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REVISION 2

NAVAL SHIPS' TECHNICAL MANUAL

CHAPTER 582
MOORING AND TOWING

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FOREWORD

Mooring and towing systems are an integral part of the design and functionality of all ships. Mooring and towing systems, in conjunction with the anchoring system, provide the full range of ship handling capabilities requisite to execute Naval missions. The purpose of NSTM Chapter 582 is to provide general information concerning ship mooring and towing systems in support of Naval operations. Information pertaining to anchoring systems, as related to mooring or towing, is included herein. For more detailed information on anchor handling refer to NSTM Chapter 581, Anchoring.

NSTM Chapter 582 is divided into two Parts : Part I for Mooring Systems and Part II for Towing Systems. Part I for Mooring Systems includes general information about mooring systems, a discussion of mooring operations and arrangements, heavy weather mooring guidelines, details about specific mooring equipment, and information on the maintenance, inspection, and testing associated with mooring systems. Part II for Towing Systems is arranged in a similar fashion and includes general information about towing, guidelines and procedures associated with towing systems, details about specific towing equipment, and information on the maintenance and inspection of towing equipment. Appendices at the end of this NSTM Chapter provide additional information, such as a list of references, a glossary of mooring and towing terminology, and detailed procedures considered too specific for inclusion in the main text of this NSTM Chapter.

Naval Surface Warfare Center, Ship Systems Engineering Station, Philadelphia PA [NSWCCD-SSES Philadelphia] as the Life Cycle Manager and In-Service Engineering Agent, revised this NSTM Chapter in conjunction with the Cognizant System Engineer at Naval Sea Systems Command. At time of this revision, the Deck Machinery mooring and towing system technical points of contact could be reached at NSWCCD-SSES 9732 (215 897-7327 or 7799 - DSN prefix 443) and NAVSEA 05P8 (202 781-3701 - DSN prefix 326).

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CHAPTER 582

MOORING AND TOWING

PART 1 — MOORING SYSTEMS

SECTION 1.
GENERAL INFORMATION

582-1.1 MOORING OVERVIEW

582-1.1.1 MOORING SYSTEMS. Mooring systems are used to secure a ship to a pier, wharf, mooring buoy, or another ship. Mooring systems include the lines, fenders, ship/pier fittings and related machinery that would be used to bring a ship into a moored configuration. In addition to the standard mooring configurations alongside a pier, wharf, or other ship; a variety of at sea mooring configurations can be employed which often utilize ship's anchors. Most moorings are provided in harbors to provide a safe haven, reduce exposure to waves, reduce ship motions, and reduce dynamic mooring loads. Mooring in harbors also provides access to various services and other forms of transportation. Ship mooring systems, equipment and configurations are discussed within this NSTM Chapter.

582-1.1.2 TYPES OF MOORINGS. The Navy uses several types of mooring systems for ships. Mooring systems can be summarized into two broad categories:

a. Fixed Moorings — Fixed moorings are defined as systems that include tension (mooring lines) and compression (fenders/camels) members. Typical fixed mooring systems include moorings at piers and wharves (berths). When berthed, ships can usually rely on shore services for most of their needs.

b. Fleet Moorings — Fleet moorings are defined as systems that include primarily tension members. Mooring loads are transferred into the earth via anchors, which is accomplished by using either Fleet Mooring buoys or the ship's anchor. When moored this way, ships must rely on their own power.

582-1.1.3 PURPOSE OF MOORING. The purpose of a mooring is to safely hold a ship in a berth or in a certain position to accomplish a specific mission. Ship moorings are provided for:

a. Loading/Unloading — Loading and unloading items such as stores, cargo, personnel, ammunition, etc.

b. Maintenance/Repairs — Scheduled maintenance and simple repairs can be performed at sea. Certain actions require shore services, special parts, and outside assistance that can only be provided while moored.

c. Mission — Moorings are used to support special mission requirements, such as surveillance, tracking, training, salvage, etc.

d. Ship Storage — Ships in an inactive or reserve status are stored at moorings. This reduces costs to simple upkeep while ensuring the ship can be made available again if needed.

582-1.2 SHIP MOORING SYSTEMS

582-1.2.1 MOORING SYSTEM DESIGN CRITERIA. Navy mooring systems have historically been designed in accordance with Design Data Sheet (DDS) 582-1. This guidance document established the criteria for determining ship environmental loads and translating projected mooring loads to size and strength requirements for the mooring system components. Navy ship design criteria have evolved and are now contained in MIL-HDBK-1026/4.

582-1.2.1.1 Determination of Mooring Loads. Environmental forces from wind and current acting on the ship produces the mooring load. The design mooring load is derived from an algorithm that sums the combined forces of wind and current loads acting in the direction that produces the highest possible force against the ship structure pushing the ship in the direction away from the pier. The design mooring load remains constant throughout the life of the ship. The algorithm for determining mooring loads is contained in MIL-HDBK-1026/4, and produces similar results to the formulas contained in the outdated DDS 582-1.

582-1.2.1.2 Minimum Design Requirement. Many Navy ship mooring systems were originally sized to safely hold a ship subjected to the combined forces of a 50-knot wind and 3 knot current. Ship design requirement has been revised to call for safe mooring at the design mooring load corresponding to a 64-knot wind and 2-knot broadside current at ship's draft equal to 90% of dredge depth. NAVSEA has determined that the original and new requirements are roughly equivalent. The revised design requirement is more definitive, more closely correlates to actual ship mooring situations, and achieves mooring design compatibility with NAVFAC pier design practices. In 1999, the revised Navy ship mooring design criteria were incorporated into MIL-HDBK-1026/4.

582-1.2.2 MOORING SERVICE TYPES. To improve the overall clarity and safety when mooring ships, NAVSEA and NAVFAC developed four Mooring Service Types (MST's) based somewhat on common weather forecasting. For each Mooring Service Type, it is intended that the ship remains safely moored under worst case conditions at that site, based on a reasonable design factor for the working load limit [sometimes referred to as Safe Working Load (SWL)] on the mooring lines and fittings. For Mooring Service Types I and II, mooring lines are provided by the ship. For Mooring Service Types III and IV, mooring lines are provided by the port facility. Definitions for MST's were also established by NAVSEA and NAVFAC, and incorporated into MIL-HDBK-1026/4. These Mooring Service Types are defined in Table 582-1-1, and should be used as explained below.

582-1.2.2.1 Mooring Service Type I. This category covers "mild weather mooringconditions. Mooring situations include ammunition facilities, fueling facilities, deperming facilities, and ports of call.

a. The intended environmental limit for MST I is up to a 34-knot wind with a current of one knot or less from any direction.
b. Mooring to MST I criteria should only be accomplished in concert with a "fair weather" forecast. A mild weather mooring arrangement should not be used if there is any likelihood of wind or current exceeding specified limits.

582-1.2.2.2 Mooring Service Types II & IIA. This category covers "storm mooring" conditions. MST II provides for safe berthing of ships in situations where severe in-port weather could be encountered. Vessel **will leave** prior to an approaching hurricane, typhoon, surge or other extreme event.

a. The intended design condition for MST II is up to a 64-knot wind with a 2-knot broadside current or less.

b. All nested ship moorings should be based on MST II.

c. Some Navy ship classes (CVN 68, LHA 1, and LHD 1/5 classes) cannot meet intended design conditions at a typical berth. Hence, an alternative MST IIA classification is provided as either up to a 50-knot wind with a 1-1/2 knot broadside current or less, or up to a 64-knot wind with a 1-knot broadside current or less. The load produced by a 50-knot wind and a 1-1/2 knot current is normally about the same as a 64-knot wind and a 1-knot current. For ships with a MST IIA classification, it is important to monitor local storm conditions to ensure that these limitations are not exceeded.

582-1.2.2.3 Mooring Service Type III. This category covers ″Heavy Weather Mooring" (HWM) of vessels that cannot or may not get underway prior to an approaching hurricane or typhoon. Situations include fitting-out, repair, drydocking, and overhaul berthing facilities. These situations can last between one month and two years. The responsibility for safe mooring and proper mooring lines for ships in MST III conditions lies with the facility.

a. Design conditions for MST III are site dependent and based on historical weather patterns for that site. The worst case design condition is up to a 90-knot wind with a 2-knot broadside current or less. All Navy ships must be capable of being moored under the worst case condition.

b. In some cases, ships may be moved to an alternate berth that is better situated for HWM.

582-1.2.2.4 Mooring Service Type IV. This category covers ″permanent moorings" for vessels that will not leave under any circumstance. MST IV must account for any weather contingency (such as major hurricane, typhoon or surge) without the option of moving the vessel to a safer berth. Situations include inactive ships, floating drydocks, ship museums, and training ships.

Table 582-1-1 MOORING SERVICE TYPES

Mooring Service Type	Description
MST I Mild Weather	Mooring in up to a 34-knot wind with a current of 1 knot or less from any direction.
MST II Storm Mooring	Mooring in up to a 64-knot wind with a 2-knot broadside current or less. This is the intended Navy ship mooring design requirement.
MST IIA Alternative Storm Mooring	Mooring in up to a 50-knot wind with a 1 1/2-knot broadside current or less; or up to 64-knot wind with a 1-knot broadside current or less. This is the minimum acceptable capability for ships that do not meet intended design criteria.
MST III Heavy Weather Mooring (HWM)	Mooring in up to a 90-knot wind with a 2-knot broadside current or less. This is the minimum requirement for vessels that cannot or may not get underway prior to an approaching hurricane or typhoon. Actual design conditions are site dependent and based on 50 year weather patterns.
MST IV Permanent Mooring	Permanent mooring of a vessel that will not leave in case of a hurricane, typhoon or surge. Design conditions are site dependent and based on 100 year weather patterns.

582-1.2.3 ACTUAL SYSTEM CAPABILITIES. The mooring capability is determined based on efficient loading of ship mooring lines at a typical pier configuration. It is difficult to be certain of a ship's actual mooring capability because mooring load is a calculated estimate for given wind and current conditions. Actual mooring capability is dependant on assumptions regarding projected wind and current loads, and on factors of safety applied when sizing lines and ship fittings. Navy ship mooring designs must be capable of meeting or exceeding the design mooring load requirements of Mooring Service Types II and III.

582-1.2.3.1 Limitations. In any mooring arrangement, the limitations must be understood. Load distribution on individual mooring lines will vary depending on how well the crew initially deploys the lines. Arrangements using single part mooring lines (see paragraph 582-2.2.2) provide better load sharing and can be practicably tended during a storm as compared to traditional three part lines.

582-1.2.3.2 Efficiency. Overall efficiency of the mooring arrangement will vary, given limitations of lead angle to the pier, differences in line length, and spacing and strength of pier fittings relative to ship fittings. Mooring efficiency is loosely defined as the ratio of the ideal moor to the actual moor. In order to assign a number to mooring efficiency, a more precise definition is the ratio of the total force exerted on the ship for a certain Mooring Service Type to the load handling capability of the actual mooring arrangement.

582-1.2.3.3 Design Factor. Design factor (or factor of safety) is defined as the ratio of the ultimate strength to the allowable stress. For mooring components (fittings and lines) it is the ratio of the calculated or measured breaking point to the maximum load allowed under given conditions. Heavy Weather Mooring (HWM) arrangements also allow a lower design factor (DF) for mooring line working load limit as a percentage of breaking strength. HWM arrangement DF is 2.5:1, whereas storm mooring DF is 3:1.

582-1.2.4 MOORING ARRANGEMENTS. Ship mooring arrangements and shipboard mooring practices have long been based on traditions that have remained unchanged over the years. Studies have shown that some mooring system components, thought to be within their design parameters, may in fact be overloaded. Better understanding of mooring dynamics allows us to substantially improve ship mooring arrangements and plans for mild, storm and heavy weather mooring.

582-1.2.4.1 Standard Mooring Arrangements. Standard mooring arrangements are developed and issued for each class of Navy ship. These initial mooring arrangements can often be found in Ship's Information Books (SB's) The initial mooring arrangement is usually evolved from preliminary system design, including layout of topside equipment and fittings, and intended layout and lead angles for the mooring lines. During the operational cycle, practical experience will enable ship's crews to evolve an effective mooring plan. Mooring plans will be modified and improved to address safety concerns or to achieve greater efficiency when tying up or getting underway. The NAVSEA or NSWCCD-SSES mooring point of contact should be notified if inconsistencies exist between ship's documented mooring arrangement drawings and normal on board practice.

582-1.2.4.2 Improved Mooring Guidelines. The technical community is often called upon to assist in developing improved mooring plans. A variety of mooring arrangements have been prepared for submarine to surface ship arrangements in support of Unitas, submarine berthing at overseas ports, and other special missions. Specific guidelines are being developed for certain ship classes and will include current mooring arrangements and plans. As available, this information will be incorporated into NSTM Chapter 582. In general, ship Mooring arrangements should have adequate stiffness to limit ship movement, and at the same time be flexible enough to provide for load sharing, reduce peak dynamic loads and allow for events, such as tidal changes.

