

ON-LINE OIL DEBRIS MONITOR

MS4000

Real-time detection of damage - anytime, anywhere.

MetalSCAN MS4000 oil debris sensor monitors metal particles generated from rotating equipment due to bearing and gear damage. Assess how much time you have to schedule maintenance before equipment failure occurs.

Requirement

The energy, marine, and aerospace industries require condition monitoring that is capable of detecting bearing and gear damage at the earliest stage of progression, and provide insight into the extent of the damage and its impact on the remaining life of the equipment.

It is understood that condition monitoring cannot be used to avoid damage occurring to the equipment, however, the right technique is used to effectively limit the damage and avoid outright failure of the equipment, where failure is defined as damage sufficient so that the equipment can no longer operate. Managing the risk from the context of the equipment operator is based upon planning the maintenance actions, thus achieving:

- Reduction of lost revenue – the equipment can be scheduled to be out of service for the shortest possible time, where the replacement equipment parts, equipment, and maintenance crews are on site at the time of shutdown.
- Reduction of repair costs - reduced equipment damage such that the extent of the repair is much less than if the equipment was to operate to failure.

An additional benefit of effective risk management is the potential for improved coverage from the insurers, which is delivered in terms of reduced premiums, reduced deductibles and/or reduced depreciation.



FEATURES

- 100% Detection of Fe and NFe metal particles
- Easy to install
- Easy to interpret
- Rugged, solid-state with no moving parts
- Full function continuous built-in test (BIT)
- Proven reliability in harsh machinery environments
- Proven reliability in high temperature environments
- Proven reliability in hazardous environments

BENEFITS

- ✓ Earliest reliable detection of component damage
- ✓ Monitor damage progression and estimate remaining life
- ✓ Avoid unplanned outages
- ✓ Avoid equipment secondary damage

LONG LIVE EQUIPMENT



Head Office
1011 Polytek Street
Ottawa ON K1J 9J3
Canada

Halifax Office
65 John Savage Avenue, Unit 5
Dartmouth NS B3B 2C9
Canada

St. John's Office
146a Glencoe Drive
Mount Pearl NL A1N 4S9
Canada

Worldwide
+1 613 744 3530
North America
1 800 363 8658

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MS4000 SYSTEM

Description

MetalSCAN is an on-line debris monitoring system designed to detect the passage of metallic particles in fluid lines. The system, which can be used in any pipe flow situation, is particularly suited to equipment applications where it detects metallic debris in a lubrication oil system and provides early indication of component damage.

The MetalSCAN MS4000 system consists of the following major components:

- A non-intrusive through flow Sensor which is fitted to the fluid line to be monitored.
- A custom low noise Sensor Cable which connects the sensor to the electronics.
- A Control Unit which processes the raw signal from the sensor and extracts information about the size and type (ferromagnetic or non-ferromagnetic) of the metallic debris detected.
- A host monitoring system which displays the current counts data, trend data, computes equipment health indices and announces warning/alarm exceedances. This function can be performed by an existing monitoring system host or by a dedicated standalone PC.

MS4000 is available in two basic configurations defined by the Control Unit option:

- 1) Multi-Sensor System - which includes from 1 to 6 Sensors and Sensor Cables, each connected to a multi-sensor Control Unit.
- 2) Single Sensor System - which includes one Sensor, one Sensor Cable, and a single-sensor Control Unit.

SPECIFICATIONS

System	Single-sensor	Multi-sensor
Power Requirement	24 VDC	24 VDC
Rated Current:	0.3A	0.8A
Communication Interface	RS485 Modbus	RS485 Modbus
Cabling Distance	up to 4000ft / 1200m	up to 4000ft / 1200m



COMPLIANCE

LC Listed (USA & Canada)

- Canada: Class I, Div 2, Groups C & D
- USA: Class I, Zone 2, Groups C & D
- NEMA 250 (Type 4)
- FCC part 15
- Conforms to ASTM D7685



