Simultaneous measurement of static and dynamic magnetic signatures of ships: trials on HMCS "Cowichan" Esquimalt, B.C. August and September, 1959

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NATIONAL RESEARCH COUNCIL OF CANADA

RADIO AND ELECTRICAL ENGINEERING DIVISION

SIMULTANEOUS MEASUREMENT OF STATIC AND DYNAMIC MAGNETIC SIGNATURES OF SHIPS

Trials on HMCS "Cowichan"
Esquimalt, B. C. August and September, 1959

OTTAWA

OCTOBER 1959 NRC# 35618

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ABSTRACT

Static and dynamic magnetic fields of a minesweeper have normally been measured by two separate test procedures. The total field of the ship was obtained by adding maximum static to maximum dynamic field without regard to the position at which each occurs. This method is laborious and in some cases, produces a pessimistic total field value.

During recent trials, the total field (static and dynamic) was obtained in a single measurement by rolling the ship while it was being towed over the magnetic range. This was made possible by use of a new rolling device developed by the Royal Canadian Navy. The composite recordings provided by this ranging method quickly and directly give a picture of the magnetic field which would be "seen" by a mine at the detection location.

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FIGURES

SIMULTANEOUS MEASUREMENT OF STATIC AND DYNAMIC MAGNETIC SIGNATURES OF SHIPS

INTRODUCTION

During investigations of magnetic fields of minesweepers, which have been carried out by the National Research Council for the Royal Canadian Navy over the past few years, static and dynamic signatures were obtained by separate sets of measurements. Static signatures were best obtained by towing the ship slowly over the magnetometer range while its even-keel magnetic profiles were being recorded [1]. Dynamic roll signatures were obtained by rolling the ship by the "running-sailor" method while it was moored over the magnetometer range by fastenings attached to the roll axis at bow and stern.

Although these methods provide static signatures directly, roll signatures must be constructed from point by point measurements. Because of the variable nature of the roll, the measured dynamic field value at each point under the ship must be computed to a common base of roll amplitude or roll velocity before profiles can be constructed. This proved to be a tedious process.

When the total field of the rolling ship was to be obtained, the results of these two separate static and dynamic measurements were combined. Because of the labour involved in combining results point by point, the maximum was obtained as the sum of the maximum static field and the maximum dynamic field without regard to the position at which each occurs. In ships where only static and "tilt" fields are of significance, the method may be satisfactory since the maxima of these fields occur at about the same position. However, in ships with comparatively large eddy-current fields, this resultant may give very pessimistic values since maximum eddy-current fields do not necessarily occur at the position of the maximum static field.

In view of the disadvantages of the above methods it appeared to be useful to have a means of obtaining a composite magnetic recording of static and dynamic fields directly. This would provide a picture of the magnetic field which would be "seen" by a mine at the detector position.

TOWING-ROLLING TRIALS

During the most recent trials [2] on the minesweeper HMCS "Cowichan" it became possible because of the development of a new rolling machine by the Royal Canadian Navy [3] to carry out static and dynamic rangings simultaneously since the ship could be towed or sailed over the range while rolling. A

number of composite recordings were made during these trials by the method described in the following paragraph.

The ship was towed along the center line of the dock (Fig. 1) by means of a long rope drawn by a power-driven capstan. A stern line was kept taut to assist in controlling the ship's position. At the same time, the ship was rolled by the machine. The ship's lateral position was constrained by lines attached at bow and stern and hand-held by men walking along the dock side. These men had little difficulty in holding the ship on the center line of the range since there was no tendency for the ship to surge laterally while the rolling machine was used.

Recordings obtained during several of these tests are shown in Fig. 2. The electrical roll-angle signal to the Brush recorder was obtained from a potentiometer attached to a Muirhead roll recorder located in the ship's generator room.

The use of the rolling device and the towing-rolling technique has the following advantages:

1) Rolling tests may be carried out on an open range.
2) Roll amplitude is very nearly constant and rolling may be maintained for long periods.
3) The range records immediately show the relative magnitudes of static and dynamic fields and can be interpreted directly without preliminary analysis.
4) Performance of both static and dynamic degaussing can be evaluated and the systems adjusted to optimum conditions.

CONCLUSION

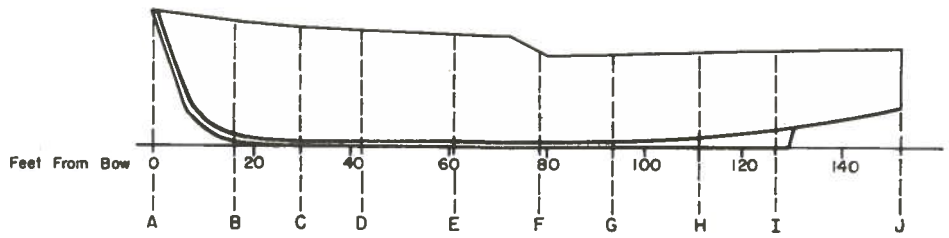
The towing-rolling technique offers a means for routine ranging of minesweepers to determine static and dynamic fields and to adjust static and dynamic degaussing systems.