582-1.2.4.3 Mooring Station Capacity. Bitt strength determines mooring station capacity. Mooring arrangements for most Navy ships deploy mooring lines in three parts to develop full mooring design capability. However, many ships tie up in a ″tanker" mooring configuration using two parts of line. This would limit ship holding power to roughly 2/3 of the intended design load for 3 part mooring lines. Single part mooring line configurations, using four strand aramid or spectra fiber, will provide full load capability at all times.

582-1.2.4.4 Heavy Weather Mooring. Heavy Weather Mooring. During repair periods when a ship cannot get underway they should have provisions in place to execute heavy weather mooring (Mooring Service Type Ill). The National Weather Service classifies hurricanes by categories. A category II hurricane has maximum winds of up to 110 mph, which is approximately equal to 95 knots. When a category II or higher hurricane is approaching, ships should be prepared for the appropriate conditions. (Note: MST III is for 90-knot winds and higher) Some ship classes have extra ship fittings available that can be used to moor for heavy weather. To obtain needed holding power, it is often necessary to run lines to pier fittings that are in the traffic area, or across the pier. Placement of lines into the pier may require pier operations to be restricted or secured. Upon notification of a major storm approaching, ship and facility personnel must coordinate a heavy weather mooring plan. Heavy Weather Mooring is covered in detail in Section 3 of this NSTM.

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582-1.2.5 SHIPBOARD MOORING EQUIPMENT. The majority of mooring systems aboard ships are relatively simple consisting of, the mooring lines, a few accessories and deck fittings, and two speed capstans. Ships do not normally carry the fenders to which they may moor against. Larger ships may have variable speed capstans for improved line handling capability and/or constant tension mooring machinery for ease of tending mooring lines.

582-1.2.5.1 Mooring Lines and Accessories. Mooring lines are used to secure a ship to a wharf, pier, dock or another ship. The size and strength of mooring lines is matched to the ship and generally increases as the size of the ship increases. Mooring lines of nylon or polyester have most often been used. Lines made of high strength, low stretch, and reduced snapback aramid fibers are also approved and are becoming more widely used because of their inherent safety characteristics. Mooring line accessories include tattletales, line throwing devices, rat guards, and fairleaders. Detailed information on mooring lines is discussed in Section 4 of this NSTM.

582-1.2.5.2 Mooring Fittings. Mooring fittings include chocks, bitts, cleats, and hawser reels. Detailed information on shipboard mooring fittings and accessories is provided in Section 5 of this NSTM.

582-1.2.5.3 Mooring Machinery. Mooring machinery facilitates the handling and securing of mooring lines. It includes the capstan head and related machinery, as well as constant tension mooring winches. Detailed coverage of mooring machinery is provided in Section 6 of this NSTM.

582-1.3 BERTHING FACILITIES

582-1.3.1 STRUCTURES. The typical pier or wharf includes several key elements for ship mooring, including mooring fittings, fenders, brow and shore services. Figure 582-1-1 shows a typical berth. In some cases camels are provided for additional standoff. All of these items must be in good condition and properly used to help ensure safe mooring.

582-1.3.1.1 Piers, Wharves, Docks and Slips. When not underway, Navy ships can be moored to: piers or wharves, fixed structures that extend from the shore, mooring buoys that are attached to the seabed, or other ships (nesting). Piers and wharves are often called docks. These structures, which extend from the shore, are in water of sufficient depth for ships to approach and moor to them. A pier is usually oriented at right angles to the shore. A wharf is parallel to the shore. The space between adjacent piers is called a slip.

582-1.3.1.2 Construction of Wharves and Piers. Wharves and piers are commonly built on piles, which allows a free flow of water under them and in the slips in between. Their underwater construction may also be solid such as a quaywall, in which case there will be no current inside the slips, but eddies may still be present. Buildings such as warehouses on the piers and wharves can vary the effect of the wind on the superstructure of a ship when it is mooring or berthed at a pier or wharf.

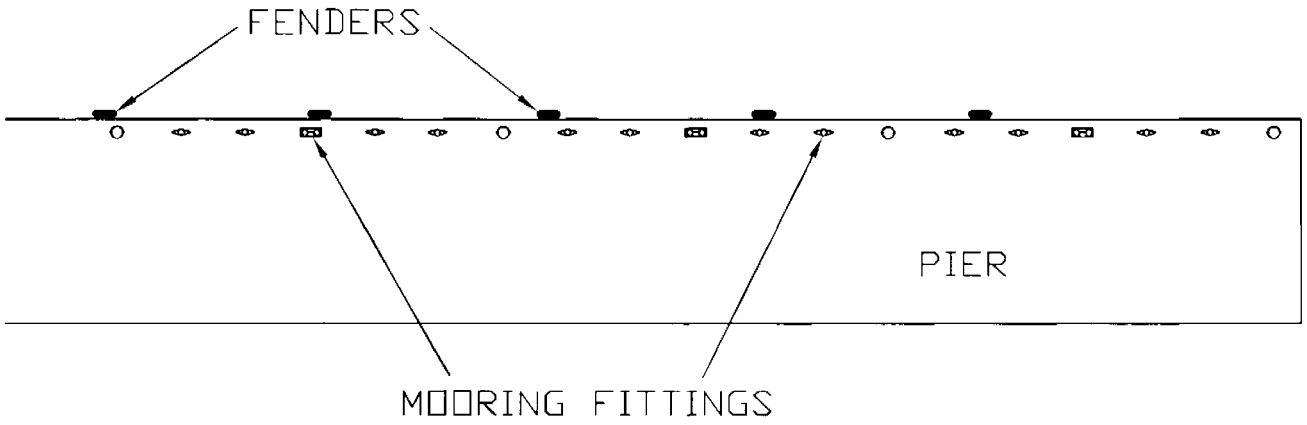


Figure 582-1-1 Typical Berth Arrangement For Piers, Wharves, Docks and Slips

582-1.3.1.3 Mooring Fittings. Mooring fittings provided on piers and wharves are cast metal structures bolted into the concrete or wood structure. The strength of the bolts is usually the factor controlling the strength of the fitting. Mooring fittings on piers or wharves are designed with a load limit that will satisfy the largest ship to be moored at that pier, plus a suitable design factor. Common pier mooring fittings are bollards and cleats. Detailed information on pier mooring fittings is provided in Section 5 of this NSTM.

582-1.3.1.4 Fenders. Fenders are used for protection between two ships, or between a ship and a pier. Fenders are needed to absorb energy, to cushion against impact loads, and to provide standoff between ships and piers. Section 6 of this NSTM provides information about fenders for ship to ship and ship to pier berthing. Detailed coverage of Navy fenders is provided in NSTM Chapter 611 and additional coverage is provided in Section 7 of this NSTM.

582-1.3.2 SHORE SERVICES. A mooring plan should address shore services interfaces. Access to the ship and brow placement must be safe. The plan must also address shore power, communications, water, fuel, consumables, and cargo/weapons handling. Berthing and Shore Support Handbooks are being developed for all classes of ships. The handbook provides ship class guidelines for ship's crew, as well as for port services and public works organizations providing berthing and pier services. It is also useful for facilities planning and design, and for planning ship maintenance activities.

582-1.3 MOORING OPERATIONS, MAINTENANCE AND TRAINING

582-1.4.1 OPERATIONS. When mooring a ship, cooperation between the ship and the facilities must be coordinated. Mooring arrangements must be determined in advance and these details must be communicated to the shore command. Services required from the shore command must also be prearranged. Cooperation and coordination are the key to all successful mooring operations. Safe mooring operations is addressed in Section 2 of this NSTM.

582-1.4.2 MAINTENANCE. The Planned maintenance System (PMS) and the equipment technical manuals are the primary sources of information on preventative and corrective maintenance. Additional information on maintenance, inspection, and testing of mooring equipment is discussed in Section 8 of this NSTM.

582-1.4.3 TRAINING. To help educate ship's crew about mooring details and dangers, the Navy has prepared many training videos. These training videos are available from:

a. Director, NETPMSA Norfolk Regional Electronic Media Center, Commercial: (757) 444-4011, DSN: 564-4011.

b. Director, NETPMSA San Diego Regional Electronic Media Center, Commercial: (619) 532-1325, DSN: 522-1325.

582-1.5 TECHNICAL AUTHORITY

582-1.5.1 TECHNICAL AUTHORITY FOR SHIP-BASED MOORING SYSTEMS. Mooring systems and equipment, permanently installed on or carried aboard ship, such as mooring winches, capstans, mooring lines, chocks, bitts, cleats, and fenders is the responsibility of the Cognizant System Engineer (SEA 05P8) and the Life Cycle Manager/In-Service Engineering Agent (NSWCCD-SSES 9732). Technical and maintenance support may be assigned to various technical authorities throughout the Navy.

582-1.5.2 TECHNICAL AUTHORITY FOR SHORE-BASED MOORING SYSTEMS. Mooring equipment, mounted or attached to piers or wharves, such as cleats, bollards, separators and camels, is under the technical responsibility of Naval Facilities Engineering Command (NAVFAC). They have the responsibility for the administration, operation and procurement of mooring and docking gear not installed on or carried aboard ships.

582-1.5.3 FOREIGN PORTS OF CALL. The U. S. Navy owns and operates many overseas naval facilities. For these facilities the above technical authorities still apply. On those occasions where a U. S. Navy ship will berth in a foreign port that is not U. S. owned or operated, NSWCCD-SSES typically provides guidance for ship berthing. NAVFAC may also provide assistance and guidance as requested.

SECTION 2.
MOORING OPERATIONS AND ARRANGEMENTS

582-2.1 MOORING CONFIGURATIONS

582-2.1.1 GENERAL INFORMATION. Mooring parallel to a pier or wharf is the most common mooring configuration for Navy ships. The following paragraphs describe this and alternative configurations used to moor Navy ships. A summary of mooring configurations is shown in table 582-2-1.

Table 582-2-1 SUMMARY OF MOORING CONFIGURATIONS

Configuration	Remarks
Pierside (Fixed Moorings)	
1. Standard	Excellent, ship is aligned parallel with pier or wharf
	Best if ship's draft does not limit its ability to tie up; ship is located near facilities; easy access provided to take on supplies, ammunition, and crew
2. Med Moor	Good for situations where reasonably precise positioning is required in a limited area
	Can be subject to larger broadside currents
3. Spud Moor	Excellent for floating drydocks
	The ship is free to move vertically on the spud as the tide rises and falls
At Sea (Fleet Moorings)	
1. Free Swinging (Single Point)	Ship will assume the most advantageous position under combined action of wind and current; best for heavy weather or transient mooring when an acceptable pier berth is unavailable
2. Multiple Point	For two points, not for precise positioning; suitable for transient mooring with limited sea room
	For three or more points, mooring precision increases

582-2.1.2 PIERSIDE MOORING (FIXED MOORINGS). Naval Surface Warfare Center, Ship Systems Engineering Station, Philadelphia PA (NSWCCD-SSES) provides pierside mooring information for the United States and around the world to support the Fleet. Point of contact at that command can be reached at NSWCCD-SSES c/9732, 215 897-7327 or 7799 - DSN prefix 443.

582-2.1.2.1 Standard Pierside Moorings. Standard pierside moorings, or mooring parallel to a pier or wharf, are discussed in detail in paragraph 582-2.5.

582-2.1.2.2 Mediterranean Type Moorings (Med Moor). In a Med Moor, the stern of the ship is secured perpendicular to a pier or fixed structure with mooring lines or anchor chains. The bow of the ship can be secured to mooring buoys or by its own anchors. A typical Med Moor arrangement is shown in figure 582-2-1. Med Moors are used where there is insufficient berthing facilities for mooring ships parallel to piers, such as in the Mediterranean Sea. Ships planning a Med Moor on deployment should practice this maneuver prior to deployment.

