

MOORING GUIDELINES

The responsibility for a club member's mooring lies entirely with the member. The purpose of these mooring guidelines is to support members in carrying out that responsibility. The guidelines for Harbour and Bay Moorings provide access to many years of learning about what works in our harbour and our bay.

To make it easier for members to maintain suitable moorings we will place orders as a club at set intervals for the component parts based on members requests, and carry some spares for those who may join during the period between orders. This system has been in operation for Bay Moorings for several years and seems both robust and popular with members, we have had far fewer boats breaking away from Bay Moorings in recent years. For Bay moorings the order is placed every three years when the moorings are brought in for maintenance.

We will place an order for harbour moorings before craning in and then determine what the right order frequency is for harbour moorings.

My thanks go to the many people who have helped produce these guidelines. If you are new to the club or have never really thought about your mooring then please ask other members for help and guidance, learning by trial and error is unnecessary and costly.

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1.0 HARBOUR MOORINGS

The 2010 late summer gale should have reminded us that mooring tackle can suffer greatly increased stress, so that gear that has just withstood the reduced summer loading will fail catastrophically. Accidents to gear will always happen but the prudent sailor seeks to reduce the chances of accidents. In a harbour in which most boats are surrounded by others, it is no more than common-sense.

This is a Guide for all the owners of boats moored in Aberdour Harbour. It is jointly issued under the auspices of the Aberdour Boat Club and the Pier and Harbour Committee and both explains how to check your mooring before Crane-In and advises on the best method of mooring. Your Club will be instituting a system of inspections to check moorings are in good repair and advise where necessary.

1.1 Checking Your Mooring

Environment: The sea is a hostile environment and chain both erodes and corrodes in the aggressive environment of the alternation salt, fresh and oxidised waters. Ropes suffer from UV degradation, as well as the grit and marine biology grinding into steel, thimbles, mousing wire and fibres. It is not an easy place in which to survive and so moorings need ongoing maintenance during the winter.

Inspection: The Club – that means you - owns the big **Ground Chains**, but you must assist by ensuring the chains near your boat remain flexible and free from the cementitious growth of calcite which causes solidification and concentration of flexure, wear and erosion. Clean them by systematically belting them along the length nearest to you with a heavy hammer to ensure the hard deposits fall off.

Shackles: Next check the **Shackles** attaching your own Risers to the ground chains. Are any corroded or missing the pin or mousing? Check by hitting the shackle smartly with the hammer and see if the pin can be tightened up with a big spanner-which may indicate that the screw thread is corroding and may therefore be approaching failure. Renew the shackle if in any doubt.

Riser Chains: Check every **link**, especially in the area which drags about on the harbour floor. The contact area between each link wears fastest. However, the rest of the link will have corroded too, so the remaining section of steel may be dangerously small, regardless of the original size of the new chain. Brand new half-inch chain is good for 2 tonnes working load, good enough for normal use but bigger chain is better for exceptional conditions.

Ropes: Next **Rope** connections from the chains to the boat (fore and aft) need inspection for: UV degradation and damage at the connection to the chain (where the hard eye or thimble often rotates a bit and can cut into the rope, or the steel eye may have rusted partly and left sharp edges or simply have embedded oxide shards into the fibres which will not remain flexible). Then, at the bow fairlead and often hidden within the protective plastic tubing, check for unravelling or fibre breakage; at each splice, for unlaying and for marine growth, embedded and sawing away at the fibres. If anything is looking suspicious, especially areas of broken or loose fibres, renewal will be necessary.

Pick-up Line: This may be filthy or worn, or the lead weights may be missing and may need replacing.

1.2 Best Practice

For ease of understanding, a simple sketch diagram is attached. Basically it shows a single point-of-contact mooring at the bow and an X shaped mooring at the stern.

