

# **RITCHIE®** NAVIGATION

## **UTILIZE & OPTIMIZE**

Ritchie's Complete Guide to Compass Navigation



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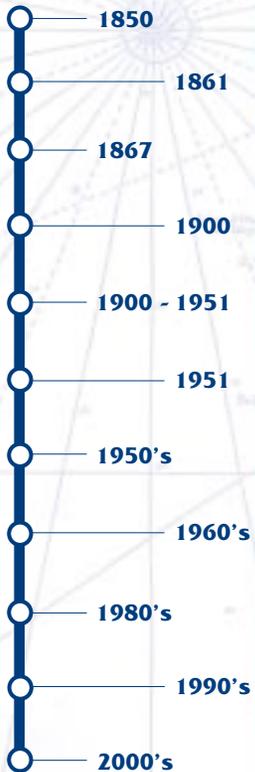
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## NAVIGATION BEGINS WITH THE RIGHT COMPASS

A leader in marine compass manufacturing for over 150 years, Ritchie has played an integral part in navigation history. What you may not realize is that we continue to do so today. A Ritchie compass is just as valuable in 2005 as it was back in the 19th century. The most essential instrument on any boat, a Ritchie compass will never fail you.

On the following pages, you'll learn how Ritchie Navigation came to be, how our products are made and how they can enable you to maximize navigation performance.





## TIME LINE

**1850** - Physicist Edward S. Ritchie begins developing first U.S.-manufactured compass, working out the kinks found in many foreign-made compasses

**1861** - U.S. Naval Observatory puts out a call for American-manufactured navigational instruments - Ritchie is the first one they contact; he receives an order for 26 compasses (10 liquid-filled)

**1867** - E.S. Ritchie & Co. becomes E.S. Ritchie & Sons

**1900** - Ritchie compasses have become a standard instrument to merchants; over 30,000 of them have been sold to merchant vessels

**1900-1951** - Ritchie continues to improve the liquid-filled compass, earning many awards for his work

**1951** - Company is purchased by Marine Compass Company, founded by Louis A. Sherman. The two companies consolidate operations under the name E.S. Ritchie and Sons

**1950's** - E.S. Ritchie and Sons improves the stability and

accuracy of its compasses based on technology developed during WWII

**1960's** - Acrylic domes are developed to replace glass; high-strength plastics replace metal castings; a stronger, lighter compass is born

**1980's** - Ritchie introduces the PowerDamp® Dial System into the Voyager®, Helmsman™, Navigator™ and Globemaster® Compass Series. The PowerDamp Plus® Dial System is introduced in the SuperSport™ Series SS-1000, SS-2000 and SS-5000. And our modular compass capsule designs are introduced in the Explorer™ Series

**1990's** - The RitchieSport® Compass Series X-10, X-11 and X-15 compasses are introduced, as are neutrally buoyant dials in the Voyager and Helmsman

**2000's** - Ritchie develops and introduces the Trek™ Series and completely redesigns the Voyager and Helmsman Series. The Navigator Direct Read Dial, the largest direct read dial in market at the time, is developed

# ABOUT RITCHIE

## ENGINEERING & MANUFACTURING

### Talent, Efficiency and "R2D2"

Ever since Ritchie's beginnings, our talented Engineering Department has been a critical part of our team. Nowadays, our engineers use computers and specialized instrumentation to find better, more efficient ways to build compasses, like the Multiple Compass Filling Station - or as we like to call it, "R2D2" - which allows us to fill 200 RitchieSport or Explorer compasses at a time.



## Making Things Perfect

With an average of 14 years of experience, Ritchie's craftsmen put every ounce of energy they have into getting the product right.

Accuracy and dependability come first every step of the way.

The quality of our materials is unmatched in the industry. We hand balance our compasses before placing parts into the compass bowl, ensuring optimum performance and accuracy. We also use the special Helmholtz coil machine, which allows us to set the magnetic field

of our compasses according to which part of the world you're in.

Ritchie has consistently met the Wheel Mark, and has upheld quality assurance standards and ISO Specifications. How do we do it?