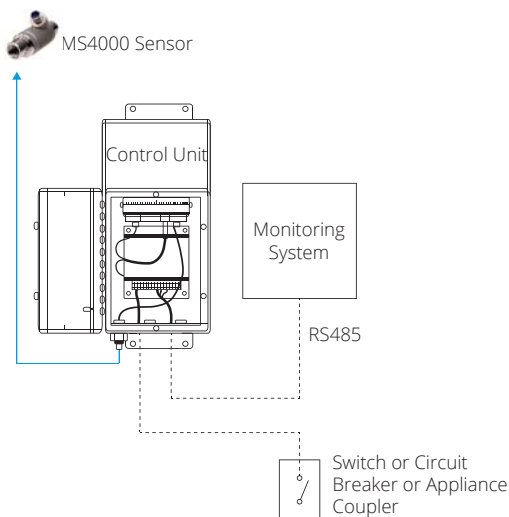
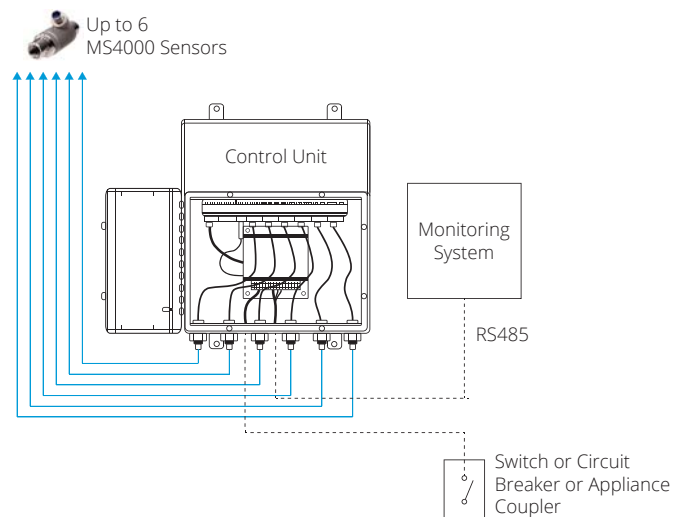
CE Marking

- IP 66

ATEX: II 3G
IECEx: Ex nA IIB T4 GC

Note 1

- NEMA 4 - Standard Enclosure
- NEMA 4x - Stainless Steel Enclosure

**SINGLE-SENSOR SYSTEM****MULTI-SENSOR SYSTEM****LONG LIVE EQUIPMENT**

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MS4000 SENSOR

Description

The MS4000 Sensors are welded stainless steel assemblies designed to be installed directly into the fluid line with fluid flowing in either direction. The sensors are designed to operate in severe industrial and/or hazardous environments with large temperature extremes and high vibration levels. They are available in three sizes: 3/8", 3/4" and 1-1/4" nominal line diameter. The sensing element consists of three internal coils. The two outside field coils are oppositely wound and are driven by an alternating current source so that their respective magnetic fields are opposed and cancel at the center point between the field coils. The centrally positioned sense coil measures the disturbances in the magnetic fields caused by metallic particles as they pass through the sensor. The magnitude of the disturbance measured as a voltage defines the size of the particle and the phase shift of the signal defines whether the metallic particle is ferromagnetic (Fe) or non-ferromagnetic (NFe).

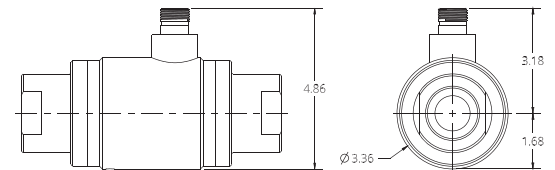
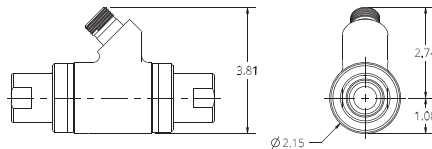
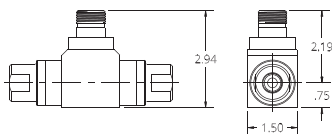
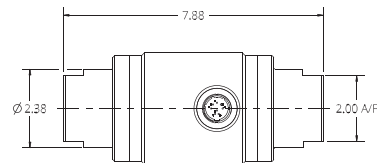
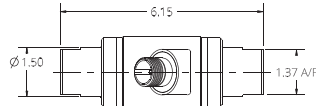
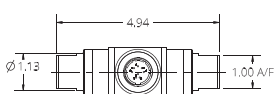
SPECIFICATIONS