The Bow Mooring is reasonably straightforward with the chain taking the wear involved in rubbing along the harbour floor and the rope being long enough to keep the chain well clear of the boat's hull, but never to rub on the gravel. In practice about 4-4.5 metres of chain is about right and you can adjust the rope before you splice (or have spliced) in the permanent mooring eye. When a Snubber is fitted, the rope may have to be slightly longer.

Snubber. The calculation of the increase in forces acting on a moored boat in the harbour in rough weather is clarified below. Suffice to say, certain combinations of wind, sea or tide increase the stress suffered by moorings and one effective way of reducing the stress is by fitting a Snubber: bought or home-made. The easy way of making one is to roll a motor inner tube into a twisted thong, then tying and winding the rope riser of the bow mooring round it 3 or 4 times between the chain and the stem fitting. Simple, cheap and robust and it works.

For the **X shaped Stern Mooring**, the bottom part is chain and the top part rope on the same principle as the bow mooring. The risers should be attached to the ground chain at about 2.5 metres either side of the boat's centreline. The linking of the 2 ropes and 2 chains at the centre of the X should be done with care. Probably the best way is to have a large welded link where the 2 risers meet; then each rope can be spliced to that link. Alternatively a moused shackle can be used, but that will always need checking every time you go onboard as it is a potential weakness in your mooring system.

The **Length of Chain** calculation is also shown below. However, it can be done empirically by noting how far up the Pier the highest tides come; roughly estimating where your boat 'sits' between its ground chains and deciding how long the chain risers need to be to avoid fouling the hull or rudder. Even using the calculation below, it will need to be physically checked with your boat in the water.

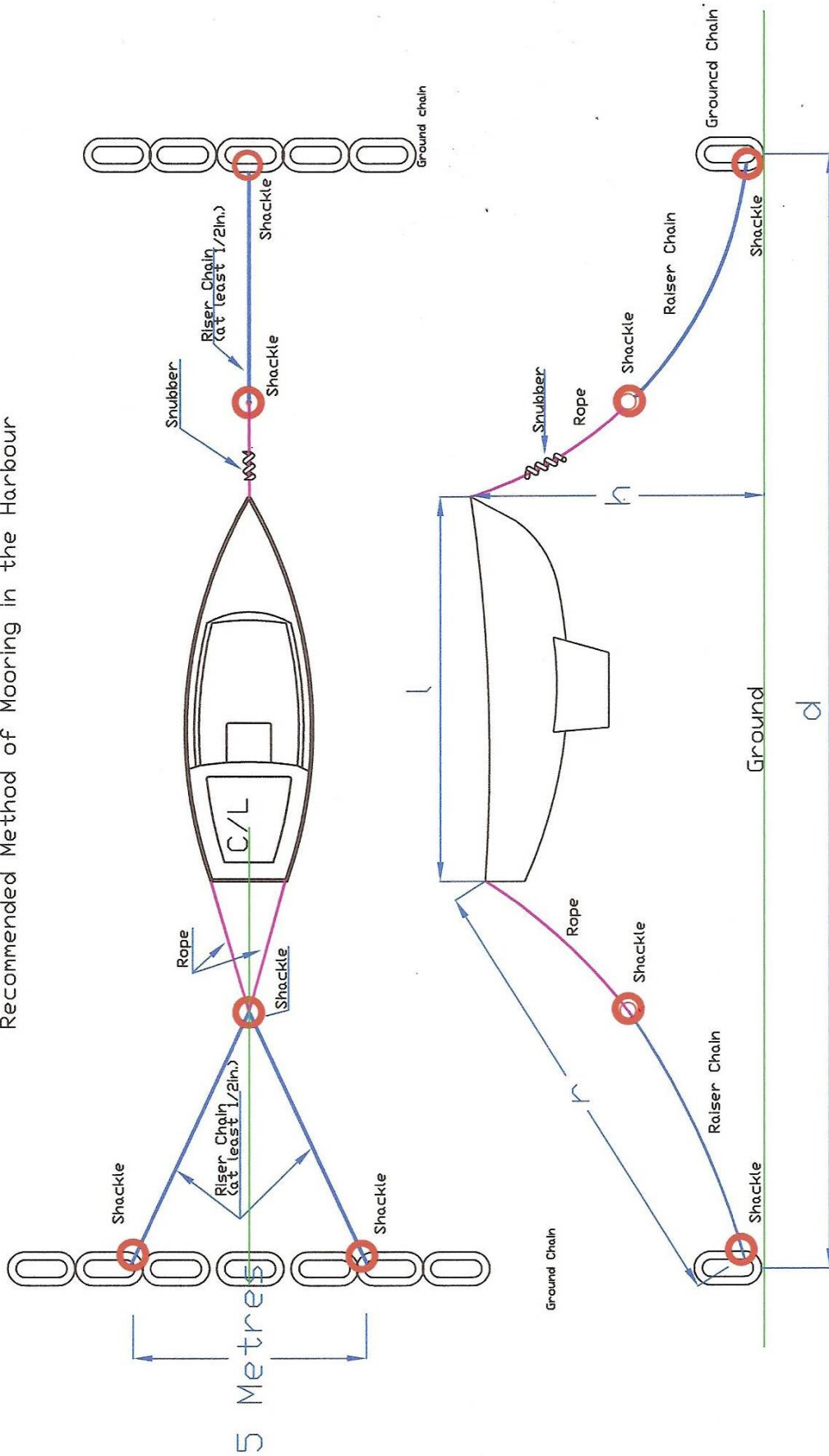
Floating Lines are a hazard to other sailors. Ballast light lines by fixing small weights or use lead-cored line so that your light lines do not float around the harbour to foul propellers etc,

