



Demon-6

Magnetic Wear Debris Sensor

Product Description

The **Debris Monitor** version 6 or **DEMON-6** is an on-line ferrous metal wear debris sensor from Caledonia Instrumentation Systems Ltd. The instrument works in a real-time mode and is connected directly into the oil lubrication system pipe work or oil reservoir container.

The sensor is a digital instrument and communicates via an RS232 or RS485 serial digital communications interface. The output from the sensor is a value that relates to the amount of ferrous metal in milligrams (mg) captured on the sensor head. The sensor attracts particulate from sub micron size upwards onto the sensor head until it becomes either saturated, or a defined mg level is reached as set by the end user. The instrument will then initiate a 'flush' cycle. During this flush cycle the captured debris is removed from the sensor head and will release and flow in the oil typically into a filter downstream of the where the unit is installed.



Figure 1 The DEMON-6 Sensor

The instrument then returns to zero or a 'clean' state. The sensor will then repeat the process of capturing debris. By analysing the instrument data and using oil and machine condition monitoring software algorithms, the sensor can be used to predict bearing and gearbox fatigue stages, possibly before catastrophic failure.

Product Application

The DEMON-6 shown in figure 1 can be used in a wide variety of applications where wear from machinery includes components that are a ferrous metal. Applications include wind turbines, industrial gearboxes, pulp and paper mills with bearing systems, mining applications and many others. Caledonia Instrumentation Systems Ltd can, if required, facilitate the task of adapting their technology to equipment lubrication systems and assist in the development required in integrating into clients control systems. This will then make the data directly available in real time when transferred to the end users SCADA or DCS system.



Data Analysis and Trending

The sensor captures and measures the amount of ferrous particulate on the sensor head as a weight of debris generated by the machine and present within the lubricant. The instrument calibrates the debris as an accumulative mass in milligrams (mg). This accumulative value is collected over a period of time. This could be stated as typically 'n' mg per day, per week, per month etc.

The sensor after qualifying the debris present will output the debris data value to the acquisition system and a longer term trend can be obtained.

The trend line in figure 2 shows a reasonably linear progression for several months and an expected gradual increase due to 'normal' machine wear patterns or characteristics. The example trend also shows an increase in the rate of debris generation from point 'A'. The bearing wear progression then becomes less severe for a period until point 'B' when a second and more rapid wear stage for the bearing occurs and the progression then continues until failure.

This is entirely typical for rotating machinery where bearing or gear components will show initial signs of wear through metallic particulate in the oil and the sensor. If these are measured real time by the acquisition System instrument, the data can be manipulated to show the failure propagation as a rate of change progression. If the SCADA or DCS system has threshold or alarm set points, this would warn the operator of the pending failure. These alarm points would be set with knowledge of the system under test and to ensure that the system runs within tolerance limits. They are end user definable and adjustable from application to application and as they are adjusted within the SCADA or DCS system, they can be modified at any time by the operator.

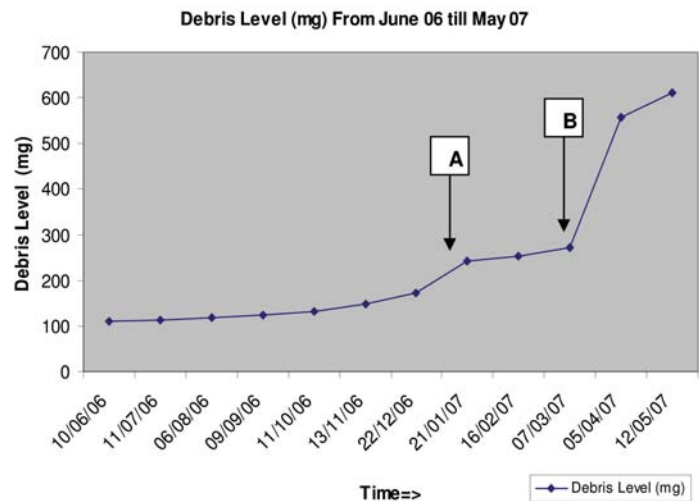


Figure 2 The Data Trend from the DEMON 6 as 'mg per month'



Figure 3 shows the rate of change for the same example trending month to month and examples of user threshold points set for a system under test.

This rate of change trend line shown highlights more clearly the critical points and with alarm 'high' and 'high-high' points set at points 'C' and 'D' the monitoring system can identify the potential failure at point 'C' and prevent the catastrophic failure that occurred after the rate of change went higher than second alarm point 'D'.

Either of these points when reached would have a definite system repair cost to the end user and this would be due to the expense of the machine parts and labour cost, down time and loss of productivity for the plant item.

In preventing possible catastrophic failure, however, the repair or replacement of a bearing or gear can be completed under scheduled maintenance procedures.

Sensor & System Communications

The Demon-6 instrument as standard, communicates using a protocol called MODBUS Serial and this industrial communication standard allows the sensor to directly communicate with most industrial control and monitoring systems. Caledonia Instrumentation Systems Ltd is able to oversee the integration of the sensor into the user's software system making the installation as straight forward as possible.

Caledonia Instrumentation Systems Ltd will also provide a stand alone software application that allows the user to set up alarms and monitor the machine under test from a stand alone system laptop or desktop PC. Wireless RS485 serial communications and Ethernet 802.11g are available and easily configurable for remote monitoring applications.

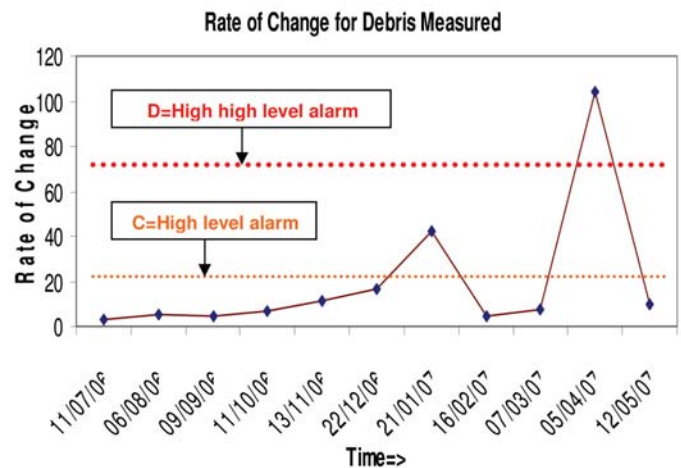


Figure 3 The Data Trend from the DEMON 6 as 'rate of change'



Product Specifications

Discrimination	Ferrous Metal
Particle Size	Any size
Sensitivity	Adjustable
Capture Efficiency	Adjustable
Working Pressure	20 Bar max.
Fluid Temperature	0° C to + 90° C
Working Fluid	Mineral & Synthetic Oil
Working Viscosity	1 to 650 cSt
Flow Rate	TBC
Seals	Non-magnetic bonded
Power Supply	12-30 V DC
Current Consumption	TBC
Main Body Material	Aluminium
Union Material	Brass
Manifold Material	Brass
Pipe Coupling	3/8" BSPP
Data Processing	8bit PIC Microcontroller
Data Interface	RS232 & RS485/422
Serial Protocol	MODBUS Serial Protocol
Serial Data	9600bps, 8 data bits, 1 stop bits no parity