Condition monitoring and analysis of hydraulic and lubrication fluids
Eaton combines sales, engineering, manufacturing, customer service and technical sales support with a focused business goal in mind: providing optimum filtration solutions for our customers.

Following a path of continuous improvement, Eaton has maintained quality as a fundamental corporate strategy and a hallmark of all products and services. Eaton is a leader in manufacturing filtration products and solutions that include measurement, diagnostic and analysis technology—as well as more than 4,000 hydraulic filter elements and corresponding filter housings.

Condition monitoring and analysis of hydraulic and lubrication fluids

- In-line measuring
- On-line/off-line measuring
- Sensors
- Laboratory analysis and measurement
Cleanliness is the measure of any solid or liquid contamination that is not part of a hydraulic system’s working fluid.

Cleanliness may:
- Ensure productivity at maximum efficiency
- Reduce service costs through preventative maintenance and monitoring
- Reduce equipment downtime through scheduled inspections
- Minimize safety hazards and prevent contamination-related outages
- Extend the service life of system components, which improves operating profitability by reducing maintenance costs
- Reduce repair costs and system downtime

Support services
In addition to precision equipment and accessories for condition monitoring and analysis of hydraulic and lubrication fluids, Eaton provides a wide range of services, such as:
- State-of-the-art laboratory testing services
- Maintenance, calibration with certificate, software updates, trials
- On-site services: training, commissioning, repairs, equipment replacement
- Extensive network of sales and customer representatives
- Product specialists for customer application support
- Global technical support

Calibration services
- Performance tests
- Device cleaning
- Secondary calibration
- Replacement of used and worn mechanical components
- Replacement of printing paper and ink ribbons
- Software updates
- 24-hour trials
- Calibration certification

Laboratory services
- Performed by certified specialists
- Employ the latest measuring instruments and testing devices
- Determination of contamination classes
- Contamination analysis
- Oil condition analysis
- Filter element inspection

Fluids are the lifeblood of every hydraulic system. Fluid analysis is an important factor for determining whether your hydraulic system can operate efficiently and effectively.

Inadequate fluid conditions are responsible for up to eighty percent of all hydraulic system failures. An effective fluid analysis program will help identify contamination and other problems not visible to the naked eye.
Solid contaminants are the main cause of failure and downtime in hydraulic and lubrication systems. Knowing the precise level of contamination is essential for the efficiency and functionality of a system. Contaminants can be introduced to a system during installation, accumulate inside during its operation, or introduced by external influences.

This knowledge enables the operator to influence the system and intervene with appropriate corrective measures.

**Effects of solid contamination**
- Increases system wear due to abrasion and erosion
- Shortens service life of system components and increases system failure
- Shortens service life of the fluid

**Contamination monitoring systems**
- Provide immediate and precise diagnosis of the condition of a hydraulic system
- Monitor of filter performance so that it can be compared with the standards required for specific system components
- Provide precise determination of the optimal time to replace filter elements
- Reliably monitor the commissioning of new systems
- Diagnose hydraulic components such as pumps, bearings or gaskets
- Determine of the condition of new fluids during system start-up
- Verify the effectiveness of off-line filtration
- Document the effect of external conditions on the particle level of solid contaminants in the hydraulic system

**Advantages of immediate diagnosis**
- Rapid results, no need to wait for lab analysis
- Timely and appropriate corrective actions
- Improve quality control

**Measuring methods**
The measurement systems and sets for monitoring oil condition are equipped with laser sensors that detect particles in fluid using the light blockade principle.

The MPS metal particle sensors detect coarse metal particles using an inductive measurement process.

Particles can be costly in a hydraulic system
The presence of water in hydraulic fluids is the second most common cause of failure and downtime in hydraulic and lubrication systems.

**Effects of water in hydraulic fluids**
- Shortened service life of the fluid
- Reduced performance of the lubrication fluid
- Deterioration of control characteristics
- Reduced filterability
- Increased wear to the components
- Increased noise levels
- Loss of polarizing additives
- Increased acidity
- Rust formation
- Increased contamination levels

**How water enters a system**
- Improper storage
- Residue from cleaning
- Humidity/condensation
- Through bearings or penetrable points (such as hair-line cracks, caps, faulty gaskets, etc.)

