



Monmouth Boat Club

Moorings

Monmouth Boat Club Mooring Booklet

Created By: Charles Hanson

February 1989

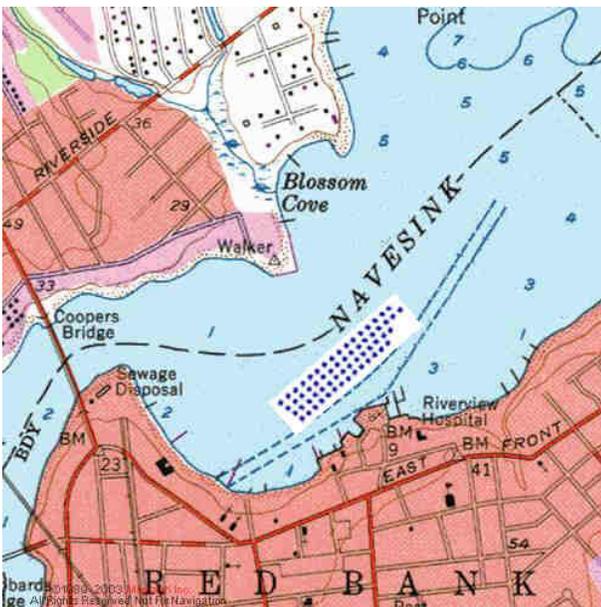
Revised By: Bill Carton
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February 2003

Introduction:

The Monmouth Boat Club (MBC) mooring field consists of 52 boats moored on the north side of the Navesink River channel. Boat lengths vary from 16 feet to over 30 feet. Beginning in 1987, Monmouth Boat Club set a boat length standard of not greater than 35 feet LOA and a draft of 5 feet. This ensures that regardless of how the wind shifts, each boat is separated by at least 35 feet. Approximately 40 feet of scope is specified to allow the moored fleet to withstand the winds, rain and tide of severe storms.

The MBC Supervisor of moorings is responsible for assigning each boat to its spot on the mooring grid. Due to the shallow depth of the field, which varies between three and six feet at Mean Low Water (MLW), the boat assignments are designed to prevent any boat from grounding at low tide and presenting a danger to adjacent boats as the wind and current shift directions.



During the winter season, mooring buoys are removed and the tackle is tied together and dropped to the bottom. This allows our neighboring Ice Boat Club, safe access to the river ice.

The moorings are hauled every three years and the mushrooms, chain, shackles, and swivels are given a

thorough inspection. In addition, the boat owner is advised to inspect his or her pennant, chafing gear and buoy several times during the season. It is the boat owner's responsibility to protect the pennant with chafing gear. The boats in the field are safe only if everyone inspects and maintains their mooring tackle.

MBC Boat Owner's Responsibilities

As a boat owner in the MBC Mooring Field, you will have the following responsibilities:

- 1) Maintain your mooring tackle in top condition.
- 2) Inform the Mooring Supervisor of low water or grounding problems, or underwater obstructions.
- 3) Have your mooring and buoy in its assigned location by June 30th. Mooring assignments will be posted on the Cruising Fleet bulletin board.
- 4) Attach an ID tag to the top of your mooring chain. The owner will be fined if a mooring has no ID tag.
- 5) Have ready for "Moorings In" a snap shackle with a temporary floatation device with the owners name and location clearly marked on it. The owner will be fined if temporary floatation is not available at Moorings in.
- 6) Remove your mooring buoy and replace it with a temporary floatation device prior to the scheduled "Moorings Out" date. The owner will be fined if a buoy is not removed in time.
- 7) Properly prepare and secure your boat in case of a severe storm warning.

MBC Mooring Requirements

The MBC Mooring Requirements are also shown in diagrams on pages 8 and 9 of this booklet.

Mushroom. Only mushroom anchors are permitted in the MBC mooring field. Mushroom anchor shanks are tipped toward the southwest since the majority of severe storms come from the northeast direction. If the mushroom is pulled during the season, be sure it has been tipped again.

If the mushroom is not tipped the chain wraps around and around until it is too short and something breaks – or a diver has gone down and unwrapped the chain. It is doubtful that a mushroom can be tipped after months of settling in even if the chain wrap is undone.

The minimum mushroom weights are listed below. Larger mushrooms are of course permitted.

