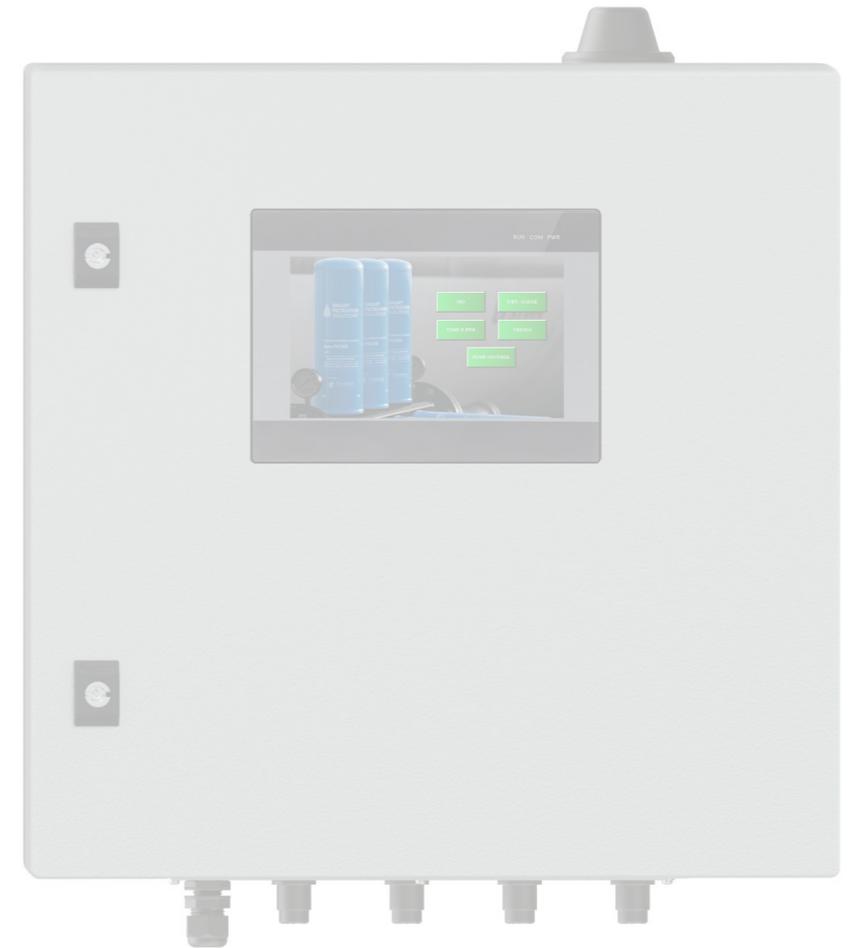




## What is Smart Fuel Intelligence?

The Smart Fuel Intelligence is an Integrated IIoT Assembly with SFS-1 Particle Monitor, SFS H<sub>2</sub>O – Relative Humidity Sensor Profiled to Diesel and Scaled in Ppm, Integrated Flow Control Valve Optimizing Flow to the Particle Monitor and Integrated Gauge Pressure Port & Sampling Port connected to the Smart-IIoT cloud-based condition monitoring platform. Smart Fuel Intelligence uses SFS-1 Particle Monitor along with a series of in-line sensors to continuously monitor differential pressure on filters, water content, and ISO 4406 cleanliness levels.



# CLOUD BASED CONDITION MONITORING

## SFS-1 PARTICLE MONITOR



### Reporting Fluid Cleanliness: ISO4406:99

The SFS-1 Particle Monitor is a compact particle measurement device for continuous monitoring of contamination and wear in diesel, hydraulic fluids and lubricants.

#### Recognizing Changes:

SFS-1 Particle Monitor precisely display any change in contamination of a system. Thus you can react quickly with an increase in particle concentration and countermeasures can be taken. Subsequent damages are minimized and costs are reduced.

#### High Pressure Range

The SFS-1 Particle Monitor is designed for operating with high pressure. Thus it can directly be mounted to a pressure line.

#### Intuitive Operating

The SFS-1 Particle Monitor is equipped with an intensely illuminated graphic display and a keypad by which you may set up all required adjustments. The menu navigation is made up intuitively and logically.

#### Wide communication possibilities

The SFS-1 Particle Monitor exports data to a serial interface or optionally to a CAN-Bus (CANopen + SAE J1939). In parallel, the configurable 4 - 20 mA interface can be connected (With Smart IloT Sync). Over a digital alarm output you will be warned when limits are exceeded or fallen below. Readings can run time-controlled, manually or started and stopped over a digital input. The data can also be stored on the integrated memory unit.

#### Design Characteristics

The fluid side, the SFS-1 Particle Monitor is equipped with two Minimes connections to connect the sensor generally in the off-line circuit to the system. The electrical connection is installed via an 8-pole M12 x 1 circular plug. The integrated data memory allows data recording over a longer period. Besides all its technical functions, the SFS-1 Particle Monitor scores by its compact and optical design.