Sensor Nominal Line Size	3/8 inch	3/4 inch	1-1/4 inch
Bore	0.30" / 7.6mm	0.70" / 17.8mm	1.06" / 26.9mm
Plumbing Connection (female)	-6 SAE O-ring Boss	-12 SAE O-ring Boss	-20 SAE O-ring Boss
Minimum Ambient Temperature	-40°F / -40°C	-40°F / -40°C	-40°F / -40°C
Maximum Ambient Temperature	375°F / 190°C	375°F / 190°C	375°F / 190°C
Weight	1.5lbs / 0.7kg	2.0lbs / 0.9kg	5.5lbs / 2.5kg
Electrical Connector	MIL-DTL-38999	MIL-DTL-38999	MIL-DTL-38999

Minimum Detectable Particle Size	3/8 inch	3/4 inch	1-1/4 inch
Fe (ESD*/sphere)	65µm / 100µm	130µm / 200µm	180µm / 275µm
NFe silver (ESD*/sphere)	200µm / 305µm	270µm / 415µm	345µm / 530µm

Fluid Conditions	3/8 inch	3/4 inch	1-1/4 inch
Maximum Temperature	375°F / 190°C	375°F / 190°C	375°F / 190°C
Maximum Pressure	500 psi / 3500 kPa	500 psi / 3500 kPa	100 psi / 700 kPa
Minimum Flow Rate	0.056 USGPM 0.21 L/min	0.50 USGPM 1.9 L/min	2.1 USGPM 8.0 L/min
Maximum Flow Rate	4.3 USGPM 16.2 L/min	48 USGPM 180 L/min	175 USGPM 665 L/min

* The Equivalent Spherical Diameter (ESD) of an irregular-shaped object is the diameter of a sphere of equivalent volume.

**3/8 INCH SENSOR****3/4 INCH SENSOR****1-1/4 INCH SENSOR****LONG LIVE EQUIPMENT**

Head Office
1011 Polytek Street
Ottawa ON K1J 9J3
Canada

Halifax Office
65 John Savage Avenue, Unit 5
Dartmouth NS B3B 2C9
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St. John's Office
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MS4000 CONTROL UNIT

Description

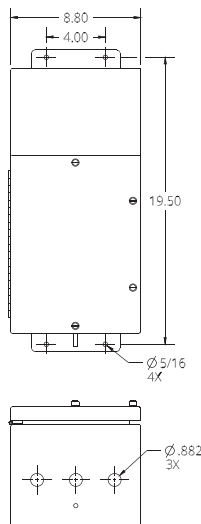
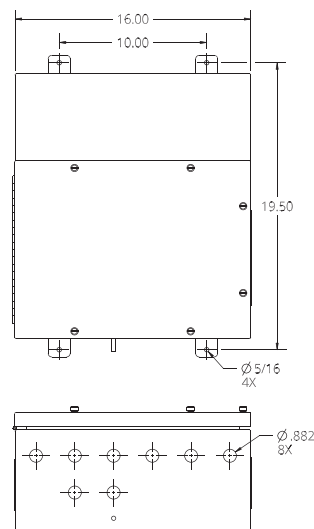
The MS4000 Control Unit houses the modular electronics for MS4000 system and is available as either a multi-sensor unit with capacity for up to 6 sensors or a single-sensor unit designed for only one sensor. In either case, the enclosure is a steel housing designed for back-side mounting on a bulkhead or plate with all interconnecting cables entering through the bottom of the unit. Note that the electronics of the control unit cannot be relocated outside of this enclosure (i.e. in another rack) due to EMI and signal grounding control requirements.

