3. The Magnetic Compass

Introduction

A reliable compass is essential to steer an accurate course
Primary reference for steering the boat when out of sight of land, in fog or no visible aids
Installation and adjustment are critical for accuracy
Magnetic compass seldom 100% accurate
Magnetic variation (difference between true north and magnetic north) means rarely pointing to true directions
Subject to deviation (on board influences)

Earth's Magnetic Field

Earth revolves in an easterly direction on its north-south axis
On a globe meridians are north-south lines wide apart at the equator then closer together and eventually meet at the poles

Mercator Projection

On a Mercator projection meridians are shown as parallel lines running vertically
Directions of bearings or courses are determined by measuring the angle between a meridian and the boats bearing or course line
These are true directions because they are measured from true north, the geographic north pole
The grid of latitude and longitude was developed to enable directions and measurements to be calculated on maps and charts

The Magnetic Poles

North Star (Polaris) which is almost directly above the geographic north pole was used for many centuries as a reference for a north direction
Magnetic compasses have also been used for many centuries to find north
If one takes a bearing on the North Star with a magnetic compass in most cases it will be considerably different from 000°

Variation

A magnetic compass does not point directly to magnetic north but aligns itself with the *nearest line of magnetic force or the magnetic meridian*
At any location, the difference east or west between the directions of the true meridian and the magnetic meridian is called *variation*

Deviation

A local magnetic influence that alters the magnetic field near a compass that causes the card to deviate from the magnetic meridian

Deviation is the angular difference, east or west, between *magnetic north* and *compass north*

Causes of Deviation

presence of ferrous metals: steel hulls, stays, shrouds, steering wheels, tools, keys, an engine etc.
wires carrying direct current for electronic equipment, navigational instruments, radios

Effect of the Boat's Magnetic Field on the Compass

Figures 3.2 and 3.3

Compass Installation

If mounted on a bulkhead, as on many sailboats, should be a within 2^{o} of vertical

1. Good Visibility

Easy to see for helmsman
If wheel and compass are not in line a parallax error can develop.

2. Free of Magnetic Influences

Use a small non-magnetic screwdriver to set compensating magnets to neutral (no influence) before installing a compass
Try to locate the compass at least 1.0 m (3 ft) from the engine instruments
Place the compass in its proposed location
Align the sighting axis with the boat's centre line
Note the compass reading
Maintain the alignment while compass is slowly moved around
The card will only move when influenced by a magnetic object
Test the effect of moving fixed metal objects (turn the wheel, open windshield etc.)

3. Where Electrical Influences are Minimal

Check all electrical devices one at a time for their effect on the compass
All electrical wire should be twisted to minimize the effect of direct current

4. Where Vibration is Least
Mount the compass on the part of the boat that is as solid as possible

Slew of the Compass

The compass must be installed so that the line of sight through its lubber line and the centre of the compass card is exactly on the boats fore-and-aft centre line or exactly parallel to it.
An improperly aligned compass will have a constant error in all directions.
This is know as slew.
A slewed compass can never be never be properly adjusted for deviation

Mounting

The compass must be level
The correcting magnets should be set to zero
Double check to make sure the alignment is correct before mounting.
Fasten the unit with non-magnetic screws

Removing Gross Deviation (Compensating the Compass)

Make sure that all wiring, ferrous metal and equipment is in its regular position.

Choose calm water and no current for a an uninterrupted run.

For N-S run start from a fixed aid or temporary marker.

Start close by and run due north by compass.

Drop a temporary marker over the stern.

Make a 180^{o} turn and pass close to the temporary marker heading visually for the start marker.
Accurately note the compass heading on this reciprocal course. If there is no deviation the compass will read 180^{o}.
If it does not the difference between 180^{o} and the reading represents the sum of the deviations on the north and south headings.

Reduce the deviation by using the compensating magnets built into the compass. Turn the N-S adjusting screw to take out half the error, the average of the N and S deviations

Repeat the same pattern in an east-west direction again taking out half the error

Adjusting the E-W magnets will affect the N-S deviation therefore repeat the runs again. Take out half the error each time.

After this STOP. The gross deviation will have been compensated as much as practicable and only minor residual deviation will be left.

Determining Deviation

Difference between the magnetic courses and compass heading is *deviation*.
You can determine deviation by *running magnetic courses*.

Select a local chart that has a number of aids or landmarks reasonable close together.
Determine true and magnetic courses between them in both dirctions and set up a TVMDC table.
Run a series of legs along each course as described previously to determine the deviation in each direction

Procedure

On a day with light wind and no current come close alongside the first aid.
Steer for the second one at a slow cruising speed.
Read the heading as soon as the compass settles down and enter it on the table.
Do this for every combination of aids available.

Deviation can be checked throughout the boating season; while running a range, travelling straight portions of a canal, moving parallel to a seawall in a harbour.