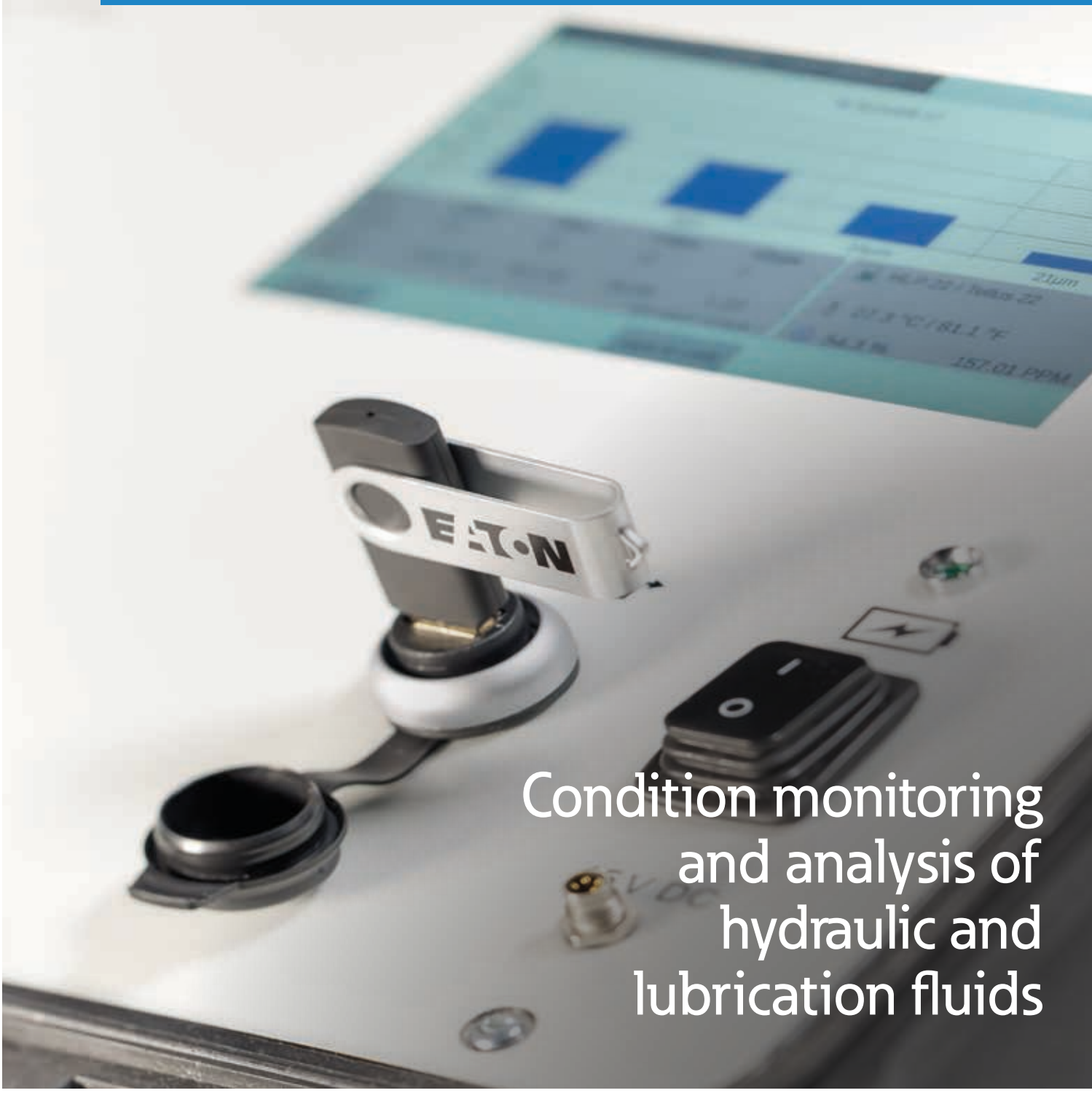
Filtration Products



Condition monitoring and analysis of hydraulic and lubrication fluids

Powering Business Worldwide

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
- 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

