



ECHOMASTER™

RADAR REFLECTORS

INSTRUCTIONS

#152 Echomaster with Anodized Plates

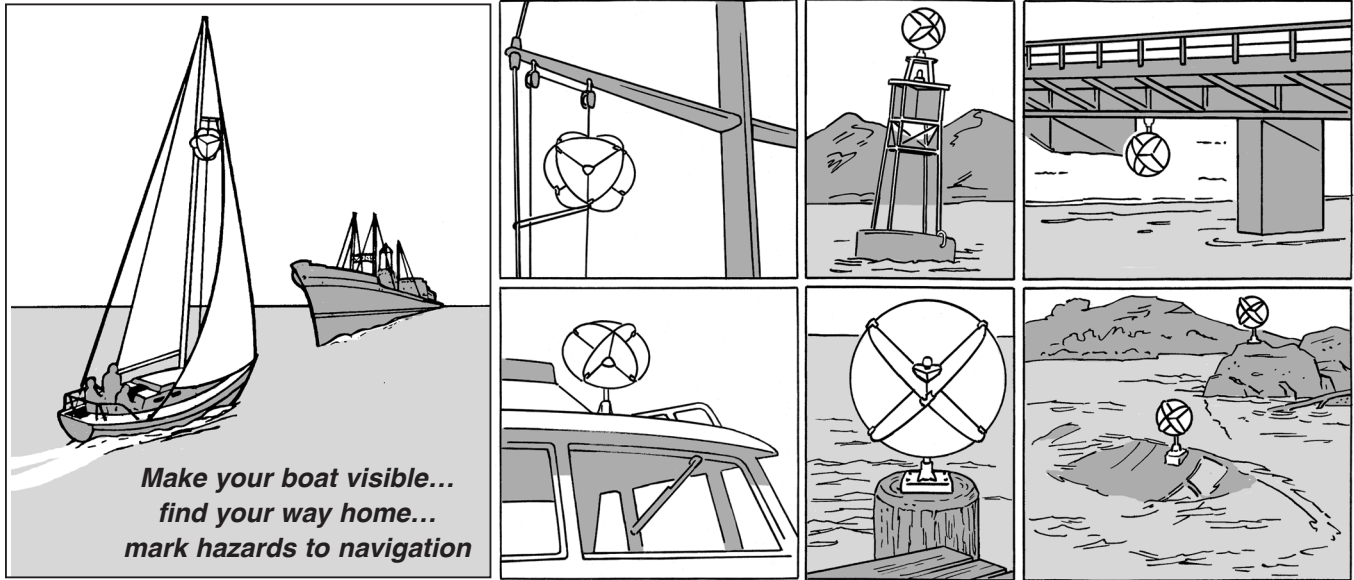
#156 Hanging Mount System (no reflector)

Discontinued in 2014:

#153 Deluxe Hanging Echomaster

#157 Surface Mount System

Echomaster radar reflectors give ships a chance to see your boat in fog and low visibility conditions—a must for serious boaters. Radar reflectors may be mounted on a buoy or piling to help identify your dock or mooring in less than perfect conditions. They are also used to supplement official markings on hazards to navigation such as bridges, rocks, submerged trees, sunken boats.



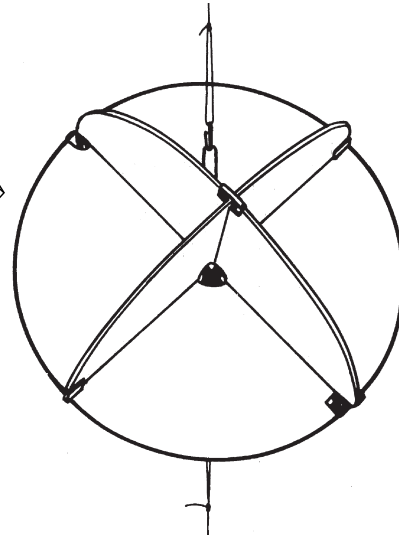
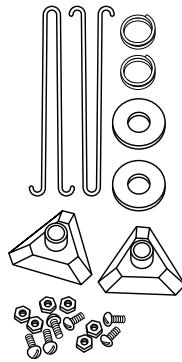
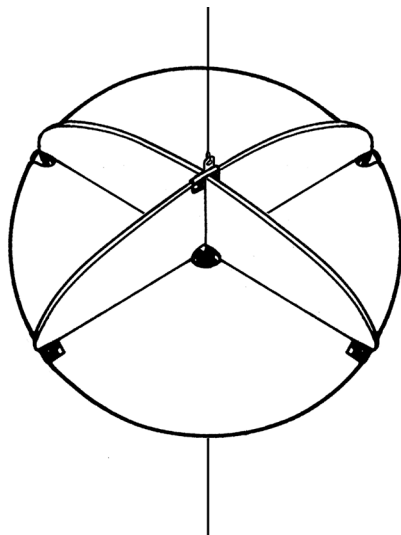
*Make your boat visible...
find your way home...
mark hazards to navigation*

