Mag-03 & Spectramag-6

Low cost magnetic signature measurement system

Bartington Instruments' three-axis fluxgate sensors are widely used in magnetic signature ranges, both on land and at sea. This application note describes how a small, highly cost-effective land range facility can be constructed using just 1 or 2 sensors to provide a high quality measurement facility for smaller objects. This system is ideal for diver magnetic hygiene checks, as a portable system, and for testing items before taking on board magnetically critical vessels, like minesweepers.

The importance of magnetic "cleanliness" in naval marine environments is well-known. Good cleanliness, giving a low magnetic signature, reduces the chances of submarines and surface vessels being detected by magnetic methods.

Magnetic influence mine detection is a scenario where magnetic cleanliness is critical. A minesweeper, ROV or diver needs to be able to approach these threats without risk of inadvertently triggering the device. To minimise the magnetic signature of a complex system like a minesweeper, it is important to control the magnetic effect of every item on board. All sub-systems and items on the ship will have their signature measured, to ensure they are sufficiently non-magnetic. The signature and position of all items can be applied to a model, to accurately predict and control the overall signature. This modelling and control must continue throughout the life of the vessel, so any new or replacement items must be similarly tested and added to the overall model.

A magnetic range, consisting of an array of three-axis fluxgate magnetometers, is used to measure magnetic signatures. Land based, fixed ranges are good for testing large items and sub-systems. However, they are expensive facilities and not a cost effective way to test much smaller items.

Implementation of a low cost system

An extremely simple magnetic test range, suitable for objects that can be carried by one or two people, can be constructed at very low cost using just two three-axis magnetometers.

The system comprises:

- A measurement magnetometer (Bartington Instruments Mag-03MSB100).
- A background field magnetometer (Bartington Instruments Mag-03MSB100).
- A data acquisition unit (Bartington Instruments Spectramag-6).
- A Windows PC running the Spectramag-6 software.
- A suitable non-magnetic test table or platform.

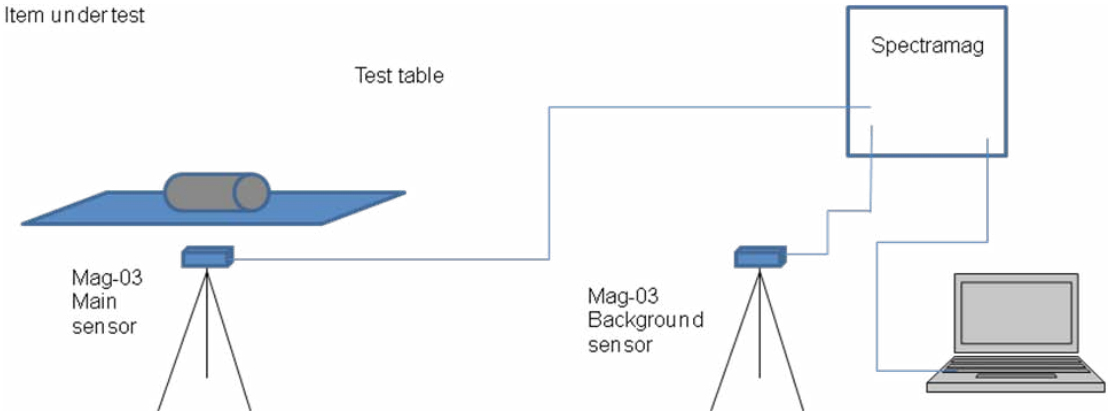

Figure 1. Range schematic diagram range. The main (measurement) sensor is mounted a fixed distance below the surface of the test table. The x-y-z orientation of the sensor relative to the table and also relative to north must be recorded.

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Items under test are moved across the table, and the data recording system monitors the magnetic field variation in the three x-y-z axes. The Spectramag-6 is an ideal instrument for this. Its 24-bit a-to-d system gives signal resolution to better than 0.1nT; digital sampling rate is user settable; and data is both displayed and recorded in real-time. A typical output plot for an item traversing the sensor is shown in Figure 2. The peak values for all three axes can be quickly determined, and if required the plot can be printed out for record-keeping.

The background sensor is recommended in most circumstances, to prevent external magnetic influences affecting the result. This sensor must be mounted in the same x-y-z orientation as the main sensor (ensure that both x sensors are parallel, both y sensors parallel, etc.). The sensor should be far enough away from the main sensor to ensure it will not be affected by the item under test, but close enough that both sensors will respond similarly to external magnetic field changes. A typical distance would be about 3 to 5 metres. When a background sensor is used, then the Spectramag-6 must be set to record data in differential mode (i.e. displayed readings are the difference between the main sensor and the background sensor.

The test table should be non-magnetic and stable (a heavy wooden table is ideal).

Items should be slid across the surface of the table, allowing the distance from the object base to the sensor to be well-controlled.

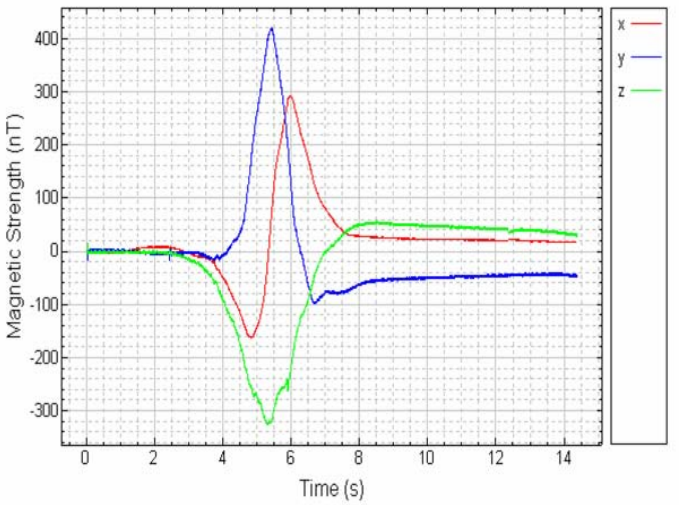

Figure 2. Typical output for a test object.

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