#### Measurement Principles:

The SFS-1 Particle Monitor is an optical particle monitor which works to a so-called light extinction principle. This means that particles are classified within a measuring cell with the help of a laser regarding their size and quantity. The device is calibrated to ISO 11943. It calculates and displays results according to ISO 4406:99, SAE AS 4059, NAS 1638 und GOST 17216.

#### Calibration:

The instrument is calibrated following procedures described in ISO 11943. The equipment used in the calibration is primary calibrated in accordance with ISO 11171 and therefore traceable to NIST SRM 2806A.

#### Technical data

Sensor data	Size	Unit
<i>Max. operating pressure</i>		
dynamic	420 (6090)	bar (psi)
static	600 (8700)	bar (psi)
Permissible flow rate	50 ... 400	ml/min
<i>Operating conditions</i>		
Temperature	-20 ... +85 (+4 ... +185)	°C °F
Rel. humidity	0 ... 100	% r.H. (non-condensing)
Display readable up to	+60 (+140)	°C °F
Compatible fluids	mineral oils (H, HL, HLP, HLPD, HVLP), synthetic esters (HETG, HEPG, HEES, HEPR), polyalkylenglycols (PAG), zinc and ash-free oils (ZAF), polyalphaolefins (PAO) phosphate ester*1	
Wetted materials	Stainless steel, sapphire, chrome, FFKM*1, NBR*2, Minimesse coupling*2, zinc/nickel	
Protection class <sup>1</sup>	IP67	-
Power supply	9 ... 33	V
Power input	max. 0.3	A
Max. power consumption	2	W
Sensor data	Size	Unit
<i>Output</i>		
Power output <sup>2</sup>	4 ... 20	mA
Accuracy power output <sup>2</sup>	± 2	%
Interfaces	RS 232/CANopen/ SAE J1939	-
Alarm contact	Open Collector	-
<i>Digital input for start and stop</i>		
Power supply	9 ... 33	V
Data memory	3000	data records
<i>Connecting dimensions</i>		
Fluid connections	G¼ Minimesse*2 M16x2	inch -
Electrical connection	M12 x 1, 8-pole	-
Tightening torque M12-connection	0.1	Nm
<i>Display particle measurement</i>		
ISO 4406:99	0 ... 28 (calibrated area 10 ... 22)	ordinal number (OZ)
SAE AS 4059E	000 ... 12	ordinal number (OZ)
NAS 1638 (based) <sup>3</sup>	00 ... 12	ordinal number (OZ)
GOST 17216 (based) <sup>3</sup>	00 ... 17	ordinal number (OZ)
Size channels	4, 6, 14, 21	µm (c)
<i>Measuring accuracy</i>		
Particle measurement (in calibrated area)	±1	ordinal number (OZ)
Weight	~720	g

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# CLOUD BASED CONDITION MONITORING

## SFS H<sub>2</sub>O+ RELATIVE HUMIDITY SENSOR



### Application:

Stationary screw-in sensor for continuous determination of the oil condition, humidity and temperature in hydraulic and lubricating oils.

### Features:

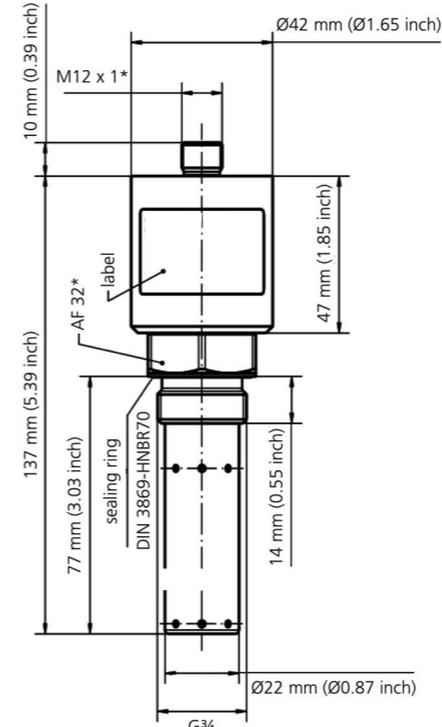
Measurement of changes in hydraulic fluids and lubricants. Data is continuously documented evaluated and stored. In that way deterioration and changes in the oil (e.g. water leakage, oil change, ...) can be indicated. Through this, damage can be recognized or completely avoided at an early stage. This offers the opportunity to prevent machine failures as well as to prolong maintenance and oil change intervals by means of appropriate measures. Furthermore, by monitoring the lubricant, correctly performed maintenance work and the use of the required lubricant quality may be documented.

