851-160164/AA006/3-13

Echo sounder transducer installation

This document presents guide lines regarding selection of transducer mounting locations on the vessel's hull, and explains how transducers can be installed at the chosen locations.

Contents

1 TRANSDUCER LOCATIONS

1.1 General

A single answer to the question where to locate the transducer cannot be given. It depends very much on the vessel's construction. However, there are some important guide lines.

1.2 Go deep

The upper water layers of the sea contain a myriad of small air bubbles created by the breaking waves. In heavy seas the uppermost 5 – 10 metres may be air–filled, with the highest concentrations near the surface. Air bubbles absorb and reflect the sound energy, and may in worst cases block the sound transmission totally. Therefore, mount the transducer at a deep position on the hull.

Consider the situation when the vessel is unloaded, and when it is pitching in heavy seas. The transducer must never be lifted free of the water surface. Not only will the sound transmission be blocked, but the transducer may be damaged by slamming against the sea surface.

Another reason to go deep is cavitation in front of high power transducers. Cavitation is the formation of small bubbles in the water due to the resulting local pressure becoming negative during parts of the acoustic pressure cycles. The cavitation threshold increases with the hydrostatic pressure.

1.3 The boundary water layer

When the vessel forces its way through the sea, the friction between the hull and the water creates a boundary layer. The thickness of the boundary layer depends upon vessel speed and the roughness of the hull. Objects protruding from the hull, and dents in the hull, disturb the flow and increase the thickness of the boundary layer. The flow in this boundary layer may be laminar or turbulent. A laminar flow is a nicely ordered, parallel movement of the water. A turbulent flow has a disorderly pattern, full of eddies. The boundary layer increases in thickness when the flow goes from laminar to turbulent. Figure 1 (next page) sketches the boundary layer of a vessel moving through the water.

Furthermore, air bubbles in the sea water are pressed down below the hull and mixed into the boundary layer. The boundary layer is thin underneath the forward part of the vessel, and increases in thickness as it moves towards aft. If the sides of the hull are steep, some of the air bubbles in the boundary layer may escape to the sea surface along the vessel sides. It is our experience that a wide and flat bottom, with a rising angle less than around 13 degrees, is prone to giving air problems for the transducer. In any case a transducer location in the forward part of the hull is preferred in order to minimise the influence of the boundary layer.

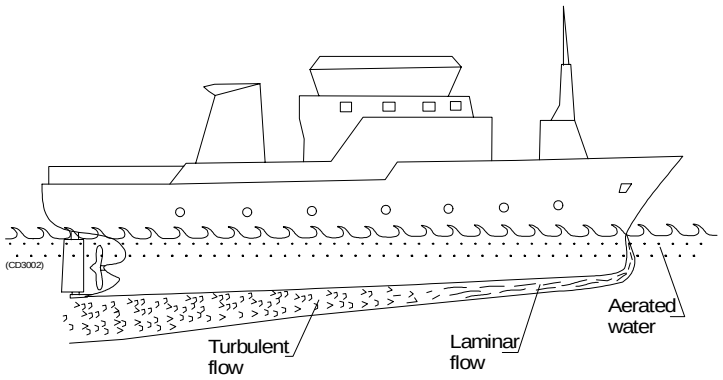

Figure 1 Sketch of the boundary layer underneath the vessel.

1.4 Propeller noise

The propulsion propeller is the dominant noise source on most fishing vessels, research vessels, merchant vessels and pleasure crafts. The noise is transmitted through the sea water. Therefore the transducer should be placed far away from the propeller, which means on the fore part of the hull. Positions outside the direct line of sight from the propeller are favourable. On small vessels with short distances it is advised to mount the transducer on that side of the keel where the propeller blades move upwards, because the propeller cavitation is strongest on the other side. The cavitation starts most easily when the water flows in the same direction as the propeller blade, and that is to some degree the case at that side of the keel where the propeller blades move downwards.

Bow thruster propellers are awful machines. When they are in operation, the noise and cavitation bubbles make the echo sounder useless, almost no matter where the transducer is installed. And when not in operation, the tunnel creates turbulence, and if the vessel is pitching, the tunnel may be filled with air or aerated water in the upper position and release this in the lower position. Therefore, an echo sounder transducer should be placed well away from the bow thruster.

1.5 Vessel heave

Heave is the up and down movement of the vessel. It disturbs the echo traces in the echogram, so that a flat bottom is displayed as a wave. A transducer location in the middle of the vessel minimises the influence of vessel roll and pitch.

1.6 Noise from protruding objects on the hull

Objects protruding from the hull, such as zinc anodes, sonar transducers or even the vessel's keel, generate turbulence and flow noise. Also holes and pipe outlets are noise sources. They may act as resonant cavities amplifying the flow noise at certain frequencies. Do not place an echo sounder transducer in the vicinity of such objects, and especially not close behind them.

1.7 Summing up on transducer location

Some of the above guide lines are conflicting, and each case has to be treated individually in order to find the best compromise. Generally the propeller noise is the dominant factor, and a recommended transducer location is in the fore part of the hull, with maximum distance from the bow equal to one third of the total length of the hull at the water line, see the top figure on the next page (figure 2).

If the vessel hull has a bulbous bow, this may well be a good transducer location, but also here must be taken into consideration the flow pattern of the aerated water. Often the foremost part of the bulb is preferable as shown in the bottom figure on the next page (figure 3).