#152 Echomaster Radar Reflector

Anodized aluminum plates. May be assembled around a backstay, or make your own bridle and hang from holes drilled in corner latches. #156 Hanging Mount System can be purchased separately.

#156 Hanging Mount System

Use to suspend unit from mast or rigging in perfect “catch rain” position. Reflector not included



Echomaster Specifications

Reflector plates are 12.5" (32 cm) diameter, circular. Provide 13.2 square yards (12 sq. meters) of maximum effective radar cross section in the X or 3 cm band (9–9.6 GHz frequency), based on optimum orientation between the reflector and radar. Offer equivalent radar cross section of conventional triangular plate reflector with approximate 17" (43 cm) diagonal dimension.

Plates are made of robust 0.05" (1.3 mm) marine grade aluminum; sufficient thickness to minimize flexing. Dimples in plates allow corner latches to attach precisely, minimizing angular distortion.

Windage holes reduce aerodynamic drag and allow assembly of the reflector around a backstay. Windage hole size 1.25" (32 mm).

Captive corner latches are tough, injection molded plastic to assure minimum angle error. Corner latches allow reflector to be quickly and easily assembled and demounted. Reflector stows flat.

Weight without mounting hardware: 1.65 lbs. (.75 kg). #156 mounting harness weighs 1.5 oz. (.4 kg).

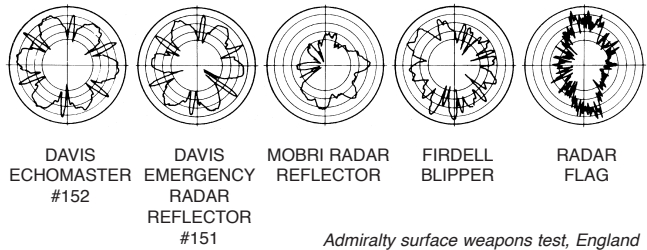


The U.S. Coast Guard is considering marine radar reflector requirements that would apply to pleasure boats operating in waters of the United States. Already such laws exist in many other countries such as the United Kingdom, Canada and Germany. In distress situations the Coast Guard can be materially aided in search and rescue by the deployment of a good radar reflector.

Echomaster's superiority is proven. It was ranked "the best radar reflector" and one of the top ten sailing products by *Practical Sailor*. SRI rated Echomaster "superior" after the most rigorous tests ever conducted on radar reflectors, some costing 10 times as much.

How a Ship's Radar Sees Your Boat

The radar of a ship making a complete circle around a boat would hit the boat's radar reflector from all angles. If the boat were stationary and we plotted how strong the reflected signal is at all angles, we would arrive at **performance diagrams** such as this...



The outside of the circle is what a 10² meter cross section of a metallic sphere would reflect—the laboratory standard. The larger the performance plot, the better the radar reflector. Peaks in the pattern should approach the laboratory standard and be uniformly distributed 360° around the fixed reference point (your boat). Valleys should be minimal in width. The Davis reflectors show good balance: strong peaks, narrow valleys. Other reflectors have inadequate peaks or large areas of weak response, making them seem smaller on an oncoming ship's radar screen.