The multi-sensor Control Unit includes separate modules for power input, power supply, control, and sensor interface, each plugged into a backplane chassis. The chassis has a capacity for 6 separate sensor modules. The single sensor Control Unit is similar to the multi-sensor unit except it has the capacity to house only one sensor module.

Communication to the host is via industry standard Modbus RS485 serial communications which supports up to 30 separate Control Units (single or multi) can be linked together to a single host monitoring system communication port.

SPECIFICATIONS

Control Unit	Single-sensor	Multi-sensor
Environment	Splash proof - for outdoor and indoor installations (IP66)	Splash proof - for outdoor and indoor installations (IP66)
Finish	Painted mild steel (blue)	Painted mild steel (blue) or optional stainless steel
Enclosure Size - nominal	8.80w x 20.5h x 8.33d (in) 224w x 521h x 212d (mm)	16w x 20.5h x 8.33d (in) 406w x 521h x 212d (mm)
Minimum Ambient Temperature	-40°F / -40°C	-40°F / -40°C
Maximum Ambient Temperature	131°F / 55°C	131°F / 55°C
Maximum Weight	25.5lbs / 11.6kg	36.0lbs / 16.3kg (6 sensors)

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1011 Polytek Street
Ottawa ON K1J 9J3
Canada

Halifax Office
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Dartmouth NS B3B 2C9
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MS4000 SENSOR CABLE

Description

The MS4000 Sensor is electrically connected to the Control Unit using the Sensor Cables provided as part of the MetalSCAN system. The inductive coils of the sensor assembly are designed to achieve maximum sensitivity to particles present in the flow. The cabling and connectors play a significant part in achieving the level of sensitivity necessary for the system to operate properly. The cables are factory assembled and available in 12 and 20 foot lengths. The result is an extremely robust cable connection system that provides assurance of the required detection performance and sensitivity.

A double shield is provided on each of the four coaxial cables within the cable assembly. Each coaxial cable is terminated at the Control Unit end via a BNC connector while at the sensor end the cables are brought together into a single aerospace grade MIL-DTL-38999 Series III connector. The coaxial cables are further shielded by a tinned copper braid covering and then mechanically contained by a high temperature silicone impregnated fibreglass sleeve.

SPECIFICATIONS

Sensor Cable Length	12ft / 3.7m	20ft / 6.1m
Connector (sensor end)	MIL-DTL-38999 Series III	MIL-DTL-38999 Series III
Connectors (Control Unit End)	4x BNC	4x BNC
Minimum Ambient Temperature	-40°F / -40°C	-40°F / -40°C
Maximum Ambient Temperature	375°F / 190°C	375°F / 190°C
Weight	3lbs / 1.4kg	4lbs / 1.8kg



MS4000 SENSOR BRACKETS

Description

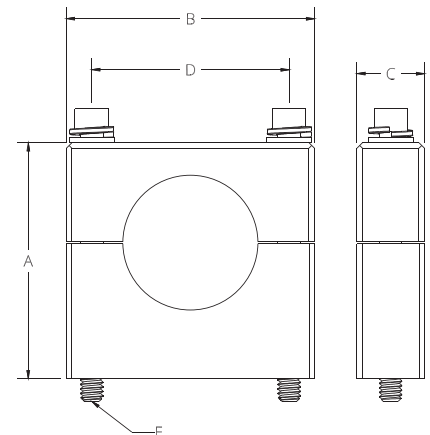
The sensors can be installed in any orientation with fluid flowing in either direction. The recommended location for the sensors is directly downstream of the wear elements in the lubrication system. There must be no debris traps or filters between the sensor and the oil wetted components being monitored.

The sensors can be supported by brackets attached to the ends of the body as shown below, or by the fluid line, provided that the fluid line is well supported. The sensor body is not designed to support mechanical loads.

Sensor bracket material: Anodized aluminum (clamps) and stainless steel (bolts and washers).