### Measurement Principles:

The sensor records the following physical oil characteristics as well as its periodic change: Temperature, relative oil humidity and water activity resp., relative dielectric number (relative permittivity) and conductivity of the fluid. As especially the conductivity and the relative dielectric number show a strong connection to the temperature, next to the characteristic values at current temperature the sensor also sends the data at reference temperature (40 °C / 104 °F). The sensor is able to evaluate condition changes automatically.

### Design Characteristics:

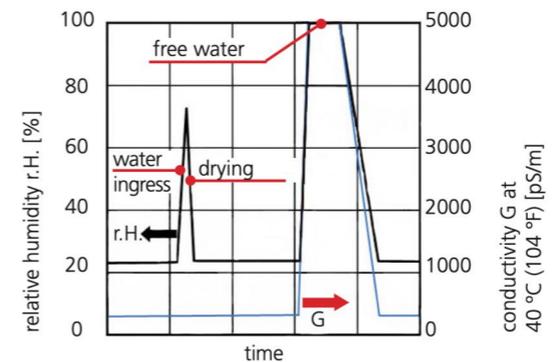
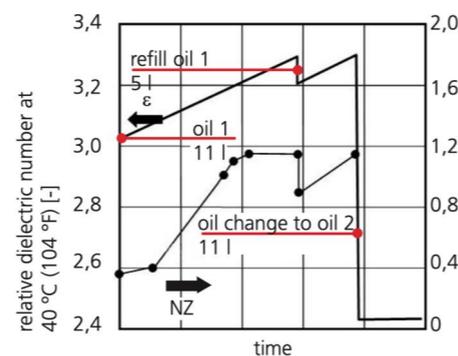
The sensor is provided with a G<sup>3/4</sup> thread and can be integrated in the tank. The communication with the sensor either takes place over a serial RS 232 interface, two analogue outputs (4 ... 20 mA) or CANopen. In order to also enable a long-term record of data up to half a year, the sensor is provided with an internal data storage unit.



\* mm Dimensions

### Application Example:

By using the sensor different changes of the oil condition can be detected. The following example shows a typical course of relative dielectric number, conductivity and relative humidity during various changes of the condition in the system. By means of the characteristics, different oil types may be differed, oil refreshing and oil change can be detected and the relative humidity, free water as well as the deterioration and deterioration rate can be defined respectively.



### Technical data

Sensor data	Size	Unit
Max. operating pressure	50 (725)	bar (psi)
<i>Operating conditions</i>		
Temperature <sup>1</sup>	-20 ... +85 (-4 ... +185)	°C (°F)
Rel. humidity <sup>1</sup>	0 ... 100	% r.H. (non-condensing)

Compatible fluids	mineral oils (H, HL, HLP, HLPD, HVLP), synthetic esters (HETG, HEPG, HEES, HEPR), polyalkylenglycols (PAG), zinc and ash-free oils (ZAF), polyalphaolefins (PAO)
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Wetted materials	aluminum, HNBR, polyurethane resin, epoxy resin, chemical nickel/gold (ENIG), soldering tin (Sn96,5Ag3Cu0,5NiGe), aluminum oxide, glass (DuPont QQ550) gold, silver-palladium
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Protection class <sup>2</sup>	IP67
Power supply <sup>3</sup>	9 ... 33 V
Power input	max. 0.2 A

Sensor data	Size	Unit
<i>Output</i>		
Power output (2x) <sup>4</sup>	4 ... 20	mA
Accuracy power output <sup>5</sup>	± 2	%
Interfaces	RS 232/CANopen	-

<i>Connections</i>		
Threaded connection	G <sup>3/4</sup>	inch
Tightening torque of threaded connection	45 ± 4.5	Nm
Electrical connection	M12 x 1, 8-pole	-
Tightening torque M12-connection	0.1	Nm

<i>Measuring range</i>		
Rel. dielectric number	1 ... 7	-
Rel. humidity	0 ... 100	% r.H.
Conductivity	100 ... 800,000	pS/m
Temperature	-20 ... +85 (-4 ... +185)	°C (°F)

<i>Measuring resolution</i>		
Rel. dielectric number	1*10 <sup>-4</sup>	-
Rel. humidity	0.1	% r.H.
Conductivity	1	pS/m
Temperature	0.1	K

<i>Measuring accuracy<sup>6</sup></i>		
Rel. dielectric number <sup>7</sup>	rel. ± 0.015	-
Rel. humidity (10 ... 90%) <sup>8</sup>	± 3	% r.H.
Rel. humidity (<10%, >90%) <sup>8</sup>	± 5	% r.H.
Conductivity (100 ... 2000 pS/m)	± 200	pS/m
Conductivity (2000 ... 800,000 pS/m)	Typ. < ± 10	%
Temperature	± 2	K

Response time humidity measurement (0 to 100%)	< 10	min
Weight	140	g