

Compass Safe Distance Testing

Objectives

To test the magnetic deviation applied to a compass by a given piece of equipment (Device Under Test - DUT) as part of electromagnetic compatibility (EMC) testing, and determine the distance at which the DUT can be positioned from a compass without exceeding the threshold set in the EMC standards.

Instrumentation

- Mag B probe and Mag-01H single axis fluxgate magnetometer.
- Mag-03/Mag-13 with PSU1 and Data Acquisition Card.

Background

Compasses align with the Earth's geomagnetic field (magnetic North). Any object or equipment that has its own magnetic field will interact locally with the geomagnetic field. If this occurs near a compass then the compass will be diverted away from North, along the line of the resultant field from the interaction.

International regulations stipulate that equipment must adhere to the EMC Directive.¹ Part of EMC testing is compass safe distance measurement. This testing determines the minimum distance at which equipment does not cause unacceptable deviation of a compass' direction.

The acceptable level of deviation must not exceed $5.4/H^\circ$ for a ship's standard compass and $18/H^\circ$ for steering, standby steering and emergency compasses, where H° is the horizontal geomagnetic field maximum.

Method

The DUT is tested three times:

1. Switched off,
2. Degaussed and switched off,
3. Switched on.

Each time, the unit is rotated to determine which orientation provides the maximum deviation. The Mag B probe is then aligned along the H-field with 0° deviation. The value of H is displayed on the Mag-01H. The field value for the minimum distance can then be calculated using the equations:

$$\tan \theta = H_{\text{EUT}} [\mu\text{T}] / H_{\text{Earth}} [\mu\text{T}]$$

$$H_{\text{EUT}} = H_{\text{Earth}} \times \tan \theta [\mu\text{T}]$$

$$H_{\text{EUT}} = H_{\text{Earth}} \times \tan(5.4 / H_{\text{Earth}}) [\mu\text{T}]$$

Once the field value limit has been calculated, the EUT is placed along the axis perpendicular to the Mag B probe, and moved towards the probe until the calculated field value limit is reached on the Mag-01H display. This distance is noted.

The largest distance acquired in the three tests is taken as the DUT compass safe distance.



¹ <http://ec.europa.eu/enterprise/sectors/electrical/emc/>

Alternative Method

An alternative method which will result in an identical result and may simplify the setup consists of using a three-axis sensor (such as Mag-13MS). Placing two of the axes horizontally will allow determination of the direction of magnetic north in the horizontal plane (H), using simple trigonometry and the readings from the two horizontal axes. Once the background angle to one of the two axes is known, it is then a simple matter of monitoring the angle as a DUT is brought into its vicinity to confirm the distance at which the maximum deviation is reached.

