

# Mag-03RC and DAS1 used in magnetic signature range measurements

## Instrumentation

- Mag-03RC submersible three-axis range magnetic field sensor.
- DAS1 magnetic range data acquisition system.

## Objectives

To measure the magnetic moment (i.e. the strength of interaction with other magnetic fields) of a vessel at a known location in the Earth's magnetic field.

## Applications

- Measuring the magnetic signature of submarines or surface vessels pre and post degaussing.

## Background

Degaussing is the process of removing magnetisation from an object by applying an opposing or alternating magnetic field to it. This is most commonly achieved by passing a known current through sets of coils around the item of interest.

To optimise the degaussing process, the magnetic signature is determined beforehand so that the appropriate current can be best applied to specific areas. The magnetic signature of the vessel is modelled

computationally. The data used to formulate the model is collected using measurements taken on a magnetic signature range. The range is then also used to check the efficacy of the degaussing process.

## Method

The Mag-03RC and DAS1 have been specifically designed to work in maritime magnetic signature ranges. A signature range would consist of an array of Mag-03RC sensors installed in a grid or cross configuration on the sea floor at a known depth, connected to a DAS1, which can be connected to up to 160 sensors. A range will normally be installed near a naval base or dockyard, with typically between 20-30 sensors. (As well as containing magnetic field sensors, ranges are often multi-influence and can also contain acoustic, electrical and pressure sensors.)

Permanent magnetic signature ranges allow accurate reading of the vessel's magnetic moment, but only in the area where the range is located. The value of the Earth's magnetic field varies throughout the world: as a vessel travels around the world, its signature will change as it interacts with the local magnetic field. To allow for this, portable signature ranges can be used. The DAS1 and the rest of the data acquisition function can be contained within a shipping container that is placed on shore, with the Mag-03RCs and any other sensors weighted down and installed on the sea bed by boat.



The Mag-03RC contains an in-built test unit that can apply a known field to each axis to test functionality. It can therefore be installed for long periods and tested in situ.

The signature range must be placed far enough from the shore to allow vessels with a deep draft, and submerged submarines, to sail through it with enough clearance from the sea floor and the correct height above sensors. However, if the range is placed too far from the shore then this will cause signal degradation along the length of long cables connecting to the DAS1. To prevent this and to allow the range to be located in the most suitable location possible, the Mag-03RC has additional electronics to allow cable lengths of up to 2km.

The numbers and arrangements of sensors used vary, depending on the complexity of the model that is to be produced. The more sensors that are used, the more data

points are collected and the more complex the computer model can be. The Mag-03RC can also be mounted at different depths in order to assess the vertical variations of the vessel's magnetic moment.

Measurements taken on the signature ranges require certain conditions. In tidal areas, measurements are made at particular times of day to ensure that the water depth is correct. Sea states are also important to consider: although the vessels are capable of sailing in higher sea states, moving up and down with the swell will affect the measurements as the ship's distance from the sensors changes. Therefore, measurements should be made in calm sea conditions.

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