- Boats to 21ft: 200lbs min.**
- Boats 22 to 25ft: 250lbs min.**
- Boats 26 to 30ft: 300lbs min.**
- Boats 31 to 35ft: 350lbs min.**

MBC Failure Mode Analysis Root Cause:
1). Undersize Mushroom, 2) Mushroom not tipped.

Chain

All boats shall have a 30 foot total chain length, consisting of 15 feet each of heavy (Bottom) and light (Upper) chain. The Bottom and Upper section of chain shall be joined by a swivel with two shackles. The swivel allows the boat to swing on its mooring without the chain binding or wrapping around the mushroom shank. The chain size listed below is the minimum requirement. Heavier chain may be used if desired.

- Boats to 26ft:
 - Bottom: 15ft of 1/2 inch chain
 - Upper: 15ft of 3/8 inch chain

- Boats over 26ft:
 - Bottom: 15ft of 5/8 inch chain
 - Upper: 15ft of 1/2 inch chain



Chain shall be hot dip galvanized. ACCO Chain & Lifting Products Div. Type "MC" Mooring Chain is preferred as it is 50% stronger than Proof Coil Chain and the long-link design provides increased room for attachment of shackles.

When moorings are pulled and chain is evaluated for wear keep in mind that once the galvanized coating has eroded chain erosion accelerates. Assure that the chain you put down has enough "beef" to erode for another 3 years without creating a problem.



Failure Mode Analysis Root Cause:
3). Undersize Chain, 4) Worn Chain Re-used

Swivels and Shackles.

Each section of the mooring tackle shall be joined by the specified swivels and shackles, which should be one size larger than the chain link size (i.e. 3/8" chain requires a 1/2 "shackle and 1/2" swivel).

- Swivels shall be eye-to-eye welded bolt type, hot-dip galvanized, drop-forged, domestic manufacture.



Seizing Wire

The threaded pins of all shackles must be safety wired with stainless steel or monel wire to prevent them from loosening under load and backing out. Make several parallel turns, twist the ends and tuck under out of harms way.

Do not use Galvanized Wire or Nylon Cable Ties to safety close your shackles. Nylon cable ties become brittle with time and will fail, Galvanized Wire corrodes.



Shackles shall be screw-pin type, hot-dip galvanized, drop-forged, domestic manufacture, Federal Spec RR-C-217b type IV.

A little waterproof grease on the threads will make it possible to unscrew the pin when the mooring is next pulled for service.

Shackles and open-jaw swivels, which are closed with an unthreaded clevis pin and cotter key, are not permitted on mooring tackle.

Failure Mode Analysis Root Cause: 5) Used Wrong Type Shackle or Swivel, 6) Did Not Use Specified Seizing Wire.

Swivels, shackles and thimbles are the weakest links in the mooring tackle. They are fairly inexpensive and it is wise to replace them every three years. Domestic manufacture, drop-forged are higher quality, stronger.

“Better is better - especially on those parts one cannot inspect.” - Andy Draxler

Buoy

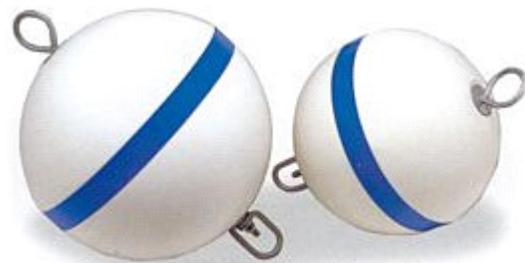
A buoy must have enough floatation to support the weight of the upper chain and any barnacle accumulation through the season. The location number and owner’s name must be on each buoy.

The use of anti-fouling paint to limit the growth of barnacles on your buoy has pro’s and con’s. If you do paint your buoy, be aware that the copper in anti-fouling paint can react with zinc galvanizing to increase corrosion. Frequent inspections by the owner should be made during the season to be sure your upper chain is not weakened by corrosion.

There are two styles of buoys available – 1) Traditional with metal rod through buoy, 2) Pass-through type where the mooring chain passes through a PVC Tube in the center of the buoy

When using the rod-type buoy, the pennant should never be attached to the eye on the top of the buoy. The rod going through the buoy is not easily inspected and is subject to corrosion. It could break under the load of a boat.

On the rod-type buoy a short (two foot) chain shall be used between the upper swivel beneath the buoy and the rope pennant. This will prevent barnacles from chafing the rope and will allow the boat to swing on its mooring without fouling the chain. The short chain shall be joined to the rope with a wired shackle to a thimble.