Some Basic General Points

1. All shackles should be moused with monel wire or plastic coated galvanised steel wire; not with cable ties. (Plastic coated galvanised steel wire will be available in the workshop for use by members entirely at their own risk.
2. Protect the bow rope riser with a polythene tube at the stem head.
3. Where ropes are secured to chain use metal, not plastic, thimbles or use a fisherman's bend.
4. Weight light lines so they don't float

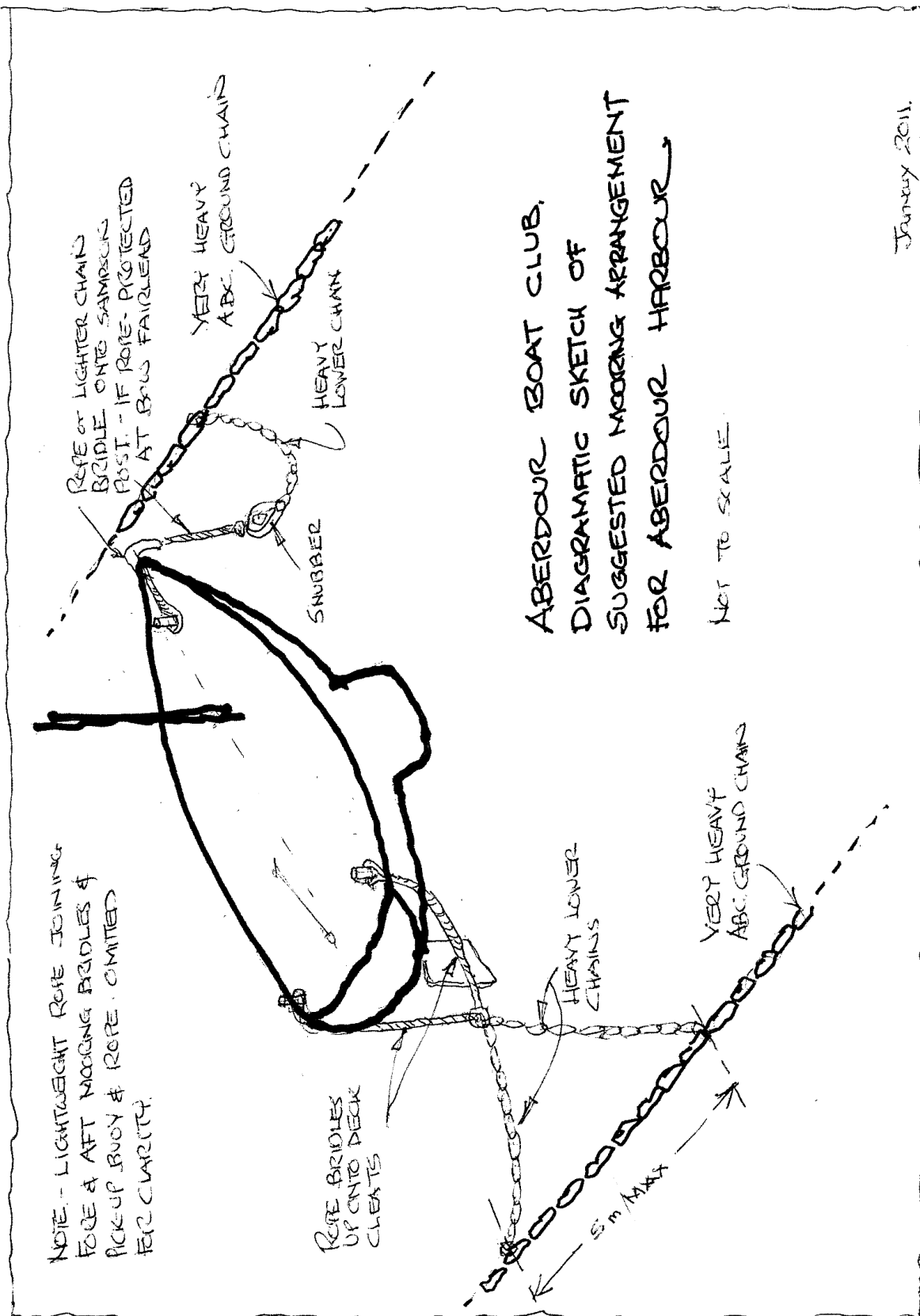
1.3 Harbour Mooring Diagram

Recommended Method of Mooring in the Harbour



○ Shackle
Size to be determined by chain or other attachment point.

1.4 Harbour Mooring Sketch



With grateful thanks to Andy Carnduff and Nick Thomson

1.5 Simple Calculations

Increase of Forces imposed by Rough Weather

In Aberdour Harbour in an easterly sea at that critical stage of the tide when a boat just floats, is the time when boats are most at risk of breaking free. The boats float in turn as the tide rises and move or surge downwind, sometimes athwart the line of the mooring and potentially approaching their neighbour if she is still aground. In bad conditions the boats take turns in surfing backwards on alternate waves, accelerating and rearing backwards until abruptly stopped either by hitting the rudder on the hard harbour floor or by the bow cable coming up, bar taut – straining deck fitting, bow fairlead and mooring tackle. Sometimes things break and the boat swings around colliding with adjacent boats. This is where a Snubber is useful to reduce the strain. Also, use nylon cable, as it is elastic too.

When at anchor we rely on the catenary of the long anchor chain to eliminate any shock load in the system, whereas, in a harbour mooring, the risers are too short and lightweight. To quantify the forces involved: a 3 ton boat accelerating to, say, 2 knots and then stopping instantly can apply several times her own weight as a loading to the mooring tackle. Andy Carnduff opines that the physicists among us will recall the formula $P=Ma$, where, if the deceleration 'a' is greater than the gravitational constant of acceleration 'g', the load 'P' will be greater than the weight 'M' of the boat. Thus imposing a greatly increased load, sometimes even more than double, on the constituent parts of your mooring system.