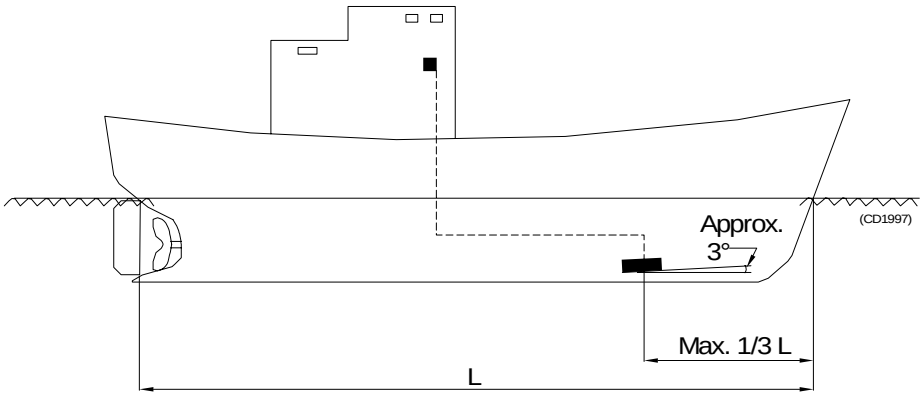

Figure 2 Recommended location of the transducer on the hull

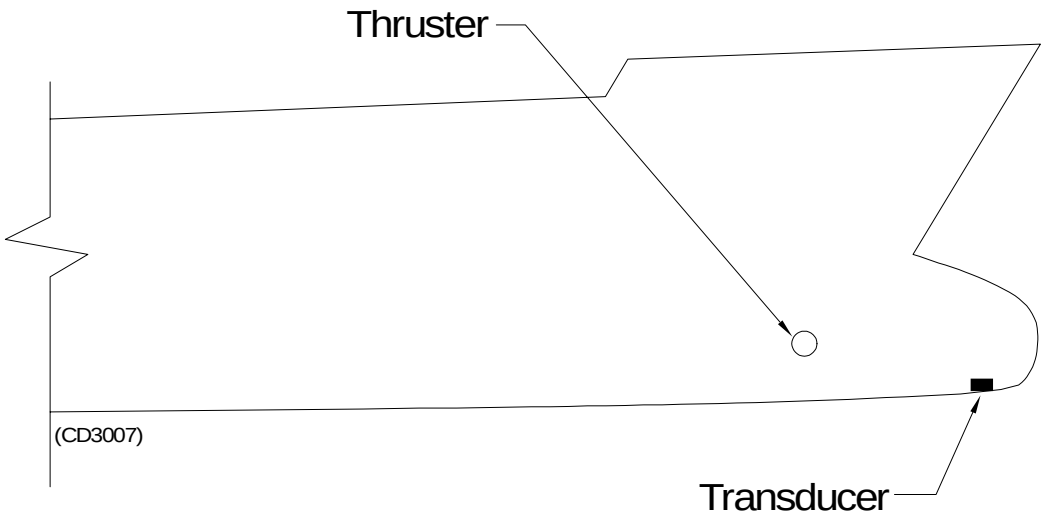

Figure 3 Transducer location on a bulbous bow

2 WAYS OF MOUNTING THE TRANSDUCER

2.1 Inclination of the transducer face

Incline the transducer face approximately 3° as shown in the figure on the previous page, so that the flowing water meets it directly. This assures laminar water flow. Mounting screws should not be extruding from the transducer, and the space around the screws could be filled with a compound or a locking ring.

2.2 External mount

Some transducers have a streamlined housing, designed for installation outside the hull.