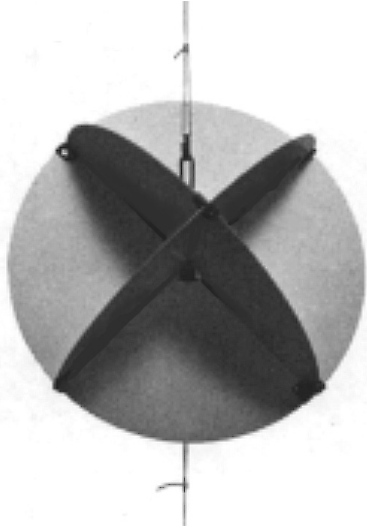
The radar display on a ship will typically show surrounding conditions for at least 12 nautical miles (22 km), with gain and sea clutter controls for adjustment. But boats of today, with fiberglass hulls and sleek designs (curved or slanted surfaces reflect much less), do not possess enough reflective qualities to make them highly visible on a radar screen. The response may be small, weak or intermittent. Even a boat's metal mast (a curved surface) and engine (mounted low, in the realm of sea clutter) do not possess enough reflective qualities to make the boat highly visible to radar. And container vessels and tankers of today require long stopping time and wide turning radius. Ensuring the detectability and recognition of your craft at a long distance from an overtaking vessel under all weather and sea conditions is critical to avoid disaster. Without a radar reflector (or radar of your own) you're left to peer into the fog or darkness or listen for bells, foghorns, propellers, or the mighty bowwave from an onrushing "skyscraper of steel." Even if you did spot them, which way would you turn? Best to let them "see" you instead.

Positioning the Reflector

A cabin, deckhouse, sails, stacks, etc. have a “shadow effect,” blocking a radar signal. To minimize this, the reflector should be fitted as high as possible.

Height also helps eliminate the effect of heavy sea and swell conditions which might otherwise blend the observed signal into sea clutter on the radar display.

Echomaster is designed to mount in the “catch rain” position by being suspended by the halyard/harness system. Alternatively, Echomaster may be permanently affixed to a mast structure.



Suspended by halyard or harness. The orientation shown is the perfect “catch rain” position.



Rigid mounting on a mast structure using pipe fittings. Simple instructions for such a surface mount system are given later in this document.

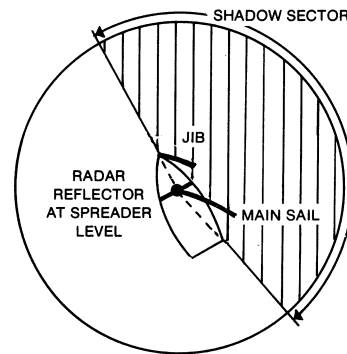
In the “catch rain” position, Echomaster’s octahedral cluster orients all panels at 20° to the axis of symmetry. At this angle, all the inner pockets have the unique property of always reflecting a radar signal back to its originating source with high effectiveness. At the same time, optimum 360° azimuth coverage is provided. The pocket pointing straight up will aid in airborne search and rescue operations.

To better illustrate the advantage that can be gained by placing the radar reflector higher above the water, study the table below.

REFLECTOR HEIGHT	DISTANCE TO RADAR HORIZON
5 ft. (1.5 m)	2.5 nautical miles (4.6 km)
10 ft. (3.1 m)	4.0 nautical miles (7.4 km)
15 ft. (4.6 m)	4.5 nautical miles (8.3 km)
20 ft. (6.1 m)	5.5 nautical miles (10.2 km)
25 ft. (7.6 m)	6.0 nautical miles (11.1 km)
30 ft. (9.1 m)	6.5 nautical miles (12.0 km)
35 ft. (10.7 m)	7.0 nautical miles (13.0 km)

Radar waves are bent from a straight line path toward the earth as they travel outward from a ship’s antenna. Refraction, or bending, is due to the density and water vapor content of the atmosphere, allowing X band waves to travel about 6% beyond the optical or line-of-sight horizon. Values in the table are approximate; reliable detection ranges for common radar reflectors seldom equal the radar horizon distances indicated above.

Avoiding shadowing by the sails is important. In the diagram below, radar beams in the shaded sector are not reflected well because the sails, if wet, shadow the radar reflector. Higher mounting minimizes this.



If you have a radar installation on your boat, it may be necessary to keep the Echomaster reflector a minimum distance away from the radar antenna. You should consult with your radar dealer or manufacturer to avoid possible damage to equipment or adverse performance.

Assembling the Reflector Plates

1. Slide full circular plates

#1 and #2 together as shown in Figure A. Notice that the stamped arrows are to be located side-by-side, in the same corner.

