collects in the top of the de-aerator. Again, it is recommended that the installer has a vessel on-hand at this step to capture any oil that may come out of the bleed valve while it is open.
8. Monitor the system closely for 20 minutes and check for oil leaks and oil flow through the flow indicator and for any abnormalities.

Once installed and commissioned the system will operate continuously.

Regular visual inspections must include:

- Checking for leaks
- Check if flow indicator turns
- Check if pump is operating

## **Troubleshooting:**

If a leak is detected on the cylinder flanges, check to ensure that the bolt torque is at 65 lb-ft (88 Newton-meters).

If the flow indicator is not turning but the pump is operating, first tighten all quick couplers to ensure that the annular ball valve has been released. If the flow indicator is still not turning, slightly loosen the flow indicator glass cover as it may be impeding the impeller rotation. If the flow indicator still does not turn, the particle oil filter cartridge could be blocked and may require replacement.

If the pump is not operating, check for an electrical fault.

**TYPICAL INSTALLATION AT THE TRANSFORMER DRAIN VALVE**



**ALTERNATE INSTALLATION TO DRAIN VALVE**



## **APPENDIX B**

### **OPERATION AND MAINTENANCE INSTRUCTIONS**

After commissioning of the DRYKEEP™ system, only periodic inspections are required to check for unforeseen oil leaks and normal operation.

#### **PERIODIC CHECKS:**

Check for any oil leaks – tighten bolts if required (cylinder flange bolt torque must be 65 lb-ft or 88 Nm); tighten particle oil filter cartridge if leaking.

Check for pump operation – an inoperative pump could be caused by an electrical defect.

Check for flow at the flow indicator – lack of flow may indicate a blocked oil filter or pump not operating. Glass cover of flow indicator may be too tight, impeding the movement of the paddle wheel. Loosen glass very slightly.

Check for tightness of all quick couplers. If not tight, the built-in annular ball valve may not open.

#### **TROUBLESHOOTING:**

The most probable conditions that could occur are a leak at a flange gasket, connection, or joint, clogging of the particle oil filter, or malfunctioning of the pump.

If a leak is detected on the cylinder flanges, check to ensure that the bolt torque is at 65 lb-ft (88 Newton-meters).

If the flow indicator is not turning but the pump is operating, first tighten all quick couplers to ensure that the annular ball valve has been released. If the flow indicator is still not turning, slightly loosen the flow indicator glass cover as it may be impeding the impeller rotation. If the flow indicator still does not turn, the particle oil filter cartridge could be blocked and may require replacement.

#### **Particle Oil Filter Cartridge Replacement:**

To replace the particle oil filter cartridge, shut off the pump and close the V1 inlet and V2 or V4 active outlet valve as well as the V3 valve below the de-aerator.

Use a small bucket to reclaim any oil spills from the pipes during the filter change. Unscrew the cartridge counter-clockwise and dispose of oil in the cartridge by inverting it over the bucket. Dispose of the cartridge. Replace the cartridge by clockwise screwing on a new one. Wipe the cartridge and surrounding pipe-work clean of oil with a cloth. Open the V1 inlet valve and the V3 valve underneath the de-aerator. Start the pump. Open the V5 bleed valve on the de-aerator, throttle and close after all air has escaped. Monitor the system closely for 20 minutes and check for oil leaks and flow through the flow indicator and for any abnormalities.

**NOTE:** If the DRYKEEP™ has to be isolated for any reason, the inlet valve V1 should remain open and close the active outlet valve V2 or V4 and isolate the pump. The V1 inlet valve is left open to allow for thermal expansion of the oil inside the DRYKEEP™.

If a vacuum is to be applied to the transformer, the DRYKEEP™ must be isolated.