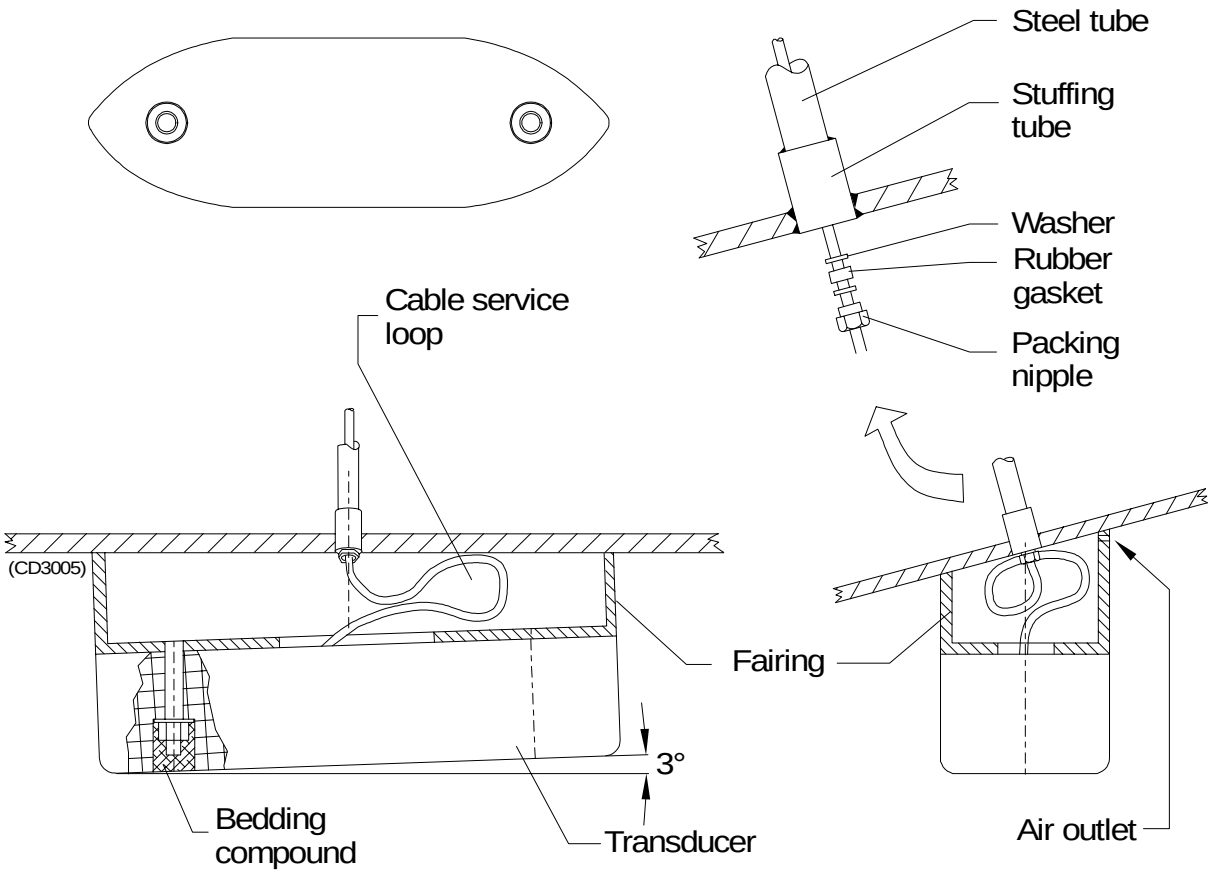

Figure 4 External mounting on steel hulls

A fairing, made by the shipyard, is placed between the transducer and the hull, to adapt for the deadrise angle of the hull. The fairing can be made of wood or steel, and should have the same outline dimensions as the transducer. These transducers are mainly used on smaller vessels. A location approximately 0.5 m aside from the keel may be adequate for the passage of water between the keel and the transducer. The figures above (figure 4) and below (figure 5) illustrate external mounting of transducers on steel hulls and on wood or polyester hulls respectively.

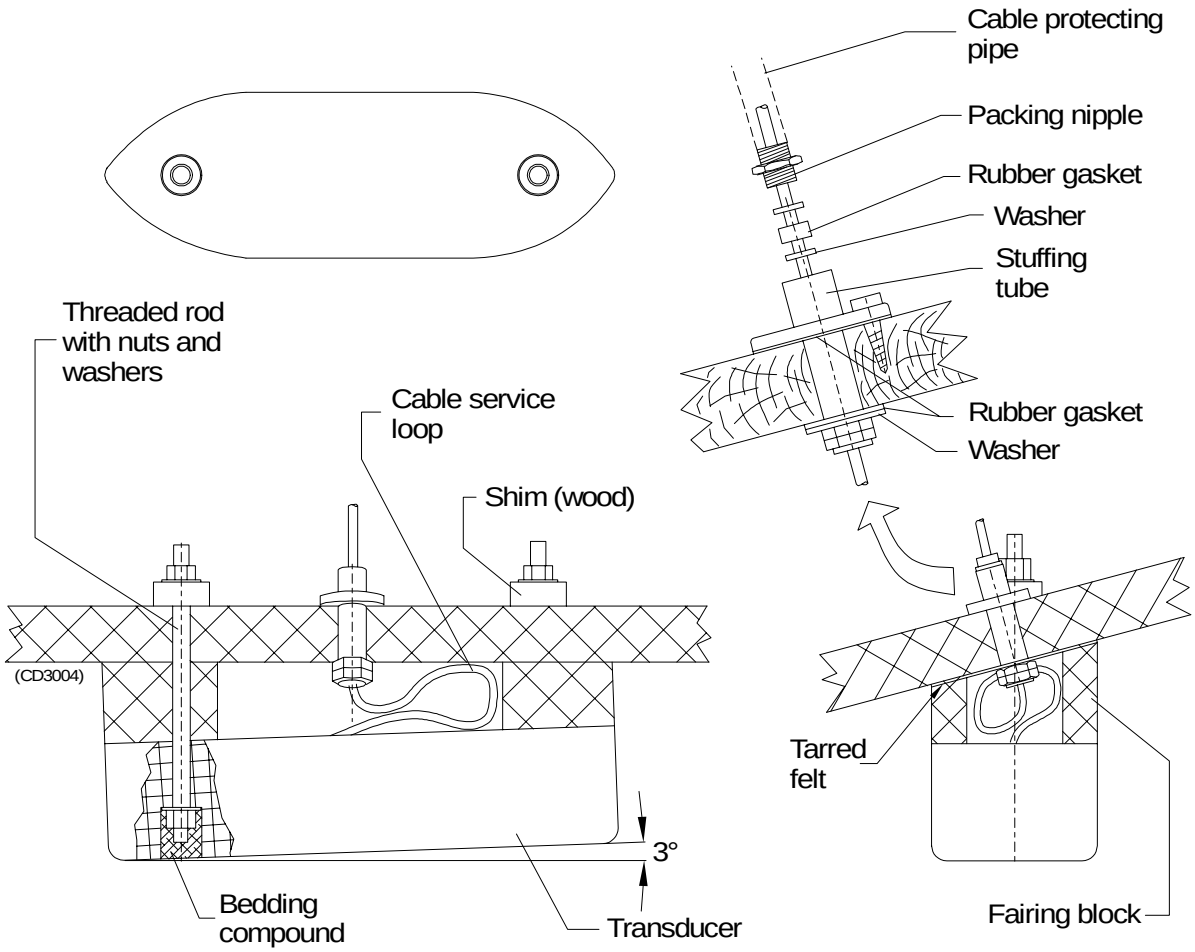

Figure 5 External mounting on wood or polyester hulls

2.3 Transducer blister

Other transducers are designed for installation into the hull or in a blister. In general, a blister installation is the recommended method. It brings the transducer below the boundary layer. A blister is illustrated below.