**Types of water in a system**
- Dissolved water (up to the saturation limit of the fluid)
- Emulsified and free water (above the saturation limit of the fluid)

**Measuring principle**
The WSPS 05 sensor is a capacitive sensor that uses a polymer foil as a dielectric between two electrodes. This foil can absorb water molecules due to its microporous structure. The absorption causes the capacity of the sensor and the frequency of the resonant circuit to change. The change in frequency is detected and converted into an electrical output signal.

**What is measured**
The WSPS 05 sensor measures the relative water content in a fluid. The result is expressed as a percent of water saturation of the fluid. A value of 100 percent means that the fluid is completely saturated and contains hazardous free water.

The measurement results of the WSPS 05 sensor are different from those of water content analysis using the Karl Fischer method, which specify the total amount of free and dissolved water in the fluid.

A theoretical relation to water content in ppm (mg/kg) according to the Karl Fischer method, can be established using the specific saturation curve and the temperature of the tested fluid.

The characteristic curves for different fluids are programmed as standard in the display unit of the WSTM 01 set. Characteristic curves for additional oils can also be programmed.
### Monitoring of Hydraulic and Lubrication Fluids

#### Element spectral analysis – potential sources of metals in oil

<table>
<thead>
<tr>
<th>Element</th>
<th>Potential Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>Abrasives, aluminum mill, bauxite, bearing metal, catalyst, coal</td>
</tr>
<tr>
<td>Antimony</td>
<td>Journal bearings, solder</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Antioxidants, bactericide, mineral oil</td>
</tr>
<tr>
<td>Barium</td>
<td>Engine additives,gressa</td>
</tr>
<tr>
<td>Beryllium</td>
<td>Aircraft construction, bearings, mineral oil</td>
</tr>
<tr>
<td>Bismuth</td>
<td>Journal bearings</td>
</tr>
<tr>
<td>Boron</td>
<td>EP additives, coolant inhibitor</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Journal bearings, platings</td>
</tr>
<tr>
<td>Calcium</td>
<td>Cement dust, detergent, fuller’s earth, grease, gypsum, hard water, lignite, limonite, mining dust, oil additive, road dust, rubber, salt water, slag</td>
</tr>
<tr>
<td>Carbon</td>
<td>Carbides, carbon steel, graphite, hard metal, mineral oil, soot, synthetic material</td>
</tr>
<tr>
<td>Chromium</td>
<td>Chrome plating, hardcoat, paint, ring plating, stainless steel, tooling steels</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Additives, hard metal, tooling steels</td>
</tr>
<tr>
<td>Hafnium</td>
<td>Nuclear technology</td>
</tr>
<tr>
<td>Iron</td>
<td>Asbestos, cast iron, catalyst, cleaning detergent, fly ash, mill scale, ore dust, paint, rust, talc, zeolite</td>
</tr>
<tr>
<td>Lead</td>
<td>Babbit, bearing overlay, gasoline additive, solder, paint</td>
</tr>
<tr>
<td>Lithium</td>
<td>Dust, grease, salt water</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Aluminum alloy, engine additives, fuller’s earth, hard water, road dust, salt water, turbines</td>
</tr>
<tr>
<td>Mercury</td>
<td>Bactericide, batteries</td>
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<tr>
<td>Molybdenum</td>
<td>Metal alloys, EP additives, MoS, rings</td>
</tr>
<tr>
<td>Nickel</td>
<td>Hard steel, plating, stainless steel, steelite</td>
</tr>
<tr>
<td>Nisboium</td>
<td>Turbine blades</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>In AW/EP additives, cleaning detergent, oil additives, surface finish catalyst, mineral oil</td>
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<tr>
<td>Platinum</td>
<td>Titanium additive, coolant inhibitor, fertilizer, fly ash, granite, paper mill dust</td>
</tr>
<tr>
<td>Scandium</td>
<td>ICP reference</td>
</tr>
<tr>
<td>Silicon</td>
<td>Anti-foam additives, asbestos, cement dust, coolant additives, fly ash, fly ash, foundry dust, glasses, granite, limonite, mica, road dust, slag, steel, synthetic lubricant, talc, wet clutch</td>
</tr>
<tr>
<td>Silver</td>
<td>Bearing overleys, needle bearings, solder</td>
</tr>
<tr>
<td>Sodium</td>
<td>Additives, base stocks, coolant inhibitor, dirt, fly ash, grease, paper mill dust, road dust, salt, salt water</td>
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<tr>
<td>Sulfur</td>
<td>Gypsum, mineral oil, MoS, rubber</td>
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<tr>
<td>Tantalum</td>
<td>Hard metals, tooling steels</td>
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<tr>
<td>Tellurium</td>
<td>Mineral oil</td>
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<tr>
<td>Titanium</td>
<td>Hard metal, paints, turbine bearings, turbine blades</td>
</tr>
<tr>
<td>Tungsten</td>
<td>Hard metal, tooling steels</td>
</tr>
<tr>
<td>Uranium</td>
<td>Or dust, road dust (some types)</td>
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<tr>
<td>Vanadium</td>
<td>Mineral oil, turbine blades, valves</td>
</tr>
<tr>
<td>Yttrium</td>
<td>ICP reference</td>
</tr>
<tr>
<td>Zinc</td>
<td>AW additives, brass, galvanizing, grease, hard steel, oil additives, plating, solder</td>
</tr>
<tr>
<td>Zirconium</td>
<td>Abrasives, nuclear technology</td>
</tr>
</tbody>
</table>