## **APPENDIX C**

### **CYLINDER REPLACEMENT INSTRUCTIONS**

Once the cartridges have been saturated with moisture they need to be replaced with new or regenerated cartridges. The following procedure must be followed:

1. Isolate the electrical supply to the pump.
2. Close inlet valve (V1) at the bottom of the DRYKEEP™ system
3. Close the active outlet valve (V2 or V4) at the top of the DRYKEEP™ system.
4. Starting from the left hand cylinder and working towards the right hand cylinder unscrew (by hand) the top and bottom quick couplers on each cylinder.
5. Disengage the quick couplers by unscrewing and pulling apart in the sequence below:
  - 1<sup>st</sup> - bottom of left-hand cylinder.
  - 2<sup>nd</sup> - top of left-hand cylinder.
  - 3<sup>rd</sup> - bottom of the center cylinder.  
Remove connecting pipe
  - 4<sup>th</sup> - top of center cylinder.
  - 5<sup>th</sup> - bottom of right hand cylinder.  
Remove connecting pipe
  - 6<sup>th</sup> - top of the right hand cylinder.
6. The quick couplers contain annular ball valves that are self-sealing on removal. Any cylinder can be removed by removing the clamps. Note that each cylinder weighs approximately 110 lbs (50kgs), so two persons are recommended for cylinder removal. Use the two lifting handles on each cylinder.
7. Position the fresh cylinders onto the frame by using the lifting handles and clamps.
8. Replace the pipes by engaging the quick couplers and manually tighten the couplers.
9. The system is now ready to be re-commissioned. The following procedure must be followed to prevent air from entering the transformer:
  - a. Open the inlet valve (V1) of the DRYKEEP™ system and start the pump by switching on the electrical supply.
  - b. Slowly open the bleed valve (V5) on the de-aerator tank. It is recommended that the installer has a vessel on-hand at this step to capture any oil that may come out of the bleed valve while it is open.
  - c. Ensure that all the trapped air in the system escapes through the bleed valve.
  - d. Close the bleed valve on the de-aerator tank (V5).
  - e. Slowly open the active outlet valve (V2 or V4) of the DRYKEEP™ system.
  - f. Open the bleed valve (V5) intermittently to remove air from the system that collects in the top of the de-aerator. Again, it is recommended that the installer has a vessel on-hand at this step to capture any oil that may come out of the bleed valve while it is open.
  - g. Monitor the system closely for 20 minutes and check for oil leaks and oil flow through the flow indicator and for any abnormalities.

## **DRYKEEP™ FREQUENTLY ASKED QUESTIONS**

### ***1. DOES DRYKEEP™ HAVE A MONOPOLY ON THE MOLECULAR SIEVE TECHNOLOGY?***

DRYKEEP™ does not have a monopoly on the Molecular Sieve Technology. The process is acknowledged by the IEEE Transformer Maintenance Committee as a viable method for drying out transformers. They would never acknowledge a system that was a sole source. (Refer to C57-140-2006, paragraph 7.2). DRYKEEP™ happens to be the leader in molecular sieve on-line continuous drying of both the oil and paper insulation. The success lies in DRYKEEP™'s low cost, low maintenance and non-invasive method of getting moisture out of the paper insulation where 98% of the moisture resides. DRYKEEP™ was developed and manufactured by South African government agencies, specifically the Nuclear Energy Corporation of South Africa (NECSA) and Rotek Engineering Division of ESKOM, the 5th largest power company in the world. DRYKEEP™ has been in service since 1997 and is installed on over 800 transformers worldwide. Many of the leading power companies in the world have adopted and even specified that all their new transformers must have DRYKEEP™ factory installed.

### ***2. WHEN A TRANSFORMER IS EQUIPPED WITH DRYKEEP™, HOW LONG BEFORE THE MOISTURE LEVEL WILL START TO REDUCE?***

DRYKEEP™ starts reducing the moisture level immediately. How long it takes to dry out the insulation depends upon the size of the transformer and how wet it was before the DRYKEEP™ was installed. For example, a 20 mva transformer probably would dry out in 10 to 12 months. Once you dry it down to a safe level (~1.3%), you would only need to change the cylinders every 5 or 6 years. Larger transformers could take up to 2 years to dry down to a safe level.

### ***3. HOW DO WE KNOW WHICH ONE OF THE CYLINDERS ARE SATURATED?***

All 3 cylinders become saturated at the same time and are replaced as a group.