Blue stripe is reflective for nighttime visibility.



On the pass-through type buoy, the chain is pulled through the center of the buoy and is secured to a galvanized ring with a wired shackle. A Large shackle can take the place of the galvanized ring. The pennant thimble is spliced into the galvanized ring or attached to a large shackle. A galvanized mooring collar is available to protect the top of the pass-through tube. This can be supplemented with a wooden or rubber shock bumper placed on the top of the buoy right below the shackle to increase the life span of the buoy.

Pennant. The pennant can be either:

- 1) **Premium Three-Strand Nylon** - First quality 3-strand, heat stabilized, four stage laid nylon line, with marine overlay finish, such as New England Rope Premium Three-Strand Nylon or equivalent,



- 2) **or Yale Cordage Pennant** - pre-made pennant - (Polydyne - polyester, urethane maxi jacket coating, chafe sleeve, spliced over galvanized thimble) **These have much higher breaking strength than the Nylon.** The 5/8" Polydyne is stronger than the 3/4" Nylon and is an option where chock size will not accommodate a 3/4" line.



Pennant size shall be:

- Boats to 21ft: 1 / 2"
- Boats 22 to 25ft: 5 / 8"
- Boats 26 to 30ft: 5 / 8" - 3 / 4" *
- Boats 31 to 35ft: 3 / 4".

*Use the largest pennant and chafe gear that will fit through the chock.

Maximum Pennant Length.

- Pass-through type buoy: 2.5 times distance from chock on foredeck to waterline.
- Rod-type buoy: rope plus chain connected to bottom of buoy shall not exceed three times the distance from chock on foredeck to waterline.

This is necessary to preserve the minimum distance between adjacent boats.

Three-strand nylon pennants shall have an eye-splice tight to a thimble at the buoy end and at least a 12" bight at the boat end. The Cruising Fleet gives rope splicing classes each season to demonstrate the proper method to splice your pennant to a thimble.

Failure Mode Analysis Root Cause:

- 7) **Poor quality and/or undersized Nylon Pennant failed in storm.**
- 8) **Did Not Splice Tight to Thimble - seizing securing pennant to thimble failed, pennant chafed through in storm**

Secondary Pennant - Some advocate using two pennants – a primary and a secondary about 2 or 3 feet longer. **Pro:** Failure of the primary pennant the boat is riding on does not release the boat. **Con:** 1) Two pennants can twist together as the boat swings and occasionally must be unwound. If not corrected pennants will chafe against each other. Use chafe gear end to end and regular inspection. 2) As the boat drifts in light conditions one of the pennants can dip under the mooring ball and chafe against the chain. This can be prevented by flotation (like pool floats or swim noodles) attached to both pennants at mooring ball end to prevent dipping under the mooring ball in drifting conditions. Also, install chafe gear on the pennant near the ball as well as on the boat end.

Chaffing Gear

Pendants shall be protected with chafe gear which is inspected and maintained throughout the season.

Chafe gear shall be used where the pennant(s) pass through the chock and if two pennants are used, where the lines cross on the deck. Chaffing at this crossing point caused a boat to break loose during a storm.

Canvas, Leather or Polyester chaffing gear are preferred, with Polyester the most abrasion resistant according to tests by Practical Sailor.



Rubber and vinyl hose can cause problems – edges get sharp and cut as the stuff gets old or if not properly faired in the first place and the hose can cause failure of nylon line by causing heat buildup in the nylon line core when the line is working hard in storm conditions. Rated poorly by Practical Sailor rubber chafe guards contributed to a boat breaking free in a storm – DO NOT USE!



Leather Chafe Guards are better than rubber and the least expensive. Leather is popular on traditional design boats, is easy to make with a punch, needle and seizing line. Longest install time and not as effective as polyester. Polyester Chafe Guards are most abrasion resistant, as tested by Practical Sailor. Come split for use on made up lines and one piece for lines not yet spliced. HIGHLY RECOMMENDED.

Failure Mode Analysis Root Cause:
9) Inadequate, poorly maintained chafe gear caused pennant to wear through.

Boats will break loose when inadequate or no chafing gear is used.

Identification. In addition to the mooring buoy, there shall be a permanent ID tag attached at the top of the upper chain just below the buoy. This is to identify the mooring owner after buoys are removed for winter drop. Old credit cards make the best ID tags, plastic or stainless steel tags also work well.

