

Magmeter MF500M

Magnetite Meter

DIVERSE

www.diverse-technologies.net

Applications

- Magnetite detection in pipes
- Pipe occlusion estimation



Features

- Measures magnetite effect
- Ideal for use with cooling pipes
- Rugged stainless steel probe
- Auto Zero facility
- Smart instrument able to estimate degree of occlusion
- Measures Magnetite levels
- Digital display
- Audible confirmation
- Selectable occlusion display
- Calibration sample
- Supplied with a protective carrying case and full user instructions

Overview

The Diverse MF500M is a hand held, battery operated Magnetite Meter using a novel magnetic force probe. The instrument may be used to determine the amount of magnetite in cooling pipes.

The magnetic detector is housed in a separate stainless steel hand held case providing maximum protection and magnetic transparency. The processor based meter has a user friendly menu driven interface to allow simple operation.

The sensor measures magnetic force and this is compensated for gravity effects so that minimal change to the reading occurs for different orientations of the probe. It displays raw data from the sensor, as well as estimates of the amount of magnetite in a given (non-magnetic) pipe. Auto zero can be requested at any time by the press of a single button. Using a measurement rate, either magnetite thickness or sector fill can be estimated.

Measurements of magnetite force levels are displayed on the unit and can be stored in its internal memory for later recall. Audible confirmation of measurement and zeroing facilitates use in restrictive environment.

Supplied with a calibration sample. User can modify pipe occlusion calibration.

The Software embedded in the MF500M provides acquisition of the magnetic force extended by the magnetic effect of the magnetite. The force is a measure of the amount of magnetite and its range. This information is used together with the geometry of the pipe (assumed linear with defined diameter and wall thickness) to gauge the amount of occlusion. The force effect is dependent on how the magnetite appears in the pipe. It may be deposited in a similar way to calcite, or appear as broken magnetite. The density reduction of broken magnetite is built into the instrument, so that the degree of occlusion can be inferred for each scenario.

The user can modify the pipe occlusion calibration for different pipe wall thickness or magnetite packing density. Settings are stored at power off but the instrument has the facility to revert to the factory calibration.

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About Magmeter MF500M

Stainless steel superheated steam and re-heater tubes, operating with high temperature steam for extended periods, develop a two-part oxide layer on the inner bore of the tubes. The magnetite oxide is characterised by two distinct phases which have different coefficients of expansion. The layer closest to the tube centre which is iron rich, and an inner layer which is chrome rich. At metal temperatures of 90C to 150C, the outer layer of magnetite oxide tends to delaminate from the tightly adhering inner layer and parent metal.

Delamination of this outer layer and a small amount of inner layer causes magnetite to fall under gravity and block the bottom of vertical or pendant super heated tubes. If total blockage occurs in a tube, the steam flow paths being established in a boiler as it builds steam pressure bypass this blocked tube. Without the cooling steam, this causes overheating of the blocked tube leg which results in failure of the tube.

Failure of a single tube results in that tube moving violently amongst neighbouring tubes which causes other tubes to become damaged and potentially rupture. Steam escaping onto nearby tube walls becomes another mechanism of failure. Eventually, so much steam will be lost that a gas side pressure excursion will remove the boiler from service, or the boiler feed pumps will not maintain the feed. Repair of the damage may take several weeks.

So the requirement is to measure a thin layer of iron inside a stainless steel tube.

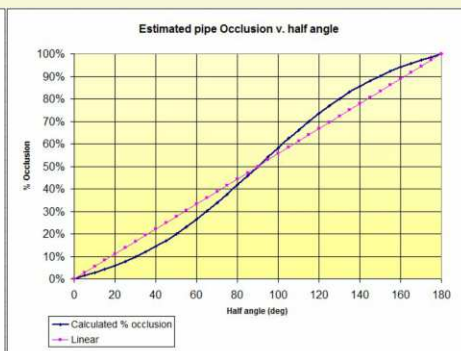
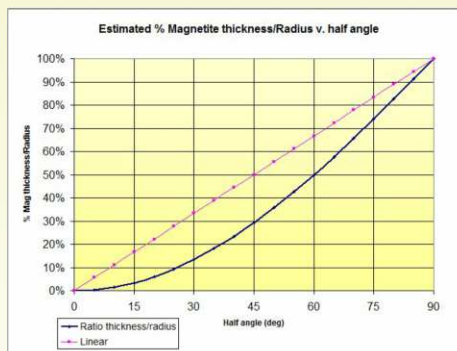


The MF500M provides an indication of the amount of magnetite within steam tubes. It assumes that the containing tube is essentially non-magnetic made usually of stainless steel. The magnetite is magnetic with magnetic properties similar to iron. This provides a route to measure the levels of

magnetite: the magnetic material in the range of the detection head provides a force dependent on the volume of magnetite present. The instrument provides a high magnetic field and measures the resulting force.

For vertical pipes any magnetite is by definition attached to the vertical walls and is thus at a maximum packing density of a solid. In contrast, horizontal or zones at the bottom of vertical pipes are zones where magnetite accumulates. Here the packing density is much smaller. The magnetite meter allows the user to correct the measurement based on this knowledge.

A measurement rote starts with knowledge that the magnetite is coated around the sides of the pipe or accumulated at the bottom of horizontal sections. The rote allows estimation of either coating thickness or sector fill.



Magmeter MF500M Specification

Reading range	0 to 2047 force units
Occlusion	0 to 100%
Technique	Uses net magnetic force to identify magnetite and magnetic material
Accuracy	Reading range: 0 - 2047 force units. These are arbitrary units, and each instrument needs to be calibrated to the specific pipe geometry and magnetite samples
Zero	Can be zeroed at anytime - measurement technique requires unit to be zeroed in the measurement orientation
Probe orientation	Measurement independent of probe orientation provided it is zeroed first in that orientation
Gravity	Zero removes gravity offset
Display	4 lines of 16 characters Shows value and user interface messages
Functions	Raw force, occlusion for solid and broken magnetite
Internal data sample rate	500 samples per second
Repeatability	+/-5% assuming sample is degaussed
Probe size	20mm x25mm, 150mm long
Detection	Detects the magnetic force between the sensing magnet and the magnetite. The signal is offset by an estimate of the gravitational force.
Storage	Maximum of 20 records can be stored
Probe cable length	1.5m typical
Calibration:	Calibration is indicative only. Unit is supplied with a calibration sample so that the instrument functionality can be verified
Power:	4 standard AA cells , typical lifetime 12 months. Continuous use 30 hours
Instrument size:	165 x 100 x 50mm
Weight in case:	1.3kg
Environmental:	10 - 40C operating, 0 - 80C storage
Humidity	0-90% non condensing
Display update rate:	0.3 seconds
Warranty	12 months