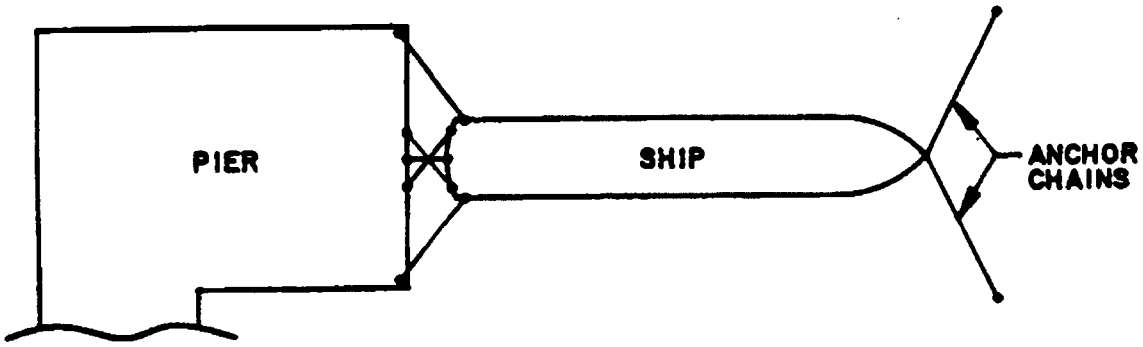


Figure 582-2-1 Med Moor

582-2.1.2.2.1 Med Moor Procedures for Tenders. Med Moors are particularly well suited for submarine and destroyer tenders because both sides of the ship are available for other vessels along side. However, Med mooring and unmooring for large ships, such as tenders, is difficult and time consuming. An example of a Mediterranean mooring/unmooring procedure used at NATO Santo Stefano, Italy is provided in Appendix C.1 for information only. This Med Moor is accomplished using fixed buoys and specially outfitted stern mooring equipment. Each ship must evaluate it's own capabilities and the pier facilities, and modify procedures to ensure safe operations.

582-2.1.2.2.2 Med Moor Procedures for Combatants. The Mediterranean moor consists of mooring one end of the ship to a mole or pier and anchoring the other end. Ships may use a Med Moor when there is insufficient pier space and they want to limit ship movement. The procedure is similar to tenders. An example of a Med moor is provided in Appendix C.2 for information only.

582-2.1.2.3 Spud Mooring. A spud is a steel member, usually an H-beam, a piling, or a built-up section. Moorings using spuds are called spud moorings. Spud moorings are often used to moor floating drydocks, as shown in figure 582-2-2. Spuds can also be pilings driven into the bottom, either temporarily or permanently. The ship in this case is normally connected to the spud with a large ring or collar that is free to move vertically on the spud as the tide rises and falls.

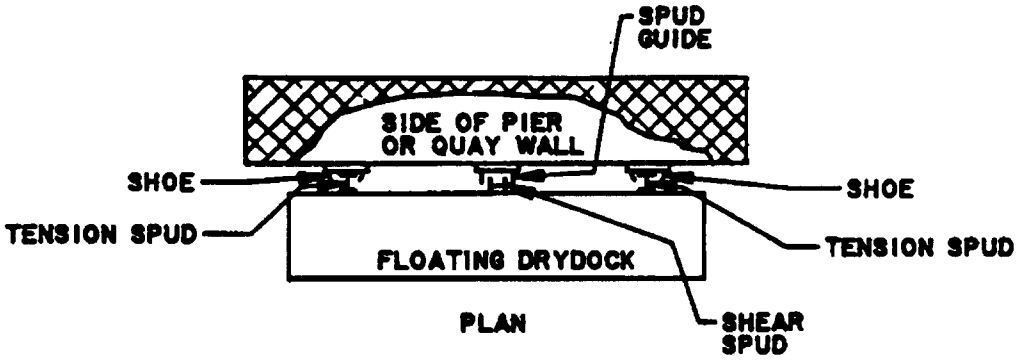


Figure 582-2-2 Spud Mooring

582-2.1.3 MOORING AT SEA (FLEET MOORINGS). Naval Facilities Engineering Service Center (NFESC) designs, installs, and maintains fleet moorings in the United States and around the world to support the Fleet. Point of contact at that command can be reached at NFESC c/55, 202 433-2396 or 5517 - DSN prefix 288. Navy buoys have different capacities as shown in table 582-2-2.

582-2.1.3.1 Free Swinging Mooring. A ship at single point anchor or moored to a buoy is a free-swinging mooring. A buoy moor is normally restrained by anchor chain, however wire rope can be used. This type of mooring is generally more economical than a multiple-point mooring but requires ample anchorage to prevent the vessel from interfering with navigation, adjacent structures, or neighboring vessels. In general, a buoy moor requires less swing circle than a ship swinging on its own anchor. For more information on anchoring, see NSTM Chapter 581. A typical free-swinging, single point mooring arrangement is shown in figure 582-2-3.

Table 582-2-2 FLEET MOORING BUOY CAPACITIES

CLASS	WORKING HOLDING CAPACITY (pounds)
AA	300,000
BB	250,000
CC	200,000
DD	175,000
A	150,000
B	125,000
C	100,000
D	75,000
E	50,000
SPECIAL	Various specialized moorings are designed/installed by NFESC (example: hurricane moorings for MCM/MHC class vessels at NAVSTA Ingleside, TX.

582-2.1.3.2 Multiple Point Moorings. The Navy uses several types of multiple point moorings. Selection of a specific type of multiple point mooring depends upon site conditions, existing facilities, and mooring use. Some of the more common types of multiple point moorings are discussed in the following paragraphs.

582-2.1.3.2.1 Bow And Stern Buoy Moor. In this type of moor, mooring the ship's bow to the forward buoy is accomplished in either manner described in the preceding section. At the same time, a stern line or cable is run to the stern buoy. The ship approaches at an angle of about 20 degrees to the geographical line-of-bearing of the two buoys. While lines are being passed to the bow buoy party, similar lines are passed from the ship by boat to the stern buoy party. After the lines are made fast to the buoys, adjustments are made from on deck to spot the ship equidistantly, bow and stern, from the respective buoys. Most ships use an anchor chain forward and a nylon towing hawser or a wire rope aft. A typical bow and stern buoy mooring arrangement is shown in figure 582-2-4.

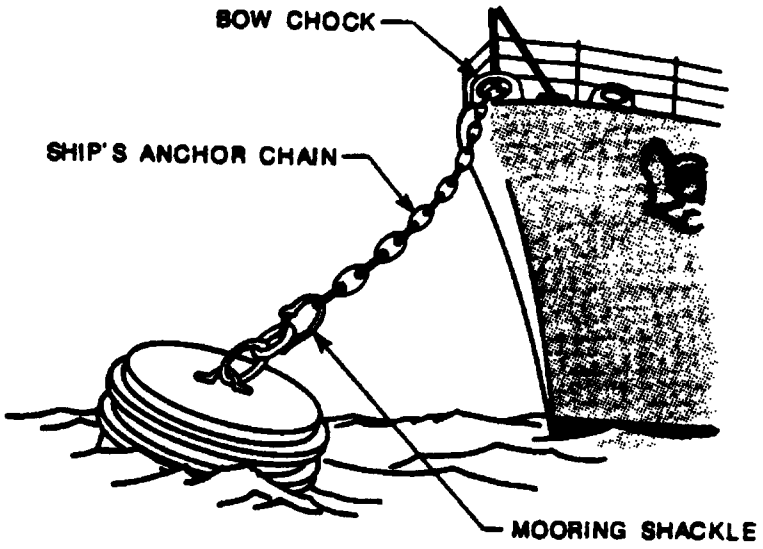


Figure 582-2-3 Free Swinging (Single Point Mooring)

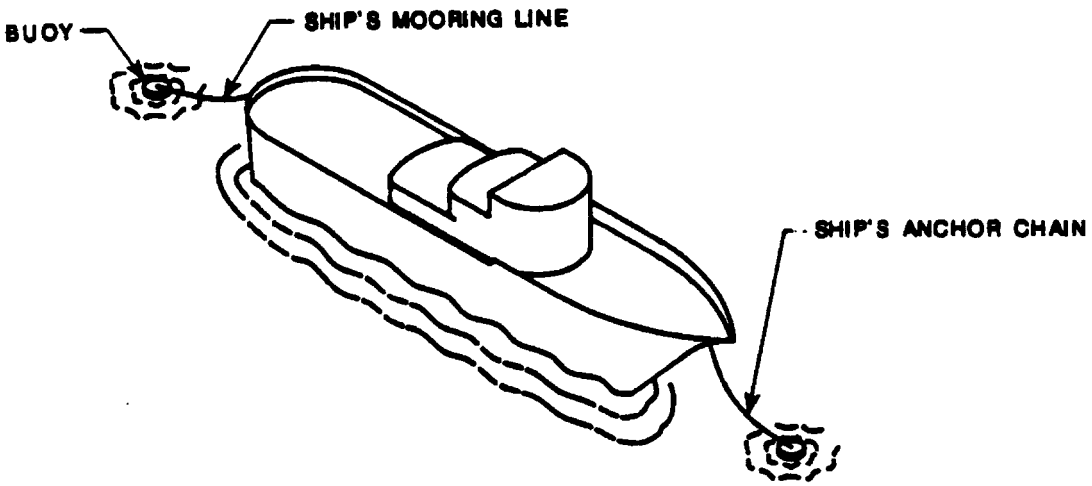


Figure 582-2-4 Bow And Stern Mooring

582-2.1.3.2.2 Four Point Moorings. A four point mooring consists of a ship secured at four points to mooring buoys or anchors. A typical four point mooring arrangement is shown in figure 582-2-5. It is most frequently used by salvage ships to achieve precise station keeping above the salvage area. The four point mooring concept can be extended to more than four points.

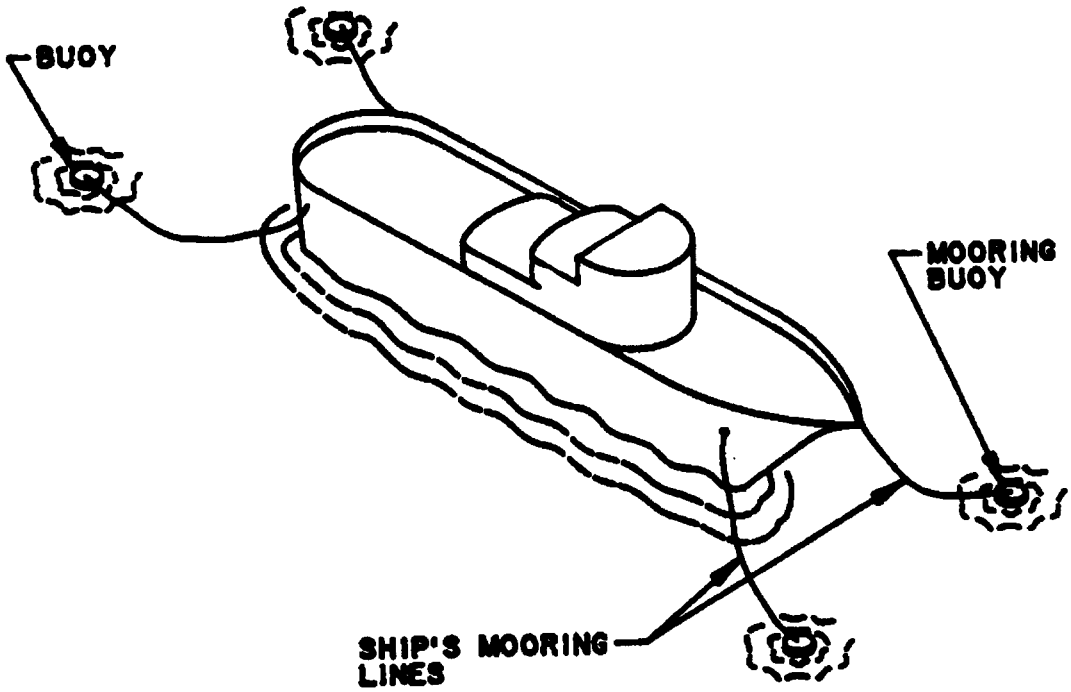
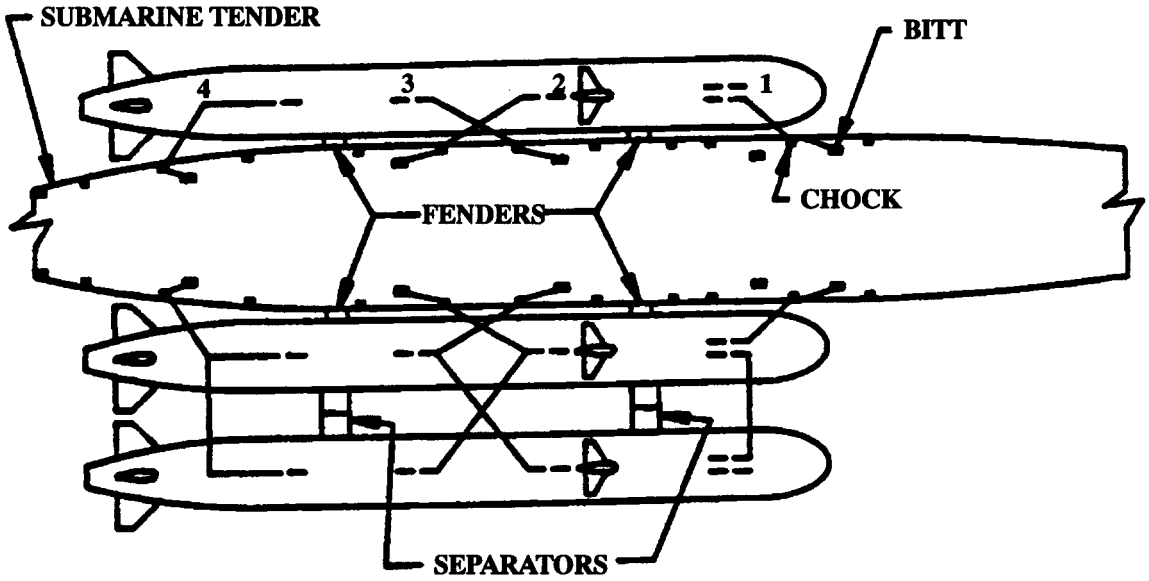


Figure 582-2-5 Four Point Mooring

582-2.1.4 VARIATIONS OF AT SEA/PIERSIDE MOORING

582-2.1.4.1 Nested Ship Moorings. A multiple ship (nested) mooring consists of ships moored side by side, using the regular mooring lines. These moorings are normally bow and stern. Multiple ship moorings are used to moor both active and inactive ships. A typical nested ship mooring for active ships consists of a tender or similar ship with submarine(s) secured to either one or both sides, as shown in figure 582-2-6. Multiple ship moorings often consist of two similar ships in a bow and stern mooring. When ships are not similar, the larger ship is normally against the pier. The loads imparted on the mooring lines for nested ships can be much greater than the loads for single ship mooring. Therefore, whenever ships are in a nested configuration, Mooring Service Type II mooring arrangements should be used.



