

The PATROL In-Line Debris Detector

In the continuing pursuit of increasing overall profitability machine and plant maintenance costs are coming under ever closer scrutiny. A by now well-established approach to maintenance savings is by careful introduction of machine Condition Monitoring. The CM equipment indicates operating conditions, so that intervention is made only when readings indicate some form of deterioration. Continuous improvements in reliability are to be had in the longer term. Many methods of monitoring are available, vibration, acoustic, thermal, lubricant and wear debris monitoring among the most prominent. However many techniques have proved themselves difficult to run effectively. What is needed to take maintenance savings further forward is to automatically assess condition and respond accordingly, by including condition monitoring sensors on or preferably in-line.

Manor Technology brings to in-line condition monitoring its PATROL sensor. Its (patented) inductive bridge sensor combined with elegantly simple electronics, combine to give performance benefits in arduous continuous use. PATROL today offers a mature capability to see wear debris production in real time. It is a flow through device with essentially zero flow obstruction or pressure drop. There are no sampling errors or gross capture efficiency uncertainties. Integral shielding and electronics promote excellent sensitivity and dual Fe / Non-Fe outputs inform of material type.



PATROL monitors wear debris in the system continuously, in contrast to sampling or collecting systems. This ensures that bursts of particles will not be missed, and so can provide uniquely beneficial insights into wear debris generation under transient load or marginal lubrication conditions.

Key features and benefits

- ☑ Compact unit complete with integral high temperature electronics
- ☑ No flow obstruction; minimal pressure drop
- ☑ Modest all up weight
- ☑ Lowest baseline noise levels
- ☑ Excellent electromagnetic compatibility
- ☑ Supreme sensitivity
- ☑ Negligible flow rate variation across wide range
- ☑ Insensitivity to debris position across bore
- ☑ Full material discrimination from 'Ferrous' and 'Non-Ferrous' outputs
- ☑ Self test exercises all key functions
- ☑ Very low power consumption (0.5 W)
- ☑ Patented technology combined with extensive know-how
- ☑ Advanced data analysis methods well established

PATROL provides the most sensitive known inductive detection of ferrous wear particles in a flow; a single 25 micron (10^{-6} m) diameter steel bearing particle is readily detected in the 5 mm sensor version (50-60 micron in 12 mm bore).

In a real flow system large particles are always accompanied by many smaller particles below the threshold of detection for a single particle. In PATROL these provide a combined output which MTML has dubbed the 'Ferrous Noise Signal' (FNS). A simple measure of the FNS gives a lot of information about fine wear debris generation which generally precedes the generation of larger chunks seen by rival detection systems. This feature is available due to PATROL's low noise and high stability.

Specifications

The following table is provided for guidance and does not represent the limits of PATROL performance. Note that the outputs are live analogue voltages and particle counting / binning is not offered with the sensor. Typical data for 5 mm bore sensor. Bore sizes to 25 mm diameter are available

Electronic / electrical	
Power supply	12-18V dc
Current demand	35 mA typical
Operating temperature, oil flow	0 to 125 °C (to 250 °C special)
Operating temperature, ambient	100 °C (to 175 °C special)
Storage temperature	-25 to 125 °C (to 175 °C special)
Connector	9 way D-type plug standard
Outputs	Ferrous and Non-Ferrous
Levels	+/- 5V range into $\geq 2k\Omega$
Output noise	<10 mV rms
Self check	Exercises both channels
Sensitivity: Ferrous channel	25 μ m equivalent spherical diameter (ESD) steel
Sensitivity: Non-Ferrous channel	90 μ m (ESD) copper
Maximum single particle size	300 μ m (ESD), output not clipping
Coil separation between centres	22 mm, typical
Filter cut-off	1kHz, typical
Flow rate range	0.7 to 30 litres / min
Mechanical	
Dimensions	110 mm long x 55 mm diameter
Mass	800g
Wetted materials	PEEK, Nitrile rubber, steel

Application areas

PATROL was initially developed for monitoring of mission critical military aircraft use for both engines and transmissions. As such its performance has been evaluated by DERA on behalf of the UK MoD. In the development process costs have tumbled as performance has been established. PATROL is now eminently applicable to many industrial systems monitoring such as:

Gas turbine engines
 Reciprocating engines, petrol & diesel
 Electrical Power generation
 Gearboxes & transmissions
 Paper / sugar / ore milling
 Hydraulic machinery
 Filtration monitoring

Please contact Mike Hutchings, Director & Chief Designer at MTML, to discuss your application.

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