#### Off-line systems

- **Warne Saturation, temperature, water content (ppm)**
- **ISO 4406:99, NAS 1638**

#### On-line systems

- **ISO 4406:99, NAS 1638**
- **WSTM 01 set**
- **WSPS 05 sensor**
- **CCT 01 set**
- **CCM 01 set**
- **USB-B**
- **CAN**
- **USB stick**
- **User computer**
- **LabVIEW data manager**
- **Excel data sheet**
- **PLC**
- **Programmable control**

#### Most sensitive component systems

<table>
<thead>
<tr>
<th>Most sensitive component systems</th>
<th>ISO target level</th>
<th>Filter micron ratings1</th>
<th>ISO target level</th>
<th>Filter micron ratings1</th>
<th>ISO target level</th>
<th>Filter micron ratings1</th>
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<tbody>
<tr>
<td><strong>PUMPS</strong></td>
<td></td>
<td></td>
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<tr>
<td>Varia</td>
<td>22/19/14</td>
<td>25VG</td>
<td>20/16/13</td>
<td>10VG</td>
<td>20/16/13</td>
<td>10VG</td>
</tr>
<tr>
<td>Fixed piston</td>
<td>20/16/13</td>
<td>10VG</td>
<td>20/16/13</td>
<td>6VG</td>
<td>19/15/11</td>
<td>3VG</td>
</tr>
<tr>
<td>Variable piston</td>
<td>20/16/13</td>
<td>6VG</td>
<td>18/15/11</td>
<td>3VG</td>
<td>18/14/10</td>
<td>3VG</td>
</tr>
<tr>
<td><strong>VALVES</strong></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Check valve</td>
<td>22/19/14</td>
<td>25VG</td>
<td>20/16/13</td>
<td>10VG</td>
<td>20/16/13</td>
<td>10VG</td>
</tr>
<tr>
<td>Directional valve solenoid</td>
<td>22/19/14</td>
<td>25VG</td>
<td>20/16/13</td>
<td>10VG</td>
<td>20/16/13</td>
<td>10VG</td>
</tr>
<tr>
<td>Flow control valve</td>
<td>22/19/14</td>
<td>25VG</td>
<td>20/16/13</td>
<td>10VG</td>
<td>20/16/13</td>
<td>10VG</td>
</tr>
<tr>
<td>Screw-in valve</td>
<td>20/16/13</td>
<td>10VG</td>
<td>20/16/13</td>
<td>6VG</td>
<td>19/15/11</td>
<td>3VG</td>
</tr>
<tr>
<td>Proportional valve</td>
<td>19/15/11</td>
<td>3VG</td>
<td>18/14/10</td>
<td>3VG</td>
<td>17/13/9</td>
<td>3VG</td>
</tr>
<tr>
<td>Serve valve</td>
<td>18/14/10</td>
<td>3VG</td>
<td>17/13/9</td>
<td>3VG</td>
<td>16/12/9</td>
<td>2VG</td>
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<tr>
<td><strong>ACTUATORS</strong></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Cylinders, vane and gear motors</td>
<td>23/19/15</td>
<td>25VG</td>
<td>22/18/14</td>
<td>18VG</td>
<td>22/18/14</td>
<td>20VG</td>
</tr>
<tr>
<td>Piston motors</td>
<td>20/16/13</td>
<td>10VG</td>
<td>20/16/13</td>
<td>6VG</td>
<td>19/15/10</td>
<td>6VG</td>
</tr>
<tr>
<td>Hydrostatic drives</td>
<td>19/15/11</td>
<td>6VG</td>
<td>18/14/10</td>
<td>3VG</td>
<td>17/13/9</td>
<td>3VG</td>
</tr>
<tr>
<td><strong>TEST BENCHES</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>15/11/7</td>
<td>1VG</td>
<td>15/11/7</td>