LINE NO.	NAME		
1	BOW LINE	3	FORWARD WAIST SPRING
2	AFTER WAIST SPRING	4	STERN LINE

Figure 582-2-6 Nested Ship Mooring

582-2.1.4.2 Heavy Weather Mooring. Mooring to withstand the conditions specified in Mooring Service Type III is defined as Heavy Weather Mooring. A ship may be positioned along side the pier the same as in standard mooring, but lines are usually run across the pier, thus closing it to almost all operations. A variation is to place a ship on a free swinging mooring buoy capable of withstanding MST III conditions. Heavy weather mooring is covered in section 3 of this NSTM.

582-2.1.4.3 Mooring to an Ice Shelf. When operating in arctic or antarctic regions, ships must sometimes moor to ice formations. The mooring lines are secured to these ice formations using timbers (called deadmen) buried in the ice. Figure 582-2-7 shows a ship moored in ice using deadmen. This type of arrangement is convenient because the deadmen can be left in the ice when the ship departs. Icebreakers can moor to the edge of an ice shelf by ramming the ship into the ice until the hull contacts the ice from the bow to amidships. Ice anchors or the ship's regular anchors can then be deployed to keep the ship from sliding back off the ice shelf. The anchors can be set into holes chipped out of the ice.

582-2.2 MOORING PHILOSOPHY

582-2.2.1 APPROACHING A BERTH. Observe the wind and current carefully when approaching the pier or wharf. Wind and current blowing and running at right angles to the pier or wharf usually present more of a problem than when they are moving parallel to the face of the pier or wharf. When possible, use the wind and current to aid in the mooring evolution.

582.2.2.2 MOORING PLAN. A mooring plan will help ship's personnel to keep the ship under control as it approaches the dock. Make the plan before attempting the actual approach. The plan should consider the effects of wind and current on the ship's momentum. The plan should have an approach course as well as points during the approach where speed will be reduced or engines stopped.

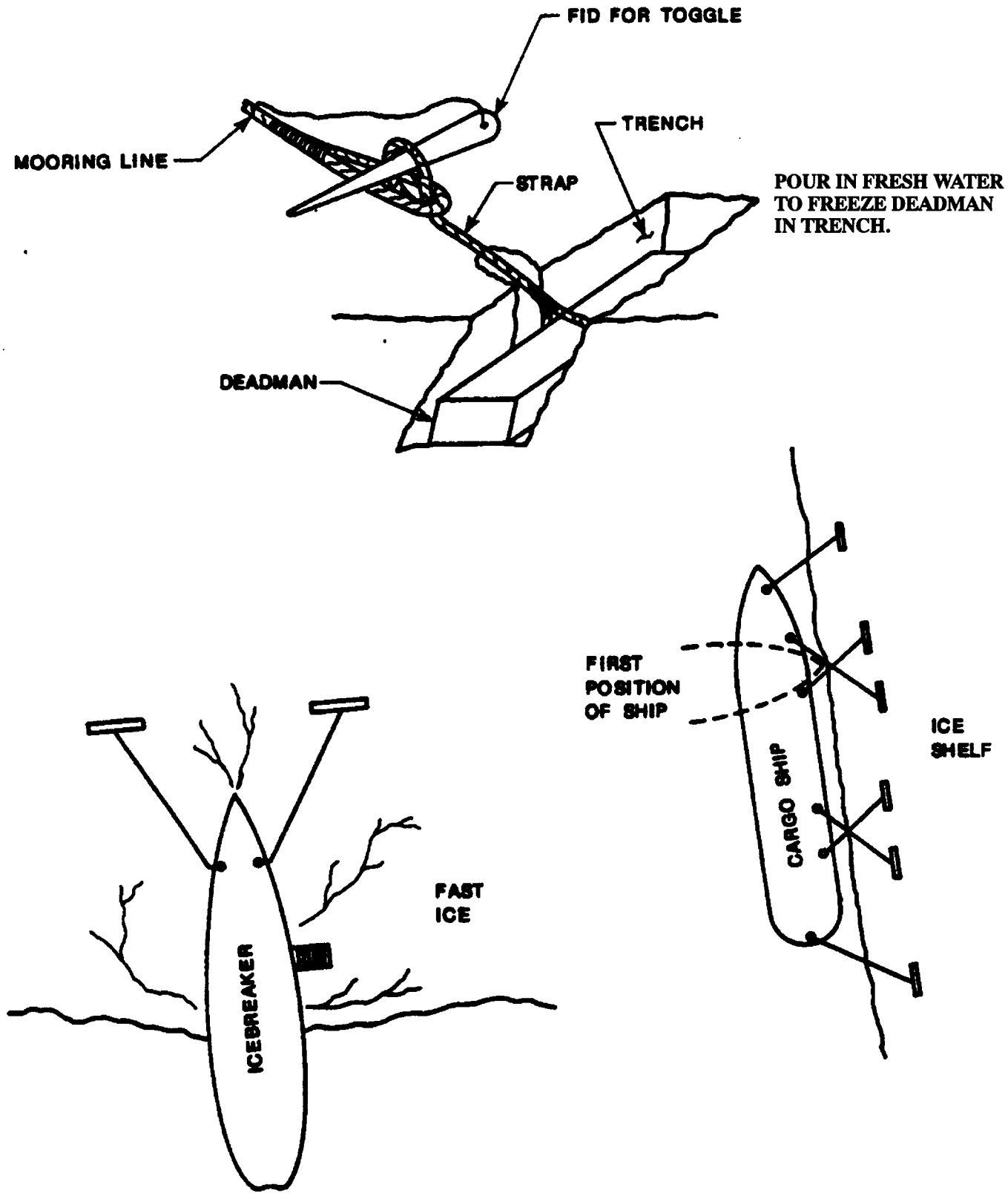


Figure 582-2-7 Using Deadman to Moor to the Ice Shelf

582-2.2.3 BERTHING A SHIP. Berthing is defined as the process of bringing a ship in to a moored configuration. There are two basic ways of berthing a ship: assisted or unassisted. Assisted berthing usually involves tugboats. In an unassisted berthing, the ship uses its own resources only.

582-2.2.3.1 Assisted Berthing/Ship Maneuvering with Tugboats. Tugboats can be used to assist in the docking of a ship. Essentially tugs either push or pull the ship, to help guide or position it. Tugs also use tow lines to help maneuver ships to and from berths. They push a ship into a berth, or move it away from a berth by moving between the dock and the ship's hull and pushing it away from the dock. When tugs are holding a ship against a pier, do not over-tighten the initial mooring lines. Depending on how the tugs move away, the lines may become overloaded and break. Short aft mooring lines on combatant ships are particularly susceptible to this possibility.

582-2.2.3.2 Unassisted Berthing. Great care must be taken when berthing a ship without assistance. The ship is exposed to a combination of wind and current that imposes a force on the hull which must be overcome by the capstans and mooring lines to warp the ship to pier. Twin or multiple screw ships have better maneuverability for unassisted berthing. It is more difficult for a single screw ship to berth unassisted. A few unassisted berthing procedures are given below.

582-2.2.3.2.1 Port Side Mooring of a Single Screw Ship. It is easy to dock a single screw ship (right-handed propeller) when there is no current or wind acting on the ship. Head the ship for a point a short distance outboard of the location where the bridge will be when the ship is moored. The approach course should be at an angle of 10 or 15 degrees with the pier wall. Use a slow approach speed and stop the propeller when the ship has sufficient headway to reach the berth. Maintain sufficient headway to steer when the ship is almost abreast of the berth. When the bow has been eased in alongside the berth, the propeller can be ″backed" to stop the ship and to swing the stern to port. When the ship is parallel to the pier, ″breast" it in using the mooring lines and winches.

582-2.2.3.2.2 Starboard Side Mooring of a Single Screw Ship. When a single screw ship moors starboard side to, the angle of approach should be about 10 degrees. Maintain minimum speed for proper steerage to minimize the ship's momentum. As the bow approaches the pier, put the rudder to port and, if necessary, use a short burst of power ahead to swing the bow away from the pier while the stern swings toward the pier. Use a short burst of power astern just before the ship is parallel to the pier. The sideways force from the propeller should halt the ship's swing so that it stops parallel with the pier abreast of the berth. The bridge should be at the initial point of approach when the ship is finished with this mooring evolution. During the starboard side approach, the port anchor may be used to help with steering. For details on how to use the ship's anchor when mooring starboard side to, consult Knight's Modern Seamanship or U. S. Navy Naval Shiphandling.

582-2.2.3.2.3 Ship Maneuvering with Thrusters. Thrusters are installed in some ships to improve their maneuvering capabilities at low or zero speeds. The type of thruster and its location in the ship's hull determine if it can be used to help maneuver the ship when approaching or leaving a mooring.

582-2.2.4 MAINTAINING A SAFE BERTH. There are several actions ships crew can take to keep the ship safely moored, especially during storm conditions. External influences on safe mooring include ship displacement and natural forces such as wind, current, and tide. Personnel must be able to monitor and adjust line loading during periods of heavy weather, and other external influences.

582-2.2.4.1 Effect of Wind and Current on Mooring Lines. Depending on the direction, wind and current may either ease or put more strain on the mooring lines. Attention must be paid to shifting conditions, and appropriate action must be taken to prevent excessive ship movement. Of particular concern is movement that could make the brow unsafe or unstable.

582-2.2.4.2 Effect of Tide and Ship Displacement on Mooring Line Loads. Mooring line loads are affected by changes in tide level and ship displacement (loaded vs. ballasted conditions). Variations in tide level and ship displacement can increase or decrease mooring line loads unless the lines are tended (let out or heaved in).

582-2.2.4.3 Monitoring Mooring Lines. Wind load increases by a factor of 4 as wind speed doubles, and any changes in loading must be distributed amongst the mooring lines to hold the ship in position. Condition of mooring lines must be regularly monitored to ensure that:

a. Individual line loads are reasonably balanced. Unbalanced loads from untended lines can lead to overloading and parting of mooring lines.

b. Ship has not shifted substantially within the berth. Excessive shifting can impact safety of brow and shore services connections.

c. Mooring lines are run with proper chaffing protection at chocks and other contact surfaces such as concrete pier caps. Lack of chaffing material can lead to greatly accelerated line wear.

582-2.2.5 LEAVING A BERTH. Departing a pier is usually less difficult than approaching it. Carefully plan the departure after observing the wind and current. Then slack the mooring lines observing the effect of the wind and current. When the ship does not drift away from the pier, it is necessary to use power to move the stern away from the pier or wharf.

582-2.2.5.1 Single Screw Ship Moored Port Side To and Getting Underway. When the ship is moored port side to the pier and is preparing to depart, an after bow spring line is used to hold the stern of the ship as it goes ahead slowly and the bow springs in. Left rudder is used to help get the stern clear of the pier. The ship's lines are then cast off. The ship is then backed down slowly with right full rudder until clear of the pier. As the stern gradually turns toward the pier, the engines are stopped when the ship is parallel to the pier and several beams' width from it. The ship then proceeds ahead with sufficient right rudder to bring the bow to the required departure course.

582-2.2.5.2 Single Screw Ship Moored Starboard Side To and Getting Underway. When the engine is backed for a single screw ship with the starboard side to the pier, the stern swings to port and the ship starts moving aft. With the bow turned toward the pier, the rudder is put over to the right to clear the pier as the ship goes astern. When the stern is about 50 feet out, the bow will be pointed toward the pier. A quarter breast mooring line can now be used as a spring line as the ship continues going slowly astern. When this line is held the bow comes away from the pier. When clear of the pier or wharf and able to proceed ahead, the ship casts off lines and goes ahead.