### ***4. HOW AND WHEN DO WE CHECK FOR SATURATION?***

The standard way to check for saturation is to take an oil sample at the inlet bypass valve to DRYKEEP™ and, by using either the Karl Fischer Titration Test or a test instrument such as the Doble or Vaisala portable unit, determine the parts per million (ppm) moisture content in the oil. Always record the top oil temperature when taking samples for the titration test. Do the same at the outlet by-pass valve. When the inlet and outlet ppm readings converge or read the same, the cylinders are saturated.

### ***5. HOW OFTEN DO WE NEED TO TAKE OIL SAMPLES/CHECK THE MOISTURE OF THE OIL?***

The frequency of oil sampling is recommended as follows:

- The first sample should be taken prior to commissioning;
- Thereafter, sampling should be taken after 1, 3, and 6 months have passed;
- Thereafter, sampling should be done as dictated by normal company maintenance standards and policies.

### ***6. HOW CAN WE PROVE THAT DRYKEEP™ IS A COST-WORTHY INVESTMENT WHEN COMPARED TO A TRANSFORMER WITHOUT DRYKEEP™?***

Think of DRYKEEP™ as an insurance policy for your transformer. Large utilities like ESKOM (South Africa) have repeatedly installed DRYKEEP™ on both new and older wet transformers. Experience has shown that by keeping the moisture in paper at a low level, the life of the insulation increased ten-fold. The relatively low cost of DRYKEEP™ compared to the cost of replacing an expensive transformer more than justifies the relatively small investment.

**7. CAN YOU ESTIMATE THE INCREASED LIFE TIME OF A TRANSFORMER (NEW AND OLD) EQUIPPED WITH DRYKEEP™?**

Each transformer will have a different life span based on the frequency and intensity of the maintenance, ambient temperatures, loading factor, and operating temperatures. We do know from tests performed by Rotek Engineering of South Africa showed that the life of the paper insulation is increased ten-fold when a transformer is equipped with DRYKEEP™.

**8. THE MAINTENANCE INSTRUCTIONS OF DRYKEEP™ DON'T SPECIFY HOW FREQUENTLY THE MAINTENANCE PROCEDURE/INSPECTION SHOULD BE DONE SUCH AS ONCE A YEAR OR TWICE A YEAR...ETC.**

We cannot dictate how frequently the customer performs their routine maintenance.

**9. PLEASE ADVISE THE CHARACTERISTICS OF THE MOLECULAR SIEVE.**

Below is a general description of the product. We cannot divulge the actual size or coatings used in the manufacturing process. This is proprietary information.

**DRYKEEP™ Molecular Sieve Beads**

Molecular sieve beads combine the highly selective adsorption properties of Zeolites with high mechanical integrity due to advanced manufacturing and de-dusting technologies. After synthesis, each zeolite crystal is only a few microns across. To be of use in our fixed bed adsorption processes, it is necessary to form particles in a specific diameter. Expertise in molecular sieve beading has led to optimized bead properties for the DRYKEEP™ system. For regenerative applications like petrochemicals drying with zeolite adsorbents, special binders are applied; this gives our molecular sieves a high stability against contaminants in the feed stream, thus allowing a long unit lifetime.

**10. IS THE DRYKEEP™ SYSTEM INSTALLED BY THE CUSTOMER OR BY THE SUPPLIER?**

Installation is so simple that typically the customer easily does it themselves. Power companies prefer not to have strangers working inside their energized substations. They usually have their own workers do the installation. We provide detailed instructions with each DRYKEEP™ unit and are always available for site supervision during installation, or if necessary DryKeep USA can arrange for a contractor to do the installation.

**11. IS IT NECESSARY TO SHUT DOWN TRANSFORMER WHEN INSTALLING DRYKEEP™?**

It is advisable to shut off the transformer, especially when installing the return piping to the fill valve which is at top area of the transformer. It is not necessary to de-energize the transformer when replacing the saturated cylinders.

