TMR™ N₂
TOTAL MOISTURE REMOVAL NITROGEN SYSTEM

HIGHLY EFFECTIVE, LOW COST WATER REMOVAL SYSTEMS FOR ATMOSPHERIC BREATHING LUBRICANT RESERVOIRS

Overview
Water is the most common and damaging contaminant found in hydraulic and lubricating systems. Water can exist in 3 forms: free, dissolved and emulsified. EPT’s Total Moisture Removal Nitrogen (TMR™ N₂) systems cost effectively remove all 3 forms of water from lubricants and hydraulic fluids through mass transfer which is a highly effective, non-mechanical process. Most water removal systems use heat, vacuum and pumps, which are all expensive to operate and maintain, to force the separation of water from the lubricant. The TMR™ N₂ system exploits the principle of chemical equilibrium to remove all types of water in a much more gentle, and energy efficient methodology.

In many applications, the primary mode of water ingress is atmosphere, which provides an unlimited source of water whenever the moisture content in the atmosphere is higher than in the lubricant. Atmospheric water ingress rates are typically low and constant, which lends itself perfectly to the TMR™ N₂ system. Using mechanical separation systems in this scenario would simply dehydrate the lubricant to an unsaturated state so that it can absorb more water from atmosphere. This creates an energy intensive cycle that fails to address the primary cause of water ingress.
Free Flowing Nitrogen Blankets

TMR™ N₂ systems produce ≥97% N₂ gas that is extremely dry (-67.8°C/-90°F dew point and <0.01% relative humidity) using a small amount of standard compressed air at ambient conditions (24°C/75°F). The N₂ gas is introduced into the reservoir headspace at a point above the lubricant surface forming a nitrogen blanket. As the clean, dry N₂ gas sweeps across the reservoir, it will absorb water vapor which is forced out of lubricant as it moves towards moisture equilibrium with the nitrogen blanket.

TMR™ N₂ systems reverse the normal reservoir breathing cycle (see illustration) so that reservoirs are always discharging a small amount of high purity N₂. In this configuration, reservoirs will be continually insulated with a free-flowing nitrogen blanket which eliminates the ingestion of atmospheric water, particulate, and metal ions. Lubricant and hydraulic reservoirs operating in sea water environments, heavy industrial or agricultural regions can accumulate soluble metal ions, which are catalysts that accelerate lubricant breakdown.

Moving Beyond Water Removal to Managing Oxidation Levels

TMR™ N₂ systems offer the additional benefit of eliminating fluid contact with oxygen, which along with water and metals, comprise the 3 primary catalysts of oxidation. Therefore, these systems offer users the ability to move beyond reactionary maintenance and actually manage the factors that accelerate oxidation. By continually managing water and oxygen levels and by eliminating metal ion ingression from atmosphere, users can lower the rate of lubricant breakdown, reducing maintenance requirements and extending fluid life.

Long-life, Low-cost, with Minimal Maintenance

TMR™ N₂ systems have very low maintenance requirements. Two inlet air filters need to be replaced every 6 months to remove residual oil from the compressed air source, which would otherwise reduce system life. With proper maintenance, TMR™ N₂ systems should last 8 years or more at which time only the generation unit would need to be replaced. The total cost of ownership of a TMR™ N₂ system over 8 years is estimated to be $5,500 – $8,000 in total (depending on size), which in many cases is $50,000 lower than mechanical systems frequently used in these applications. That is a return on investment (ROI) of $44,500 or 809%. When you consider that one TMR™ N₂ system can be shared between two reservoirs that are close in proximity, the ROI is even more dramatic.

High Performance with Predictable Results

CASE STUDY

TMR™ system started on 2-Jul-14

Water Content (ppm)
CONTAMINATION SOURCES

ATMOSPHERIC HUMIDITY

AIR POLLUTION

COASTAL ENVIRONMENTS

Atmospheric Breathing Lubricant Reservoirs

Humid air & metal ions from sea water or industrial environments enter fluid reservoir and catalyze degradation processes.

TMR™ N₂ Conditioned Reservoir

NITROGEN OUTLET

Relative Humidity <1%

AIR INLET

0.69 MPa (100 psi)

38 – 187 LPM (80 – 397 SCFH)

FLUID LEVEL

LUBRICATING FLUID

Water migrates from wet fluid to dry headspace

HEADSPACE AIR

AIR Relative Humidity 40-100%

FLUID LEVEL

LUBRICATING FLUID

Water levels vary with Atmospheric Humidity

Key Issues with Atmospheric Breathing Lubricant Reservoirs

- The lubricant has unlimited access to water when atmospheric moisture levels are greater than lubricant moisture levels.
- Breather elements cannot reduce existing water levels.
- Breather elements, which are designed to reduce condensation, have limited capacity and cannot prevent water ingression from atmosphere via mass transfer.

Note: extraction fans used to prevent condensation make this situation worse.

