FORUM

Decca Speed Trials

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1. INTRODUCTION. The Decca method of conducting speed trials and its considerable advantages over other methods have been described in this *Journal*[1, 2] and elsewhere.[3] Decca is nowadays widely and successfully used for acceptance trials (speed, calibration of (Sal) log, turning circles and (crash) stopways) by Royal and Merchant Navy ships of Britain, the Netherlands, France, Denmark, Sweden and probably of other nations.

The results of *speed* trials of Netherlands Merchant Navy ships are given in the present paper. Those of the equally successful turning circles and stopways are not given here, since their numerical results would be of little interest to the reader; a pictorial representation—among other things allowing for a comparison between various interesting turning habits of different ships—would be more suitable, but would occupy too much space.

2. SHORT DESCRIPTION OF THE METHOD. Each speed determination consists of 4 to 6 runs, alternatively in opposite directions. In each run 20 photographs of the decometers are taken at 30-second (or, for very high speeds of 30 kt. or more, 15-second) intervals and one single run therefore takes 9½ minutes. Specially calibrated Decca receivers are used to ensure a much higher accuracy than is achieved (and needed) for normal navigational purposes.

With the aid of special, large-scale, Decca charts or special tables, all these decometer readings—80 in 4 runs or 120 in 6 runs—are converted into rectangular coordinates X, Y. The final speed—in which the drift has automatically been eliminated—is then computed from a least square adjustment of all the Decca fixes, which enables the standard error in the final speed V, through the water to be computed.

In turning circles and stopways, photographic readings are taken every 15 seconds and also converted to X, Y coordinates. From a plot on a scale 1 : 10,000 or larger, the turning circle or the stopway can be scaled off. Drift is eliminated from 2 consecutive turns. Stopways usually are derived from one single run, made perpendicular to the (predicted) current. For a large ship (some 30,000 tons) a double turn takes between 15 and 20 minutes; a single stopway takes about 10 minutes.

A full programme of acceptance trials consists of 3 speeds at different numbers of engine revolutions, each of 4 or 6 runs (the final speeds are used for calibration of the log), 2 double turning circles and one (full astern) stopway.

The development and reading of the films (35 mm.), the conversion to X, Y coordinates, the least square adjustment for the speed and the plotting of turning circles and stopways, for a full programme, takes from two to three days.

https://doi.org/10.1017/S0373463300029684 Published online by Cambridge University Press

During acceptance trials, however, everybody on board is always very anxious about immediate results, especially with regard to the speed. To satisfy this demand, it has become normal practice to compute a preliminary speed from first and last *visual* decometer readings in each run. This preliminary speed is available a couple of minutes after the termination of the last run; its accuracy is sufficient for this requirement, but unacceptable as a final result; for instance for comparison with developed h.p. and fuel consumption or for comparison with ship trial tank data.

Even when one would consider the preliminary speed to be of acceptable accuracy as a definite result, it should be kept in mind that the far better accuracy of the final speed can be obtained without spending any extra time on the speed trials.

3. DEFINITION OF DECCA DAY AND NIGHT. As the Decca method of acceptance trials makes use of differences in successive positions in one single run (or double turning circle) the absolute accuracy of the Decca fixes is of very little importance.

As one single run takes only 10 minutes (15 to 20 for a double turning circle), the accuracy of the method is dependent on the short-time stability of the radiated Decca patterns.

When there is no sky-wave, this short-time stability (in the areas used for the trials) is better than 0·01 lane. At distances in excess of 50 n.m. from one of the transmitters, sky-wave starts to affect the pattern stability to about 0·01 lane when the Sun's altitude becomes less than 15°; at still lower or negative altitudes, the sky-wave effect may become considerable and may cause comparatively large swings or instability of the radiated patterns. These swings have a long period, usually about 2 hours; they affect the absolute accuracy of a Decca fix to an amount, acceptable for navigation, but unacceptably large for accurate position fixing, as is for instance required in surveying. In acceptance trials, however, the differences in fixes over the comparatively short periods, are not seriously affected, as may be seen from a comparison of Tables I and II.

It is for the above reasons, that for work of survey accuracy and for acceptance trials, the 'Decca Day' is defined as the period of the day when the Sun's altitude is 15° or more; the rest of the 24-hour period is the 'Decca Night'.

4. SUMMARY OF SPEED TRIALS.

TABLE I. SUMMARY OF SPEED TRIALS EXPRESSED AS PERCENTAGE OF SPEED

Period	a	b	c	d	e
Day	60	0·18	0·28	(0·60) 0·32	3·08, 1·80
Night	31	0·30	0·38	(1·20) 0·45	2·16, 1·72

a = number of speed determinations (each for 4 or 6 runs)
b = mean value of standard errors in final speed
c = mean value of error in preliminary speed
d = extreme value of standard error in final speed (very low speed in brackets)
e = extreme value of error in preliminary speed.

https://doi.org/10.1017/S0373463300029684 Published online by Cambridge University Press

TABLE II. COMPARISON BETWEEN DECCA (NIGHT) AND MEASURED MILE

Engine revs. (1)	4 Runs meas. mile & st.devn. (2)	4 Runs Decca & st.devn. (3)	(2)–(3) & st.devn.
110	16′76 ± 0′04	16·66 ± 0′07	+ 0′10 (0·60%) ± 0′08 (0·48%)
115	17·58 ± 0·04	17·53 ± 0·06	+ 0·05 (0·28%) ± 0·07 (0·40%)
119	18·01 ± 0·04	18·032 ± 0·038	− 0·022 (0·12%) ± 0·05 (0·28%)

5. CONCLUSIONS.

Table I. The accuracy of day as well as night speed trials is sufficient for all practical needs. Nevertheless, whenever possible, day trials are to be preferred. The preliminary speed serves a useful purpose, but cannot be sufficiently relied upon as a substitute for the final speed.

Table II. Even under the unfavourable circumstances during the night, no systematic error can be shown between V determined by Decca and on the measured mile (random errors in their differences are of the same order of magnitude as the random errors of V determined by Decca).

As to the magnitude of (possible) *systematic* errors in a speed determined on the measured mile, reference is made to (4). *Systematic* errors in Decca speeds will never exceed 0·1 per cent of V (2) and most likely will be very considerably smaller.

REFERENCES

1 Verstelle, J. Th. (1953). Methods of conducting ships' speed trials. This *Journal*, **6**, 297.

2 Verstelle, J. Th. (1955). Speed trials with the Decca Navigator. This *Journal*, **8**, 41.

3 Verstelle, J. Th. (1958). The Decca system for ship acceptance trials, *International Hydrographic Review*, Vol. XXXVI, No. 1, July 1959 (reproduced from Netherlands Hydrographic News Letter, no. 27, March 1958).

4 Verstelle, J. Th. (1958). Accuracy of speed trials on the measured mile, *International Hydrographic Review*, Vol. XXXV, No. 2, November 1958 (reproduced from Netherlands Hydrographic News Letter, No. 28, April 1958).

Note: Earlier publications on this subject have become more or less obsolescent and are not mentioned here.

The Polaroid Procedure for Photographing Radar Screens

from J. A. Klerk and W. Steensma

WHEN reading articles on radar-navigation in various nautical magazines, one is constantly struck by the difficulty of comparing the different targets on the screen and of interpreting the changes that take place in the right way. So plotting becomes still more necessary in order to get: (a) the nearest approach,

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