The magnetic compass

Magnetic compasses are still required on all commercial vessels, but their maintenance and adjustment is becoming something of a lost art. Rod Hesp looks at what's needed

Rod Hesp

For over 2000 years, the magnetic compass has played a role in the advancement of society. From navigation and exploration to topography and space exploration, the compass has been a significant instrument. Due largely to the invention of the gyro compass, the magnetic compass has been regarded as a secondary means of navigation in the marine industry. The gyro compass has developed over the past 60 years and now offers mariners a reliable true geographic heading, often within a single degree of accuracy. Nevertheless, once a ship is at sea there must always be a secondary system, in this case the magnetic compass.

Common faults

Much like a lifeboat, the magnetic compass is rarely used on larger vessels. However, it is seen to be an important instrument and must be present and maintained in a reliable operational condition on all commercial vessels. Lifeboats and other lifesaving apparatus are for the most part well serviced and well maintained and duly inspected, most crews being proficient in their use. Sadly, this is not the case when it comes to the magnetic compass. Some vessels do maintain their compass but few maintain it in excellent condition.

All too often, defects in the magnetic compass only come to light in the course of a Port State Control visit. When the installations are inspected, the access screws to the magnet racks are found to be seized, the nuts on the quadrantle spheres are rusted solid, and nobody knows where the spares are kept. Few mariners are aware that it is common practice for the flux sensor for the off-course alarm to be attached to the magnetic compass. If this is defective, the alarm may well fail to perform as intended. Finally and perhaps, most surprisingly, the calculations observed in the compass observation book when determining the deviation are often incorrect. Entries are scarce – often weeks apart – and accompanied by the note 'overcast'.

Carriage requirements

All flag states set out carriage requirements for the magnetic compass on commercial vessels in their regulations. The general requirement is for a magnetic compass at the steering position or visible at the steering position. Foreign-going vessels must supply an azimuth ring to utilise in obtaining bearings from the magnetic compass. If there is an off-course sensor fitted to the top of the compass, there must be means to disconnect the sensor, allowing the azimuth ring to be placed on the compass. The binnacle should provide means to compensate for the vessel's magnetic fields, and it is recommended that spare correcting magnets, flinders bar (rods) and quadrantle plates for specific designs are available. The binnacle should be illuminated, and should also have illumination from an emergency source. The majority of administrations require the carriage of a spare compass of the same design as the compass in the binnacle, although this may vary between administrations.

Use, storage and maintenance

When the compass is observed through a periscope from the steering position, it is recommended that the light be turned off unless it is being used for steering or to check the magnetic heading. Given that the binnacle is wrapped in a canvas cover, the bulbs in the binnacle act as a slow cooker and the heat increases the rate of failure of the seals in the compass. In addition, where compasses are lit from above, this invariably results in a burn mark on the top glass of the compass.

The compass heading may be electronically displayed at the helm position on vessels which have a flux sensor installed on the compass. The displayed heading should be regularly compared to the actual compass heading observed through the periscope or at the compass, and the sensor adjusted to ensure the headings are the same. On some vessels there is no means of reading the heading directly from the helm position and the only magnetic heading is an electronic display. Good practice requires that the heading should be compared directly to the heading on the compass by physically viewing the compass, and checking by radio with the heading displayed. Adjusting for discrepancies may not be a simple operation in some installations and a technician should be called for service.

As with lifeboats and LSA equipment, the compass should be inspected at least every month. The mirror glasses should be cleaned, the compass observed for any bubbles in the fluid, and both lights checked. Ensure the binnacle cover is intact and protecting the binnacle from the elements and the lashing is adequate yet not excessive and readily untied. Locate and inspect the spare compass and spare parts ensuring their location is recorded for future access. Periodic oiling of the correcting magnet cover access screws (bolts), quadrantle sphere securing nuts and flinders bar tube is also necessary (rotating the flinders bar is an option).

The spare compass should be stowed upside down to avoid damage from pounding etc. Spare correcting magnets should be stowed a metre from the other spare compass parts and the spare compass. It is also good practice to carry spare binnacle light bulbs, as the type of bulbs used may not be readily available in some ports of call.

Observation records

Compass observation records should be entered every watch, or at worst once a day – and Port State Control inspectors do take note of the frequency of observation! The optimum observations would observe the errors on as many different headings as possible during the voyage. With the introduction of the gyro compass, the mariner observes a gyro bearing by sun, by star or by transit and calculates a gyro error. The magnetic heading is observed and gyro error and magnetic variation are applied to obtain the compass deviation for that heading. Checking the gyro is obviously essential and should be carried out consistently. Variances in gyro error are usually – but not always – due to observer error. When the inputs are correct the gyro error should not vary more than by a degree. However, magnetic compass error varies with heading. Consequently, there is a real need to record errors on as many headings as possible to check the deviation card and assist the compass adjuster in the next adjustment. If the skies are overcast etc,

the recommended practice is to assume the gyro error is consistent and compare it to the magnetic compass, record the deviation calculated and enter 'gyro' in place of 'sun', etc. in the compass observation book. A common practice on most vessels is to record the heading by gyro and magnetic compass in the bridge log book at the end of each watch or when headings change. If time is limited or it is not convenient to perform a compass error check, then simply enter the information in the compass book, again stating 'gyro' as the object used to check the magnetic compass. This practice is of particular use when in pilotage waters, as invariably the headings change more frequently than when on an ocean passage. Future articles will look at practical ways to adjust the magnetic compass.

GPS and satcom

Finally, the merits of the GPS and satellite compass require some review. There should be little doubt that ocean navigation has been revolutionised by the development of the GPS. ECDIS, electronic charts and AIS all rely on GPS. The global positions obtained from the GPS are truly finite given the required accuracy of mariners. However, the data extrapolated by system receivers is subject to misinterpretation. The course and speed displayed is the course and speed made good (across the earth's surface), not through the water, giving rise to potential errors in navigation, collision avoidance and comparison with the magnetic compass. The greater the tide, current and wind, the greater potential error in the course and speed displayed on the vessel – and in the data received by other vessels eg via AIS.

With the rapid advancement of technology, it is certainly possible that the navigator may rely on this data without verifying it. It is recommended that the GPS heading should be compared to that of the gyro compass. New technology, although continuing to rely on the GPS, continues to address the potential faults in heading data. The satellite compass (satcom) offers accuracy in course through the water to within one degree. Simply put, the satcom receiver obtains three positions microseconds apart: A1, B1 and C1, which together give the heading. As the vessel moves position, A2, B2 and C2 are obtained and again the heading between them is calculated. The basic GPS calculates a heading between A1 and A2, which is subject to set and drift. The limitation of the satcom is that it depends on the reception of a GPS signal that may be intermittent, particularly in coastal areas. Satcoms are becoming ever more popular as a secondary compass, as they are significantly less expensive than a gyro compass. The satcom is a practical and inexpensive option for smaller vessels such as tugs, fishing vessels and pleasure craft, although it must be provided in addition to and not instead of the magnetic compass. The heading data displayed on the satcom is a true heading, so local variation must be applied when comparing it to the magnetic compass.

Rod Hesp is a Master Mariner (UK/Canada), and a Transport Canada Certified Compass Adjuster

The Institute has a significant number of compass adjusters in membership and a special interest group for them has been suggested. If you have ideas on how to take this forward, please contact the CEO, Philip Wake, at cpw@nautinst.org

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