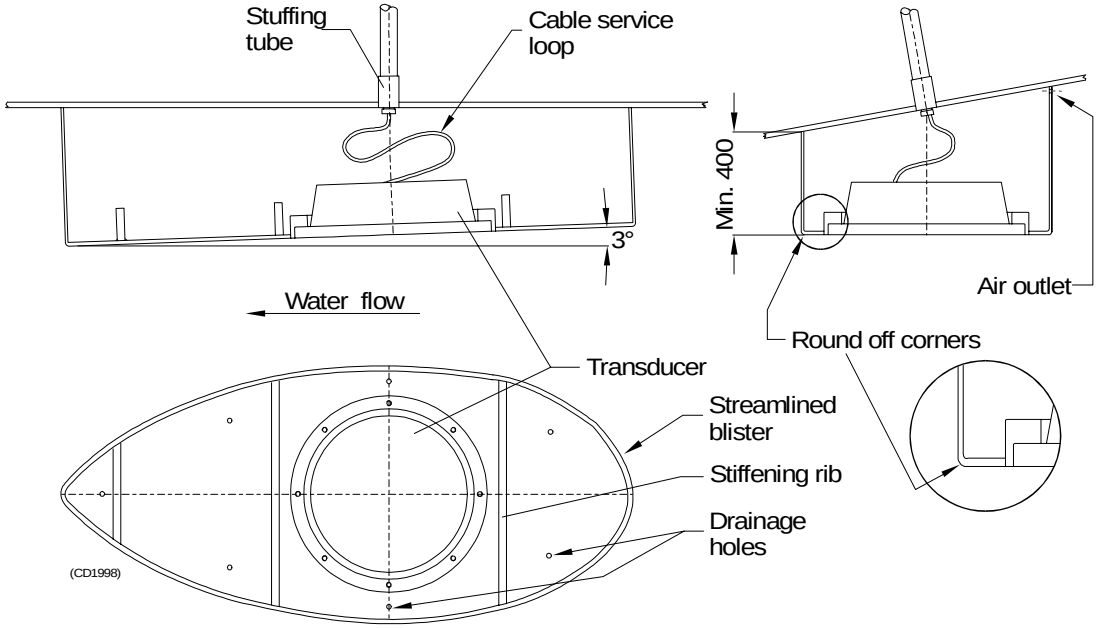

Figure 6 Transducer blister

The best performance is obtained with a blister height of 40 cm or more. A streamlined shape and rounded edges reduce the flow noise. A vertical leading edge or front will guide the aerated water to the sides of the blister. The orientation of the blister should follow the water flow. On a conventional hull shape, without a bulb, the front of the blister should have a few degrees toe–in towards the bow (see figure 7 on the next page). The blister is placed on one of the sides of the hull, and the distance from the keel is a trade off between a close distance giving a turbulent flow of water in a narrow passage, and a large distance bringing the transducer higher up and also more affected by vessel roll. Normally a distance of approximately 1 m is a good compromise, see figure 8.

Let the interior of the blister be filled with sea water, by a drainage hole in the bottom and an air outlet on the top. Especially for large transducers it is an important security precaution to have water pressure behind the transducer to counterbalance the outside pressure during vessel pitch in a rough sea.

The transducer cable penetrates the hull in a stuffing tube, see the figure above. Leave an adequate loop of the cable behind the transducer for easy mounting or removal of the transducer.