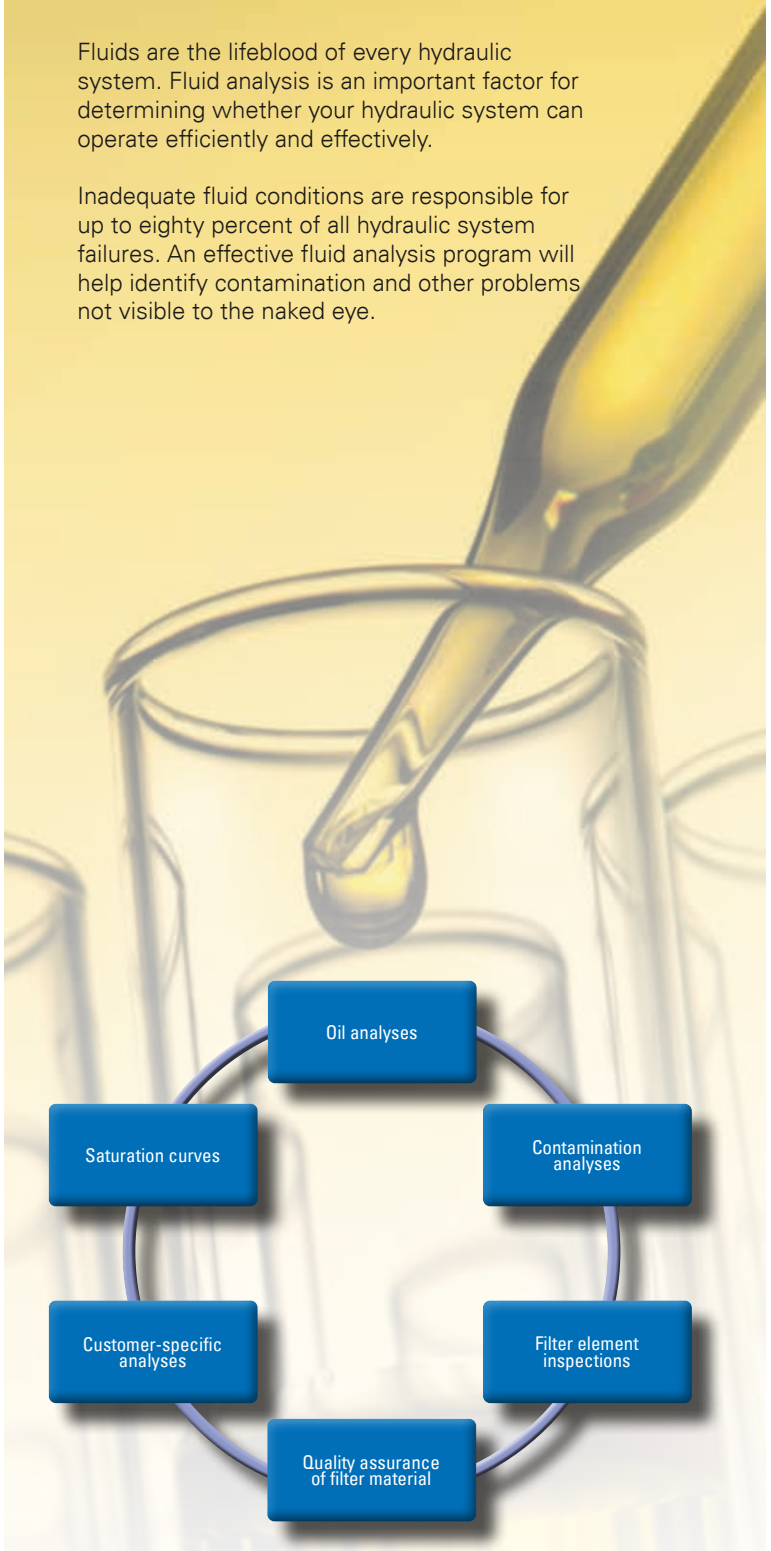
- Performance tests
- Device cleaning
- Secondary calibration
- Replacement of used and worn mechanical components
- Replacement of printing paper and ink ribbons
- Software updates
- 24-hour trials
- Calibration certification

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 Contamination

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

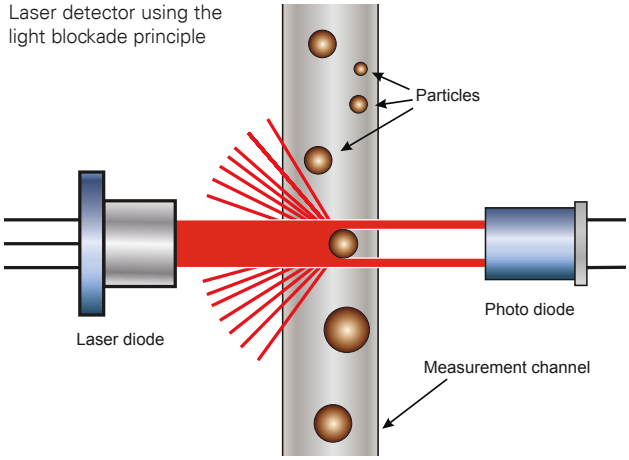
- Rapid results, no need to wait for lab analysis
- Timely and appropriate corrective actions
- Improve quality control

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.