Summary of Requirements

| Boat Size | Mushroom Weight lbs | Bottom Chain | Top Chain | Pennant |
|-----------|---------------------|--------------|-----------|----------|
| To 21' | 200 | 1/2" | 3/8" | 1/2" |
| 21-25' | 250 | 1/2" | 3/8" | 5/8" |
| 26-30' | 300 | 5/8" | 1/2" | 5/8-3/4" |
| 31-35' | 350 | 5/8" | 1/2" | 3/4" |

Moorings-In. Moorings in usually takes place at the end of March. In those years when moorings are dropped, each boat owner is required to have a temporary mooring float with snap shackle available to attach to the mooring tackle as it is retrieved from the bottom.

During those years when moorings are pulled, the mooring field will be marked with stakes prior to the drop. Each mooring will be inspected by the mooring supervisor or by his/her committee. The owner will be advised if the mooring tackle does not meet MBC standards or is improperly identified. Any mooring found deficient, will not be dropped until the necessary repairs are made. Over six tons of mooring gear must be ferried to their assigned spots and dropped. Each boat owner should be present to help with the efforts.

Moorings-In work takes place when the water is still quite cold and the weather is often inclement. The drop line used to tie the mooring chains together may become cut or chaff through, resulting in the temporary loss (we hope) of one or more moorings. Your assistance and cooperation is needed to make the job go smoothly as possible.

Moorings-Out: Moorings-Out usually takes place in late October or early November. During those years when moorings are dropped, each boat owner must remove his or her mooring buoy and pennant and replace it with a temporary mooring float with snap shackle prior to this date. Owners will be fined if a temporary float is not attached to the chain by this day.

The **temporary float** can be several plastic bottles on a length of rope long enough to allow the chain to lie on the bottom at high tide. If the bottles are filled with foam peanuts, crumbled foam coffee cups, or expanding sealing foam available at home stores in aerosol cans they will still float even if the bottles are damaged. Make sure the line is tied with a bowline and the loose end is taped to the standing end of the line.



Bowline A favorite knot with sailors and one of the best known and widely used of all knots. It is easily constructed whenever a loop is required that will not slip, jam or fail.

Each owner must have an **ID tag** at the top of the chain to allow the work crews to verify that each mooring has been tied to the drop line. This avoids confusion in the spring as to whose mooring has been retrieved. Owners can be fined if there are no ID tags

in place. The removed bottles will be stacked behind the boatyard shed after the tackle is dropped for a period of one month. At the end of this time, if the bottles have not been retrieved and removed from behind the shed by their owners, they will be discarded into the trash.

Please be polite and clean the barnacles off the top two feet of chain. It is easier on the hands of the work crews. This ensures the drop line will not be cut by barnacles.

During the years that the moorings are pulled, they will be stored behind the boatyard shed. A contractor will be hired to pull the mushrooms and place them onto the bulkhead. Since several tons of mushrooms and tackle have to be moved in one day, all owners should be available to lend a hand with these efforts. Moorings will be inspected in early spring so volume orders can be placed for chain and other hardware.

Moving your Mooring

Boat owners cannot move their mooring from its assigned location without permission from the Mooring Supervisor. If it becomes necessary to move your mooring due to grounding or underwater obstruction, please notify the Mooring Supervisor.

A minimum of two people are required to move a mooring. It is best performed at mean low tide. Secure the T-cantilever to the bow knees of the boat with large C-clamps. Take up the slack in the chain and secure the chain to the T-Cantilever. Drive in a circular direction until the mushroom is free. Take up the additional slack in the chain as necessary to move the mushroom to its new location. Finally, tip the mushroom shank toward the south-west direction.

In Case of a Severe Storm Warning

Each boat owner is responsible for ensuring the integrity of his or her ground tackle, pennant, and boat prior to a storm. Allow enough time when a severe storm warning is issued to get to your boat and secure it.

The MBC mooring requirements are adequate to withstand hurricane force winds if the standards are maintained by all boat owners. The type of bottom we have in the Navesink River affords good holding, there is no exposure to sea swells and there is ample swinging room to prevent boats from hitting each other. The greatest danger is from boats which may break loose or drag down onto another boat. The boat owner will have to decide whether to leave the boat on the mooring or haul the boat.