<td>17/13/9</td>
<td>3VG</td>
<td>16/12/9</td>
<td>2VG</td>
</tr>
<tr>
<td><strong>LUBRICATION OILS</strong></td>
<td></td>
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<tr>
<td>Paper machine oils</td>
<td>20/16/13</td>
<td>10VG</td>
<td>10/8</td>
<td>n/a</td>
<td>10/8</td>
<td>n/a</td>
</tr>
<tr>
<td>Steam turbine oils</td>
<td>19/15/11</td>
<td>6VG</td>
<td>10/8</td>
<td>n/a</td>
<td>10/8</td>
<td>n/a</td>
</tr>
<tr>
<td>Diesel engines</td>
<td>20/16/13</td>
<td>10VG</td>
<td>10/8</td>
<td>n/a</td>
<td>10/8</td>
<td>n/a</td>
</tr>
<tr>
<td>Mobile gearboxes</td>
<td>20/16/13</td>
<td>10VG</td>
<td>10/8</td>
<td>n/a</td>
<td>10/8</td>
<td>n/a</td>
</tr>
<tr>
<td>Industrial gearboxes</td>
<td>19/15/11</td>
<td>6VG</td>
<td>10/8</td>
<td>n/a</td>
<td>10/8</td>
<td>n/a</td>
</tr>
<tr>
<td>Radial bearings</td>
<td>19/15/11</td>
<td>6VG</td>
<td>10/8</td>
<td>n/a</td>
<td>10/8</td>
<td>n/a</td>
</tr>
<tr>
<td>Roller bearings</td>
<td>18/14/10</td>
<td>3VG</td>
<td>10/8</td>
<td>n/a</td>
<td>10/8</td>
<td>n/a</td>
</tr>
<tr>
<td>Ball bearings</td>
<td>17/13/9</td>
<td>3VG</td>
<td>10/8</td>
<td>n/a</td>
<td>10/8</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Note: 
1. Severe conditions may include high flow surges, pressure spikes, frequent cold starts, extremely heavy duty use or the presence of water.
2. Two or more system filters of the recommended filter micron rating may be required to achieve and maintain the desired cleanliness level.
CCM 01 set
Contamination control and monitoring system

Features
• Cost-effective in-line monitoring solution for continuous operations
• Particle counter consisting of PFS 01 laser sensor for hydraulic and lubrication fluids and CCM 01 display unit
• Reliable determination of contamination classes according to ISO 4406:99 or NAS 1638 (switchable)
• Installation in new and existing systems
• Internal memory for storing results (100 measured values)
• Automatic monitoring function with control signal output when thresholds are exceeded (programmable)
• RS-232 interface
• LabVIEW data manager software (export to Microsoft Excel) for data management on an external computer
• CAN bus interface (CANopen compatible)
• Alphanumerical display
• Sturdy case

Technical data

Operating parameters
Power supply: 24 VDC/0.15 A/3.6 VA
Power supply (external unit): 100 to 240 VAC/50/60 Hz/24 VDC/0.6 A
Protection class: IP 65 (when cover is closed)
Max. operating pressure: ≤ 725 psi (50 bar)
Viscosity: 45 to 1,854 SUS (10 to 400 mm²/s)
Fluid temperature: 32 to 158 °F (0 to 70 °C)
Ambient temperature: 32 to 158 °F (0 to 70 °C)
Connection: G 1” threaded or G ¾” threaded
Max. volume flow: 13.2 gpm (50 l/min)
Min. volume flow: 0.13 gpm (0.5 l/min)