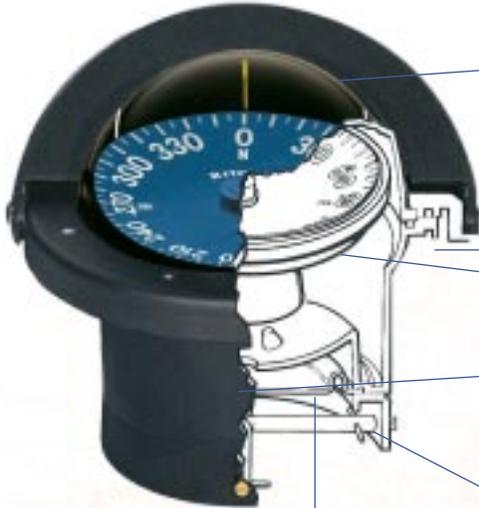
Incredible attention to detail, provided by our in-house master craftsmen. Each component purchased from an outside vendor is evaluated with a critical eye before being passed along for assembly to ensure the utmost in quality control.



**ENGINEERING & MANUFACTURING**

# COMPASS CONSTRUCTION

You've read about how much care we put into producing our products. Now it's time to take a look at what makes them unique.



## Fluid Baffle & Roller Diaphragm.

Enhance the steady performance of the Ritchie compass. Baffle reduces turbulence in the dampening fluid, while diaphragm allows fluid to expand or contract with changes in temperature or pressure, without forming a bubble.

## NiteVu™ LED Night Lighting Systems.

Available with most of Ritchie's models. Provides optimum illumination of dial and lubber lines without hindering night vision. Comes standard for 12-volt operation. Other voltages available on special order.

## Compass Bowls & Housings.

Provide maximum protection and support for internal compass components. Made from brass or high-strength glass-reinforced polymers.

## Corrector Magnets.

A standard on all Ritchie compasses intended for use on boats that might have deviation problems, our built-in compensators are non-interactive magnets that are balanced and optimally spaced for accurate correction when something on-board draws compass magnets away from the Earth's magnetic field.

## Bezels & O-Rings.

O-ring is a custom blend compound that is non-reactive with dampening fluid. Bezels are formed from high-strength plastics, aluminum or machined bronze – all critical to preventing fluid leakage.

## Gimbal Systems.

An internal gimbaling system is most often applied to prevent the compass from bottoming out due to the pitch and roll or heel of the boat. In the diagram, you'll see the bi-axes gimbal system used in many Ritchie models. Dial assembly shown is suspended by Gimbal Rings and Pans formed from ultra lightweight aluminum and held in place with spring-loaded brass pins. Brass Counter Balance keeps the entire system level.

### **Ritchie Dials.**

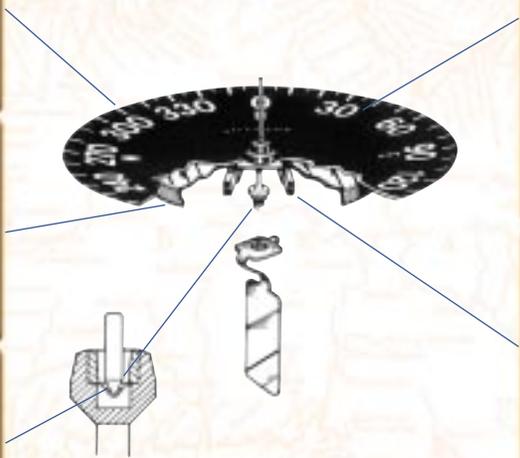
Measurements are given in the apparent visual size. Models available in sizes from 2" (5.08cm) to 6" (15.24cm) in diameter. In many models, you can select Traditional Flat-Card or Direct Reading. The CombiDial, both flat card and direct reading in one, is available in several Voyager, Helmsman and Navigator models.

### **PowerDamp® System.**

This proven system is found in Ritchie Flat-Card Dials. It consists of lightweight baffle that eliminates spinning and dial jumping at high speeds and in rough conditions. Direct Reading and CombiDial dials are formed so that their shapes also provide PowerDamp performance.

### **Pivot and Jewel Movement.**

All Ritchie compasses use a Hardened Steel Pivot and Triple Cup Sapphire Jewel Movement. They are microscopically matched to provide smooth dial operation and fast lock-on, even under the most severe conditions. There are no plastic pivots or jewels in Ritchie Compasses.



### **Dial Readability.**

Ritchie Dials are individually designed with extra large five-degree numerals and easy-to-see increments. Precision spacing of increments allows the helmsman to hold a steady course within one or two degrees of the intended heading. Globemaster dials also available with two-degree increments on special order.