582-2.2.5.3 Twin or Multiple Screw Ship Getting Underway. A twin or multiple screw ship can easily depart a pier by holding the after bow spring line and slacking off all other lines. The outboard engine is put slow ahead until the inboard propeller is clear of the pier. Fenders should be used as necessary on the bow. Once the inboard propeller is clear, all lines are let go and both engines backed slow. The discharge current from the inboard propeller will help breast the ship out. The conning officer should look aft to note any tendency of the ship to start swinging either way. The engines should be used for steering until sufficient sternway is reached and the rudders can be used. The distance between the pier and the bow should be noted and the rate of turn controlled to prevent touching the pier. The discharge current from the inboard propeller tends to keep the bow off the pier.

582-2.2.6 SOURCES OF INFORMATION ON APPROACHING/LEAVING A BERTH. Only a few of the situations encountered when a ship is approaching or leaving a mooring have been described. For more detailed information and descriptions on approaching or leaving a mooring, refer to U. S. Navy Naval Shiphandling, Knight's Modern Seamanship, and/or Boatswain's Mate Training Manual.

582-2.2.7 FACILITIES. The facility provides Port Operation functions that include the expertise of harbor pilots. Condition rating of piers and wharves should be known through recent documented inspection. The facility will provide berths with adequate depth and area for each type of ship it can support. Location, type, and capacity of mooring fittings will be adequate for mooring. Location and type of fendering/camels for each situation will also be provided.

582-2.3 PRELIMINARY MOORING PREPARATIONS

582-2.3.1 RECOMMENDED ACTIONS/SHIP BERTH INSPECTIONS. Prior to fully mooring, there are several recommended actions that the ship should take, as summarized in table 582-2-3.

Table 582-2-3 RECOMMENDED ACTIONS/INSPECTIONS PRIOR TO FULLY MOORING A SURFACE SHIP

ACTION	DISCUSSION
Check channel/tides/Currents/weather/traffic	Check with Port Ops and the Harbor Pilot the to ensure access to the port (channel depth, channel width, clearance under bridges) is adequate; determine tide levels and currents; coordinate with harbor traffic and other ship mooring; and determine the weather to ensure it is safe to enter the port. Ensure adequate tug, utilities, and shore support is available.
Check berth	Check with Port Ops, the Harbor Pilot and Public Works that the water depth at the berth, length of the berth, strength of the pier, and condition of the berth are adequate and suitable for the given class of ship.
Keep berthing velocity low	The kinetic energy of the ship goes up dramatically as the ship speed increases. Therefore, it is recommended that the ship velocity be kept to 1.5 foot per second (0.9 knot).
Check fenders and camels	Check with Port Ops and the Harbor Pilot to be sure the fenders and camels on the pier/wharf are in good condition and suitable.
Inspect mooring fittings	Make a visual check of all mooring fittings to determine what capacity they are, where they are located, and make sure they are in good working order. Mooring fittings should not be used if they are cracked, bolts are missing or if the pier/wharf is cracked/damaged in the area of the fitting. In general bollards and bitts should be used for mooring; cleats should not be used unless absolutely necessary. The NFESC criteria document, UFC 4-150-08, Inspection of Mooring Hardware, can aid in this inspection.

Once the ship is fully moored, personnel should go ashore and double check the last two actions in table 582-2.3, fenders and/or camels, and mooring fittings.

582-2.3.2 SUITABILITY OF MOORING FITTINGS. When a ship moors at a pier or wharf, there is usually a number of mooring fittings that can be used. The approach taken for U.S. Navy ship moorings is to develop the ′best’ mooring using existing fittings and at the same time not overload the mooring fittings. Therefore, the number, size and parts of lines run to a single fitting need to be specified so that the fitting is not overloaded. Mooring fittings come in different sizes and strengths. Bollards and bitts are designed for mooring. Cleats have low strength and are usually designed only for small craft or to assist in mooring. Cleats should not be used for mooring unless absolutely necessary. Standard pier and wharf mooring fittings are discussed in Section 5 of this NSTM.

582-2.4 LINE HANDLING

582-2.4.1 LINE HANDLING SAFETY. To best understand line handling safety, a discussion of what constitutes an unsafe condition is in order. A few of the most common unsafe conditions are:

a. Cramped conditions - tight quarters and low overheads.

b. Interference - bitts too close too capstans and tripping hazards.

c. Personnel in harms way - Poor capstan control locations and inherent hazard areas created when lines are under tension (see figure 582-2-9).

All of the examples above are design or fixed conditions, which must be dealt with. Some ship configurations are less safe than others (i.e. LCC 19/20). In such cases, extra attention to safety is warranted. Suggestions have been made with respect to outfitting ships with axes or hatchets for emergency use. It is doubtful that the crew can effectively use an ax or hatchet to cut a mooring line in sufficient time to avert impending danger. Therefore, this practice is discouraged.

582-2.4.2 SAFETY PRECAUTIONS. When using synthetic fiber lines, there are certain safety precautions that must be observed. Consult NSTM Chapter 613, Wire and Fiber Rope and Rigging, for a complete listing of precautions to be observed when handling synthetic fiber ropes. Some of the more important safety precautions are:

WARNING

Ropes may surge suddenly causing injury to line handlers. Non-aramid synthetic ropes stretch under load, recover rapidly, and have a low coefficient of friction.

a. Exercise extreme care when easing out or ″checking” synthetic lines under heavy load from around bitts, cleats, and other holding devices. To maintain control when checking lines, take no more than two round turns on a cleat or bitt, as recommended in NSTM Chapter 613, Wire and Fiber Rope and Rigging. When checking a synthetic line under heavy load, take two round turns followed by no more than two figure eight bends; figure eight bends tend to lock up and surge unexpectedly. The use of figure eight bends in checking a line under heavy load will present a danger to personnel and cause extreme difficulty in handling lines.

b. Figure eight bends can cause problems especially when used on synthetic fiber ropes. With these ropes, the figure eight bends lock up under heavy loads (primarily on the loaded side). As the rope on the loaded side elongates, its diameter decreases and the rope comprising the figure eight bend(s) slips suddenly. The rope then surges so rapidly that it can ride over the top of the bitts.

WARNING

Post safety observers to ensure that line handlers stand a minimum of 6 feet from bitts under load. This is particularly important in mooring operations.

c. Nylon rope stretches to nearly one and one half times its original length prior to parting. Upon parting, it instantaneously returns to its original length causing the broken ends to snap back with hazardous force. In view of this danger, it is imperative that no one stands in the direct line of pull when heavy loads are applied on the line. Polyester rope stretches to nearly one and one third times its original length before parting and is equally dangerous. Aramid rope stretches about six percent over its original length. Nevertheless the risk of injury from a parting aramid rope snapping back should not be overlooked. Table 582-2-4 shows the approximate elongation of nylon and polyester ropes at breaking. These elongation percentages were taken from the military specifications and commercial item descriptions for the ropes. To educate the ship’s crew, specially

line handlers, about synthetic line snapback, the Navy has prepared a video training tape called ″Synthetic Line Snapback” , Order No. 82971DN, 1982. See paragraph 582-1.4.3 for ordering information.

d. Four strand aramid rope is designed to fail sequentially, meaning that one of the four strands will fail before the other strands. However, this has only been demonstrated on 50-foot test lengths. Regardless of the length of rope out when under tension, this rope should be treated with the same respect afforded other synthetic mooring lines made of nylon or polyester.

WARNING

The line handling supervisor must ensure the line is clear of obstructions and free to run before applying a strain.

Table 582-2-4 ROPE ELONGATION

Construction	Approx. Elongation At Break (Percent)
NYLON	
Three strand	55
Double braided	40
Plaited	65
POLYESTER	
Three strand	35
Double braid	30
Plaited	45
ARAMID	
Four strand	6
SPECTRA	
Four strand	6

e. Never stand in the bight of a line or in the direct line of pull when the line is being pulled or is under tension. See figure 582-2-8 for the safe work areas of a line when it is being worked. The Navy video training tape called ″Synthetic Line Snapback” also shows safety zones that should be observed when handling lines. If a line hangs up on a deck fitting, it becomes a ″bowstring” that can slip free at any time with lethal force.

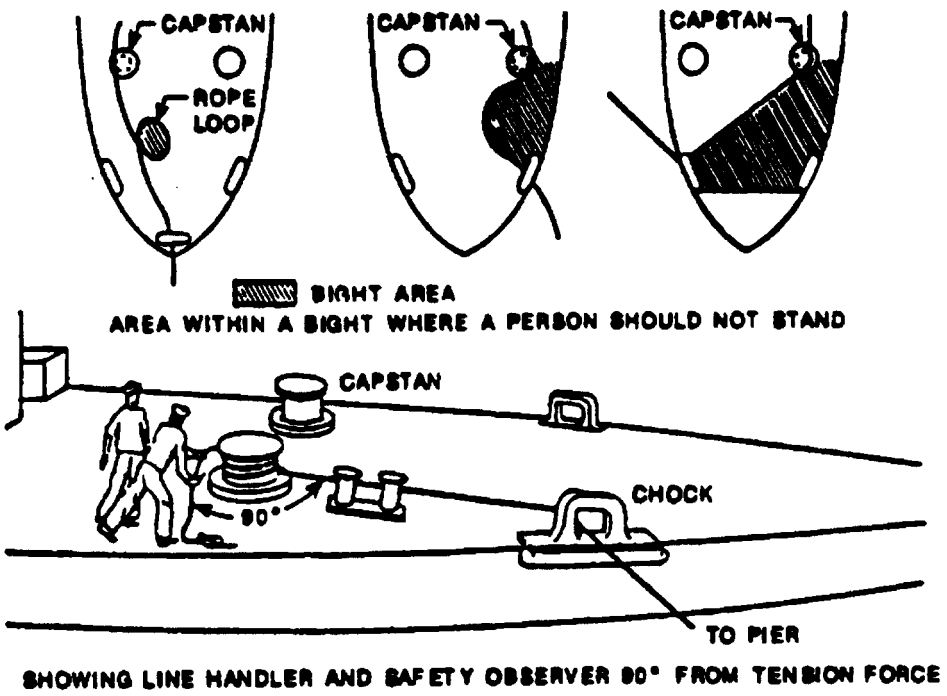


Figure 582-2-8 Safe Work Areas for Line Handler

f. A safety observer for the line handling team should be specifically assigned and should not have any other duties that would detract from observing the line handling evolution and taking action to stop an unsafe action.

g. When using machinery to heave on a synthetic line under heavy or impact loading, six or more turns should be taken on the capstan or warping head plus two overriding turns (figure 582-2-9). These extra turns will help reduce the hazard of a sudden surge when the line is being lead out.

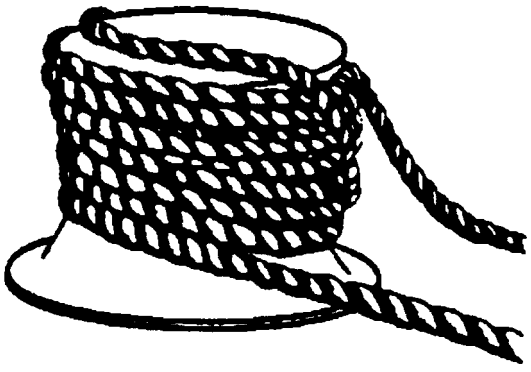


Figure 582-2-9 Capstan with Overriding Turns of Line

h. Synthetic lines that will be loaded up to or near their working load limit should be fitted with tattletales. This cord, which is fitted to the synthetic line, will become taut when the line is tensioned to its safe working load (SWL). Refer to paragraph 582-4.5.1 and NSTM Chapter 613, Wire and Fiber Rope and Rigging, for tattletale dimensions and instructions on securing it to the synthetic line.

WARNING

Heavy strains on wet nylon mooring lines should be avoided whenever possible.

i. Nylon loses 15 percent of its strength when wet but regains that strength after drying out. Whenever possible, wet lines should be dried thoroughly before stowing. Sometimes drying is not possible before the mooring lines are stowed. If line must be stowed wet, it should be laid up on gratings in long fakes so it may dry as quickly as possible. The wet rope should never be covered.

j. Do not mix lines of significantly different stretch (elongation) since the loading between them will not be equal, resulting in premature failure of the line with the least stretch.

582-2.4.3 COMMANDS FOR THE SHIP'S LINE HANDLERS. The commands used to communicate with the ship's line handlers during mooring evolutions are provided in table 582-2-5.