Measurement parameters
Automatic particle counting in 4 channels:
≥ 4 µm_m ≥ 6 µm_m ≥ 14 µm_m ≥ 21 µm_m or
≥ 6.4 µm_n ≥ 14 µm_n ≥ 21 µm_n ≥ 38 µm_n
Contamination classes: ISO 4406:99, NAS 1638
Accuracy: ±1 (contamination class)

CCT 01 set
Transmitter system for contamination control

Features
• Cost-effective in-line monitoring solution for continuous operations
• Contamination class transmitter consisting of PFS 01 laser sensor for hydraulic and lubrication fluids and CCT 01 transmitter system for contamination control
• Reliable determination of contamination classes according to ISO 4406:99
• Output of contamination classes as per ISO 4406:99 as electrical signal (3 x 4 to 20 mA)
• Installation in new and existing systems
• Internal memory for storing results (1,000 measured values)
• USB interface for configuration and data transfer of current and saved measured values
• LabVIEW data manager software (export to Microsoft Excel) for data management on an external computer
• CAN bus interface (CANopen compatible)
• Sturdy case

Technical data

Operating parameters
Power supply: 24 VDC/0.15 A/3.6 VA
Power supply (external unit): 100 to 240 VAC/50/60 Hz/24 VDC/0.6 A
Protection class: IP 65 (when cover is closed)
Max. operating pressure: ≤ 725 psi (50 bar)
Viscosity: 45 to 1,854 SUS (10 to 400 mm²/s)
Fluid temperature: 32 to 158 °F (0 to 70 °C)
Ambient temperature: 32 to 158 °F (0 to 70 °C)
Connection: G 1” threaded or G ¾” threaded
Max. volume flow: 13.2 gpm (50 l/min)
Min. volume flow: 0.13 gpm (0.5 l/min)

Measurement parameters
Automatic particle counting in 3 channels:
≥ 4 µm_m ≥ 6 µm_m ≥ 14 µm_m
Contamination classes: ISO 4406:99
Accuracy: ±1 (contamination class)
Output data: 3 x 4 to 20 mA
**WSTM 01 set**

**Features**
- Cost-effective in-line monitoring solution for continuous operations
- Display of theoretical water content for pretested fluids in ppm
- Set consisting of WSPS 05 sensor and WSTM 01 display unit
- Reliable determination of water saturation and temperature in oil-based and synthetic fluids
- Installation in new and existing systems
- Internal memory for storing results (100 measured values)
- Automatic monitoring function with control signal output when thresholds are exceeded (programmable)
- RS-232 interface
- LabVIEW data manager software (export to Microsoft Excel) for data management on an external computer
- CAN bus interface (CANopen compatible)
- Alphanumeric display
- Sturdy case

**Technical data**

**Operating parameters**
- Power supply: 12 to 30 VDC/0.1 A/max. 3 VA
- Protection class: IP 67
- Max. operating pressure: ≤ 363 psi (25 bar)
- Fluid temperature: -40 to 194 °F (-40 to 90 °C) [briefly 212 °F (100 °C)]
- Ambient temperature: -13 to 185 °F (-25 to 85 °C)
- Max. flow velocity: ≤ 79”/s (2 m/s)
- Connection: G ¾” threaded

**Measurement parameters**
- Temperature: -13 to 212 °F (-25 to 100 °C)
- Water saturation: 0 to 100 %
- Accuracy (water saturation): ± 2 %
- Accuracy (temperature): ± 0.4 %

**WSPS 05 sensor**

The WSPS 05 sensor is an effective diagnostic system for determining the saturation level of water in oil. The sensor detects the presence of free or emulsified water in hydraulic or lubrication systems, thereby enabling the user to prevent accelerated oil aging, increased wear, malfunctions and failure of components. The saturation of the fluid with water displays as a percentage. Saturation values of fluid are influenced by temperature. The WSPS 05 sensor includes an integrated thermal sensor that determines the exact temperature of the fluid during a measurement.