SPECIFICATIONS

Sensor Bracket Dimensions	A		B		C		D		E
	in	mm	in	mm	in	mm	in	mm	Bolt (Hex Socket)
3/8 Inch Sensor	1.88	48	2.25	57	0.63	16	1.75	44	1/4-20UNC x 3 in
3/4 Inch Sensor	2.60	66	2.75	70	0.75	19	2.19	56	1/4-20UNC x 3 in
1-1/4 Inch Sensor	3.75	95	4.00	102	1.00	25	3.00	76	3/8-16UNC x 4.5 in



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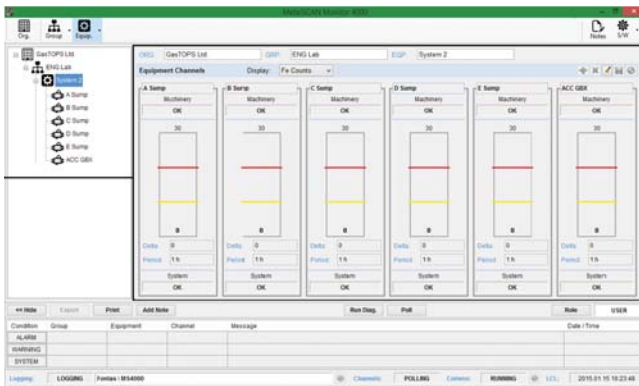
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MS4000 MONITOR SOFTWARE

Description

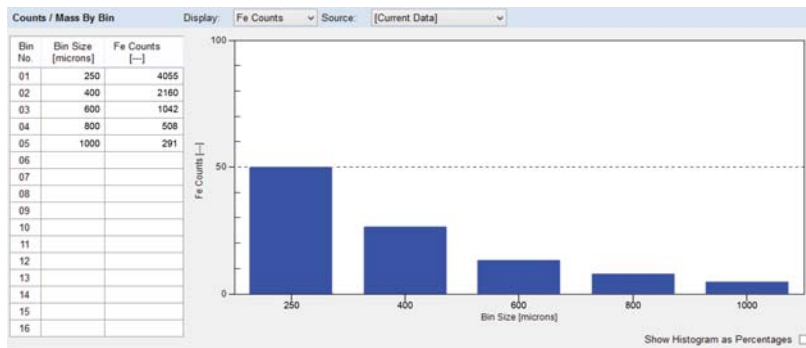
The MS4000 Monitor is a PC software application that runs under Microsoft Windows designed to interface with one or more MS4000 systems and provide the user interface for tracking the health of the machine(s) being monitored. The software provides the capability to continuously record and display MetalSCAN data, to annunciate warnings and alarms when debris accumulation exceeds user-defined limits, and to interface to external data acquisition or monitoring systems.

The MS4000 Monitor includes several display pages, which can be selected using the dedicated pushbutton controls located on the application toolbar. The three primary pages are the Status, Counts, and Trends pages.

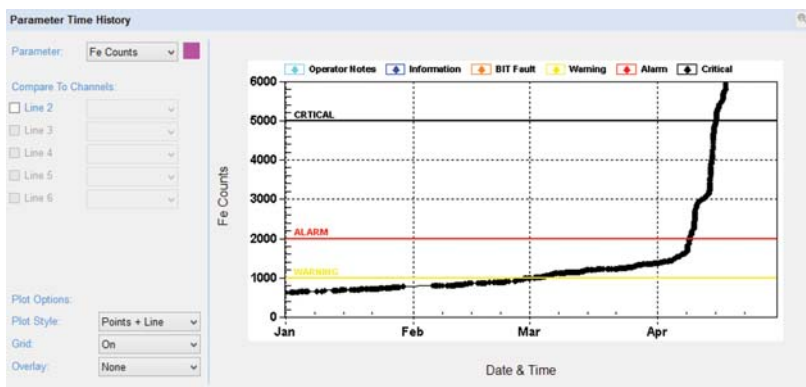


The Equipment Status page displays a summary of the debris accumulation measurements and operational health of the channel for the selected Equipment. The purpose of the Equipment Status Page is to enable the operator to quickly assess the condition of the monitored equipment. The display features bar charts that compare the accumulated debris (Fe counts, Fe mass or NFe counts) against set limits.

