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Analysis of problems related to the use of ship's course indicators

Analiza problemów wykorzystania wskaźników kursu na statkach morskich

Evgeny M. Lushnikov, Krzysztof Pleskacz

Maritime University of Szczecin, Faculty of Navigation, Institute of Marine Navigation
Akademia Morska w Szczecinie, Wydział Nawigacyjny, Instytut Nawigacji Morskiej
70-500 Szczecin, ul. Wały Chrobrego 1–2, e-mail: k.pleskacz@am.szczecin.pl

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Abstract
The article presents the results of compliance with the provisions relating to the operation of magnetic compasses and gyrocompasses. The proper conducts of ship's documents, related to this issue have been analyzed. The paper also presents proposals for action aimed at facilitating and improving the existing situation.

Słowa kluczowe: kompas magnetyczny, żyrokompas, całkowita poprawka kompasu magnetycznego, poprawka żyrokompasu

Abstrakt
W artykule zaprezentowano wyniki badań nad przestrzeganiem przepisów związanych z eksploatacją kompasów magnetycznych oraz żyrokompasów. Przeanalizowano także prawidłowe prowadzenie dokumentacji statkowej dotyczącej tego zagadnienia. Przedstawiono również propozycje działań, których celem jest ułatwienie i poprawa istniejącej sytuacji.

Introduction

In modern ships gyrocompass signal is the main source of ship's heading used by other navigation devices, but …

On the ship, 15 000 GT, bound for Danish Straits, with a coal cargo from Świnoujście, navigating in dense fog, in the area Fehmarnbelt, there was a silent failure of the gyrocompass. Autopilot got a false signal about the vessel course, other than proper by about 90° and slowly began to turn to the starboard. Radar course has shown erroneously that the ship is moving into the original direction. However, very soon began to diminish distance to the Danish coast. This alarmed the captain. Immediately reduced the speed to the minimum, compared the course on the magnetic, radar position compared with the GPS position. Having confidence in the magnetic compass, the trip continued controlled by the magnetic compass.

7500 GT ship when sailed from Rotterdam to Tarragona, navigating in the area Finisterre traffic separation zone, in ideal weather conditions began to circulate slowly. The officer realized after a while that something is wrong, when the moon began to move through windows. It took time before they identified the fault. Failure was caused by gyrocompass. The arrival of captain did not solve the problem. It turned out that the magnetic compass is unreadable due to the dust of the optical system. The vessel was loaded with grain and dust contaminated the whole system. Longer time elapsed before they were controlled by magnetic compass.

However, such events do not always have a happy end. Undetected on time a gyro failure

caused one of the largest environmental disasters in history. Supertanker "Torrey Canyon" run aground on the rocks of the Silly Island. As a result was an oil spill in volume of 130 000 tonnes.

The requirements for ship's equipment

According to the requirements of SOLAS – chapter V, for ship's navigation systems and equipment, all ships, irrespective of size, shall have:

- A properly adjusted standard magnetic compass, or other means, independent of any power supply, to determine the ship's heading and display the reading at the main steering position [1, Reg. 19, paragraph 2.1.1];
- Means of correcting heading and bearings to true at all times [1, Reg. 19, paragraph 2.1.3];
- All ships of 150 gross tonnage and upwards and passenger ships irrespective of size shall, in addition to the requirements of paragraph 2.1, be fitted with: a spare magnetic compass, interchangeable with the magnetic compass as referred to in paragraph 2.1.1,or other means to perform the function referred to in paragraph 2.1.1 by means of replacement or duplicate equipment [1, Reg. 19, paragraph 2.2.1];
- All ships of 500 gross tonnage and upwards shall be fitted with a gyrocompass, or other means, to determine and display their heading by ship borne non-magnetic means and to transmit heading information for input to the radars, automatic identification systems or automatic tracking systems [1, Reg. 19, paragraph 2.5.1].

Resolution A.382(X), annex I, paragraph 3, requires that, each magnetic compass is properly compensated and its table of curve of residual deviations is available on board in the vicinity of the compass at all times [2].

While the convention STCW in section A-VIII/ 2, part 3–1, paragraph 21.5.2 requires, that relieving officers shall personally satisfy themselves regarding the errors of gyro- and magnetic compasses [3].

All these rules and requirements have led to the development of recommendations on the use of magnetic compasses and gyrocompasses included in the collections of the implementing rules:

- Resolution IMO A.382(X), anex II – "Recommendation on performance standards for magnetic compasses";
- ISO449 – "Ships and marine technology – magnetic compasses, binnacles and azimuth reading devices – Class A";
- ISO 2269 – "Shipbuilding – Class A magnetic compasses, azimuth reading devices and binnacles – tests and certification";
- Resolution IMO A.424(XI), anex – "Recommendation on performance standards for gyrocompasses";
- ISO 8728 – "Ships and marine technology – marine gyro-compasses";
- Polish standard PN-EN 60945;
- Polish standard PN-EN 61162;
- Polish standard PN-EN 62288.

