

NAVIGATIONAL DUTIES

Navigation is the art or science of determining the position of a ship or aircraft and directing that ship or aircraft from one position to another. It can be regarded as an art because its application involves the exercise of special skills and fine techniques, which can be perfected only by experience and careful practice. On the other hand, navigation can be regarded as a science inasmuch as it is knowledge dealing with a body of facts and truths systematically arranged and showing the operation of general laws. Navigation has been practiced for thousands of years; however, modern methods date from the 18th century invention of the chronometer, a precision timepiece. As a Signalman, you may be required to assist the navigator by taking bearings, using the bearing circle or alidade. You may assist the officer of the deck (OOD) by sounding whistle signals and by being alert to aids to navigation.

To better prepare you for your navigational duties, this chapter contains information on navigational equipment, aids to navigation, and Rules of the Road.

NAVIGATIONAL EQUIPMENT

LEARNING OBJECTIVES: List and explain the use of navigational equipment that you will come in contact with as a Signalman.

The equipment described in this section is the equipment most likely to be used by you in performing navigational duties.

COMPASSES

There are two types of compasses in general shipboard use: the magnetic compass, which depends on Earth's magnetic field for its directive force, and the gyrocompass, which operates on the gyroscopic principle of the spinning wheel.

When you studied as a seaman, you learned that the magnetic compass points to the magnetic rather than the true North Pole, and that the magnetic pole is located some distance away from the true pole. You also discovered how the Navy standard compass is made, and how its needle is deflected by magnetic

materials either in a ship itself or by magnetic materials brought near the compass.

The gyrocompass, on the other hand, points to true north by operation of the gyroscopic principle. It may, however, have a slight mechanical error of a degree or two, which is known and for which due allowance is made.

Magnetic Compass

The ship's magnetic compasses are named or classed according to their use.

The standard compass is the magnetic compass used by the navigator as a standard for checking other compasses on the ship. It is so located that it is least affected by the internal magnetism of the ship. Courses or bearings given from it are designated per standard compass (PSC).

The steering compass is located near the helmsman. Along with the gyro repeater, it is the compass by which the ship is steered. Courses or bearings given from it are designated per steering compass (PSTCO).

Gyrocompass

The gyrocompass is not affected by variation and deviation. Headings or bearings from it are designated per gyrocompass (PGC).

When in proper running order, the gyrocompass points constantly to true instead of magnetic north. It may have a slight mechanical error, called gyro error, which is computed easily and remains constant for any heading.

Despite the excellence of the gyro mechanism, it is the magnetic compass—not the gyro—that is standard aboard ship. The reason is the magnetic compass operates through the attraction exerted by Earth. Consequently, the magnetic compass will never go out of commission because of power failure.

The gyrocompass, on the other hand, is powered by electricity. If the supply is cut off, the gyro is useless. Being an extremely complicated and delicate instrument, it is also subject to mechanical failure.

Some gyros, for instance, become erratic after the ship makes a series of sharp turns at high speeds. The possibility of a gyro malfunction does not mean, however, that great confidence cannot be placed in the gyro. When running properly, it can be depended upon to point faithfully and steadily to true north. But the magnetic compass, being more reliable, is used constantly to check the gyro's performance.

Typical shipboard installations of gyrocompasses consist of one or more master gyros, whose indications are transmitted electrically to repeaters located in conning stations, on bridge wings, and at other necessary points.

BEARING AND AZIMUTH CIRCLES

Strictly speaking, *azimuth* and *bearing* are the same in meaning: the horizontal angle that a line drawn from your position to the object sighted makes with a line drawn from your position to true north. The word *azimuth*, however, applies only to bearings of heavenly bodies. For example, it is not the bearing, but the azimuth of the Sun; and not the azimuth, but the bearing of Brenton Reef Tower.

A bearing circle is a nonmagnetic metal ring equipped with sighting devices that is fitted over a gyro repeater or magnetic compass. The bearing circle is used to take bearings of objects on Earth's surface.

The azimuth circle (fig. 9-1) is a bearing circle equipped with additional attachments for measuring

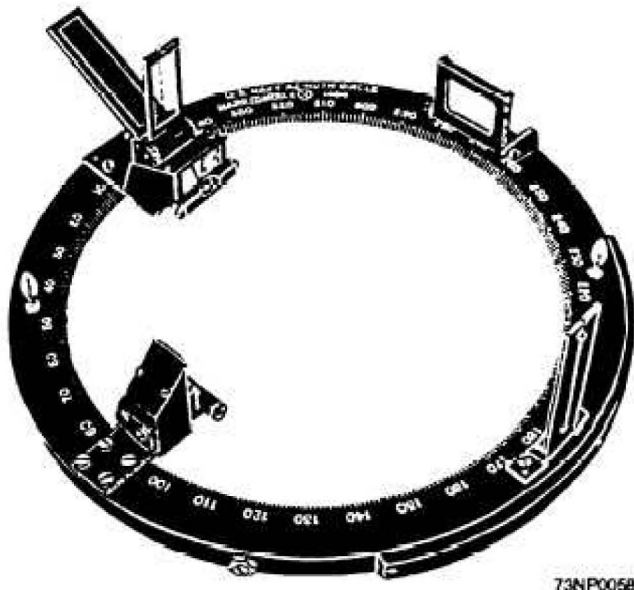


Figure 9-1.—Azimuth circle.

azimuths of celestial bodies. Either bearings or azimuths may be taken with the azimuth circle.