Particles can be costly in a hydraulic system

Laser detector using the light blockade principle

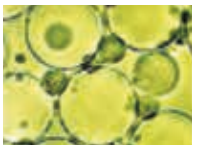


Water Contamination

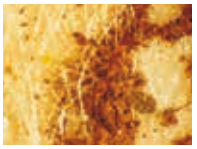
The presence of water in hydraulic fluids is the second most common cause of failure and downtime in hydraulic and lubrication systems.

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



Oil contaminated with water under the microscope

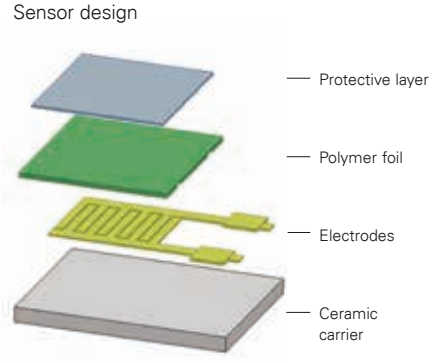


Filtered rust particle

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.)

Sensor design



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.

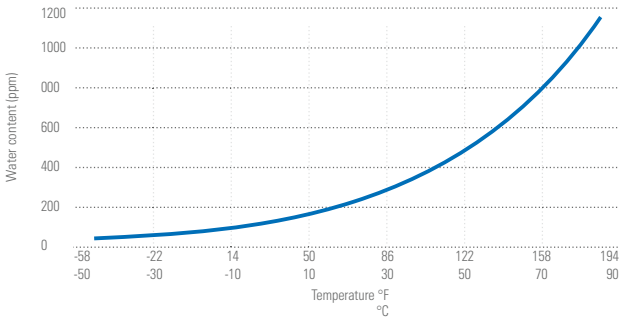
The measurement results of the WSPS 05 sensor are different from those of water content analysis using the Karl Fischer method, which specify the total amount of free and dissolved water in the fluid.

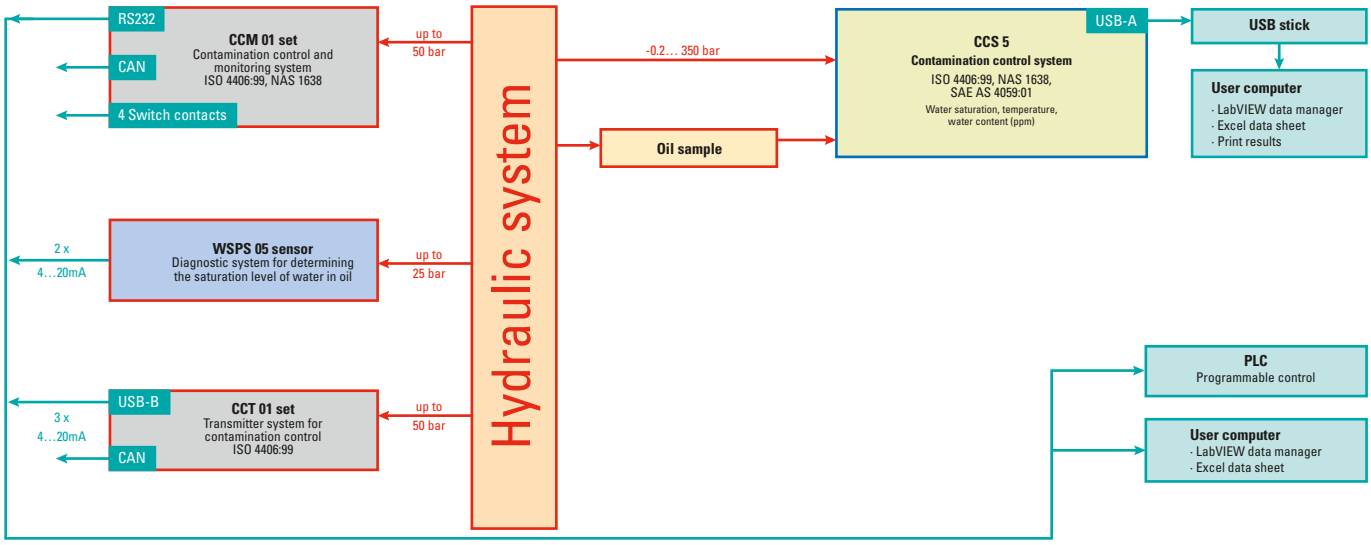
A theoretical relation to water content in ppm (mg/kg) according to the Karl Fischer method, can be established using the specific saturation curve and the temperature of the tested fluid.