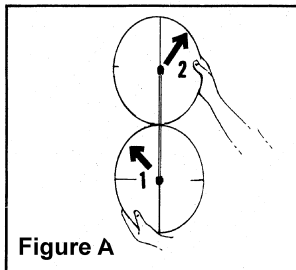


Figure A

2. Snap in place the top and bottom plastic corner latches that will hold the plates together.

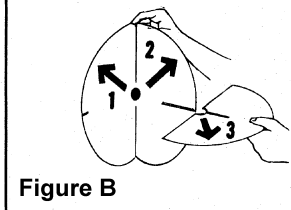


Figure B

3. Slide half plate #3, with stamped arrow, into position as shown in Figure B. This brings all three stamped arrows together in the same corner or pocket.

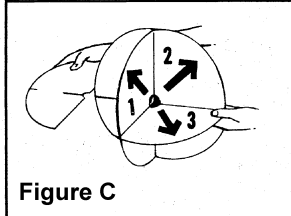


Figure C

Note: If you intend to mount the Echomaster 152 around a backstay, position plates #1 and 2 against the backstay before sliding on plate #3.

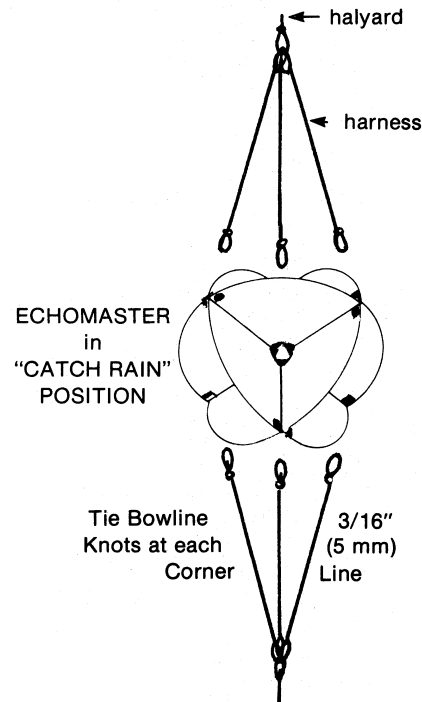
4. Snap in place the center corner latch on the half plate.
5. Slide the remaining half plate in place, as shown in Figure C (reverse this half plate if the corner latches do not match).
6. Snap in place the three remaining corner latches that secure the half plates.

Mounting Echomaster #152

The standard Echomaster #152 does not include a mounting system. The best way to install this product is to assemble it around a backstay or make your own bridle and hang from holes drilled in the corner latches.

6-Point Temporary Mounting

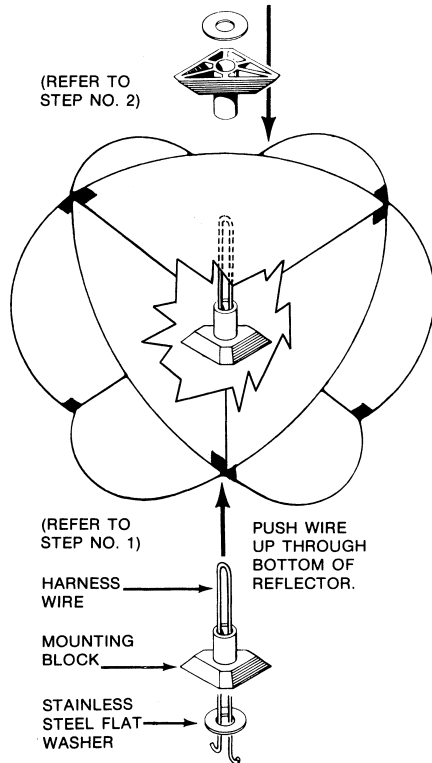
For infrequent, temporary mounting, a rope harness can be constructed as shown here:



Cut 6 equal pieces of 3/16" diameter (5 mm) line, each about 18" (45 cm) long. Tie each one to a corner latch of the reflector with a bowline knot as shown. Locate the 3 corner holes which include the 3 stamped arrows. Group these three attachment lines and tie to the hoisting halyard. This will automatically place the reflector in the "catch rain" position if all three corner lines are the same length. Attach the 3 remaining support lines to a downhaul halyard. Suspend the reflector vertically as high as possible.