Calculation of Riser Length 'R'

Measure: 'l' the deck length of your boat
'd' the distance between the ground chains
'h' the height from the harbour floor at your berth to stem head (fwd) and to transom (aft) at the height of the highest tide

Assuming your boat sits midway between the ground chains, use Pythagoras' Theorem to calculate the length of the risers bearing the following points in mind:

- Chain should take the wear on the harbour floor
- Ropes to the upper part where the hull might be in contact
- Ropes should lie clear of transom hung rudders
- Bow rope should include a Snubber

Thus the triangle formed at highest tide by each mooring cable will be 'h' high and $\frac{1}{2}(d-l)$ long. The total length of the fwd and aft riser cable is calculated using Pythagoras:-

$$R = \sqrt{h^2 + \left\{\frac{1}{2}(d - l)\right\}^2}$$

If in doubt ask your nearest 14 year old.

2.0 BAY MOORINGS

2.1 Background

Back in 2003 the club issued Guidelines for Bay Mooring and generally everyone progressively has adopted these, mostly everyone is on 8m of heavy and 16m of ½ ins up to the float, and that has worked with no failures of the chain since inception. A 3-year full on-shore inspection schedule has been maintained, so no one has riser chain older than 5 ½ years, and very few shackles older than 3 years. This should be kept as the standard. The other permanent feature is the anchor clump. This is ultimately what keeps the boat in position and we have had a robustly successful record with simple heavy gravity clumps. The seabed in the bay is mostly gravel overlain in parts by shallow mud and in others by larger stones and cobbles (particularly near Pat Blakeman's mooring inshore of Little Craigs). Gravity clumps are cheap, simple and robust, coping well with the 4-times daily change in direction of loading and minimize potential for chain fouling, the yacht settling on top of, or capsize of an embedded anchor. The few occasions when dragging has been experienced have been when the yacht turned foul on the riser and lay beam-on to the weather. This to my mind confirms that we have the correct dimensions, big enough to work in all normal conditions, just light enough to handle manually when required (on shore or by a workboat), but able to allow some movement if loadings at the yacht are in excess of the boat's own design features.

2.2 Introduction

These guidelines are intended to clarify the operation of the lease that Aberdour Boat Club obtained from the Crown Estates Commissioners agents, and is not a binding legal document. Each owner who has a mooring within the leased area shall have signed agreement with Aberdour Boat Club, which makes him entirely responsible for his own mooring. Any disputes with other yachts and moorings in the area shall be resolved owner to owner and a list of mooring owners shall be placed on the club notice board for this purpose.

The Committee and Trustees of Aberdour Boat Club shall not become involved in any disputes over moorings or yachts at their moorings.

2.3 Mooring Allocation

Owners requiring a mooring located within the Aberdour Boat Club area in the bay shall sign the lease agreement. The owner should apply to the committee each season for a place, declaring that his mooring is up to the required standard and that he has adequate insurance. The committee shall issue a plan showing the mooring location for each yacht. The owner must agree on an acceptable location before placing his mooring in position or his yacht on the mooring. The committee will normally arrange common use of a commercial barge to lift all the moorings each 3rd year.

The fee set by the committee shall be paid upon return of the application form. Payment of a fee for the use of the mooring area does not alter the existing situation where the owner is completely responsible for his mooring and any associated problems.

The mooring locations will be decided in order to make best use of the available space, and keep similar types of yachts together. The mooring locations for each owner may change from season to season, but normally existing yachts will be allocated their existing place.

2.4 Resolution of Problems

Any disputes with other yachts and moorings in the area shall be resolved owner to owner, i.e. where there is a perceived problem with another mooring, the owners should resolve the problem between them. The club will give reasonable assistance towards the resolution of problems.

2.5 Mooring Specification

The recommended specification for the mooring is described below. This specification is for guidance only, and it is each owners responsibility to lay and maintain his mooring to a satisfactory standard. Failure to maintain a satisfactory mooring endangers not only the owner's yacht but also other yachts at their moorings.

Some existing moorings may deviate from this specification, but have proven to be satisfactory over the years, in particular by having shorter heavy ground chain and longer riser chain. The recommended change to longer ground chain is due to the difficulty in inspection of the upper big shackle. The revised system has been in use since 2000, and has the advantage of allowing greater spacing between yachts in the licensed area.