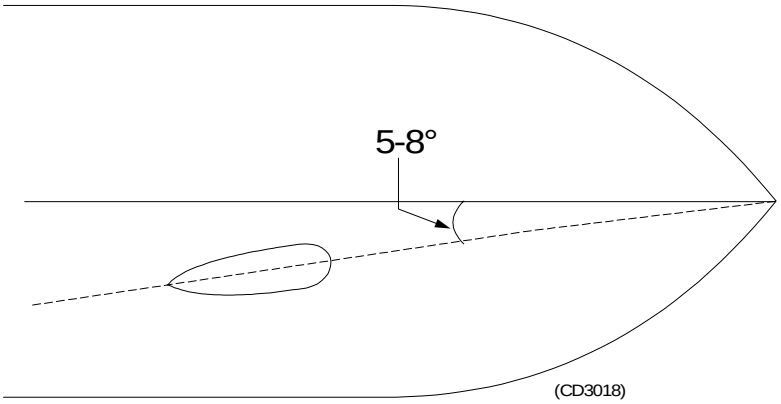

Figure 7 Blister toe–in towards the keel

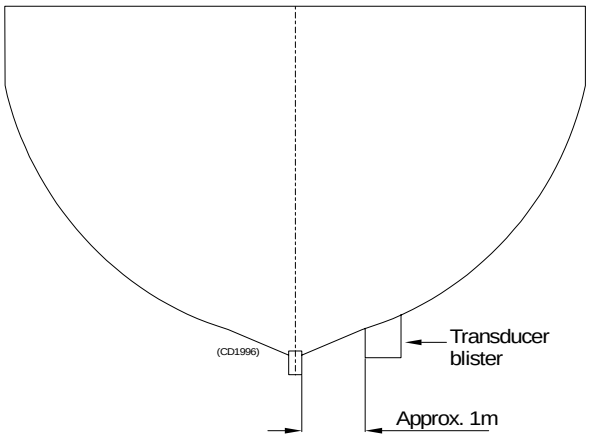

Figure 8 Location of blister relative to the keel

2.4 In a box keel

Vessels with a box keel may use this for transducer installation. The box keel is already the deepest part of the vessel. If the box keel is too narrow to accommodate the transducer, it can be widened, either symmetrically or to one side only. In the last case the installation could also be described as a blister merged into the keel. The figure below illustrates a symmetrical box keel installation.

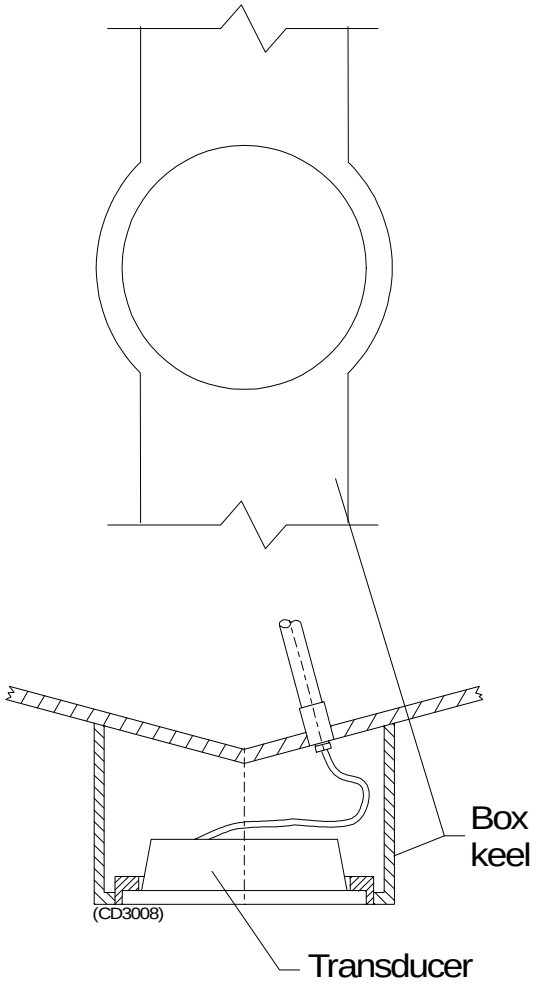

Figure 9 Symmetrical box keel installation

2.5 Retractable transducer

Retractable hull units are commonly used for horizontal looking sonars. When not in use, the transducer is retracted into a trunk. The retractable hull unit is more expensive than a blister, but on vessels having a hull where it is difficult or impossible to install a blister, it may be worth–while. A retractable hull unit with transducer is shown below.

Vessels without a keel and with a wide, flat bottom is an example where a retractable hull unit can be the only acceptable method for bringing the echo sounder transducer below the boundary layer.

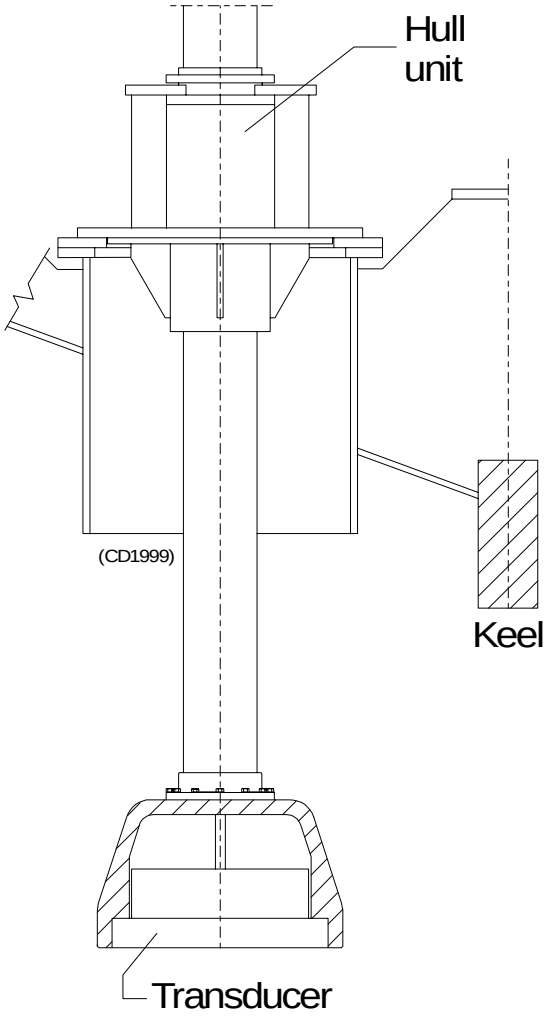

Figure 10 Retractable hull unit with transducer

2.6 Centre board

The use of a centre board with the purpose of stabilising the vessel, is well known. A relatively new experience from research vessels is that a deep centre board is a superior platform for transducers. Such instrument keels have been built with a length of 3 m, protruding also 3 m below the hull, see the figure below. At that depth, the water is free of air bubbles up to very high sea states, meaning that the vessel is able to perform reliable acoustic measurements in open sea a larger part of the year.