Taking a Bearing

Assume that you are getting a bearing on a lighthouse. Install either a bearing or azimuth circle on the gyro repeater, and make sure that the circle rotates freely. Train the vanes on the lighthouse so the lighthouse appears behind the vertical wire in the far vane. Drop your gaze to the prism at the base of the far vane, then read the bearing indicated by a hairline in the prism.

Taking an Azimuth

The azimuth circle may be used in two ways to measure the azimuth of a celestial body. The first method is used with a brilliant body such as the Sun. At the upper center in figure 9-2, you see a concave mirror; and at the lower center, a prism attachment. Sight with the mirror nearest you, and the prism toward the observed body. Light from that body is reflected from the concave mirror into the prism. The prism, in turn, throws a thin beam on the compass card. This beam strikes the graduation that indicates the azimuth.

The second method is used for azimuths of bodies whose brightness is insufficient to throw such a distinct beam. Behind the far vane on the azimuth circle is a dark glass that may be pivoted so as to pick up celestial bodies at various altitudes. When a body is sighted, its reflection appears behind the vertical wire in the far vane, and its azimuth may be read under the hairline in the prism.

The inner lip of the azimuth circle, in figure 9-2, is graduated counterclockwise in degrees. It is



Figure 9-2.—Taking an azimuth.

possible, then, to obtain relative bearings of objects by merely training the vanes on an object, then reading the graduation on the inner circle alongside the lubber's line on the pelorus or repeater.

Each of the far vanes contains a spirit level to indicate when the circle is level. Bearings taken when the azimuth or bearing circle is not on an even keel are inaccurate.

TELESCOPIC ALIDADES

Another means of taking bearings is by using an alidade, which, like the bearing circle, is mounted on a repeater. The telescopic alidade (fig. 9-3) is merely a bearing circle with a small telescope attached to it. The image is magnified, making distant objects appear larger to the observer. A series of prisms inside the low-power telescope enables the bearing-taker to read the bearing directly from the compass card without removing the eye from the eyepiece.

Bearings and azimuths may be true, per gyrocompass (PGC), magnetic, or per steering compass (PSTCO). When you are helping the navigator in piloting you probably will report bearings directly from the gyro repeater, and the navigator will correct them to true.

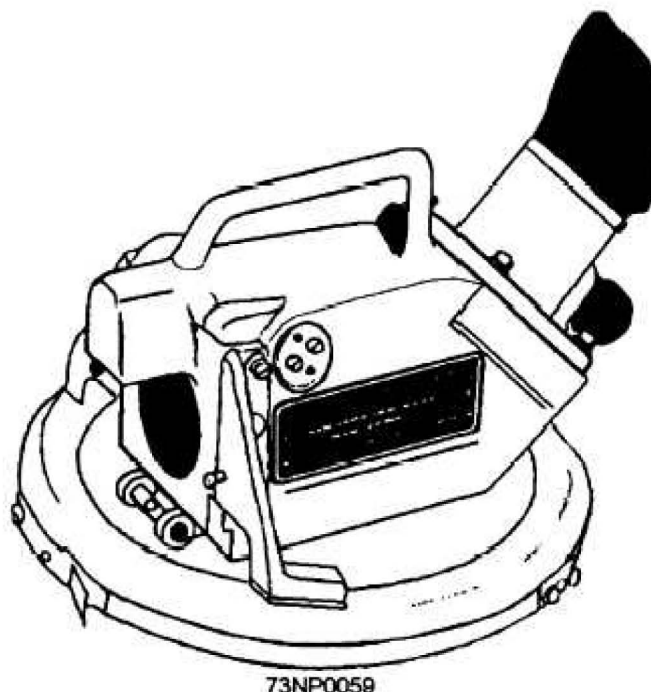


Figure 9-3.—Telescopic alidade.

LEARNING OBJECTIVES: Explain the use of navigational charts and publications. Explain chart scales, chart sounding marks, and how to make chart corrections.

A map represents pictorially all or part of Earth's surface. Maps specially designed for navigators are called charts. Navigational charts show water depths and the nature of the bottom, together with a topography of adjacent land.

A chart is a printed reproduction of a portion of Earth's surface depicting a plan view of the land and water. A chart uses standard symbols, figures, and abbreviations that supply data on water depth, characteristics of the bottom and shore, location of navigational aids, and other information useful in navigation. Figures indicating water depth are placed throughout the water area to indicate the shape of the bottom. Normally the density of sounding on a chart increases as you approach land. A chart is normally lined with a network of parallels of latitude and meridians of longitude, which aid in locating various features.

LOCATING POSITIONS ON CHARTS

Earth is approximately an oblate (flattened at the poles) spheroid. However, for most navigational purposes, Earth is assumed to be a sphere, with the North Pole and South Pole located at opposite ends of the axis on which it rotates. To establish a feature's location geographically, it is necessary to use two reference lines, one running in a north-south direction and the other in a east-west direction. Numerical designators are applied to these reference lines. The numerical system used is circular and consists of 360° , with 60 minutes or 3,600 seconds in a degree.

Lines running in the north-south direction, called meridians, start at one pole and end at the opposite pole. (See fig. 9-4.) Lines running east-west are parallel lines and are called parallels.

Meridians

The prime (0°) meridian, which is the reference line for all meridians, passes through the Royal Observatory located at Greenwich, England. Earth is divided into Eastern and Western Hemispheres. All meridians are numbered between 0° and 180° east and west of the prime meridian. In addition to the number value, each line is identified by the letter *E* or *W*, denoting the proper hemisphere.