The mooring should consist of:

1. A heavy clump weight
2. 8m of heavy ground chain (approx 25mm bar diameter, or 20mm for smaller yachts)
3. 16m of 12mm long link, riser chain, incorporating a 20mm swivel near the top.
4. A 3m connection to the yacht (the junk); this can be in braided nylon which is easier to handle or, more reliably, 10mm galvanised short link chain, terminating in a permanent bight which will fit snugly over the yachts Sampson post or deck cleat.
5. A support buoy; this may remain permanently afloat, or, with the buoy connected to the riser such that it may be lifted onboard the moored yacht, so avoiding risk of snatch and chafe and ensuring the optimum catenary on the main mooring chain.
6. A pickup buoy on 6m light (12mm) polypropylene line attached to the bight at the end of the junk.

The solid clump should have maximum contact with the sea bottom yet have no projections to foul the chain. A high content of steel or iron in the clump is preferable because concrete loses over 1/3rd of its weight in water where steel loses only 1/7th. A cast iron spoked wheel is ideal.

The heavy ground chain should connect the clump to the lighter riser chain. The length of the ground chain allows the upper connecting shackles and riser to be inspected at mid-tide. The total mooring chain will be three times the maximum water depth.

Shackles should be as large as possible for the size of chain and their pins must be moused suitable wire, monel metal or coated mild steel are best. Copper wire should never be used. Stainless steel wire is not recommended with galvanised shackles as electrolytic corrosion takes place on the shackle pin threads. The shackle threads should be well greased or coated in lanolin or silicone paste. It has been noticed that almost all mooring failures occur due to shackle failure, often by corrosion of the pin threads and this does not occur when proper coating has been done. All shackles, the swivel and the junk must be inspected regularly for wear, corrosion or damage.

SIZE OF BOAT	CLUMP			GROUND CHAIN	RISER	JUNK	
	Displacement up to:	Dry Weight Concrete Iron	Submerged Weight			Chain	Nylon
2 tonnes	200Kg	140Kg	120Kg	8m x 22mm	16m x 12mm	8mm	20mm
3 tonnes	250Kg	150Kg	150Kg	8m x 25mm	16m x 12mm	10mm	24mm
5 tonnes	300Kg	180Kg	180Kg	8m x 28mm	16m x 12mm	10mm	24mm

If your existing sound ground chain is short, ensure that for each metre less than 8m your riser is 2m longer than the 16m tabled.

Mooring should be thoroughly inspected down to the top of the ground chain twice every year and be brought ashore for complete inspection every third year.

2.6 Further Thinking on Junks

Where there have been mooring failures is in the connections and in the rope junks. Some have recommended that a chain junk should be used to the yacht, and the float held by a short rope pennant, but few folk relish heaving a chain onto the bow, particularly if it is rusty and weedy. There are several options there, which has always required the tolerance of Job by the moorings officer in the face of adamant opinion by owners; hence the clauses on “owner’s responsibility ...”.

Regarding the top connection from the riser chain to the yacht and mooring float, it should be remembered that a swinging mooring has three separate functions. First, to retain the yacht, in all weathers and sea conditions, without becoming tangled or twisted, yet be capable of easy pick-up and release by the crew. Second, when the yacht is away, to hold the mooring chain riser up and to present the pick-up buoy on its pennant to the returning yacht. Third, to offer a secure light mooring for the tender, in such a way as not to impede the return of the yacht. The good mooring will do all three.

Firstly consider the size and function of the main mooring float. It must be large enough to support the riser chain from seabed to the surface. At Aberdour, the maximum depth of water in the mooring area at high tide is between 8 and 9 metres. Allow a couple of metres for waves and horizontal loading and take 3.0kg/m as the submerged weight of ½ inch chain, so the float must be able to support 30kg – or have a displacement of, say 30 litres – so a 40-litre or 10-gallon drum is ideal, or a nice fisherman’s 16 inch soft teardrop buoy/fender. That is all the mooring float does: hold up the weight of the chain riser when the yacht is away; provided that when the yacht is there, the mooring load is carried directly by the chain and the float is not a loaded part of the system. Some people, the manufacturers of expensive floats, and even the Admiralty prefer to have the float a structural part of the mooring, but that is not necessarily the best arrangement for yachts!