Water saturation determination with WSTM 01 set

Oil sample with 100 ppm

Oil sample with 600 ppm





In-line systems **Off-line systems** **On-line systems**

Element spectral analysis – potential sources of metals in oil

Aluminum	abrasives, aluminum mill, bauxite, bearing metal, catalyst, coal contaminant, fly ash, foundry dust, granite, paint
Antimony	journal bearings, solder
Arsenic	antioxidants, bactericide, mineral oil
Barium	engine additives, grease
Beryllium	aircraft construction, bearings, mineral oil
Bismut	journal bearings
Boron	EP additives, coolant inhibitor
Cadmium	journal bearings, platings
Calcium	cement dust, detergent, fuller's earth, grease, gypsum, hard water, lignite, limestone, mining dust, oil additive, road dust, rubber, salt water, slag
Carbon	abrasives, carbides, carbon steel, graphite, hard metal, mineral oil, soot, synthetic material
Chromium	chrome plating, hardcoat, paint, ring plating, stainless steel, tooling steels
Cobalt	additives, hard metal, tooling steels
Hafnium	nuclear technology
Iron	asbestos, cast iron, catalyst, cleaning detergent, fly ash, mill scale, ore dust, paint, rust, talc, zeolite
Lead	babbitt, bearing overlay, gasoline additive, solder, paint
Lithium	dust, grease, salt water
Magnesium	aluminum alloy, engine additives, fuller's earth, hard water, road dust, salt water, turbines
Mercury	bactericide, batteries
Molybdenum	metal alloys, EP additives, MoS_2, rings
Nickel	hard steel, plating, stainless steel, stellite
Niobium	turbine blades
Phosphorus	in AW/EP additives, cleaning detergent, oil additives, surface finish
Platinum	catalyst, mineral oil
Potassium	additives, coolant inhibitor, fertilizer, fly ash, granite, paper mill dust
Scandium	ICP reference
Silicon	anti-foam additives, asbestos, cement dust, coolant additives, fly ash, foundry dust, glass, granite, limestone, mica, road dust, slag, steel, synthetic lubricant, talc, wet clutch
Silver	bearing overlay, needle bearings, solder
Sodium	additives, base stocks, coolant inhibitor, dirt, fly ash, grease, paper mill dust, road dust, salt, salt water
Sulfur	gypsum, mineral oil, MoS_2, rubber
Tantalum	hard metals, tooling steels
Tellurium	mineral oil
Titanium	hard metal, paints, turbine bearings, turbine blades
Tungsten	hard metals, tooling steels
Uranium	ore dust, road dust (some types)
Vanadium	mineral oil, turbine blades, valves
Yttrium	ICP reference
Zinc	AW additives, brass, galvanizing, grease, hard steel, oil additives, plating, solder
Zirconium	abrasives, nuclear technology

	Low pressure Under 2,030 psi (140 bar) moderate conditions		**Medium pressure** 2,030 to 3,045 psi (140 to 210 bar) or low pressure plus severe conditions[1]		**High pressure** Over 3,045 psi (210 bar) or medium pressure plus severe conditions[1]	
Most sensitive system components	**ISO target level**	**Filter micron ratings[2]**	**ISO target level**	**Filter micron ratings[2]**	**ISO target level**	**Filter micron ratings[2]**
PUMPS						
Fixed external gear	22/18/14	25VG	20/16/13	10VG	20/16/13	10VG
Vane	22/18/14	25VG	20/16/13	10VG	20/16/13	6VG
Fixed piston	20/16/13	10VG	20/16/13	6VG	19/15/11	3VG
Variable piston	20/16/13	6VG	19/15/11	3VG	18/14/10	3VG
VALVES						
Check valve	22/18/14	25VG	20/16/13	10VG	20/16/13	10VG
Directional valve solenoid	22/18/14	25VG	20/16/13	10VG	20/16/13	10VG
Flow control valve	22/18/14	25VG	20/16/13	10VG	20/16/13	10VG
Screw-in valve	20/16/13	10VG	20/16/13	6VG	19/15/11	3VG
Proportional valve	19/15/11	3VG	18/14/10	3VG	17/13/9	3VG
Servo valve	18/14/10	3VG	17/13/9	3VG	16/12/8	3VG
ACTUATORS						
Cylinders, vane and gear motors	23/19/15	25VG	22/18/14	16VG	20/16/13	6VG
Piston motors	20/16/13	10VG	20/16/13	6VG	19/15/110	6VG
Hydrostatic drives	19/15/11	6VG	18/14/10	3VG	17/13/9	3VG
TEST BENCHES	15/11/7	1VG	15/11/7	1VG	15/11/7	1VG
LUBRICATION OILS						
Paper machine oils	20/16/13	10VG	n/a	n/a	n/a	n/a
Steam turbine oils	19/15/11	6VG	n/a	n/a	n/a	n/a
Diesel engines	20/16/13	10VG	n/a	n/a	n/a	n/a
Mobile gearboxes	20/16/13	10VG	n/a	n/a	n/a	n/a
Industrial gearboxes	19/15/11	6VG	n/a	n/a	n/a	n/a
Radial bearings	19/15/11	6VG	n/a	n/a	n/a	n/a
Roller bearings	18/14/10	3VG	n/a	n/a	n/a	n/a
Ball bearings	17/13/9	3VG	n/a	n/a	n/a	n/a