It is very important that you do not increase your pennant length when a storm is forecast. This would decrease the safe distance between boats and increase the danger of collision. Boats with excessive scope tend to tack across the mooring field. They are driven to leeward by gusts and waves and spring back with the elasticity of the line.

Pre-storm preparation is very important. The boat should be made as streamlined and sea proof as possible. Sails, sail covers, dodgers, furling jibs, and any gear on deck should be removed or stowed below deck. Halyards will flog against the mast.

If it can be removed, do so. Hatches and ports should be closed and securely latched. Vents should be sealed with duct tape. Anything not bolted down should be removed. The mooring buoy may reduce the scope of the tackle during high tides due to its floatation, and may be worth removing if it is very large.

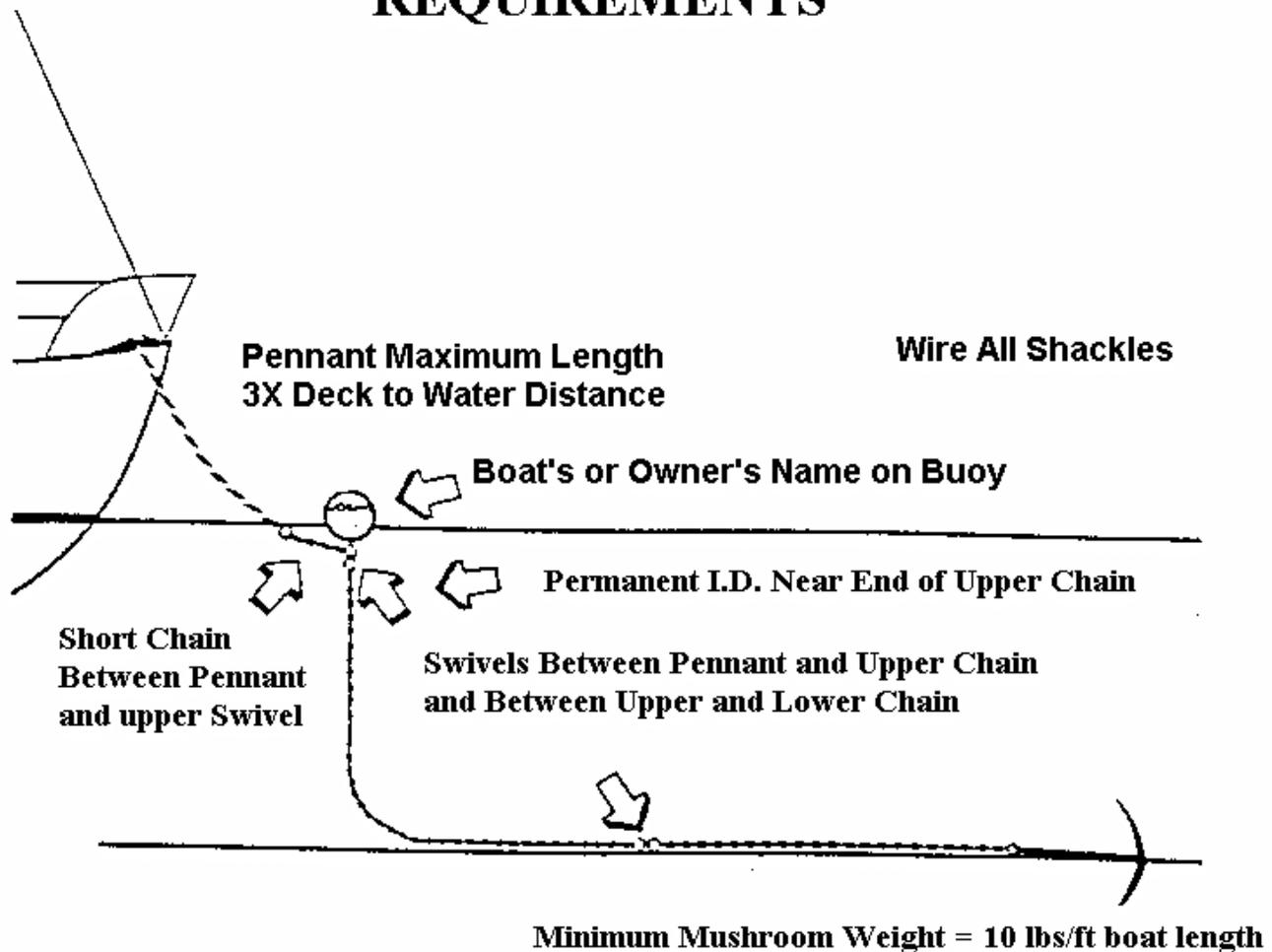
Chafe is a major concern during a storm. Lines will be subjected to large forces and even smooth chocks will abrade pennant lines. Use additional Polyester canvas, or leather chafe protection. Fasten chafe gear securely to your lines where they run through the chocks and where they cross other pennants. Double up on lines and secure them to your strongest foredeck cleats. A secondary bridle can be attached to a secure section of your boat. The strength of your deck hardware is very important. Watch the lead of lines carefully to load cleats, chocks and winches properly.