Low listed conditions of indemnification which are carried out in cases concern them:

- When a new compass is installed;
- When compass performance is unsatisfactory or unreliable;
- When deviation exceeds 5 degrees;
- After alternations and additions to vessel's structure and equipment;
- After trauma, such as lighting strike, grounding, fire, etc.
- When a record of compass deviation has not been maintained;
- After repairs involving welding, cutting, grinding, etc which may affect the compass;
- When electrical or magnetic equipment close to the compass is added, removed or altered;
- When compass deviation does not appear to correspond with that shown on deviation card;
- After using electromagnetic handling equipment for loading or discharging cargo;
- During carriage and after discharging cargoes that have magnetic properties.

The date of any adjustment and other details should be noted in the logbook. Such details should include the position of all compass correctors, as well as the vessel's position and sea conditions when the adjustments were made.

A magnetic compass' error should be determined at least once a watch while the vessel is at sea and, when possible, after any major alteration of course. Observed error should be recorded in the logbook. Checking the compass deviation regularly may indicate the need for repair, testing or adjustment. In addition, compasses should be inspected occasionally by a competent officer or compass adjuster [2].

Analysis of compliance

It was decided to verify how the compliance requirements related to the operation of magnetic compasses and gyrocompasses looks in practice. For this purpose, the survey was conducted in two

ways. In the first way the survey was conducted among the captains and chief officers, in the secound way extracts of dozens of ships' logbooks were analyzed.

Questions were directed to a hundred people taking part in various courses conducted by the Maritime University in Szczecin. Among the respondents were managers with years of experience at sea, the persons directly responsible for organizing the work on the vessel in the navigation section, and even lead supervision over lower-level officers. The average length of service for marine survey was 17 years old.

To the question, "What regularity is referred to the gyro corrections?" – 63% of respondents answered that defines a regular basis.

However:

- 45% – specify gyro corrections in watch time,
- 40% – once a week,
- 15% – once a year.

Similarly, the question of the magnetic compass total correction, positively responded only 46%:

- 53% – specify corrections in watch time,
- 9% – once a week,
- 38% – once a year.

When asked, "What methods are referred to the corrections?" Answers arranged as follows:

- Gyro correctios:
  - 62% – defined by the leading line,
  - 39% – determined by the astronavigation's methods,
  - 12% – other.
- Magnetic compass total correction:
  - 56% – defined the correction by comparison with the gyrocompass;
  - 32% – defined by the leading line;
  - 35% – determined by the astronavigation's methods;
  - 15% – other.

An important element of the operation of the magnetic compass is to compensate the errors that arise during its use. Respondents were asked about a person, therefore, deviator, compensation, and on the actual deviation, which is crucial and necessary for the proper use of a magnetic compass.

When asked, "When the respondents had witnessed conduct by a magnetic compass deviations deviator on the ship?":

- Never – 16%;
- Over the last year – 39%;
- More than a year ago – 45%.

"When was the last of deviation compensation carried out on the ship?" Responded as follows:

- Never – 23%;
- Over the last year – 42%;
- More than a year ago – 35%.

"How did the last, force table deviance?":

- Has been defined by deviator – 55%;
- Has been defined by the crew member – 27%;
- Other – 18%.

Analysis of the logbooks

To verify these results, authors analyzed 24 logbooks of commercial vessels operating under various flags. At the beginning of the analysis, it can see the variety of terms for the same concept of navigation (see Fig. 1). These terms are summarized below with a breakdown of the logs of various flags:

1. Marshall Islands: ship's head – gyro, standard, steering.
2. The Netherlands: compass course, magnetic compass, gyro compass, true heading, course made good.
3. The Netherlands, Antiqua Barbuda, Luxemburg, Liberia: ground track, course steered G/M compass, magnetic compass heading.
4. Denmark: gyro compass, standard compass, course made good.