Table 582-2-5 LINE HANDLING COMMANDS

Command	Meaning
Pass one (or number one)	Send line number one over to the pier. Place the eye over the bollard or cleat, but do not take a strain.
Slack (slack off) the bow line (number one)	Pay out the line specified, allowing it to form an easy catenary.
Take a strain on one (or number one)	Put number one line under tension.
Take the slack out of three (or number three)	Heave in on number three line, but do not take a strain.
Ease three	Pay out number three line enough to remove most of the tension.
A vast heaving	Stop heaving (taking in).
Check three	Hold number three line, but not to the breaking point, let the line surge as necessary.
Hold two	Take enough turns so that number two line will not surge.
Double up and secure	Run additional lines, or bights of lines, as needed to make the mooring secure.
Single up	Take in all lines except a single standing part to each station, preparatory to getting underway.
Stand by your lines	Man the lines, ready to cast off or moor.
Take in one (or number one)	Retrieve line number one after it has been cast off. When used by the conning officer, it means to slack one, cast it off and then pull it back aboard. When used by the officer in charge on the forecastle, it is preceded by the commands ″slack one" and ″cast off one" and merely means to retrieve line number one and bring it back on deck.
Up-behind	Cease hauling on the line and slack it quickly.
Cast off	A command to those tending the mooring lines on the pier or on another ship to disengage or throw off the lines from over the bollards or cleats.

582-2.4.4 ARRANGEMENT AND USE OF MOORING LINES. Mooring lines are arranged to hold the ship to the pier or adjacent ship/structure, with little or no movement. Figure 582-2-10 and Figure 582-2-11 show typical layouts of mooring lines and equipment used on Navy surface ships.

582.2.4.4.1 Effectiveness of Mooring Lines. The overall mooring line pattern affects the load distribution to individual lines. The effectiveness of a mooring line is influenced by its slope (that is, the vertical angle formed by the line with the pier deck), and by the horizontal angle formed by the line with the centerline of the ship. The steeper the orientation of the line the less effective it is in resisting horizontal loads. Every pier presents a

new challenge for ship's crew to achieve an optimum mooring arrangement. Use the following guidelines to maximize the load capability of a specific mooring arrangement. Mooring line nomenclature is discussed in section 4 of this NSTM.

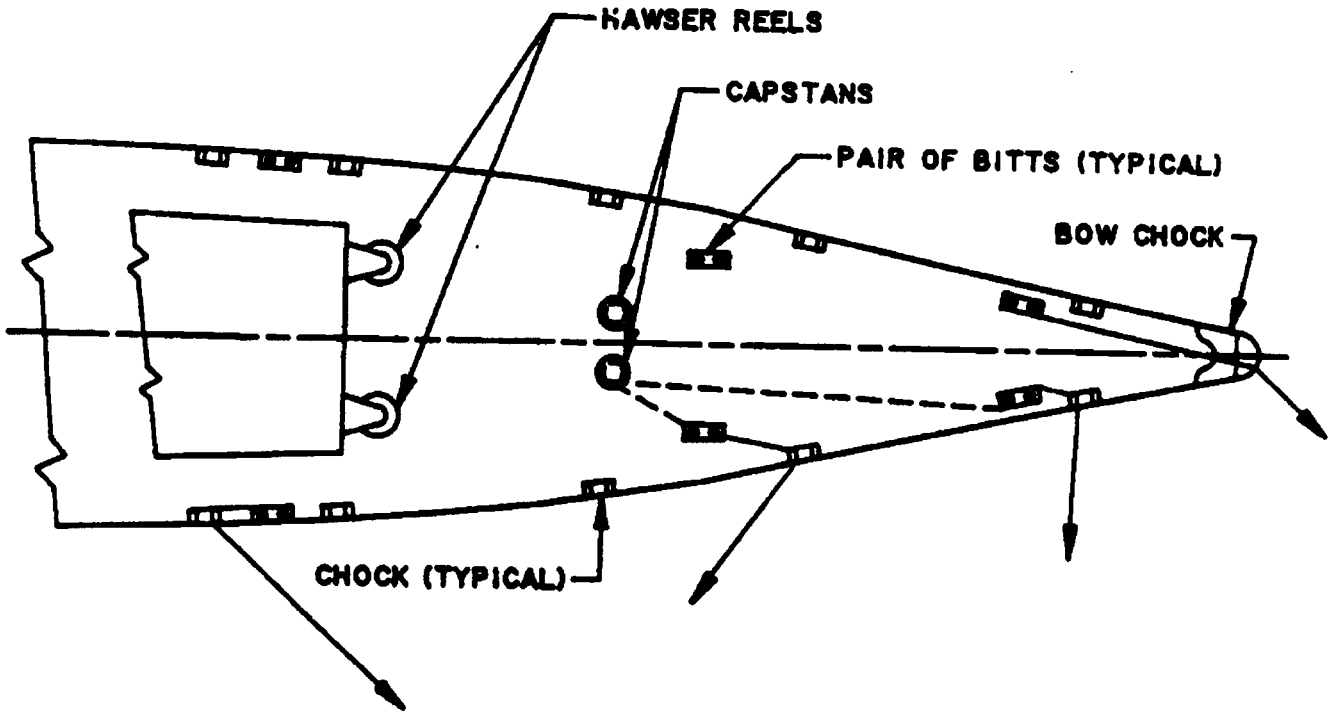


Figure 582-2-10 Typical Mooring Arrangement on Ship's Forecastle.

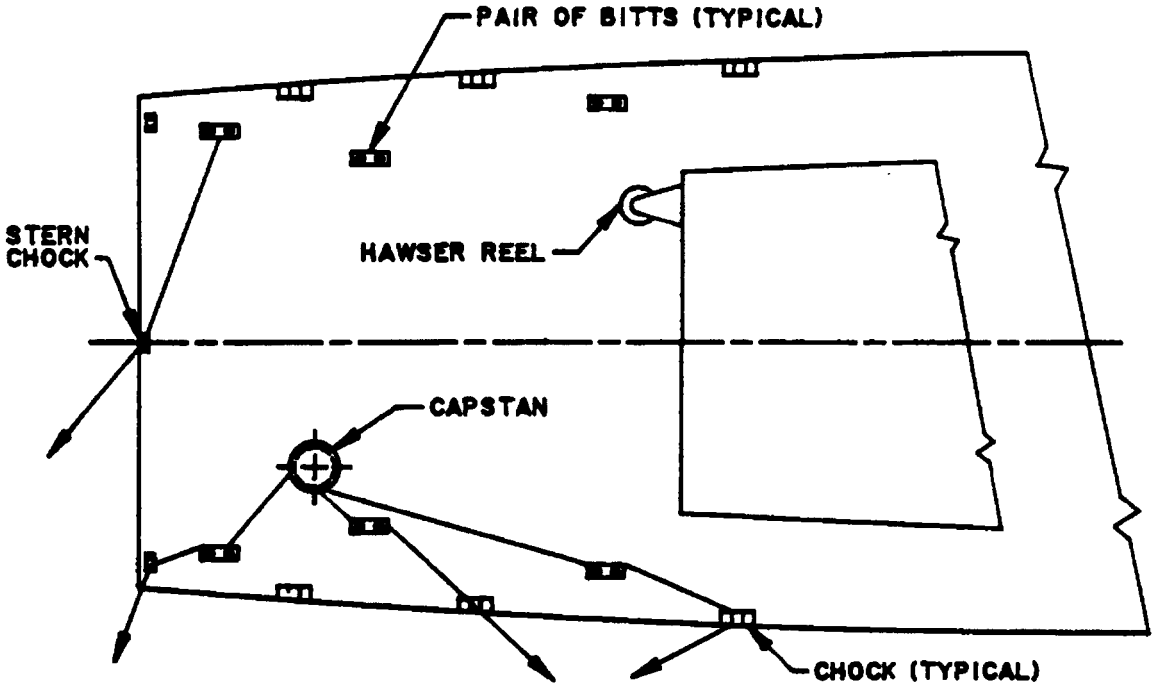


Figure 582-2-11 Typical Mooring Arrangement on Ship's Quarter.

a. Line Lead Angle.
   1. Mooring lines, including the bow and stern lines, should be arranged as symmetrically as possible about the perpendicular centerline of the ship (a line 90 degrees to the fore and aft centerline) to ensure a balanced load distribution
   2. Breast lines should be oriented perpendicular to the ship's fore and aft centerline and as far aft and forward as possible.
   3. Line lead is best if the angle the line makes to the pier fitting is less than 45 degrees.
      a) A 45 degree line angle equates to a 70% efficiency for breasting force (perpendicular to pier)
      b) A 30 degree line angle equates to an 87% efficiency for breasting force
   4. Spring lines should be oriented parallel to the longitudinal centerline of the ship.
   5. The slope of the mooring lines should be kept as slight as possible.

b. Pier Fittings:
   1. Fitting strength is sometimes difficult to ascertain, but in general only bollards should be used.
   2. Cleats are much lower in capacity than bollards and are not intended as primary mooring fittings. That being said, it may be necessary to use cleats at certain piers. When forced to use cleats, it is recommended that cleats be used for spring lines only.
   3. Normally only one mooring line should be secured to ships bitt or to a pier fitting. It is permissible for opposing spring lines to be led to the same pier fitting, because the two lines cannot become loaded at the same time. Be cautious of an overload situation.

c. Load Equalization:

1. Ensuring acceptable load equalization in all mooring lines is most important to stability of the mooring arrangement.
2. A short 50 foot line will stretch half as much as a 100 foot line for the same loading. Since the total stretch of a line is proportional to its length, the shorter lines will assume greater loads, and can quickly become overloaded during a storm. For this reason, lines will need to be tended or stretch must be taken into account at the time lines are tied off on the bitts.
   a) Try to avoid short line lengths (less than 50 feet)
   b) Slack the shortest mooring lines so that loads will equalize during storm conditions (pull line taught, then slack the line by one foot in length)
   c) Pre-tension longer mooring lines (greater than 100 feet)
3. Do not mix lines of different materials and construction. For example, nylon, polyester, double braided and three strand lines should not be used together. Also, synthetic mooring lines should not be used together with wire rope.
4. If deploying short lines in slacked condition, the shortest lines will not be taking much if any load during mild weather conditions.
5. Only one well led spring line is needed in the forward and aft direction, even under storm conditions.

CAUTION

A ship's mooring lines are sized for the loads imposed on the lines when securing the ship to the pier or wharf. When ships are moored in a nested arrangement, additional lines should be run from the outboard ship(s) to the pier or wharf. The inboard ship (the one next to the pier) should put out additional mooring lines to compensate for the loads imposed on it by the outboard ship(s). If heavy weather is anticipated, alternative mooring arrangements to nesting should be considered to alleviate any excessive loading on the inboard ship.

d. In extreme storm circumstances:

1. Lines can be run across deck temporarily, to obtain longer overall length
2. Wider camels can used between the ship and pier to achieve improved line lead angle
3. Lines can be moved to pier fittings toward the center of or across the pier
4. Ship can be moved to an alternative pier facility.

582-2.4.5 PREPARING MOORING LINES. Mooring lines may be used in ship handling when leaving or coming alongside a ship or pier. Preparations for mooring must be made before the ship comes alongside the pier or wharf. Mooring lines should be faked out on deck near the chocks through which they will pass. The faking arrangement must take into account where personnel will be stationed so that when the line is passed, it will move safely along the deck. The end of the mooring line with the eye is passed through the chock and the loop laid back on the lifelines, bulwarks, or rails so that they are ready for use. Appropriate heaving lines and messengers should be attached as needed.

582-2.4.5.1 Heaving Lines. Heaving lines, prior to being passed ashore, should be made fast to the messenger or to the eye of the mooring line, but not at the end of the eye. This will prevent them from being caught between the eye and the bollard when the eye is placed over the bollard. A line throwing device is attached to the end of

the heaving line. Per safety center directive in the mid 1990's, weighted monkey fists were to have been replaced with the international orange heaving balls. The old monkey fists were hazardous when thrown, whereas the new assembly is much safer. The line throwing assembly consists of an orange fluorescent ball attached to a small polypropylene line.

582-2.4.5.2 Messengers. Mooring lines over five inches in circumference (hawsers), because of their weight, generally need short messengers attached to them so that the heaving line does not part during passing of the mooring line. The primary purpose of the messenger is to lessen the load on the heaving line when it is raised out of the water. Use 1-1/2 inch circumference lines, 12 to 18 feet in length, as messengers. Messengers are normally made fast to the mooring line by splicing an eye into the eye of the mooring line. Some ships have no problem passing hawsers without using messengers because of their smaller lines, low freeboard, and the short distance to be covered. Ships may exercise their own discretion, based on past experience, whether to use or not to use messengers.

WARNING

Messenger lines are not designed to take strain. If the end of a mooring line under tension enters the bitts or comes up to the capstan, personnel should not use the messenger to tend the line. Personnel should clear the area.