The situation aboard a boat during a hurricane can be a dangerous one. After you have done all your can do to protect your boat and the others around it, you should leave it to fend for itself. The Club will need all hands to help secure the Club-house and yard.



Clove Hitch Use a clove hitch to attach a rope at an angle to a solid object, such as a bar or boom, to keep it from slipping when tension is applied to the rope.

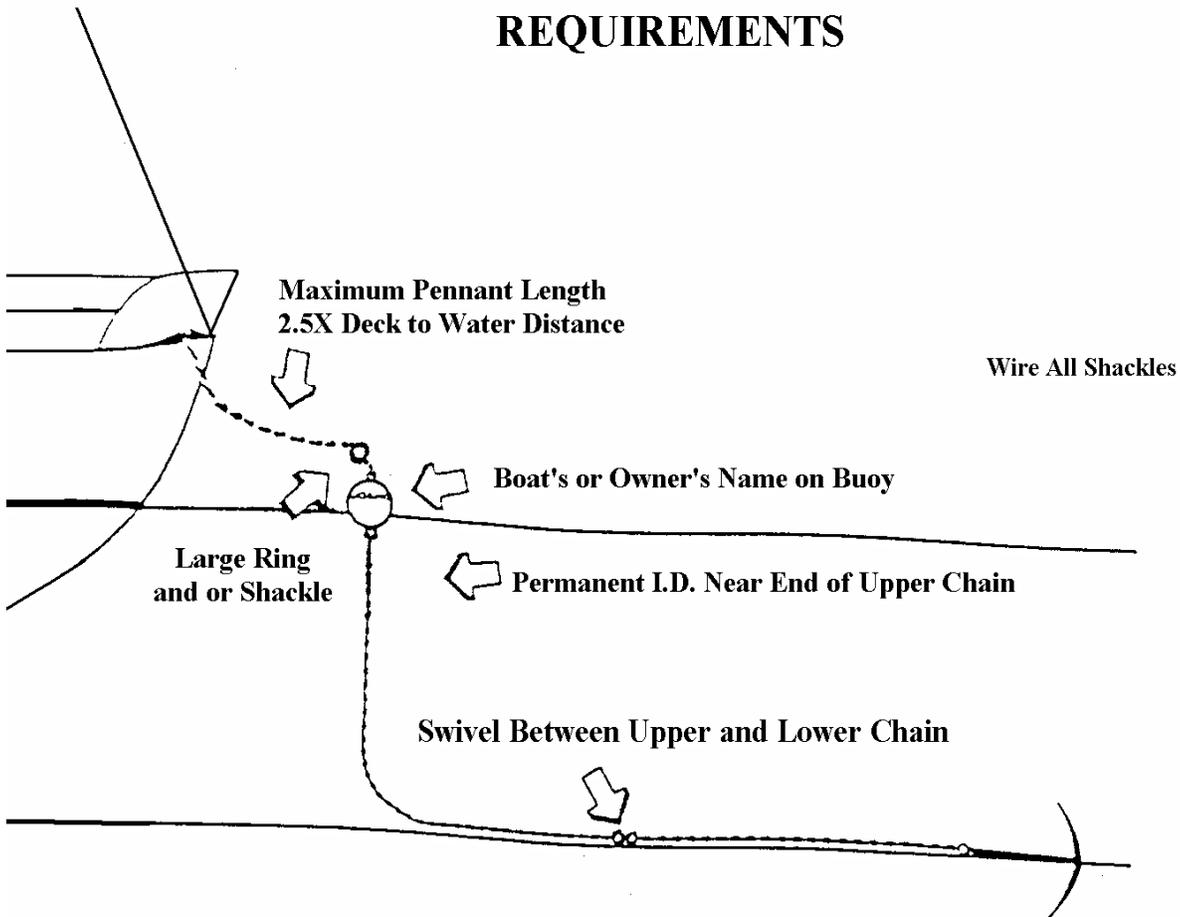
MBC MOORING REQUIREMENTS



- Rod-type buoy: Maximum Pennant Length - rope plus chain connected to bottom of buoy shall not exceed three 3 times the distance from chock on foredeck to waterline.