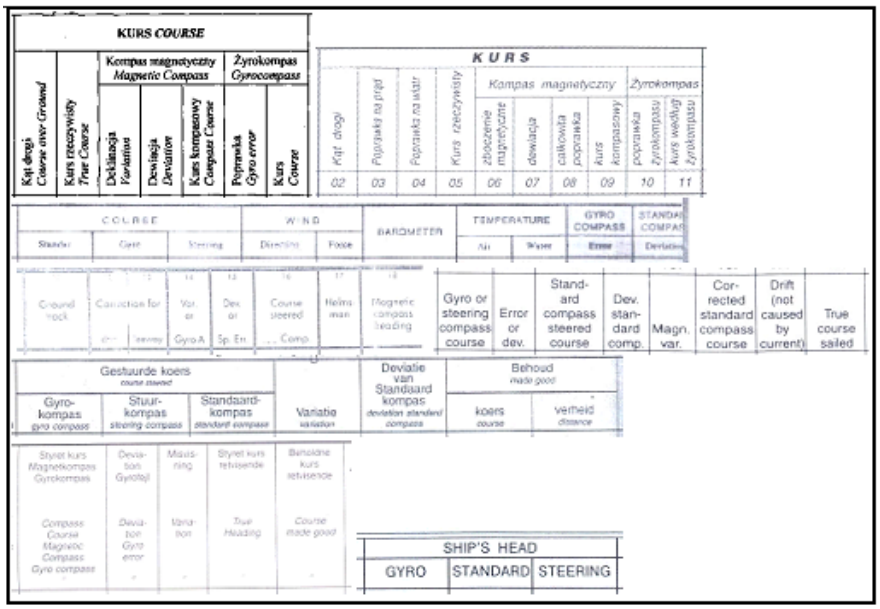

Fig. 1. Summary of selected heads of logbooks
Rys. 1. Podsumowanie wybranych nagłówków w dzienniku

5. Bahamas: gyro or steering compass, standard compass steered course, true course sailed.
6. Malta: course over ground, true course, magnetic compass course, gyrocompass course.
7. Greece; course: standard, gyro, steering.
8. Polish only identify the various types of courses: course over ground, true course, magnetic course, compass course and gyrocompass course (the ship is operating in international shipping).

And yet, all terms are clearly defined in IMO Resolution A.382 (X) or the documents implementing this resolution:

- A magnetic compass is an instrument designed to seek a certain direction in azimuth and to hold that direction permanently, and which depends, for its directional properties, upon the magnetism of the earth [2, annex II, paragraph 1.1];
- The standard compass is a magnetic compass used for navigation, mounted in a suitable binnacle containing the required correcting devices and equipped with a suitable azimuth reading device [2, annex II, paragraph 1.2];
- The steering compass is a magnetic compass used for steering purposes mounted in a suitable binnacle containing the required correcting devices [2, annex II, paragraph 1.3]. A steering magnetic compass, makes the heading information provided by the standard compass available and clearly readable by the helmsman at the main steering position [2, annex I, paragraph 1(b)];
- Course made good means the actual direction to the surface of the Earth, which moves the ship after taking into account the constant action of ocean currents, tidal currents of wind and currents of wind [4].

Because there are clear determinations, as defined by IMO, on all ships under different flags, the same term for the names of individual courses should be used.

Noticed attention in the performance of log--books made impossible to correctly control the operation of compasses:

- Recognition gyro course for the course over ground of the checks prevented any control gyrocompass indications. Absence drift and even when was: the wind in the 8–9, sea state 7, swell SW-4 m, than "ground truck" = "steered course" = 246° (many similar examples);
- Leave boxes "variation" unfilled for several watches prevented any control of total corrections;
- The field "standard compass" while leaving the empty boxes "steering compass" for several days demonstrates a lack of systematic monitoring equipment.

Conclusions

The results analysis shows that almost always only one method of determining the corrections of the compass was used. Only 13% of respondents uses two alternative methods for control gyro- and 38% for magnetic compass.

Also it should be noted that only 28% of the respondents sets gyro in accordance with good sea practice and regulations, at least once a watch. Given this fact and the fact that 56% of respondents determines corrections of the magnetic compass by comparing the gyrocompass, it should be concluded that only about 20% of the officers do that in accordance with the regulations of controlling the magnetic compass.

All the above-mentioned errors in the control of magnetic compass deviations and gyro corrections indicate neglect proper and regular inspection of these two devices on board.

The need for systematic monitoring of these devices by varied methods not limiting only to the method of celestial navigation and the use of leading line should be regularly reminded during the trainings on ships and qualifications courses. A vessel navigating in leading line is usually in difficult situation. Celestial navigation method is time consuming, requires great skill, accuracy, suitable weather conditions and has a little use in restricted water and coastal shipping.

There are other methods for corrections' determination [5]:

- Radar's leading line,
- Base line leading,
- Take a bearing by others,
- AIS,
- The drawing of two horizontal angles.

The choice of method by which the navigator will determine the correction depends on the distance from the navigational marks, external conditions, visibility, presence of navigational dangers and traffic of the other ships.

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