**12. HOW DO I KNOW WHEN TO REPLACE THE PARTICLE OIL FILTER?**

Most of our customers replace the particle filter when replacing the saturated cylinders or sooner if the transformer is very old and has dirty oil. Some customers change it during their routine inspections which occur mostly every 2 to 3 months.

**13. HOW WOULD YOU KNOW WHEN THE TRANSFORMER HAS BEEN DRIED DOWN TO THE SAFE LEVEL?**

Before installing DRYKEEP™ on the transformer(s), we will estimate the amount of moisture in the paper insulation. We will request certain information regarding the transformer characteristics before we can determine the moisture content. We will advise how many changes of saturated cylinders will be required before reaching a predetermined safe level which is about 1.3% moisture by weight left in the paper. The transformers are dried down to a safe level to avoid re-clamping of the core and coil assembly as it is not always possible to re-clamp in the field. We can, in the case of the Model RT 9, remove 2 cylinders and let the remaining cylinder keep the transformer from getting wet again.

**14. DO TRANSFORMERS NEED ANY ADDITIONAL MAINTENANCE IF EQUIPPED WITH DRYKEEP™?**

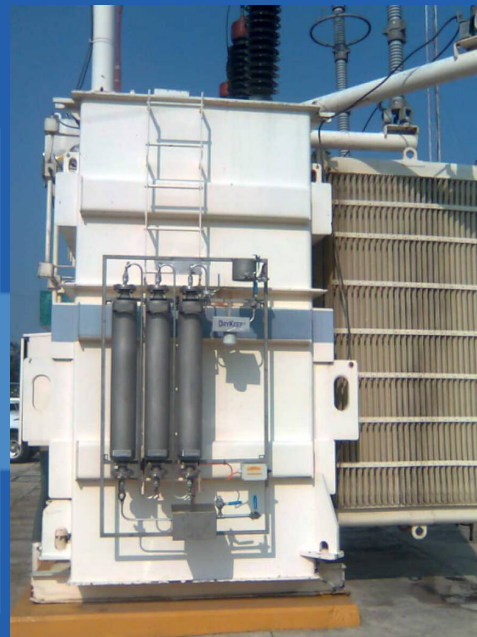
The transformer is not adversely affected in any way when DRYKEEP™ is installed. It is like any other transformer accessory such as a temperature or pressure gauge installed on a transformer. DRYKEEP™ extends the life of the paper insulation ten-fold. It allows the owner to operate it at higher temperatures and put greater loads on the transformer by maintaining the dielectric strength of the insulation system.

**15. WHAT ARE THE APPLICABLE STANDARDS FOR THE DRYKEEP™ PRODUCT?**

IEEE Standard C57-140-2006, 7.2 written by the IEEE Transformer Maintenance Sub-committee. DRYKEEP™ complies 100% with all the provisions. It carries the CE mark and is manufactured under ISO 9001 quality standards.

**16. WHAT IS THE DIFFERENCE BETWEEN DRYKEEP™ AND OTHER PRODUCTS ON THE MARKET SUCH AS THE TEMPORARY, MOBILE-STYLE OIL DRY OUT SYSTEMS?**

The difference is that DRYKEEP™, as a permanently installed dry-out system, will accomplish what the temporary, mobile-style systems can never do; dry out the paper insulation. Of all of the moisture inside of a transformer, only up to 2% can be held in the oil. 98% of the moisture inside a transformer resides in the paper insulation. Temporary, mobile style dry-out systems only dry out the oil, not the paper insulation where most of the moisture resides. Once that temporary unit is removed from the transformer and the transformer oil heats up, the moisture that remains in the paper insulation will simply diffuse to the oil, saturating the oil again as the transformer strives to maintain a state of equilibrium. It is as though there was never any dry-out system applied to it at all. Only a permanently installed system like DRYKEEP™, the leader in molecular sieve technology for transformer drying, can effectively reduce the total moisture inside of a transformer to safe levels.



**DRYKEEP™ USA**  
[www.drykeep.com](http://www.drykeep.com)

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