582-2.4.6 PASSING AND SECURING MOORING LINES. The method for passing and securing mooring lines depends on the mooring plan, the type of pier fittings and the parts of line to be secured. The sequence of operations is to pass the line and secure the initial lines on pier fittings. Next remove the slack from these initial lines and secure a single part on the ship fitting, in turn securing the ship. Then deploy the remaining mooring lines or parts of line in accordance with mooring plan and adjust the initially deployed lines as required (slack or tension or add chaffing gear). The procedure for securing mooring lines to shipboard fittings may also include taking lines to power for pre-tensioning.

582-2.4.6.1 Determining Number of Line Handling Crews needed. As a minimum, at least one breast line forward and one aft is needed to hold the ship against the pier and one spring line is needed fore and aft to prevent longitudinal ship movement. Hence, at least four line handling crews are needed to dock a ship. Depending on breaking strength of the mooring lines and present weather conditions, additional lines are normally required. Single part mooring lines are three times stronger than lines intended to be doubled up. For ships using traditional three part mooring lines, a minimum of six to eight line handling crews are needed to initially deploy mooring lines. For ships using single part mooring lines, only four line handling crews are needed.

582-2.4.6.2 Passing Mooring Lines. Ship's force passes the line to the pier by either throwing the heaving device or using a line throwing gun. By NAVSEA directive, weighted monkey fists cannot be used. Monkey fists without weights can be used but they are generally not very effective. The preferred line throwing device is a fluorescent orange heaving ball. See paragraph 582-4.5.4.1 for ordering information. Heaving lines should be passed to the line handlers on the pier or wharf as soon as possible, once the ship is within range. As the ship moves up the pier or into a slip, the pier ends of the mooring lines should also be advanced up the pier to the designated pier fitting. If the mooring station will have multiple parts of mooring line, the pier crew should receive a second heaving line when the first part of mooring line is passed. This enables the pier crew to pull a second part or bight of line along the path of the first part of line.

582-2.4.6.3 Securing Mooring Lines to Pier Fittings. In passing and securing mooring lines, ship's force must find a way to give clear direction to the pier crew. The appropriate pier fitting for each line must be determined. Lines should be placed on fitting with chaffing material centered in the contact area, and the pier crew should observe the fitting for any cuts or burrs that would require extra chaffing protection.

582-2.4.6.3.1 Dipping the Eye. When two eyes or an eye and a bight are placed on the same bollard (figure 582-2-12), the second eye should be lead up and through (dipped) the eye of the first before being placed over the bollard. With this arrangement, either line can be taken from the bollard without removing the other. This is called dipping the eye. When using a single part mooring line configuration, the eye is simply placed over the bollard.

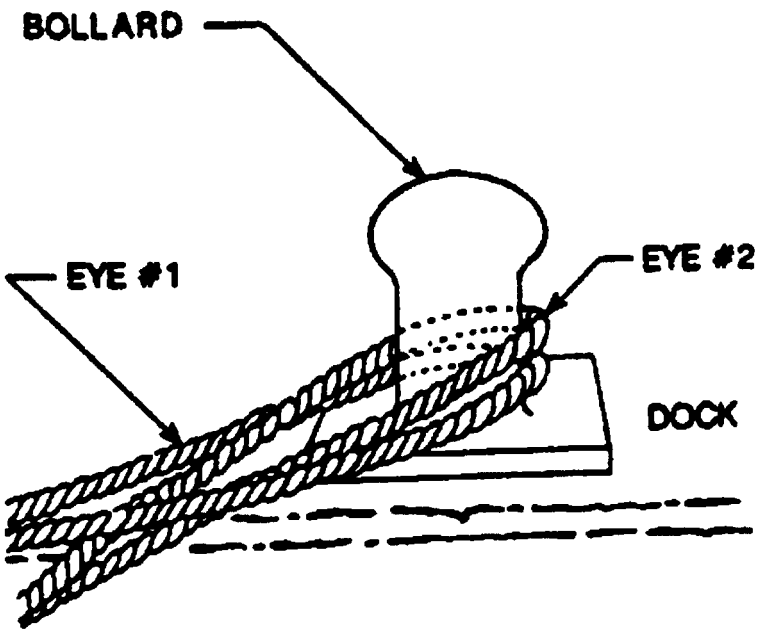


Figure 582-2-12 Bollard with Two Eyes

582-2.4.6.4 Securing Mooring Lines to Ship Fittings. Depending on the mooring plan, lines will be secured in one, two or three parts (doubled up) on the ship fittings. After positioning all mooring lines, add chaffing material in way of any contact areas such as liferails, nets, concrete pier caps or other pier obstructions. Care must be taken to ensure the chaffing material remains installed at correct contact point as lines are tensioned.

582-2.4.6.4.1 Single Part Mooring Line. Reeving of a single part mooring line should be accomplished by taking a FULL round turn to the first barrel of the bitt, followed by at least 4 figure eights. Line should then be tied off and bird-nested atop the bitt. This configuration will evenly distribute the line load on both barrels of the bitt.

582-2.4.6.4.2 Tanker moor (two parts). In a two part or tanker moor, both eyes of the same mooring line are placed on the pier fitting. The first part of line is secured on one barrel with a full round turn followed by only two figure eights and tied off. The second part of line is led to the opposite barrel and also installed with one round turn and two figure eights. The two ends of line are then alternately wrapped and bird-nested atop the bitt.

582-2.4.6.4.3 Doubled up (three parts). When securing a doubled up (three part) mooring line to a bollard, the eye is placed over first. The line is then run back to the ship, around the bitt, directly back to and around the bollard, and finally back to the bitt again. The free end of the line is then figure eighted at least 4 times before being tied off and bird-nested atop the bitt. Figure 582-2-13 shows the arrangement of synthetic mooring lines

that have been doubled up for use under conditions such as heavy weather.

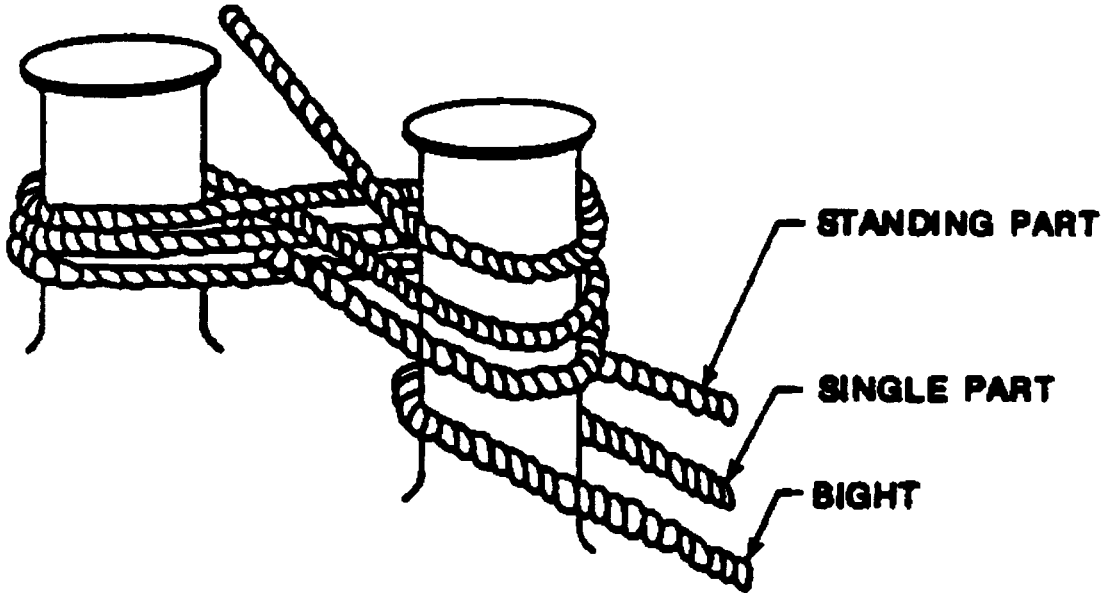


Figure 582-2-13 Correct Method for Doubling Up.

582-2.4.6.5 Taking Lines to Power. Large circumference or long mooring lines weigh too much to be tightened by hand and requires that the line be taken too power. The procedure is to wrap a few turns of line around the capstan and tension the line, leaving a slight catenary. Next set a Chinese Stopper and release the tension on the capstan. After making sure that the Chinese Stopper has held, reeve the line on the bitt using the procedures in paragraph 582-2.4.6.4.

582-2.4.7 TENDING LINES. As conditions and tides change, mooring lines can become too slack or too tight and must be tended. The procedure is to remove the line from the bitt and either slacken or tension the line as necessary. Tensioning can be done by hand or taken to power as conditions warrant. The line is then reeved around the bitt again as described above.

582-2.5 TYPICAL MOORING ARRANGEMENTS FOR THE MAJOR SHIP CLASSES

582-2.5.1 GENERAL INFORMATION. Each ship should carry a mooring guideline, which shows the mooring equipment and arrangements for that ship. This guideline would show how the mooring lines could be lead for pierside mooring and other mooring situations. NSWCCD-SSES started preparing these guidelines for each ship class in the year 2000. If these guidelines are not yet available for a particular ship class, another source of information is the Ship Information Book (SlB) for surface ships or Ship System Manual (SSM) for submarines. These documents usually have a mooring line diagram showing how to moor the ship for various situations.

582-2.5.2 SURFACE SHIP MOORING ARRANGEMENTS. Figure 582-2-14, Figure 582-2-15, and Figure 582-2-16 show some typical mooring arrangements used by Navy ships. Analysis indicates that balanced loads can best be achieved when bow of ship is about 60 feet from the forward most pier fitting to be used (this is a rule of thumb, and can vary for unusual pier configurations).

582-2.5.3 SUBMARINE MOORING ARRANGEMENTS. In addition to pierside mooring, submarines are often secured to another ship such as a tender, or nested alongside another submarine. Figure 582-2-17 shows

two submarines moored together. Figure 582-2-18 shows an end on view of some nested arrangements with the different fenders that are typically used. The recommended fender/separator location for the optimum standoff is within the parallel midbody (see figure 582-2-19) (maximum beam of hull) of a nested mooring arrangement. Submarines equipped with Wide Aperture Array (WAA) and using hydro dynamic submarine fenders for mooring must locate the fender midway between the WAA, in addition to above. Universal separators are designed for deployment at any location along the parallel midbody without reference to the WAA. In nested mooring arrangements, the wider the separation between fenders/separators the more stable the moor. Mooring lines are used to secure the submarine to the pier or tender and restrain the submarine after it is in the desired position. Hinged (retractable) cleats (figure 582-5-10) and a retractable hydraulically operated capstan (figure 582-6-2) must be deployed for use as needed for mooring the submarine. The cleats can be used in conjunction with the capstan to warp the submarine into the berth. Figure 582-2-20 shows a typical submarine mooring arrangement.

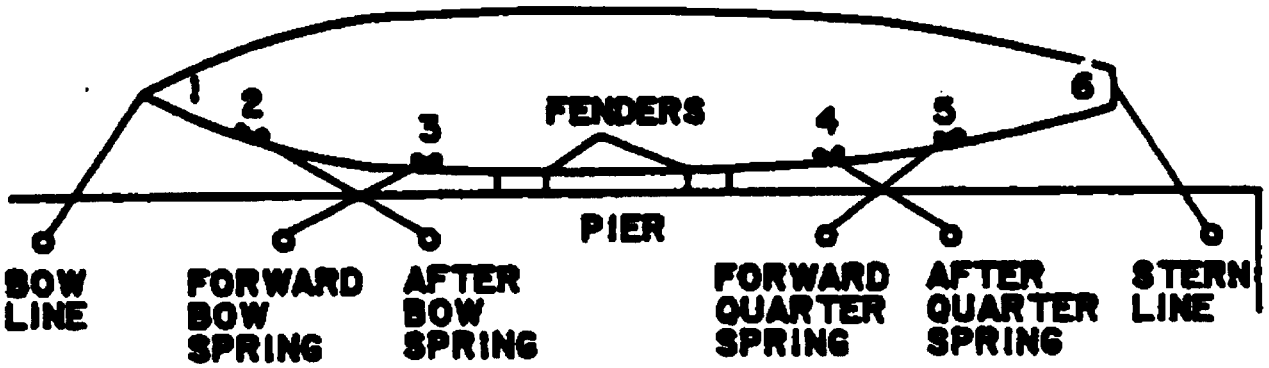
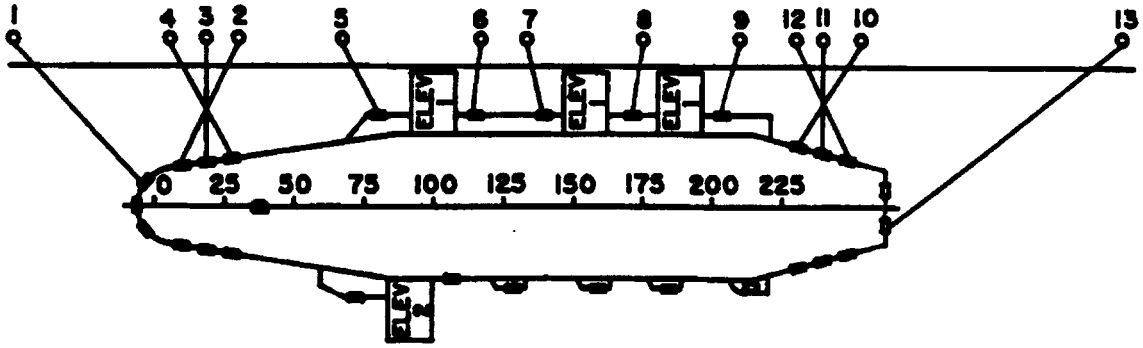
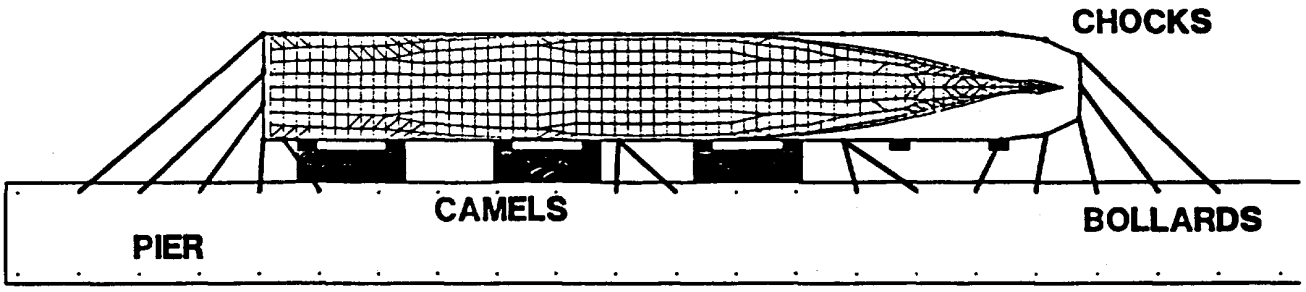