### **DirectiveForce™ Magnets.**

Our special High Gauss magnets are field balanced and matched to each compass model, dial style and size. They are attached to the underside of the dial in pairs matched to seek and lock on to magnetic North. This provides superior accuracy and smooth, rapid response.

# COMPASS CONSTRUCTION

## NAVIGATION OPTIMIZATION

When it comes to attaining optimal navigation performance and safety, there are two things to take into consideration the assimilation of magnetic and electronic data, and the compass selection process. Each plays a critical role in getting you where you need to go safely and efficiently.

### Assimilating Magnetic and Electronic Navigation Data

Even with the onset of electronic navigation, the compass is still the cornerstone of any navigation system. To achieve optimal safety and efficiency, it is necessary to coordinate the use of both electronic and magnetic navigation.

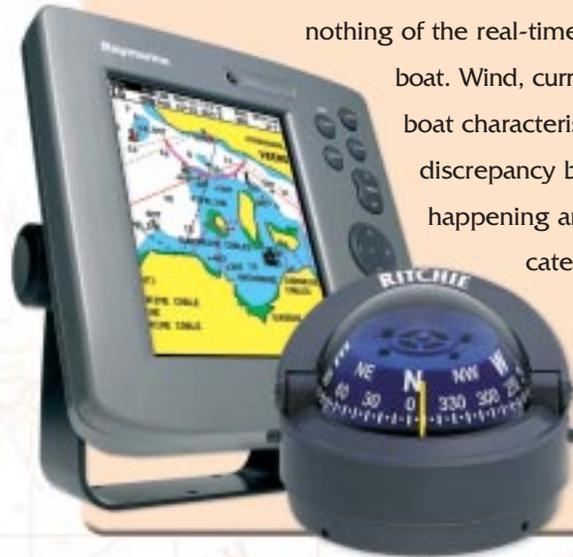
## Using GPS Data and Compass Data Together

A GPS is a great tool when used in combination with your compass. It informs you of your boat's position, using data from multiple satellites. The GPS computer will store that data and use it to calculate both the speed and direction in which your boat has been traveling. But this information says

nothing of the real-time heading of your

boat. Wind, current, boat speed, and boat characteristics can all create a discrepancy between what's really happening and what a GPS indicates. And that's where a

Ritchie compass can help you out.



## Benefits of Real-time Navigation Data

A captain needs real-time heading information to navigate properly. And when it's correctly installed and compensated, a compass will provide that information, no matter the time or speed, under any circumstances - including a power outage. You can depend on a compass to maintain a consistent course while you're underway, which greatly affects fuel consumption, time of travel and ease of steering. If you rely exclusively on a GPS, you'll not only be compromising performance, but safety as well.

## Compass Selection and Installation

On many boats, dashboard and cockpit space are taken up largely by other marine instrumentation and electronics. As a result, captains of both sail and powerboats are relying on compasses that are either too small or incorrectly positioned or mounted. This may seem like a minor detail, but it is actually vital to boating safety, performance and efficient navigation. When you select a compass, you should always consider size, readability of the card, and the design of your boat.



NAVIGATION OPTIMIZATION

## Mounting Styles

Ritchie offers a range of mounting options to choose from - this ensures maximum readability in all kinds of cockpit, deck and bulkhead configurations.



### **Flush-mount/Surface-mount:**

ideal for today's compact dashboard designs



### **Bracket-mount:**

can be mounted on the deck or dash; allows compass to remain at proper viewing angle



### **Bulkhead-mount:**

often used on sailboats to reduce interference with lines and save space



### **Dash-mount:**

ideal for small powerboats with limited dash space



### **Binnacle-mount:**

features an outer-case, often with a light-shielding hood

## Dial Design

No matter where your compass is positioned on your boat, you'll need the dial that gives you the best readability.

Choose from the dial designs below.



**Direct-read dial:** allows you to see the compass heading and lubber line from directly in front; good for when boat design requires your compass to be positioned at eye level



**Flat-card dial:** allows you to look down on the compass to see the course heading

## Positioning

In an ideal situation, a compass should be mounted directly in front of the helm, as well as directly above the centerline of the hull. If this is not possible, the compass should be mounted parallel to the centerline. And on powerboats with upper steering stations, you should have a compass installed at both locations.