| Boat Size | Mushroom Weight lbs | Lower Chain | Upper Chain | Pennant |
|-----------|---------------------|-------------|-------------|----------|
| To 21' | 200 | 1/2" | 3/8" | 1/2" |
| 21-25' | 250 | 1/2" | 3/8" | 5/8" |
| 26-30' | 300 | 5/8" | 1/2" | 5/8-3/4" |
| 31-35' | 350 | 5/8" | 1/2" | 3/4" |

MBC MOORING REQUIREMENTS



Minimum Mushroom Weight = 10 lbs/ft boat length

- Pass-through type buoy: Maximum Pennant Length is 2.5 times distance from chock on foredeck to waterline.

| Boat Size | Mushroom Weight lbs | Lower Chain | Upper Chain | Pennant |
|------------------|----------------------------|--------------------|--------------------|-----------------|
| To 21' | 200 | 1/2" | 3/8" | 1/2" |
| 21-25' | 250 | 1/2" | 3/8" | 5/8" |
| 26-30' | 300 | 5/8" | 1/2" | 5/8-3/4" |
| 31-35' | 350 | 5/8" | 1/2" | 3/4" |

MBC Equipment Problems

Failure Mode Analysis Root Cause: Following Problems have caused failure of MBC Moorings.

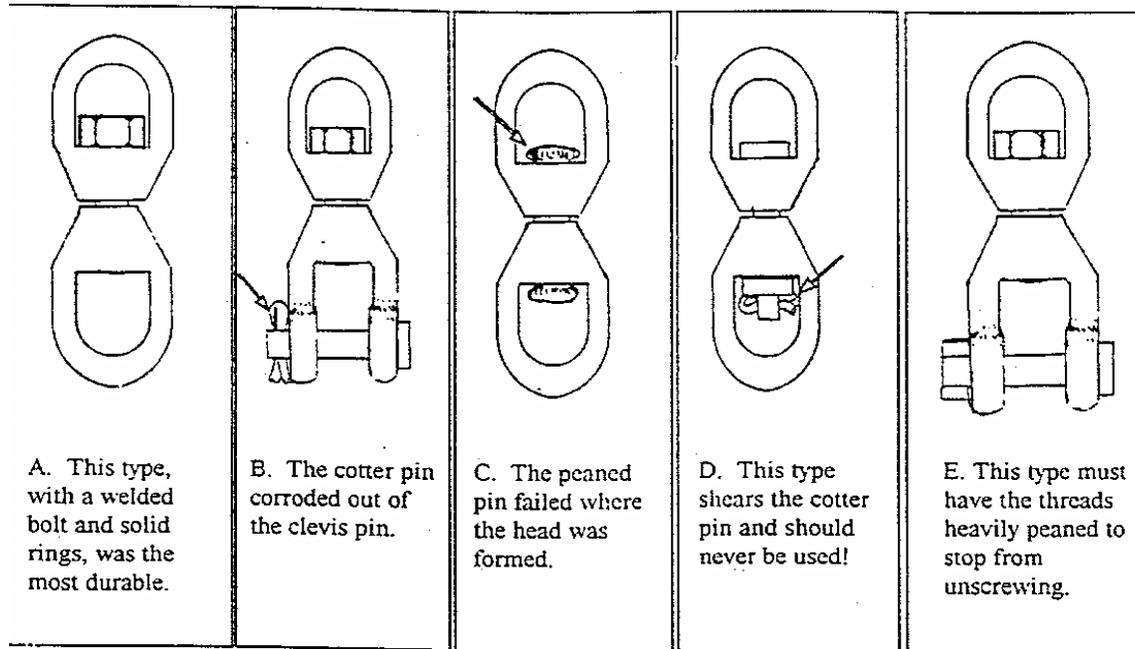
- *Undersize Chain,*
- *Worn Chain Re-used*
- *Used Wrong Type Shackle or Swivel,*
- *Did Not Use Specified Seizing Wire.*
- *Poor quality and/or undersized Nylon Pennant failed in storm.*
- *Did Not Splice Tight to Thimble - seizing securing pennant to thimble failed, pennant chafed through*
- *Inadequate, poorly maintained chafe gear caused pennant to wear through.*
- *Mushroom not tipped.*
- *Undersize Mushroom,*