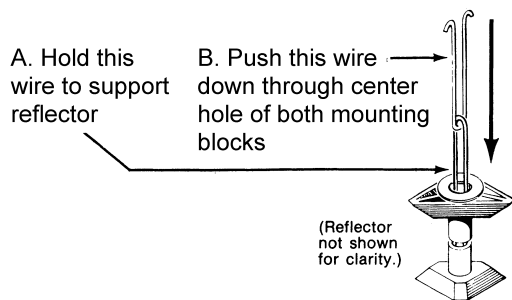
Using the #156 Hanging Mount System

Step 1. Place the assembled reflector in the “catch rain” position with the three stamped arrows in the “up” position. Assemble one flat washer and one mounting block onto a harness wire as shown below. Push the wire up through the center-hole of the radar reflector.

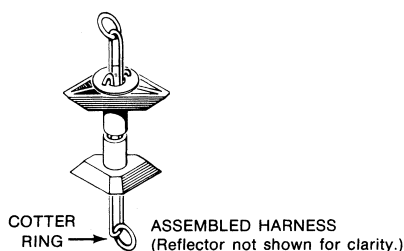


Step 2. Assemble the other mounting block and washer onto the closed end of the wire protruding through the top of the reflector.

Step 3. Link the two wires together as shown:

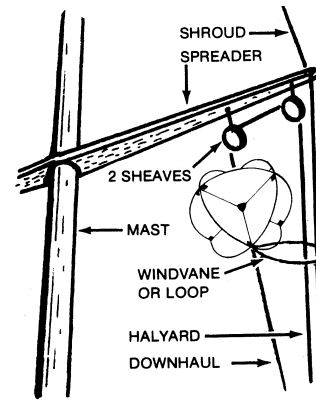


Step 4. Clip the cotter rings onto the closed end of the wires. Secure the six corner latches on the reflector with the six 1/4" (6.4 mm) nylon nuts and bolts supplied.



Suspending the Echomaster from a Spreader

Two small sheaves can be installed about 8" (20 cm) apart on the spreader, as shown here:

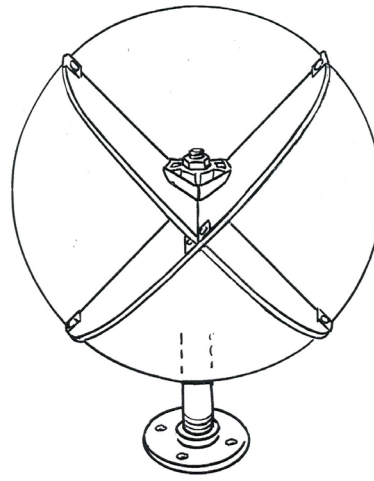


Then, using a 3/16" (5 mm) braided dacron line as a halyard and the harness of the Echomaster attached, the reflector can be hoisted to within 10" (25 cm) of the spreader. Many other solutions are equally satisfactory; however, to minimize wear and chafing on the suspension lines, we recommend the system shown here.

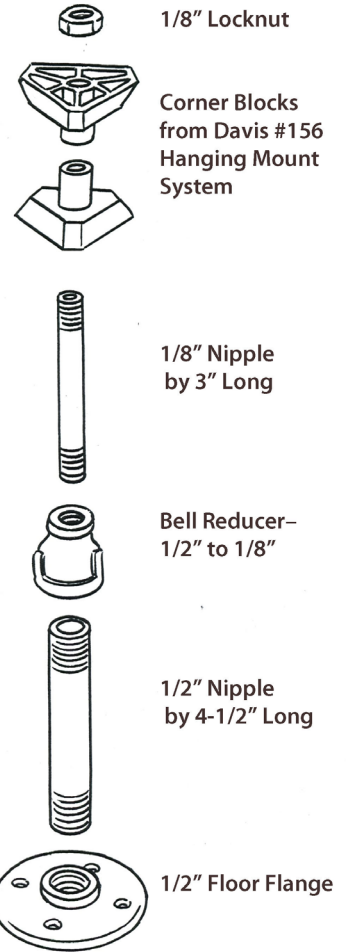
Although rotation and bouncing in the wind do not degrade Echomaster's performance, free-spinning in one direction and then the other can fray the support lines, leading to possible breakage. To limit spinning, secure a tie line to the side, or add a “windvane tail” to a hole in one of the six corner latches of the reflector. The “windvane tail” consists of a 1/8 to 3/16" (3.2–4.8 mm) line, extending 20–24" (50–60 cm). It stabilizes the reflector as the wind increases.

