THE DETERMINATION OF THE COMPASS ERROR.

A simple Method of obtaining Compass Deviations when the ordinary means are not available.

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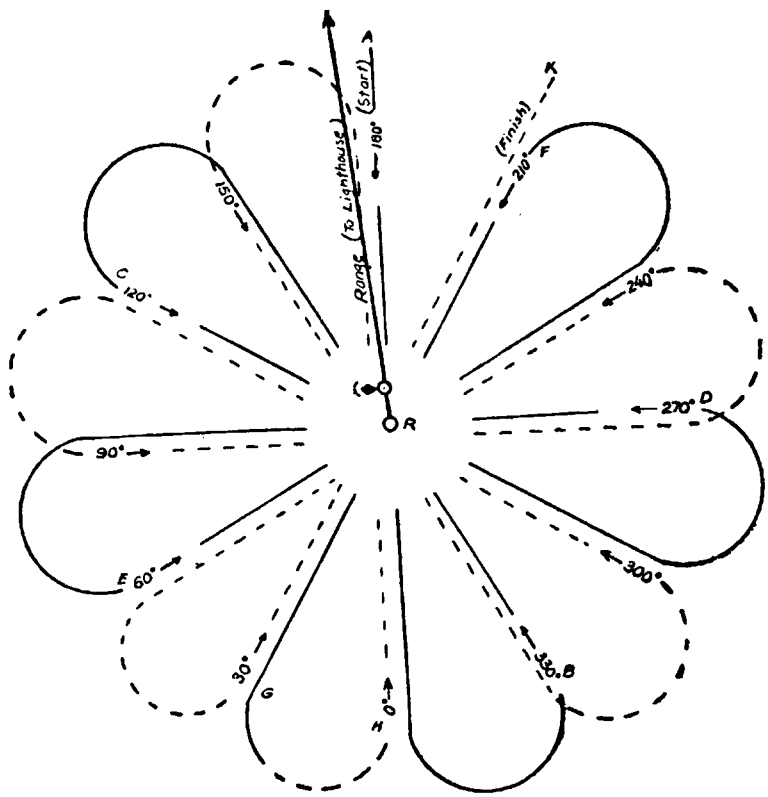
Standard books on navigation describe several methods for determining the compass error — by reciprocal bearings, requiring a station on shore; by bearings of the sun, requiring a clear day; by ranges, requiring that the magnetic bearing of the range be known; and by a distant object, requiring the object to be at a considerable distance from the ship. The following "gadget", not described in books on navigation, so far as is known, proved of value to the writer. In a sense it combines two methods, the bearing of a distant object and a range; except in the way employed, the "distant object" need be only a few miles away and the bearing of the range need not be known; in fact, the two objects comprising the range need not even be charted.



This method is confined to the determination of deviations of compasses in the fore-and-aft amidship line, when the distribution of magnetic metal to starboard and port is fairly symmetrical. Since practically all compasses are so placed, the method may be regarded as universal. It is not confined to any size vessel except that it may prove time-consuming on a slow-turning vessel of long turning radius. The writer employed the method with very satisfactory results on a vessel 250 feet in length, but it can be used on larger vessels.

The vessel steamed successively on twelve headings (on every alternate 15° rhumb) across the range of Smith Point Lighthouse, Chesapeake Bay, and the lighted buoy six and one-half miles to the southward. The bearing of this range, a few hundred yards to

the southward of the buoy, was obtained on each heading by pelorus compared with the standard compass. For the accepted correct magnetic bearing of the range the average of all the compass bearings was used. The deviation on each heading was then obtained by a comparison of the compass bearing of the range on that heading with the mean magnetic bearing of the range obtained by averaging all the compass bearings.