Undersize Chain, Worn Chain Re-used

We have experienced several mooring failures from eroded chain. When moorings are pulled and chain is evaluated for wear keep in mind that once the galvanized coating has eroded chain erosion accelerates. Assume that the chain you put down has enough "beef" to erode for another 3 years without creating a problem. The upper chain will normally show more corrosion than the lower chain through its life span. Loss of your boat can be prevented by through periodic inspections during the season

Used Wrong Type Shackle or Swivel,

Swivels proved to be the weakest link in the mooring tackle. Seven upper swivels failed one season, and most of those that failed had a peaned pin connecting the two swivel sections. The drawing below shows the weak points of the various swivel designs. Based on experience, three years is the typical life span of a swivel. All swivels should have a welded bolt (type A) one to two sizes larger than the chain. Addition shackles can be used if necessary to step up to the larger size swivel. (Note: Use of Long Link Mooring Chain instead of Proof Coil provides increase room for the shackle body and permits use of the larger shackle without the need for multiple shackles.)



Did Not Use Specified Seizing Wire.

Seizing wire is essential to keep shackle pin in place. A diver hired to inspect underwater mooring components brought in a shackle that had its threads eaten away. The only thing holding the pin was the wire. The pin was holding the boat. This incident shows both the importance of Seizing Wire and of using good quality Domestic Manufacture Shackles.

Mushroom not tipped.

If the mushroom is not tipped the chain wraps around and around until it is too short and something breaks – or a diver has gone down and unwrapped the chain. It is doubtful that a mushroom can be tipped after months of settling in even if the chain wrap is undone. When the mushroom is first installed in addition to assuring the mushroom is tipped it is ideal if a boat big enough to pull it around can spin it 3 or more times to help set the mushroom in the mud. Since our biggest storms produce strong Northeast winds the shafts should be left pointing to the Southwest.

Undersized Mushroom

Load placed on the mooring is a function of the wind speed and the size of the boat. Wind load increases as the square of the wind speed. Holding power of the mushroom is a function of the size of the mushroom, the nature of the bottom, and how well the mushroom is silted in. Minimum mushroom sizes are set to reduce the likelihood of the mushroom dragging. The minimums were based on experiences with failure of moorings at MBC, review of recommendations in Chapmans, Thompsons, practices at other Yacht Clubs and examination of data on winds experienced at our club.

| Peak Winds Experienced at MBC | | | | |
|--|-------|-------|-------|-----|
| Peak Winds Speed (Kn) | 31-40 | 41-50 | 51-60 | >61 |
| Days w Peak | 134 | 29 | 7 | 2* |
| *High peaks were 66 and 83 | | | | |
| Source: Peak Reading Anemometer at Ice Boat Club 9yrs daily weather records kept by Tom Vought, data summarized by Tom and Peggy Vought | | | | |

| Horizontal Mooring Load in Lbs | | | | |
|---------------------------------------|-------------|------|--|---------------------------------------|
| LOA in Feet | <u>Beam</u> | | <u>Mooring Load in Lbs</u> | |
| | Power | Sail | Winds Speed 52 Knots Beaufort 10 | Wind Speed 64 Knots Beaufort 11 |
| 10 | 5 | 4 | 450 | 720 |
| 15 | 6 | 5 | 750 | 1130 |
| 20 | 8 | 7 | 1080 | 1630 |
| 25 | 9 | 8 | 1470 | 2220 |
| 30 | 11 | 9 | 2100 | 3170 |
| 35 | 13 | 10 | 2700 | 4080 |
| 40 | 14 | 11 | 3600 | 5440 |

| Holding Power of a well silted in mushroom anchor | |
|--|-------------------|
| Anchor Wt Lbs | Holding Power Lbs |
| 100 | 700 |
| 200 | 1200 |
| 300 | 1900 |
| 400 | 2500 |
| 500 | 3000 |

Data for average bottoms - better holding will yield higher holding, poor bottom less
(Source: researched by Tom Duane AHYC, consistent with INAMAR publication)