Surface Mounting

You can mount your Echomaster to a hard, flat surface using some common pipe fittings and the corner blocks that come with the #156 Hanging Mount System.



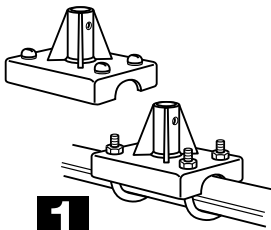
Surface Mount for Echomaster made with standard pipe fittings



Using the #157 Surface Mount System (Discontinued in 2014)

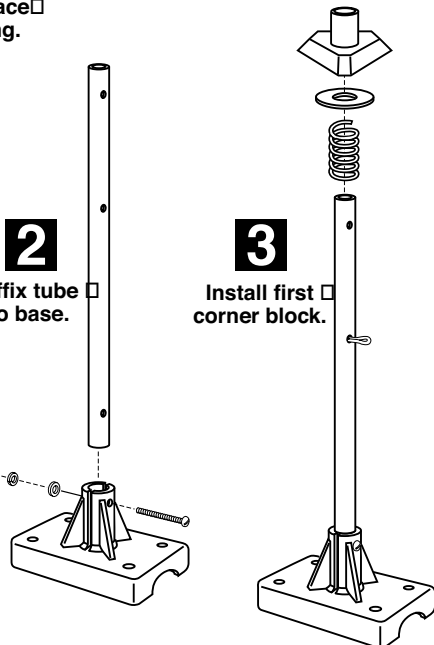
The Davis #157 allows permanent installation of an Echomaster reflector on a hard surface or a railing up to 1.25" (32 mm) in diameter. Fasteners are not included. 1 1/2" U-bolts required for rail fastening..

Follow these steps:



1

Install □
mounting □
base to □
flat surface □
or railing.



2

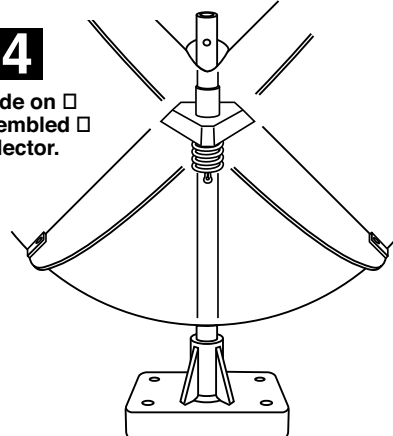
Affix tube □
to base.

3

Install first □
corner block.

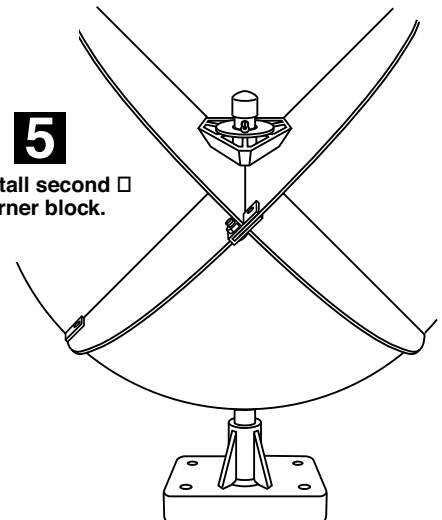
4

Slide on □
assembled □
reflector.



5

Install second □
corner block.



Echomaster Maintenance

If any reflector plates should become bent, flatten them as well as possible in order to obtain the high reflective performance for which the Echomaster has been designed.

The plates should be washed free of salt water occasionally.

WARNING: No matter what method was employed to mount the Echomaster, it is the responsibility of the user to make periodic inspections of lines and fittings to insure that no condition is developing which could lead to mounting failure and possible injury.

Davis Instruments wishes you many years of happy and safe boating with your advanced design Echomaster Radar Reflector.

For more of the science behind radar reflectors, contact Davis and ask for #R155E, a 16-page booklet.

Also Available from Davis:

EMERGENCY RADAR REFLECTOR #151



Excellent as a back-up aboard larger vessels or primary reflector on smaller boats that might not normally carry a radar reflector. Made of plastic-metal foil laminate. Opens in seconds and is very lightweight. Performs almost as well as Echomaster (see performance diagrams on page 2). 11.5" (29 cm) in diameter. Stows flat. Economical enough for any boat. Recommended "best buy" by *Practical Sailor*.

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