**Combi-dial:** a combination of the two designs; incorporates dials that can be read from both above and directly in front of the compass and maximizes readability from any angle



**Gimbaled compass:** always used on sailboats; can improve readability by allowing free movement of the compass dial in rough conditions or when boat is heeling

# MAGNETIC NAVIGATION OVERVIEW

While you may have a grasp on the importance of a compass, if you're like most people, you probably aren't too sure how it works or how you might need to adjust it. But before you have one installed, it's necessary to have a basic knowledge of the inner workings of your compass.

## How a Compass Works

Think of the Earth as having a powerful magnetic bar near its center. The compass needle consists of small, lightweight magnets balanced on a nearly frictionless pivot point. The concept behind a compass is that when that magnet is suspended in the Earth's magnetic field, it will align itself parallel to the force of that field, and thus establish a direction.

## The Difference Between True North and Magnetic North

Since the Earth's magnetic properties are not uniformly distributed, its magnetic poles are not in the same locations

as the geographic poles that you are familiar with. There are two magnetic poles, one in the northern hemisphere (over 600 miles from the North geographic pole) and one in the southern hemisphere (nearly 1500 miles from the South geographic pole).

Your compass will not point to the geographic, or true, North - which can be determined by using the compass rose on your paper chart. Nor will it provide the correct direction to the North magnetic pole. But what it will do is give you a reliable, consistent direction, which will remain constant over a period of several years. (See Variation, pg 14)

## Compass Adjustments

Before using your compass, it is important to understand the factors that affect its performance. That way, you can make appropriate adjustments before getting underway.

(See Deviation, pg 14)

# Dead Reckoning

One of the basics of navigation is a technique known as Dead Reckoning, which is the calculation of the advancement of your boat's position on a paper chart from its last accurately determined location. You use this technique to estimate the course of your vessel.

## The Dead Reckoning Glossary

Before you understand Dead Reckoning, it is important to familiarize yourself with a few essential terms.

- **DR Track:** the path your boat would be expected to follow or is believed to be following, without consideration for wind, waves, current or steering errors; represented on a paper chart by a line drawn from the last known position using courses and distances through the water; this may differ from the actual path the boat travels
- **Course:** the direction of travel through the water
- **Heading:** the direction in which a boat is pointed at any given moment; the heading can vary from the course by several degrees
- **Speed:** the rate of travel through the water; often used to determine positions along the DR track

## When You Need It

Dead Reckoning is most critical when your electronic equipment fails or can't provide accurate navigational data. Dead Reckoning can get you where you need to go and keep both your craft and your crew safe.

It is highly recommended that you plot a DR track regularly as a part of safe navigation. Plot a DR track when traveling through large, open bodies of water, particularly when landmarks are unavailable or when visibility is poor. Also plot a DR track when there is a strong possibility that an emergency will occur. It may suddenly be necessary to report your position to the Coast Guard or other organization.

## How to Do It

Dead Reckoning requires the use of charts and plots indicating both a boat's intended and actual positions. When plotting, it is essential to keep accuracy, neatness and completeness in mind. Measurements taken from the chart must be made with the utmost precision. Observations should be made as accurately as conditions permit. And all calculations should be made fully and put in writing. Neatness will help you avoid any confusion when looking at the chart, while keeping information complete will help you when you need to refer back to it. You can't rely on memory to supply details.

## Deviation

It is not uncommon for a boat's compass to be subject to nearby magnetic materials or influences. There are often magnetic forces in the environment other than that of the Earth's field. Such forces will cause the compass needle to deflect from its proper alignment with the magnetic meridian. The angle between the magnetic meridian (the direction the compass would point if there were no deviating influences) and the line from the pivot through the North point of the compass card is known as deviation.

Deviation can be East or West and range from 0-180 degrees, although larger values should not be tolerated. It changes with the craft's heading and does not change noticeably in any geographic area.

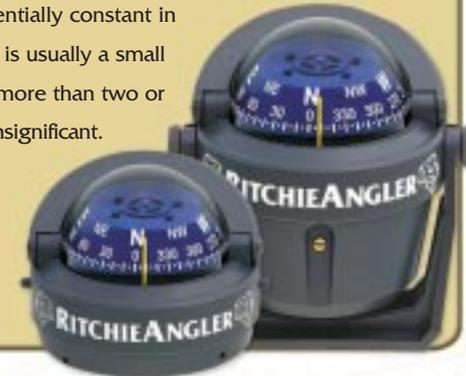
After compensating your compass (pg 16), each boat should have a deviation table - a compilation of deviations, usually one for each 15 degrees of heading by the compass. This table is valid only for the boat on which it is prepared and only for the magnetic conditions at the time the table is prepared. Should any magnetic materials be added, taken away, or relocated, you need to make a new table, or at least check the old table to make sure its values still hold true.