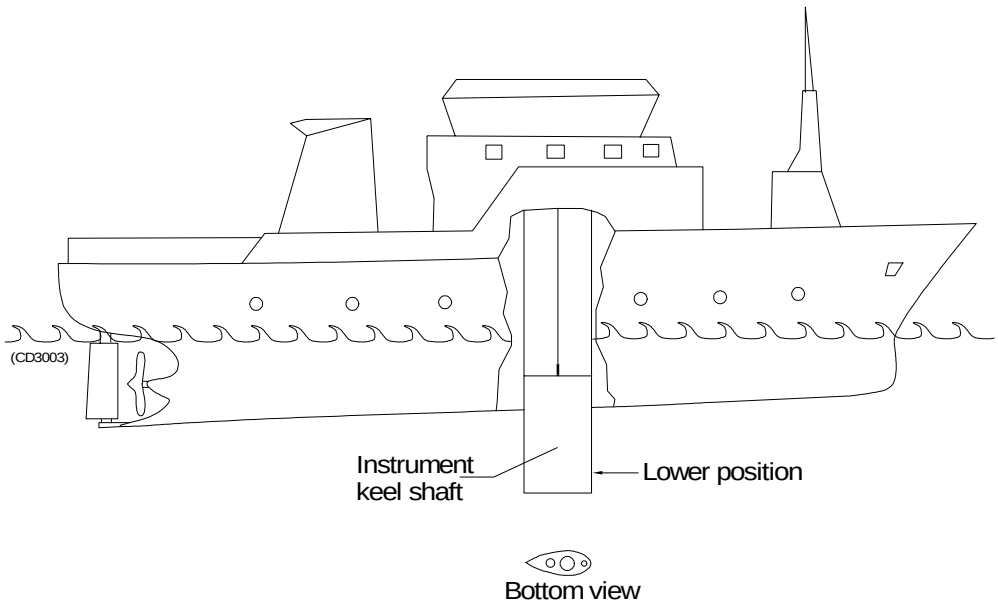

Figure 11 Deep centre board/instrument keel

2.7 Flush mounting

Flush mounting is used on very large vessels with a hull so deep that no air bubbles are found below the hull, and on vessels operating in shallow harbours or waters, where a protruding blister can not be accepted. The figure below illustrates transducer flush mounting.

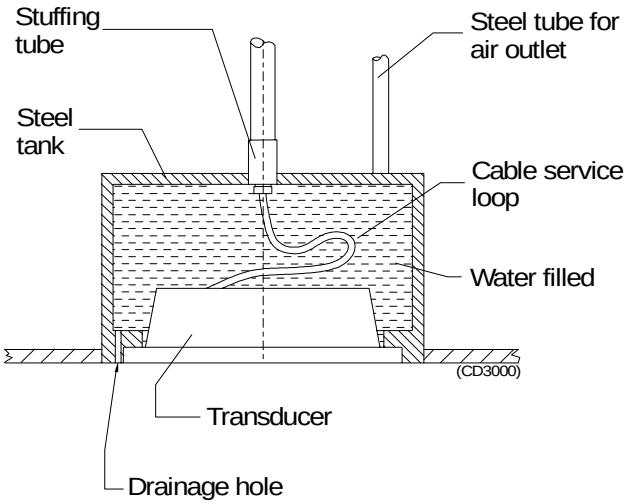

Figure 12 Flush mounting of transducer in steel tank

2.8 In a steel tank

The standard procedure for flush mounting on a steel vessel is to weld a steel tank inside the hull, and mount the transducer into this tank. As for a blister, it is recommended to let the interior of the tank be water–filled. This can be accomplished by air release through a steel tube, which is extended either to open air above the water line or to the water outside the hull at a point higher than the tank interior. If the tube is extended to open air, drainage must be provided with leakage at the transducer flange or a separate hole in the tank bottom. Transducer mounting in a steel tank is shown in the figure above (figure 12).

2.9 Behind a protective acoustic window

Vessels operating in arctic waters need special attention on transducer installation. Floating blocks of ice may damage even a flush mounted transducer face. For this situation Simrad offers ''arctic tanks'' in different sizes.

The transducer shown in the figure below is mounted inside the tank behind a strong acoustic window which could be made of polycarbonate. The tank is oil filled.