REFERENCES

1. R.M. Morris and B.O. Pedersen. "Magnetic Signature of HMCS 'Cowichan' (MCB 162) Esquimalt, B.C., March 1958". NRC Report ERA-338 (Confidential)
2. R.M. Morris, B.O. Pedersen, O. Petersons. "An Experimental Closed-Loop Degaussing System". NRC Report ERB-531 (Secret)
3. Commodore (L) J. Deane. "Rolling Trials". RCN Report CSP: C 6400-MCB162 (Confidential)

FIG. 1 ROLLING-TOWING TEST

RCN Photo



ROLL
VELOCITY

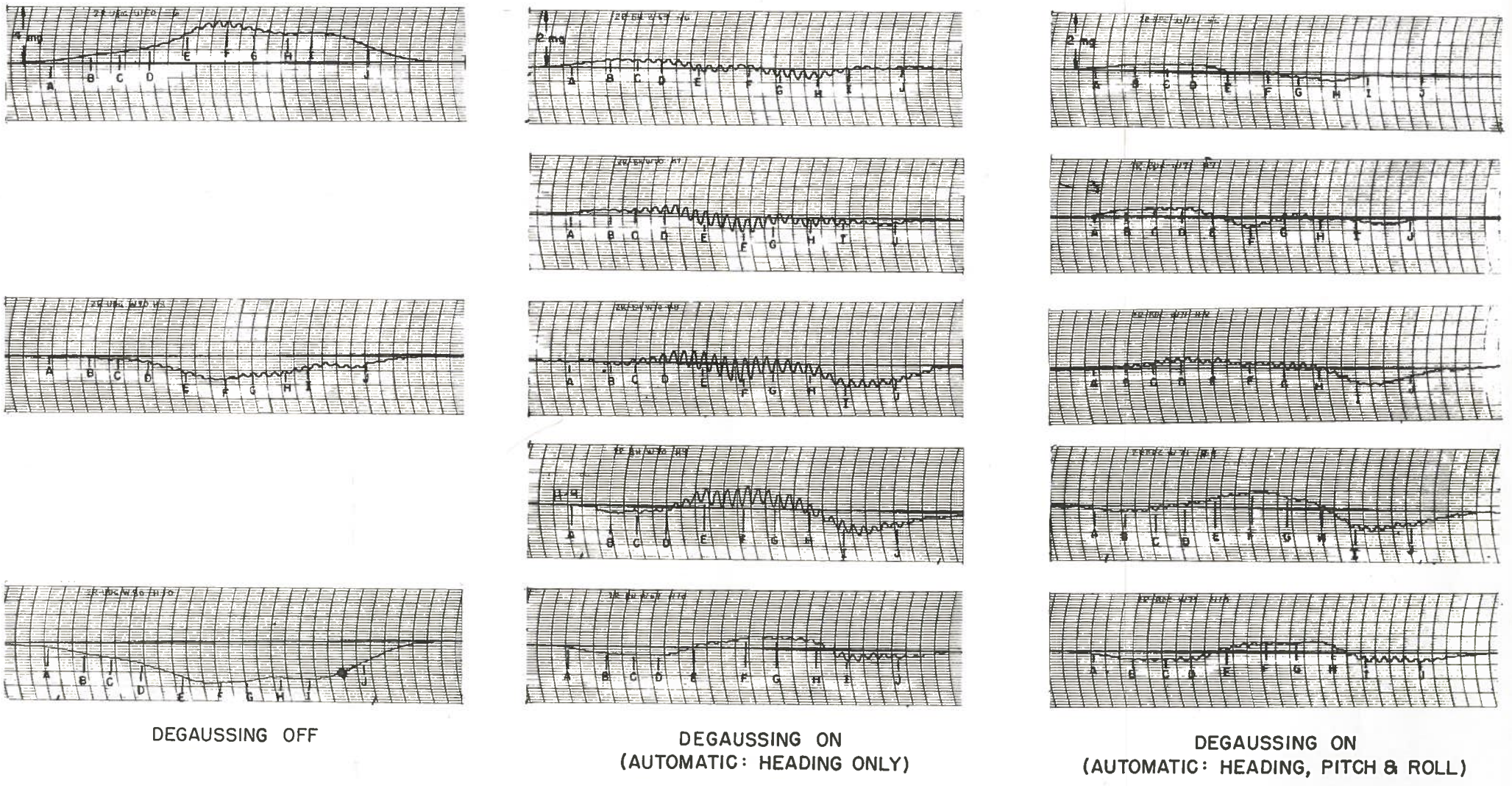
16 FT. STBD.

8 FT. STBD.

KEEL

8 FT. PORT

16 FT. PORT



DEGAUSSING OFF

DEGAUSSING ON
(AUTOMATIC: HEADING ONLY)

DEGAUSSING ON
(AUTOMATIC: HEADING, PITCH & ROLL)

NOTE: UPWARD DEFLECTIONS ARE FIELDS DIRECTED FROM PORT TO STBD.

LONGITUDINAL PROFILES OF TRANSVERSE HORIZONTAL FIELD
ROLLING – TOWING TEST

HEADING: WEST DEPTH: 22 FT. ROLL AMPLITUDE: ±6.3°

HMCS "COWICHAN" (MCB 162)

FIG. 2

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