## Variation

Variation, the most basic compass error, is the angle between the meridian and the geographic meridian (talked about earlier under "The Difference Between True North and Magnetic North," pg 12). Like deviation, variation is designated either East or West, depending on how the compass needle is deflected. A navigator can do nothing about variation except recognize its existence and make allowances for it.

Because the Earth's magnetic field is not uniform, variation changes with location. So if you followed a course using Magnetic North as opposed to True North, you could end up hundreds of miles off course, even though you started in the same place.

The amount of variation is essentially constant in any given spot. Annually there is usually a small change, but if your chart is no more than two or three years old, the change is insignificant.



## Magnetic and Electrical Influences

The location of your compass should be at least 2 feet from engine instruments, radios, bilge vapor indicators, electric gauges and any iron or steel. If any of these magnetic influences is too close, either the item or the compass must be relocated. Magnetic influence is subject to the "inverse square law," which means if you double the distance from a magnetic force to the compass, you've reduced its effect by one-fourth; triple the distance, and the effect has been lowered to a relatively insignificant one-ninth, and so forth.

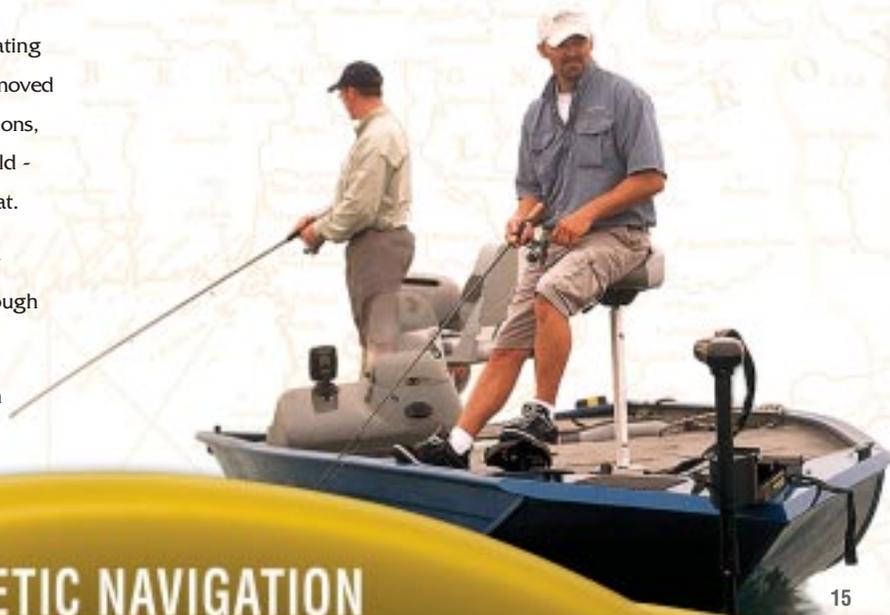
If you test for magnetic influences, be sure to do it under normal operating conditions. Any metal object that moves during boat operation should be moved as usual during testing. Turn the steering wheel all the way in both directions, work the throttle, move the gearshift lever, open and close the windshield - anything that would typically take place when you're out with your boat.

In addition to magnetic influences, your compass can be affected by electrical influences. This happens when electrical currents flowing through wires exert undesired influences on the compass.

To determine if your compass is being affected, switch on and off each of the electrical loads one at a time - the radio, bilge pump, depth

sounder, lights, and windshield wipers. Don't overlook anything near the compass that is controlled by a switch. Start your engine so that all of your boat's electric instruments are operating. If you have an auxiliary generating plant, start that too. Make full sets of checks with your craft on two cardinal headings, 90 degrees apart.

You can avoid the creation of a magnetic field by twisting together the two wires of a circuit. Any wiring beneath the compass and instrument panel should also be twisted in pairs, one pair for the two wires to each instrument switch.



## COMPENSATION

Most compasses will have deviation errors. It is nearly impossible to maintain a safe distance between your compass and magnetically undesirable objects, which means you have to live with known values of deviation as long as they are not too large. But deviation can be reduced to zero (or as close to it as

possible) if your compass is compensated, or adjusted.

Make sure all magnetic material is secure and in its sea-going position. Then, you can begin the compensation process.