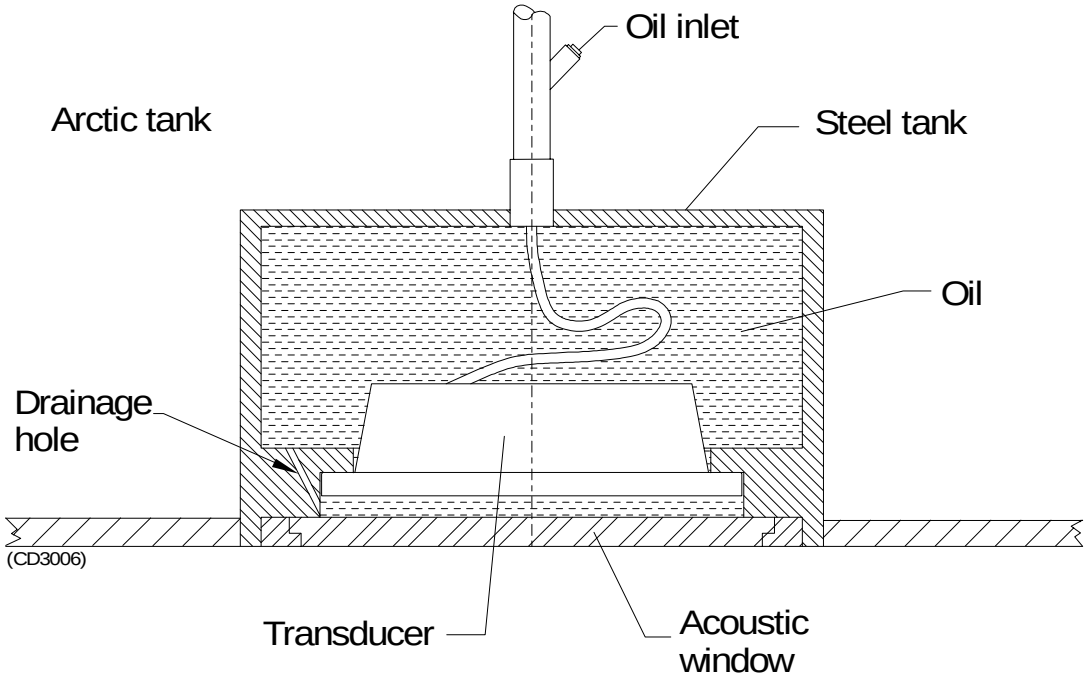

Figure 13 Arctic tank with a protective acoustic window

2.10 Inside the hull

An installation of the transducer inside the hull, and sounding through the hull, requires a good acoustic contact between the transducer face and the hull. Build a tank around the transducer and fill it with a liquid. Oil used in hydraulic systems is a well suited liquid for this purpose. It contains no gas bubbles and is non–corrosive.

Figure 14 below illustrates transducer mounting inside the hull. A substantial loss must be expected when the sound passes through the hull. Typical values of the two way loss are 3 dB for polyester, 6 dB for aluminium and 10 dB for steel. Hulls made of wood or a sandwich type with foam in the middle, attenuate the sound so much that through hull sounding must be regarded as impossible. The loss varies with the distance between transducer face and the hull. The best result is obtained when the distance is half a wavelength. Consult Simrad for advice. In addition to the loss, the beam pattern is degraded, because a larger area of the hull is set into vibrations.

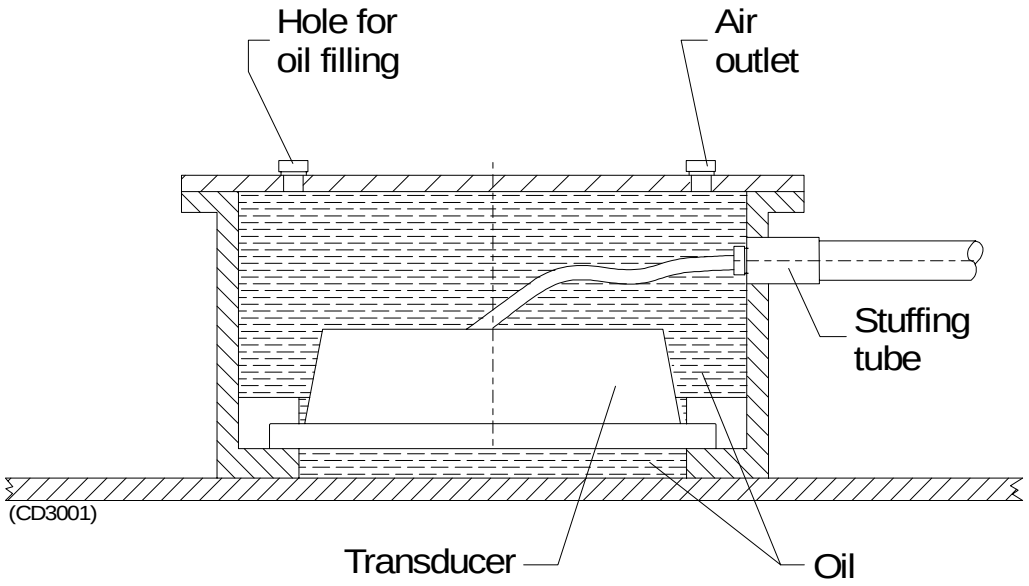

Figure 14 Transducer mounting inside the hull

2.11 Cable in steel pipe

It is strongly recommended to lay a steel tube from the transducer to the echo sounder transceiver, and draw the transducer cable through the tube. There are two reasons for this procedure.

- First, it will make it easier at a later stage to replace the transducer.
- Second, noise and interference from other electrical equipment is greatly reduced.

With a steel tube the installation satisfies the EU regulations for EMC interference. Without a steel tube, there is a risk of reduced echo sounder performance.

The tube should be unbroken and watertight from the transducer to above the water line. From there, openings or a junction box can be installed to facilitate drawing of the cable, or to add a cable extension. However, the tube should act as a continuous electrical screen all the way and be connected to the transceiver chassis.

Tube dimensions:

- minimum 35 mm inner diameter
- minimum 6 mm wall thickness (4.5 mm if galvanised).

If two or more transducers are installed close to each other it is possible to pull their cables in the same steel tube, provided the tube diameter is increased accordingly. However, for easy replacement it is recommended that each transducer has its own steel tube. The figure on the next page shows a steel tube arrangement.

Most Simrad transducers are delivered with 20 m cable. Excess cable can be cut off, or an extension cable can be added. This is possible because all Simrad transducers have a built–in transformer for tuning and matching to the cable impedance of 60 Ohms.