**Technical data**

**Operating parameters**
- Power supply: 24 VDC/0.15 A/3.6 VA
- Power supply (external unit): 100 to 240 VAC/50/60 Hz/24 VDC/0.6 A
- Protection class: IP 65 (when cover is closed)
- Max. operating pressure: ≤ 363 psi (25 bar)
- Fluid temperature: -40 to 194 °F (-40 to 90 °C) [briefly 212 °F (100 °C)]
- Ambient temperature: 32 to 122 °F (0 to 50 °C)
- Max. flow velocity: ≤ 79”/s (2 m/s)
- Connection: G ¾” threaded

**Measurement parameters**
- Temperature: -13 to 212 °F (-25 to 100 °C)
- Water saturation: 0 to 100 %
- Accuracy (water saturation): ± 2 %
- Accuracy (temperature): ± 0.4 %
- Output data: 2 x 4 to 20 mA

Recommended display unit: WSTM 01 set with numerical 4-line display for stationary in-line applications; results can be expressed in ppm for pretested fluids.
**CCS 4 Contamination control system**

The mobile CCS 4 contamination control system determines the solid contamination particle size distribution, water saturation and fluid temperature.

The CCS 4 contamination control system measurement results provide a basis for analyzing the wear on hydraulic components, observing standards and detecting damage early.

The system can be used both in pressurized operating modes and for unpressurized sampling (such as from a tank).

**Features:**

- Optical particle counting via laser sensor
- Precise evaluation of contamination classes according to ISO 4406:99, ISO 4406:87, NAS 1638 and SAE AS 4059
- Measurements are displayed as particle numbers according to contamination classes, water saturation, temperature and theoretical water content (ppm)
- Different automated measuring programs for single, continuous, cyclical and on-line measurements
- Rechargeable lithium polymer battery
- Internal memory for storing results (capacity for 4 x 100 measurements)
- Display of current and saved measured values via USB or RS-232 interface
- LabVIEW data manager software (export to Microsoft Excel) for data management on an external computer

**Technical data**

<table>
<thead>
<tr>
<th>Operating parameters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>15 VDC/5 A/75 VA</td>
</tr>
<tr>
<td>Power supply (external unit)</td>
<td>100 to 240 VAC/50/60 Hz/15 VDC/5.3 A</td>
</tr>
<tr>
<td>Protection class</td>
<td>IP 67 (when cover is closed)</td>
</tr>
<tr>
<td>Operating suction range</td>
<td>-2.9 to 2.9 psi (-0.2 to 0.2 bar)</td>
</tr>
<tr>
<td>Operating pressure range</td>
<td>22 to 6,000 psi (1.5 to 420 bar)</td>
</tr>
<tr>
<td>Viscosity</td>
<td>45 to 1,854 SUS (10 to 400 mm²/s)</td>
</tr>
<tr>
<td>Fluid temperature</td>
<td>32 to 158 °F (0 to 70 °C)</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>32 to 122 °F (0 to 50 °C)</td>
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</table>

<table>
<thead>
<tr>
<th>Measurement parameters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic particle counting in 8 channels</td>
<td>≥ 4.0 µm, ≥ 4.6 µm, ≥ 6.0 µm, ≥ 6.4 µm, ≥ 10 µm, ≥ 14 µm, ≥ 21 µm, ≥ 38 µm</td>
</tr>
<tr>
<td>Contamination classes</td>
<td>ISO 4406:99, NAS 1638, SAE AS 4059</td>
</tr>
<tr>
<td>Laser sensor calibration</td>
<td>ISO MTD in oil (ISO 11171:2000)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±1 (contamination class)</td>
</tr>
<tr>
<td>Water saturation</td>
<td>0 to 100%</td>
</tr>
<tr>
<td>Temperature</td>
<td>32 to 158 °F (0 to 70 °C)</td>
</tr>
</tbody>
</table>

External factors have a large influence on lubricants during operation, which is why data on the precise contamination particle size distribution, water saturation, and fluid temperature is used to determine and analyze a system’s condition. This valuable information ensures cost-saving measures can be introduced immediately before potential problems occur.
**Dynamic sampling**
Mini-measuring connections and tubes for dynamic sampling from pressurized pipes.

**Vacuum filtration set**
Includes an electric vacuum pump for preparing membrane samples for microscopic particle counting, gravimetric analysis and analysis of contamination types using the supplied micro magnifier.