Here are the two methods of compensation.

### Compensation Method I

1. With the compass in its intended position, but not fully secured, select a course on your chart using two identifiable marks, buoys or landmarks that are within 10 degrees of the North/South line. Select this course so that you can maneuver your craft "down range" of the marks you select.
2. From a position down range of the North/South marks, and keeping them lined up, run the boat visually along the Northerly course selected. Turn the port/starboard compensator until the compass reads correctly.
3. Reverse your direction and run the boat Southerly, keeping the marks lined up as in step 2. If the compass reads incorrectly, there is an alignment error. To correct it, rotate the compass itself to remove half of the error. Then repeat steps 1 and 2 and recheck.
4. Repeat steps 1-3, except this time, use an East/West course and the fore/aft compensator. Any alignment error should have been eliminated during the initial part of the procedure.
5. When finished, secure the compass in its final position.

## Compensation Method II\*

1. While at sea, with the compass in its intended position, but not fully secured, obtain the Loran/GPS bearing to a visual buoy or landmark that is within 10 degrees of the North/South line.
2. Position your boat along that line and steer it directly at the mark. Turn the port/starboard compensator until the compass heading matches the Loran/GPS bearing.
3. Check the Southerly course by steering away from the mark, to a bearing 180 degrees from step 2. If an alignment error is detected, rotate the compass itself to correct for half of this error. Then repeat steps 1 and 2 and recheck.
4. Repeat steps 1-3 for the East/West course, using the fore/aft compensator. Any alignment error should have been eliminated during the initial part of the procedure.
5. When finished, secure the compass in its final position.

\*When using this method, always use the bearing "To or From" on the Loran/GPS. Do not use the heading information because it is inaccurate in real time.

If you have trouble achieving compensation, contact a reputable compass adjuster. Once you've achieved proper compensation, this would be the ideal time to check for deviation and complete your final deviation table.

## Zone Balancing

To preserve accuracy when traveling large distances, the dial in your compass should be balanced in order to compensate for the dip caused by the Earth's magnetic field. Ritchie compasses come standard balanced for Zone 1, which essentially includes all of the Northern hemisphere.

If you're requesting balancing for Zones 2-7, simply indicate the zone that is most central to your boating area. Once your compass is balanced for a specific zone, it will maintain accuracy for one Zone north or south. Ritchie recommends using a compass that is balanced for the zone where the boat will be operated most frequently.

## COMPASS CARE

It's not only important to keep your compass protected, but also to be sure that your compass is properly maintained. This section will cover the importance of regular inspection of your compass and the necessary steps in dealing with commonly found problems.

## Regular Maintenance & Inspection

There are three main rules when it comes to maintenance of your compass.



1. Protect the compass from direct sunlight when it's not in use.
2. Preserve the magnetic environment that surrounds it. Make sure there are no pieces of iron or steel brought or installed near it, so that you can avoid deviation.
3. Familiarize yourself with your compass. Pay attention to how it swings. Check the consistency of readings on frequently run courses. Note if it becomes sluggish or erratic - this could mean you have undetected disturbances or a damaged pivot bearing.

## Specifics

While you're checking everything to make sure it's working correctly, you may come across a few problems that are easily fixable. Here's how to fix them.

- **Damaged jewel or worn pivot:** you can tell you have this problem by performing a simple test. Deflect the card two or three degrees with a small magnet or piece of iron. If the card does not return to its former position, the compass must be removed from the boat and taken to a reputable shop for tests and possibly repair.
- **Bubbles:** a bubble is caused by a leak and should be taken to a reputable service location for repairs.
- **Lightning:** if lightning strikes on-board or nearby, it can change the craft's magnetic field. This can also happen from electric welding. After exposure to either of these, be sure to check for deviations.
- **Storage:** when storing your boat, make sure metal objects on the boat have not acquired a magnetic field. If a piece of metal is newly magnetized, it could confuse the compass, requiring adjustment of the compensators or the creation of a new deviation table.

Visit [www.Richtie.com](http://www.Richtie.com) to find service stations in your area.

## FAQs

### Can I replace the light in my Ritchie Magnetic Compass?

Yes, Ritchie has replacement lights for most models. You can determine the light you need by referring to our Service Manual. Another option is contacting our Service Department at 781-709-3202 or emailing [service@ritchienavigation.com](mailto:service@ritchienavigation.com). With a model and serial number we can tell you which replacement light you require.