Secondly, the working mooring must be robust and have as few connections and fittings as possible as these are the weakest points, and must be easy to connect and release from the deck of the yacht, yet be absolutely reliable when left unattended for weeks at a time. It must be easy to inspect regularly for wear or damage.

Problems arise due to the sometimes violent movement of the yacht, and the relative movement of the float if it remains the primary surface point of attachment, and to the

rotation of the pick-up buoy around the float due to tidal and wind forces. Twisting of the main riser chain will occur unless an effective swivel is incorporated in the system. And of course, corrosion, erosion and marine fouling all are present particularly actively in the metre or so close to the surface: shackle pins, thimbles, chain, rope and swivels are all susceptible to these attacks.

In past years, stainless steel chain has been frowned upon in the marine environment but current technology reveals that it can be entirely satisfactory as long as some oxygen is present, by careful selection, to gain the benefits of minimal corrosion, avoidance of rust staining, and the opportunity to reduce the cross-section of steel traditionally allowed for corrosion loss. Thus, a 3-metre length of stainless steel chain, one size smaller than the riser (that means 10mm for Aberdour bay moorings) will be about the same weight as the 18- or 25-mm nylon rope commonly used and provides a much more robust connection at both the float and yacht. At the same time, consider attaching the float also by ½ metre of stainless chain, both chains attached by bow shackle above the swivel at the top of the ½ inch riser. The pick-up buoy, perhaps even one with an elevated handle to be seized directly by the anxious crew and pulled quickly in through the pulpit, is attached to the end of the yacht chain pennant by 12mm floating polypropylene about 6 metres long; and when the dinghy is left on the mooring, it is attached to the loop on the main float by its own painter, which means the pick-up buoy can be left easily accessible in the dinghy, or floating close to the float itself but with about 2 metres of pennant on the surface for the crew to catch on return. Once the pick-up pennant has been secured and the yacht comes to her natural resting position, the stainless chain can be pulled aboard through the fairlead and secured to the Samson post or bow cleats and the mooring float lifted clear of the sea by a strop up to the pulpit rail, leaving the yacht lying gently to the full catenary of the riser and (occasionally in gales) of the heavy ground chain. The interaction and jerking between float and yacht is eliminated, there is no risk of the yacht over-riding the junk and rubbing or fouling on the float, the float remains clean with no marine growth, and the group of “at risk” fittings –the top metre of the riser chain, the swivel, its two associated shackles, the two stainless pennants and their attachments to float and yacht, can all be inspected easily from the foredeck on a quiet day, preferably when the tide is low and little effort is needed to haul the whole caboodle on deck for half an hour.

Thus, a specification for mooring float and chain pennants to yacht and mooring float would read:-

- At the top of the 16m of ½ inch chain, secure a 20mm swivel using 20mm D shackle;
- To the top of the swivel, attach ½ m 10mm 316 stainless and 3m of 10mm 316 stainless short-link (anchor) chain by a single 12mm or 14mm stainless bow shackle;
- To the 1/2m chain attach a 16-inch teardrop float (this will be by lashing as the 10mm chain will not accept a shackle capable of passing through the eye in the float, at the same time, it will be convenient to attach or form a suitable loop to form the attachment for the tender and to hold the float up to the pushpit);
- To the 3m chain, add an end fitting suitable for securing to the samson post or foredeck cleats (a simple 1/2m long x 22mm nylon rope loop spliced into the chain is a suitable arrangement) ;
- Also to the end of the 3m chain, tie 6m of 12mm polypropylene rope, to the other end of which attach a light pick-up buoy.

2.7 Bay Mooring Diagram