**Disposable pipette**
For sampling fluids with severe levels of contamination.

**Static sampling**
Vacuum pump, tubes and telescopic stick for sampling fluids from tanks or packing drums.

**PAS 01 kit for sampling and oil analysis**
Mobile mini-laboratory for conducting fluid analysis.

**Static sampling**
Vacuum pump, tubes and telescopic stick for sampling fluids from tanks or packing drums.

**Disposable pipette**
For sampling fluids with severe levels of contamination.

**Dynamic sampling**
Mini-measuring connections and tubes for dynamic sampling from pressurized pipes.

**Vacuum filtration set**
Includes an electric vacuum pump for preparing membrane samples for microscopic particle counting, gravimetric analysis and analysis of contamination types using the supplied micro magnifier.

**Technical data**

<table>
<thead>
<tr>
<th>Membrane filter</th>
<th>0.45 µm</th>
<th>5 µm</th>
</tr>
</thead>
</table>

**Other consumables**
- Transparent fluid
- Petri slides

**For WAS 01 water analysis kit**
- Cleaning spray
- WIO solution

**WAS 01 kit for water analysis**
Mobile analysis kit for determining the water content percentage in mineral oils using the calcium hydride method.
Optional Accessories

For oil and water analysis

**Microscope**
Equipped with an ocular micrometer, 3 lenses with 40x, 100x, and 400x enlargement, transmitted light source and cross table for particle counting

**Bottle sampling set**
Two high-purity glass bottles (8 fl. oz. (200 ml); cleaned according to ISO 3722) with self-adhesive labels and shipping box.

**Drop-ball viscometer**
Mobile device for determining dynamic viscosity, consisting of a graduated tube with integrated thermometer, 3 measuring balls, mirror and an electronic stopwatch.

For CCS 4 contamination control system

**BSS 2 bottle sampling system**

<table>
<thead>
<tr>
<th>Technical data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply: 12 VDC/3 A/36 VA</td>
</tr>
<tr>
<td>Power supply (external unit): 110 to 230 VAC/12 VDC</td>
</tr>
<tr>
<td>Protection class: IP 40</td>
</tr>
<tr>
<td>Feed pressure: ≤ 87 psi (6 bar)</td>
</tr>
<tr>
<td>Suction: 0 to 13.8 psi (0 to -0.95 bar)</td>
</tr>
<tr>
<td>External supply pressure: 72 to 145 psi (5 to 10 bar)</td>
</tr>
<tr>
<td>(air volume Q min = 10.6 gpm [40 l/min])</td>
</tr>
<tr>
<td>Supply pressure connection: Quick-coupling NW 7.2</td>
</tr>
<tr>
<td>Hose connection: Miniature measuring connection with screw-in coupling M16x2</td>
</tr>
</tbody>
</table>

**Features**
- Facilitates optimal, laboratory-quality processing of bottle samples
- Sample degasification through internal vacuum system
- Variable adjustment of pressure for fluid supply

Optional compressor available
## CONDITION MONITORING AND ANALYSIS OF HYDRAULIC AND LUBRICATION FLUIDS

**In-line measuring systems**

<table>
<thead>
<tr>
<th>Particle counter</th>
<th>Water contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td>• CCM 01 set</td>
<td>• WSTM 01 set</td>
</tr>
<tr>
<td>• CCT 01 set</td>
<td>Water saturation, temperature</td>
</tr>
</tbody>
</table>

**On-line/off-line measuring systems**

<table>
<thead>
<tr>
<th>Particle counter</th>
<th>Water contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td>• CCS 4</td>
<td>• WPS 05</td>
</tr>
<tr>
<td>Particle counting, water saturation</td>
<td>Water saturation, temperature</td>
</tr>
</tbody>
</table>

**Sensors**

<table>
<thead>
<tr>
<th>Optional accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>• BSS 2 Bottle sampling system</td>
</tr>
</tbody>
</table>

**Laboratory analysis and measurement systems**

<table>
<thead>
<tr>
<th>Oil analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>• PAS 01 kit</td>
</tr>
</tbody>
</table>

**Water analysis**

<table>
<thead>
<tr>
<th>Optional accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Microscope</td>
</tr>
<tr>
<td>• Bottle sampling set</td>
</tr>
<tr>
<td>• Drop-ball viscometer</td>
</tr>
</tbody>
</table>

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