### What type of fluid is in my Ritchie Magnetic Compass?

Until 2001, all Ritchie compasses were filled with odorless mineral spirits. Ritchie now uses a fluid called Isopar L<sup>®</sup> that has similar properties but with some added benefits over odorless mineral spirits. These can be mixed together. If you have a Flat Top Compass it is recommended that you test the fluid to see if it is odorless mineral spirits or Isopropyl Alcohol.

\*Isopar L<sup>®</sup> is a Registered Trademark of Exxon Mobil Corporation.

### What are the wires for on my Ritchie Magnetic Compass?

Most Ritchie compasses come equipped with a night light system which should be connected to the boat's DC electrical system.

### Why are there two sets of wires on my Ritchie Magnetic Compass? What should I do with them?

Some Ritchie compasses have two sets of lights. If this is the case with your compass, twist the positive leads together (red or white wires), the two negative leads together (black wires) and connect them to an appropriately fused circuit (usually the running lights circuit).

### Will my compass still work if I do not hook up the light wires?

Yes, unlike electronics (i.e., Chart Plotters, etc.), magnetic compasses do not need electrical power to work. The only part of the compass affected by a loss of power is the night lighting.

## Does my GPS provide heading?

No, GPS can tell you where you are, where you have been, and where you are going, but it can never give you heading. GPS provides Course over Ground (COG). COG is calculated from historical position data to give average COG. It is important to realize that COG and heading are both an integral part of navigation. Conditions such as wind, tide, current and even physical properties of your boat can cause differences between COG and heading. Heading is the only reliable reference to steer your vessel accurately under all conditions. A properly compensated Magnetic compass is the best device for real time heading information.

## Why do the compass and GPS seem to disagree?

First, the factors that cause the difference between COG and heading have a greater effect at slow speeds. Second and more importantly, the GPS, which uses historical data to calculate COG, needs a straight line to give an accurate reading. When you make a turn at a slow speed, you will need to travel in a straight line for a period of time before the GPS can give you an accurate calculation. While at rest there is no historical data for the GPS, therefore there is no COG to report. The COG given by the GPS tends to be erratic and incorrect until you resume in a given direction. The magnetic compass, however, will give you accurate heading information in real time, from stop to go, and slow to fast.

## **If I have problems with my compass, is it repairable? How?**

Yes, Ritchie compasses are designed to be 100% repairable. Ritchie has a network of Authorized Service Stations throughout the world that can handle warranty as well as non-warranty repairs. The factory also has its own in-house Service Department. Ask about our Return Procedure for details. Ritchie stocks parts for all models found in our catalog as well as a number of parts for past models. If you have an older model you may contact the factory or one of our Service Stations for parts availability.

## **Why does my older Ritchie compass seem slow and unresponsive?**

Ritchie compass dials are built with matched hardened steel pivot and sapphire jewel bearing surfaces. Although years of use can be expected, these parts may begin to wear out. If you notice problems with your dial, you should contact the factory or an Authorized Service Station.

## **I have a bubble in the morning but it goes away in the afternoon. Why?**

Your compass has most likely developed a very small leak which has allowed some fluid to escape. When you observe the bubble in the morning your compass is cool and the missing fluid has allowed a bubble to form. As the temperature rises the fluid expands, taking up the volume and making the bubble disappear. This condition is a good warning that you need to have your compass serviced before more fluid escapes.



Direct-read dial



Flat-card dial



Combi-dial

## **Why is my Ritchie compass exactly 180 degrees off course?**

Ritchie makes 3 types of dials that read quite differently and if you are not familiar with the difference you may not be reading it properly. The first type is a traditional flat-card dial; the lubber line marks your heading at the rear of the compass. The second type is a direct-read dial, most commonly mistaken for being 180° off course. The key to reading the heading on a

direct-read dial is that you must read the front of the dial, not the back. If you hold your compass out in front of you at about eye level you will see the lubber line. The lubber line is marking the direction you are facing. The third dial type, the CombiDamp style dial, combines features of both dial types and generally is not confused with being 180° off course.

A Ritchie compass is an indispensable instrument on any boat. When properly selected, adjusted, mounted and cared for, it affects both your performance and efficiency on the water, and could even save your life.

**Call your local Ritchie dealer today or visit [www.ritchienavigation.com](http://www.ritchienavigation.com) for more information.**

**RITCHIE**<sup>®</sup>  
NAVIGATION

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