n/a = not applicable

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)
- 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 $\mu m_{(c)}$, ≥ 6 $\mu m_{(c)}$, ≥ 14 $\mu m_{(c)}$, ≥ 21 $\mu m_{(c)}$ or ≥ 6.4 $\mu m_{(c)}$, ≥ 14 $\mu m_{(c)}$, ≥ 21 $\mu m_{(c)}$, ≥ 38 µm(c)
Contamination classes:	ISO 4406:99, NAS 1638
Laser sensor calibration:	ISO MTD in oil (ISO 11171:2000)
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 $\mu m_{(c)}$, ≥ 6 $\mu m_{(c)}$, ≥ 14 $\mu m_{(c)}$
Contamination classes:	ISO 4406:99
Laser sensor calibration:	ISO MTD in oil (ISO 11171:2000)
Accuracy:	±1 (contamination class)
Output data:	3 x 4 to 20 mA

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:	12 to 30 VDC/0.1 A/max. 3 VA
Protection class:	IP 67
Max. operating pressure:	≤ 363 psi (25 bar)
Viscosity:	45 to 1,854 SUS (10 to 400 mm²/s)
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%
Output data:	2 x 4 to 20 mA

CCS 5 Contamination control system

The mobile CCS 5 contamination control system determines the solid contamination particle size distribution, water saturation and fluid temperature.

The CCS 5 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, 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 measurements
- Rechargeable lithium polymer battery
- Internal memory for storing results (capacity up to 100,000 measurement points)
- Transfer of saved measured values via USB stick
- LabVIEW data manager software (export to Microsoft Excel) for data management on an external computer

The CCS 5 contamination control system is equipped with an USB interface, and a number of accessories.

LabVIEW
data manager software

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.

Technical data

Operating parameters	
Power supply:	15 VDC/6 A/90 VA
Power supply (external unit):	100 to 240 VAC/50/60 Hz/15 VDC/6 A
Protection class:	IP 67 (when cover is closed)
Operating suction range:	-2.9 to 2.9 psi (-0.2 to 0.2 bar)
Operating pressure range:	22 to 5,000 psi (1.5 to 350 bar)
Viscosity:	45 to 1,854 SUS (10 to 400 mm^2/s)
Fluid temperature:	32 to 158°F (0 to 70°C)
Ambient temperature:	32 to 122°F (0 to 50°C)
Measurement parameters	
Automatic particle counting in 4 channels:	≥ 4.0 $\mu m_{(c)}$, ≥ 6.0 $\mu m_{(c)}$, ≥ 14 $\mu m_{(c)}$, ≥ 21 $\mu m_{(c)}$
Contamination classes:	ISO 4406:99, NAS 1638, SAE AS 4059
Laser sensor calibration:	ISO MTD in oil (ISO 11171:1999)
Accuracy:	±1 (contamination class)
Water saturation:	0 to 100%
Temperature:	32 to 158°F (0 to 70°C)

Oil analysis

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.

Water analysis

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

Technical data
Membrane filter
0.45 µm
5 µm
Other consumables
Transparent fluid
Petri slides
For WAS 01 water analysis kit
Cleaning spray
WIO solution

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.

CONDITION MONITORING AND ANALYSIS OF HYDRAULIC AND LUBRICATION FLUIDS

In-line measuring systems

Particle counter
- CCM 01 set
- CCT 01 set

On-line measuring systems

Particle counter
- CCS 5
  Particle counting, water saturation

Sensors

Water contamination
- WSPS 05
  Water saturation, temperature

Laboratory analysis and measurement systems

Oil analysis
- PAS 01 kit

Water analysis
- WAS 01 kit

Optional accessories
· Microscope
· Bottle sampling set
· Drop-ball viscometer

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