



FluiCheck™ Real Time Machine Monitoring System



Introduction

FluiCheck™ is a condition monitoring system that has been developed to accommodate a 'suite' of sensors that will determine the condition of a lubricant within a machine through real time measurement. The system solution has been developed to allow the end user to tailor the instrument requirements to a specific application for use as an analysis and monitoring tool. An example of such a system is shown above and comprises of a combination in monitoring a wind turbine or Marine Diesel engine application.



Figure 1 FluiCheck™

The system communicates with the lubrication system instrumentation using serial Modbus protocol. The system can also communicate through a wireless RS232 communication interface. To monitor the lubricant it requires that the sensors are plumbed into the oil system through the use of a tailored manifold for each.

The system is modular in design allowing the end user application to determine the requirements from the following suite of sensors:-

- FluiCheck™ ferrous debris measurement in Milligrams.
- FluiCheck™ moisture in oil in percentage Relative Humidity.
- FluiCheck™ MFI oil condition through a Multi frequency Impedance sensor in High, Medium, Low frequencies.
- FluiCheck™ VIS viscosity in Centipoise.



Lubrizol

The system driver modules are enclosed in a ruggedised housing which can be tailored for the environment requirements.

Instruments

FluiCheck™ has the 4 instruments listed above and these can be selected individually or as any combination of.

The FluiCheck™ MD Debris Measurement Sensor

This instrument is an on-line ferrous metal wear debris 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. 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.

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 FluiCheck™ MS moisture in Oil Sensor

This Moisture detection sensor gives an output in relative humidity (RH) through measuring very small 'parts per million' presence of water in the presence of hydrocarbons. The sensor is connected into a system through a pipe manifold or by threading it into a sump or container. The instrument will measure up to 100 percent saturation Relative Humidity level. The sensor also gives out an oil temperature value which can be used to determine the condition of the system-lubricant. When a machine runs from an initial start up position, the amount of moisture within the oil will change with the changing machine runtime oil temperature. The sensor in measuring both the oil temperature and moisture content of the machine oil can use the parameters to determine any deviation or difference from a known *RH v temperature* profile. It will then give as an output in real time, instrument data that would be used to assess the change in condition due to the ingress of water into the system.



The FluiCheck™ MFI Multi Frequency Impedance Sensor

The MFI sensor system can measure, diagnose and predict a lubricant's condition by monitoring and, as a function of lubricant use, trending temperature-compensated electrochemical responses to electrical signals applied between electrodes immersed in the lubricant.

The output signals are referenced as high frequency, medium frequency and low frequency, with the actual signal frequencies dependent on electrode-geometry and other variables within the oil.

Changes in a lubricant's high-frequency electrochemical response are, in general, related to bulk property changes, which for heavy-duty diesel applications are primarily due to soot changes. Changes in a lubricant's medium frequency electrochemical response are, in general, related to changes that occur in detergent and dispersant additives in the bulk solution. Changes in a lubricant's low frequency electrochemical response are, in general, related to changes that occur in surface active additives and to small quantities, on the order of 100 ppm, of free water/coolant contamination.

The FluiCheck™ VIS Rotational Viscosity Sensor

The rotational viscometer measures viscosity in Centipoise from the principle of a fixed rotational speed motor that when rotating within the oil gives a variable current feedback in response to variations in oil mechanical resistance which is related to the oil temperature and viscosity. The instrument uses a calibrated temperature profile for the lubricant

viscosity to calculate the measured viscosity and derive a viscosity value associated with the state of the lubricant under test. From the theoretical and calculated viscosity an error profile can be obtained.

Additional Control and Measurement Modules

The FluiCheck™ has also the option of providing 4 Relay modules within that can be used to control valves and other process equipment. The device is controlled through the same Modbus protocol as the instrument drivers. This would offer 4 channels with a 24 Volt, 2A switching and control capability. The system has the option of 4 analogue input channels at 16 bit resolution able to measure process signals such as pressures, temperatures and flow measuring devices for example.

Additional Digital Serial Sensor Modules

The system can accommodate additional serial digital devices and can easily be integrated into the Modbus system. Device drivers would be written to complete this as required.

System Software

The FluiCheck™ system can communicate with either software developed to run independent of the end user's control system or be integrated into their SCADA or DCS software system. This would involve the development of user interface graphics and data collection functions that were to the end users requirements and specifications.



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System Modules

The system as shown opposite has been developed to accommodate any number or types of instrument combinations and built to suite a client's needs and requirements. All the 'black box' modules are separately addressable and stand alone items. The system opposite has a 4 relay module present and has 4-16 bit analogue input capability. The system has a 110v/240v AC supply powering a 24v DC system supply for the entire configuration.



Product Specifications

Housing Body Material	Mild Steel
Union & Manifold Materials	Aluminium (anodized) or Brass
Seals	Various
Fluid Interface	Variable
Working Pressure	10 Bar max.
Sensor Mounting	Oil Resistant PCB with Lacquered Contacts
Working Fluid	Mineral & Synthetic Oil
Temperature Range	5° to 100° C
Instrument Accuracy	±2% when calibrated
Temperature Accuracy	±2° C when calibrated
Power Supply	110 AC / 240V AC and instruments are 6-30 V DC
Current Consumption	Variable
Data Processing	8 bit PIC Microcontroller within Drivers and Instruments
Data Interface	RS232 & RS485
Serial Protocol	MODBUS software Protocol
Serial Data	9600bps, 8 data bits, 1 stop bits no parity
Analogue Input	4 Channel with 0 to 5V each channel at 16 bit resolution
Relay Output	4 Channel capable of 24v, 2A each channel