The method was conceived rather from necessity than choice. It has the advantage, however, that it can be used at any time when terrestrial objects are visible — in clear or cloudy weather, during the day or night. It can also be varied according to circumstances. During the day a flag buoy may be anchored and the vessel "swung" with that in range with a lighthouse or headland, or another vessel at anchor in range with a lighthouse or with any natural object; at night a lantern on a small boat at anchor may be used in range with a light, none of which need be charted objects.

The "swing" can be made without manœuvring the vessel with the engines (see figure). The vessel can begin at *A*, with the lighted buoy a few degrees off the bow, and head 180° (south) by compass. As she passes the range at position *R* the bearing of the range is observed by compass or by pelorus, compared with compass. After continuing past the range about the same distance as from position *A* to position *R*, with a starboard helm, she turns to position *B* and on to a course 330° (by compass), again observing the compass bearing of the range at position *R* as she crosses it. This procedure is continued with a starboard helm in each case as indicated by solid lines on the diagram (see figure), on to a course 120° at position *C*; then to 270° at position *D*; to 60° at position *E*; to 210° at position *F*. Having completed the 210° course at position *G*, still with a starboard helm, she swings to 0° (north) (by compass) at position *H*, and now following the broken lines of the diagram steers successively on the following headings (by compass): 150°, 300°, 90°, 240° and 30°, completing the "swing" at position *K*. (In order to obviate any confusion the dashed lines and solid lines have been widely separated in preparing the diagram. In actual practice, of course, the two systems of courses on opposite headings represented by these lines may cover practically the same ground). The vessel has now headed successively on the following compass courses in the order named: 180°, 330°, 120°, 270°, 60°, 210°, 0°, 150°, 300°, 90°, 240° and 30°, with the following compass bearings of the range on the different headings:

Ship's head by compass. (A)	*Bearings of range by compass.* (B)	*Average bearing of range by compass.* (C)	*Difference of columns* B & C *or deviation.* (D)
Degrees	Degrees	Degrees	Degrees
0	351 or 351	359.7	+ 8.7 or 9 E.
30	353 or 353	359.7	+ 6.7 or 7 E.
60	358 or 358	359.7	+ 1.7 or 2 E.
90	4 or 364	359.7	— 4.3 or 4 W.
120	7 or 367	359.7	— 7.3 or 7 W.
150	8 or 368	359.7	— 8.3 or 8 W.
180	8 or 368	359.7	— 8.3 or 8 W.
210	7 or 367	359.7	— 7.3 or 7 W.
240	3 or 363	359.7	— 3.3 or 3 W.
270	356 or 356	359.7	+ 3.7 or 4 E.
300	352 or 352	359.7	+ 7.7 or 8 E.
330	349 or 349	359.7	+ 10.7 or 11 E.

Average of bearings by compass : 359.7.

The average is taken of all the bearings of the range by compass on all headings, in this case 359°7. For purposes of illustration it may be unfortunate that Smith Point Lighthouse actually happens to bear 359° ½ from the lighted buoy, that is, so nearly 360° or the whole of a circle; while, of course, this average bearing might be any degree of the compass, depending upon the actual geographic positions of the objects comprising the range and their actual bearings from each other.

The deviation on each heading is then obtained by comparing the bearing on that heading with this average magnetic bearing. These deviations are plotted, as usually done, on the NAPIER diagram, from which the deviations may be taken by inspection for any other headings. In this case the deviations were obtained with the ship's head on given compass courses. The deviation on each heading is therefore laid down on the dotted line passing through that graduation of the vertical scale of the NAPIER diagram representing that heading.

As under other methods, a single swing with one helm will furnish determinations of deviations with a precision sufficient for practical purposes. For the greatest accuracy, of course, two swings should be made with different helms, and for the final NAPIER curve the mean of the two deviations on each course taken, as is usually done.

It is realized that coefficient A cannot be determined from the swing illustrated. Since A becomes, however, of appreciable amount only when the compass is located off the amidship line, or for some like cause, its value is usually so small that it may be neglected for all practical purposes, or its value from a previous swing may be used.