

ISOGONIC LINES ON U.S. COAST AND GEODETIC SURVEY NAUTICAL CHARTS

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Mapping the earth's features to show their relative locations dates back to the ancient Greeks, who devised a geographic coordinate system long before the compass. Being astronomers, the Greeks based their methods on the determination of a true meridian by star observations, which was unsuitable for navigation.

This problem was solved by the invention of the magnetic compass, which provided a means whereby direction could be defined with reference to an earthly phenomenon and orientation could be determined, provided that the orientation of the initial direction or compass pointing was known. In view of the fact that the difference in the pointing of the needle and true north was not great in the locality where the compass was first used in navigation, it is not surprising that it was then assumed that the needle pointed to true north. The fact that it doesn't, however, presents the problem of charting the approximately correct orientation of the earth's magnetic field so that a mariner using his compass would be able to plot his observed course or bearing in relation to the charted features.

Our knowledge of the earth's magnetic field is attained primarily from direct observations. The discovery of magnetic declination, or the variation from true north of the compass pointing, was the first important fact observed relative to the earth's magnetism. Early navigators and explorers contributed many observations on this characteristic. These observations provided the cartographers of that time with valuable information for revising the charted compass roses. In view of the fact that magnetic declination is now known to vary not only with locality, but also with time, the problem of furnishing the mariner with up-to-date information requires a program in which the charted magnetic data will be constantly revised in accordance with information furnished by new observations.

Since shortly after its inception in 1807, the U.S. Coast and Geodetic Survey has been carrying out a slowly expanding program of magnetic observations and surveys in conjunction with its nautical charts. The accrued results of this work constitute a general magnetic survey of the entire country with observations in nearly every county. The stations are not uniformly distributed, and in some cases their spacing is as great as 40 miles. To date, magnetic observations have been made at several thousand places. At approximately 100 of these stations, observations are being repeated at frequent intervals. In addition, continuous photographic records of changes in the principal magnetic elements are being obtained at seven magnetic observatories located in the United States, Alaska, the Hawaiian Islands, and Puerto Rico. From the data collected by this program it has been possible to produce isogonic charts of the United States, the accuracy of which has been estimated to have a probable error of not over 30 minutes. These isogonic charts are produced at intervals of every five years and the epoch dates selected are in agreement with the 1949 resolution of the International Hydrographic Bureau, namely the Epoch 1950.0, 1955.0, 1960.0, etc.

Since the early history of chart making, compass roses have been a standard feature on nautical charts. The invention of isogonic lines as a more suitable method of delineating the magnetic declination characteristics over large areas of the earth's surface was disclosed in 1641.

In 1855, the U.S. Coast Survey (the Bureau's name at that time) published an outline map of the United States showing isogonic lines fringing the coastal areas. This map, subsequently revised from later observations, was used to add isogonic lines to the early sailing charts of the Pacific coast. The first of these charts covered the waters from San Diego to San Francisco. This chart, published in 1888, showed isogonic lines for every degree, extending to about 150 miles offshore. By 1892, two other charts completed the isogonic-line chart coverage of the West coast and Alaska. In 1911 and the years following, these early charts were superseded by a new series of sailing and general charts constructed on a more suitable scale and coverage. In 1935, as new series of charts on both the East and West coasts were completed, it was decided that certain small-scale charts could be improved by using the isogonic form of charting magnetic declination rather than the accustomed correction shown on only three or four widely-spaced compass roses.

Prior to 1950, no definite rule had been made for determining on which charts isogonic lines would be an improvement and on which they serve no useful purpose. In 1950, the Coast and Geodetic Survey adopted the following policy for showing isogonic lines on nautical charts.

Isogonic lines are to be shown only on those charts where a difference in variation of one degree, in general, would be represented on the charts by a distance of not over 12 inches.

This decision authorized the use of isogonic lines on 27 charts covering the East coast, West coast, Alaska, and the Hawaiian Archipelago. The largest scale in this series is 1 : 300 000

It was also decided that charts using isogonic lines should use a special compass rose. This rose consists of a compass circle with zero at true north and of a centerline oriented in accordance with the direction and amount of variation. The amount of variation, the year determined (in parentheses), and the annual change are given along the centerline.

The purpose of this special rose, which omits the inner magnetic compass circles, is to eliminate the possibility of a mariner using the magnetic circles to lay out courses in areas of quite different variations.

It is a policy of the Bureau to symbolize isogonic lines by magenta solid lines on all nautical charts except those containing magenta Loran lines of position. On such Loran charts, the isogonic lines are changed to a dashed-line symbol, but are retained on the magenta plate.