- Sea water and industrial environments will also contribute metal ions which increases the rate of lubricant breakdown.
- Common water removal alternatives including vacuum dehydrators that effectively remove water, but do not address the contamination source creating an energy intensive cycle where the fluid absorbs as much water as it can hold from atmosphere.

Key Benefits of TMR™ N₂ Systems

- High purity N₂ (≥97%) is generated at the source providing unlimited capacity to reduce existing moisture.
- Maintains water at very low levels (<50 ppm total or <350 ppm for EHC fluids) reducing the rate of lubricant breakdown.
- Free flowing N₂ is exhausted out the breather element or facility exhaust, reversing the typical flow configuration and eliminating one of the key ingression points for water and particulate contamination.
- Eliminates lubricant contact with oxygen, reducing oxidation and promoting the removal of H₂, CO, C₂H₄ and other harmful breakdown gases.
- Normally eliminates the need for expensive vacuum dehydration equipment or disposable filter elements when water ingression rates are low or solely from atmosphere.
- Very low maintenance requirements (30 minutes per year).
- Quick return on investment (ROI).
**TMR N₂ System Sizing**

TMR™ N₂ systems are regulated, intrinsically safe and have a manually adjusted flow control valve with flow meter. They are designed to remove up to 100 – 300 ppm water per day and sized according to the headspace volume. Reservoirs need a breather element (or suitable exhaust) and excessive atmosphere access points should be sealed. Reservoir extraction fans are not ideal in applications without bearings and should be removed if feasible.

### SIZING AND TECHNICAL SPECIFICATIONS

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<th>PART NUMBER</th>
<th>601902</th>
<th>60190</th>
<th>601904</th>
<th>601905</th>
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<tr>
<td>Reservoir Volume (L/gal)</td>
<td>≤1532/400</td>
<td>≤3028/800</td>
<td>≤7570/2000</td>
<td>≤11356/3000</td>
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<tr>
<td>Daily Water Removal (ppm)</td>
<td>100-300</td>
<td>100-300</td>
<td>100-300</td>
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<tr>
<td>Connections: Inlet/Outlet FNPT (in.)</td>
<td>¼</td>
<td>¼</td>
<td>¼</td>
<td>¼</td>
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<tr>
<td>Dimensions LxWxH (mm/in.)</td>
<td>466 x 162 x 762/18 ⅜ x 6 ⅜ x 30</td>
<td>466 x 162 x 1217/18 ⅜ x 6 ⅜ x 47 ⅞</td>
<td>499 x 168 x 1217/19 ⅝ x 6 ⅜ x 47 ⅞</td>
<td>442 x 365 x 1769/17 ⅝ x 6 ⅜ x 69 ⅝</td>
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<tr>
<td>Shipping Dimensions LxWxH (mm/in.)</td>
<td>508 x 254 x 864/20 x 10 x 34</td>
<td>534 x 280 x 1296/21 x 11 x 51</td>
<td>534 x 280 x 1296/21 x 11 x 51</td>
<td>508 x 250 x 607/20 x 10 x 29</td>
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<tr>
<td>Shipping Weight (kg/lb)</td>
<td>10/21</td>
<td>20/44</td>
<td>22/48</td>
<td>PART 1 PART 2</td>
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<tr>
<td>N₂ Output – Manual Control with Flow Meter (LPM/SCFH)</td>
<td>0-25/0-50</td>
<td>0-25/0-50</td>
<td>0-50/0-100</td>
<td>0-100/0-200</td>
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<tr>
<td>Pre-set Flow Rate (LPM/SCFH)</td>
<td>14/30</td>
<td>21/45</td>
<td>35/75</td>
<td>70/150</td>
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<tr>
<td>% N₂ at Pre-set Flow Rate at 0.69 MPa/100 psi Air Temp. of 21°C/70°F</td>
<td>97%</td>
<td>&gt;97%</td>
<td>&gt;97%</td>
<td>&gt;97%</td>
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<tr>
<td>Air Consumption Max. at 0.69 MPa/100 psi (LPM/SCFH)</td>
<td>0-38/0-80</td>
<td>0-64/0-136</td>
<td>0-114/0-241</td>
<td>0-187/0-397</td>
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**Note:** Temperature of membrane must stay ≥24°C/75°F for optimal performance. Nitrogen recovery will be hindered if temperature averages ≤24°C/75°F.

### REPLACEMENT PARTS

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<tr>
<td>Particulate Filter</td>
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<td>Oil Coalescer</td>
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<td>Pressure Gauge</td>
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<td>Replacement Membrane</td>
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### AVAILABLE OPTIONS

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<th>DESCRIPTION</th>
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<td>Manifold to share 1 TMR™ N₂ with 2 reservoirs.</td>
<td>M1</td>
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### Additional Resources

1. White Paper: Effectively Eliminating Water Contamination from Hydraulic and Lubricating Fluids
2. TMR™ Air System Product Information

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