The Equipment Status page also provides the capability to visibly annunciate alarm, warning and system conditions. Whenever MS4000 Monitor detects a new alarm or warning condition, it automatically changes the display page to annunciate the system or equipment health condition by displaying a colored contour around the affected channel.



The Counts page provides high resolution current information of the accumulated debris including ferromagnetic (Fe) and non-ferromagnetic (NFe) count totals, categorized by size and by type, either Fe or NFe. It also provides a graphical display of size distribution by counts or mass, for any selected sensor.



The Trends page displays the time history of debris accumulation data along with the user-defined warning or alarm limits for the selected parameter, allowing the user to assess the current severity of the equipment condition, to review the time history, and to estimate the remaining operating life of the equipment.

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MS4000 SYSTEM

Ordering Information

One Sensor MS4000 System (Single)

Order: System - 01S

Including: 24 VDC single sensor control unit, 1 x 3/4" sensor, 1 x 20 ft. sensor cable, USB/RS485 converter, MS4000 Monitor Software, user's manual, 12 month warranty.

One Sensor MS4000 System (Multi)

Order: System - 01M

Including: 24 VDC multi-sensor control unit, 1 x 3/4" sensor, 1 x 20 ft. sensor cable, USB/RS485 converter, MS4000 Monitor Software, user's manual, 12 month warranty.

Two Sensor MS4000 System

Order: System - 02M

Including: 24 VDC multi-sensor control unit, 2 x 3/4" sensors, 2 x 20 ft. sensor cables, USB/RS485 converter, MS4000 Monitor Software, user's manual, 12 month warranty.

Three Sensor MS4000 System

Order: System - 03M

Including: 24 VDC multi-sensor control unit, 3 x 3/4" sensors, 3 x 20 ft. sensor cables, USB/RS485 converter, MS4000 Monitor Software, user's manual, 12 month warranty.

Four Sensor MS4000 System

Order: System - 04M

Including: 24 VDC multi-sensor control unit, 4 x 3/4" sensors, 4 x 20 ft. sensor cables, USB/RS485 converter, MS4000 Monitor Software, user's manual, 12 month warranty.

Five Sensor MS4000 System

Order: System - 05M

Including: 24 VDC multi-sensor control unit, 5 x 3/4" sensors, 5 x 20 ft. sensor cables, USB/RS485 converter, MS4000 Monitor Software, user's manual, 12 month warranty.

Six Sensor MS4000 System

Order: System - 06M

Including: 24 VDC multi-sensor control unit, 6 x 3/4" sensors, 6 x 20 ft. sensor cables, USB/RS485 converter, MS4000 Monitor Software, user's manual, 12 month warranty.



OPTIONS

MS4000 Sensor - 3/8"**Order: Option - 13**

Substitute 3/8" Sensor (per sensor), 12 month warranty.

MS4000 Cable - 12ft**Order: Option - 06**

Substitute 12 ft. Sensor Cable (per cable), 12 month warranty.

MS4000 Sensor - 1-1/4"**Order: Option - 05**

Substitute 1-1/4" Sensor (per sensor), 12 month warranty.

MS4000 Stainless Steel Enclosure**Order: Option - 07**

Substitute NEMA 4x Stainless Steel Control Unit Enclosure, 12 month warranty.

MS4000 ATEX Barrier Kit**Order: Option - 17x**

MetalSCAN Barrier Kit for RS485 communication intrinsic safety isolation required for ATEX certification, including: barrier unit, serial hull modem cable, ATEX system label, 12 month warranty.

Computer with MetalSCAN Software**Order: Option - 01x**

Computer with pre-configured MetalSCAN software.

**MS4000 Analog and Relay Interface Module
Requires Option - 01x****Order: Option - 19x (4 Analog Outputs)****Order: Option - 20x (Additional 4 Analog Outputs)**

Note: Option - 20x only available when ordered with Option - 19x, maximum of 2x expansion modules.

MS4000 Analog and Relay Interface Module contains relays that activate on warnings or alarms caused by Fe and NFe mass, particle counts, system faults or module communication errors detected by MetalSCAN.

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