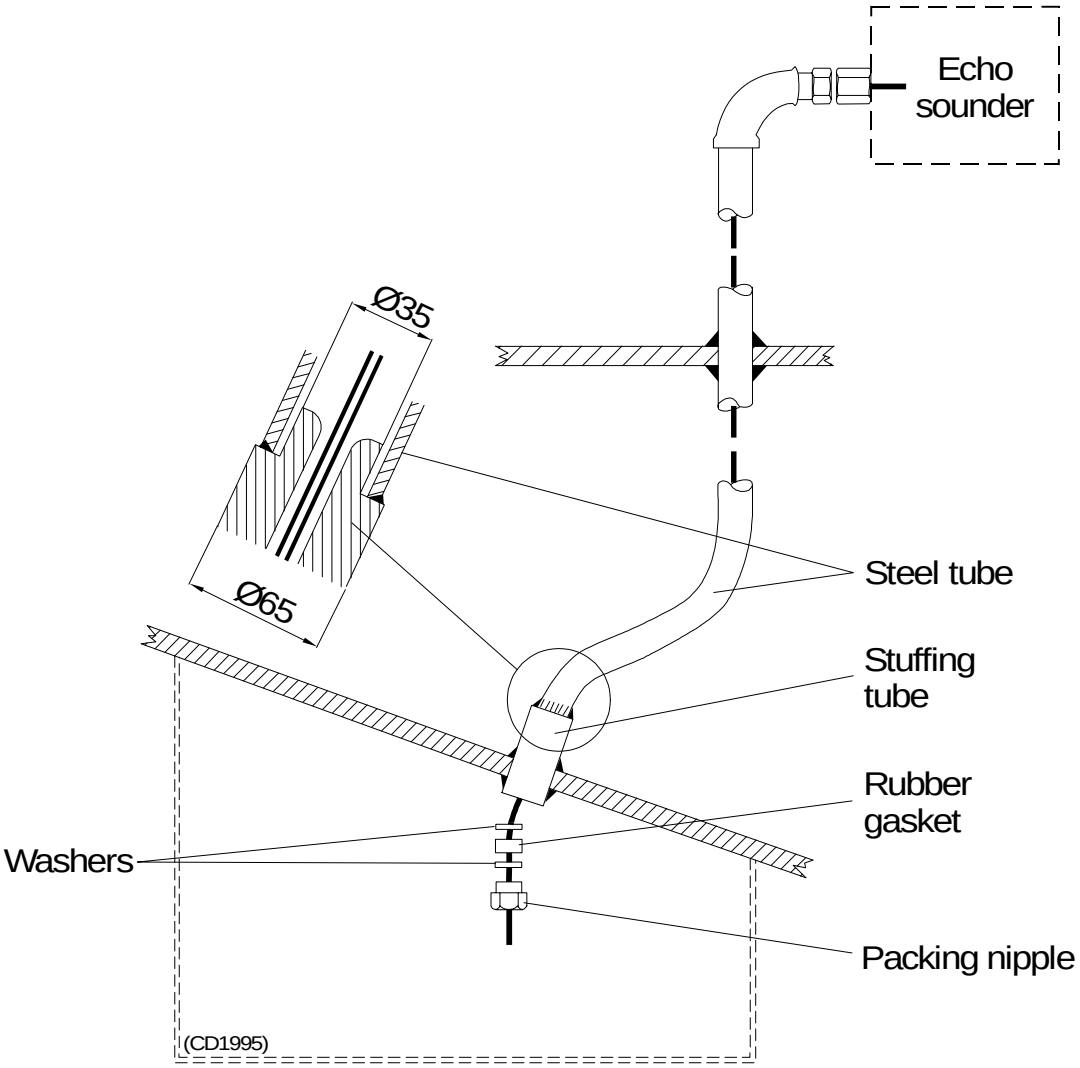

Figure 15 Example steel tube arrangement

3 HANDLING AND MAINTENANCE

Do not lift the transducer by the cable.

Some transducers are delivered with a cover plate on the face for protection during transport. Let this plate stay on as long as possible, but do not forget to remove it before the vessel goes into the sea.

An antifouling paint may be applied to the transducer face. Because some paint types may be aggressive to the polyurethane in the transducer face, please consult Simrad's list of approved paints on the next page.

Note !

The Simrad NL doppler log and the arctic tanks are made of special types of materials, and must never be painted nor cleaned with chemicals.

During dry docking of the vessel, the transducer face may be cleaned for shells and other marine fouling. Be careful not to make cuts in the transducer face. Use a piece of wood or a very fine grade emery paper.

4 APPROVED ANTIFOULING PAINTS

This is Simrad's list of approved antifouling paints on polyurethane transducer housing.

From Jotun Paints, Sandefjord Norway:

- Antifouling Seamate HB 33
- Antifouling Seamate HB 66
- Antifouling Seamate HB 99
- Racing
- Non–stop

From International Paints:

- Intersleek tie coat + 425 FCS
  - BXA386/BXA390/BXA391 Grey
  - HKA563/HKA570/HKA571 Yellow

Mix BXA386, BXA390 and BXA391 first, then apply.

When dry, mix HKA563, HKA570 and HKA571, apply.

From Hempel IFA Coatings AS:

- Hempel A/F Classic 76550

Note ! *Refer to the manufacturer's documentation and data sheets for a complete procedure.*