Figure 582-2-14 Mooring Lines for a Destroyer.

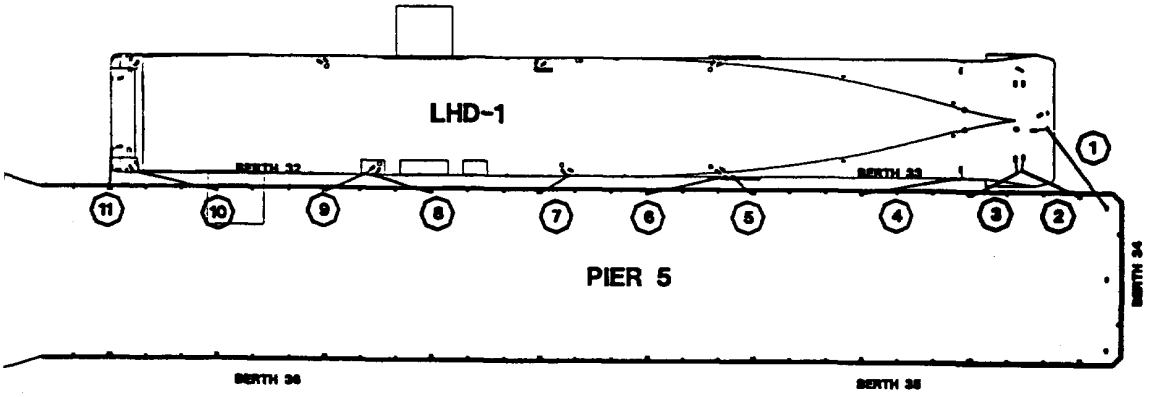


LINE NO	NAME		
1	BOW LINE	8	WAIST BREST
2	AFTER BOW SPRING	9	AFTER WAIST SPRING
3	BOW BREAST	10	AFTER QUARTER SPRING
4	FORWARD BOW SPRING	11	QUARTER BREST
5	FORWARD WAIST SPRING	12	FORWARD QUARTER SPRING
6	AFTER WAIST SPRING	13	STERN LINE
7	FORWARD WAIST SPRING		

Figure 582-2-15 Mooring Lines for a Carrier.



LHA-1 Mooring Next to Pier with Camels



LHD-1 MOORING AT NORFOLK NAVAL SHIPYARD

Figure 582-2-16 Mooring Lines for an LHA/LHD.

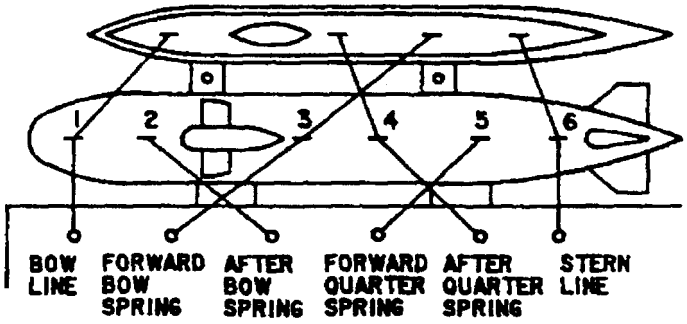


Figure 582-2-17 Mooring Lines for a Large Missile Submarine and Attack Submarine.

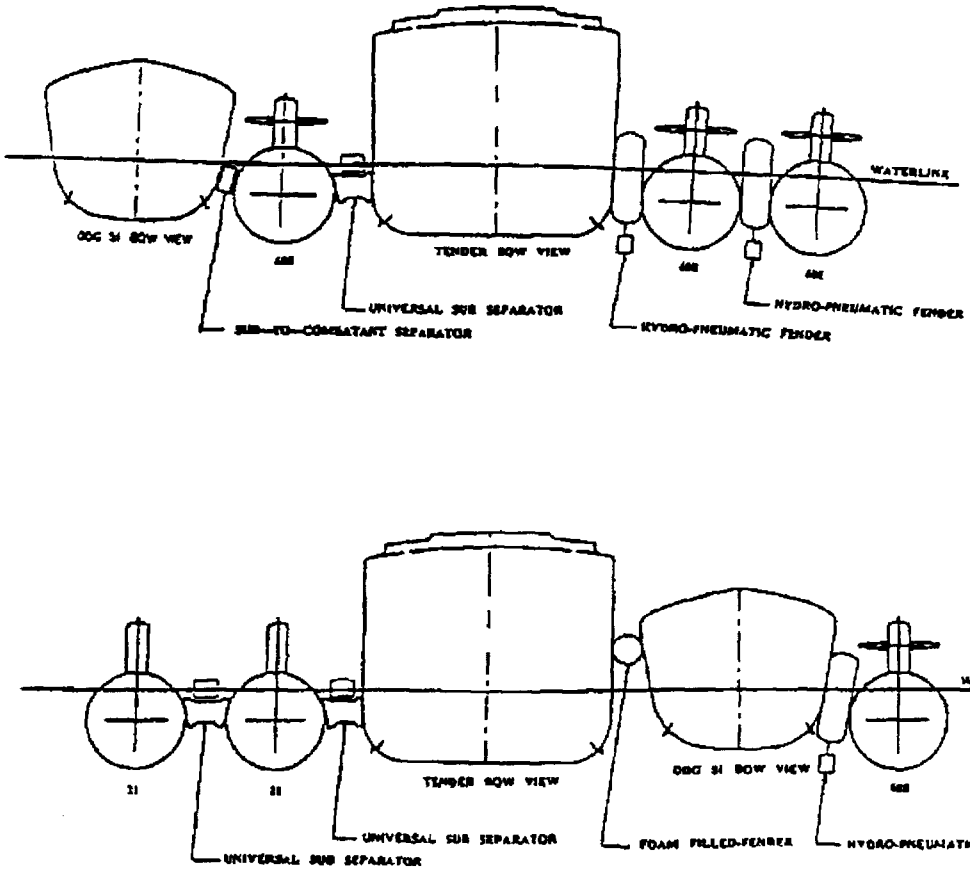


Figure 582-2-18 Nested Submarine Mooring with Fenders.

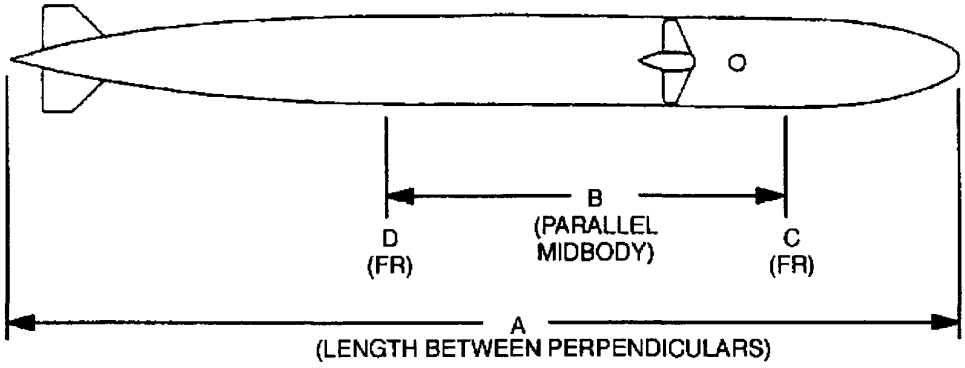
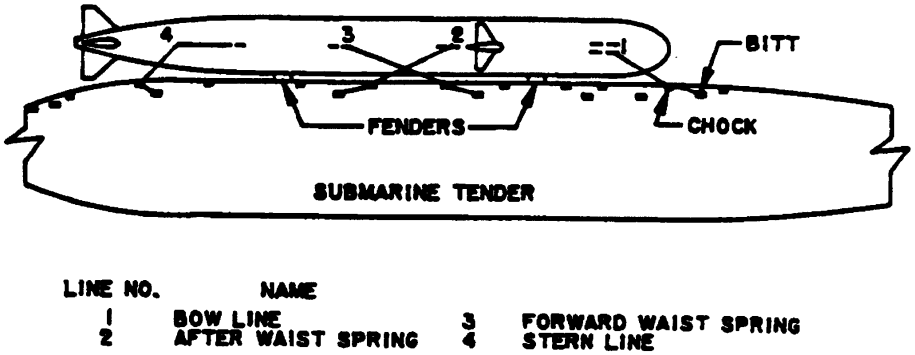


Figure 582-2-19 Submarine Parallel Midbody.



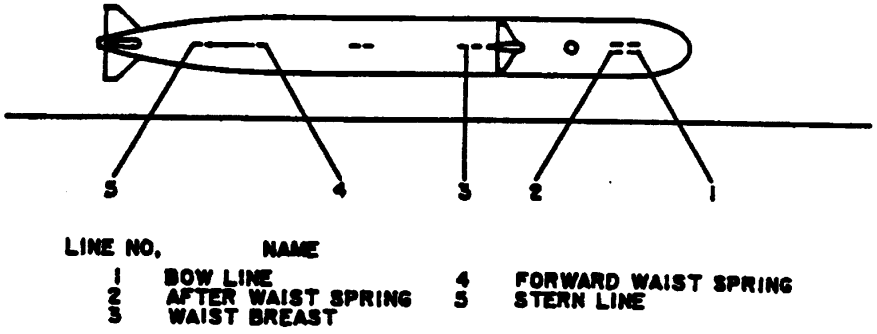


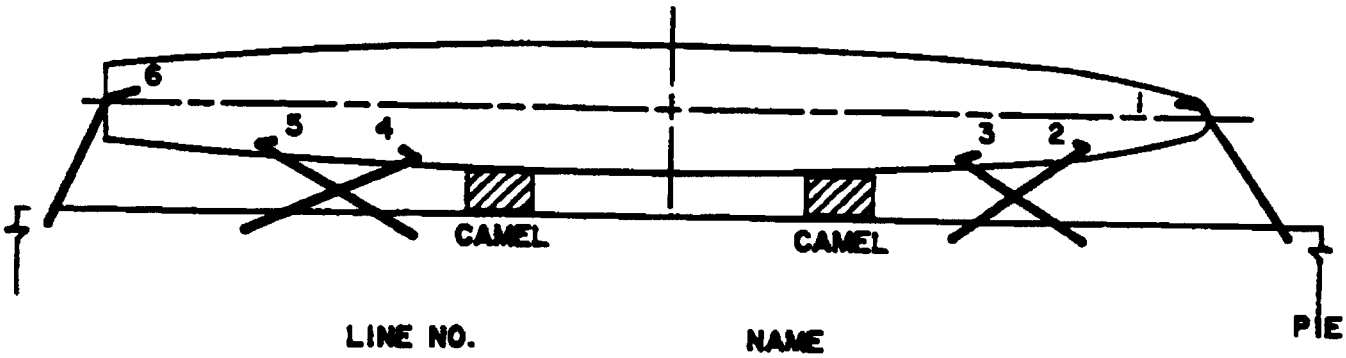
Figure 582-2-20 Typical Submarine Mooring Arrangement.

SECTION 3.

HEAVY WEATHER MOORING

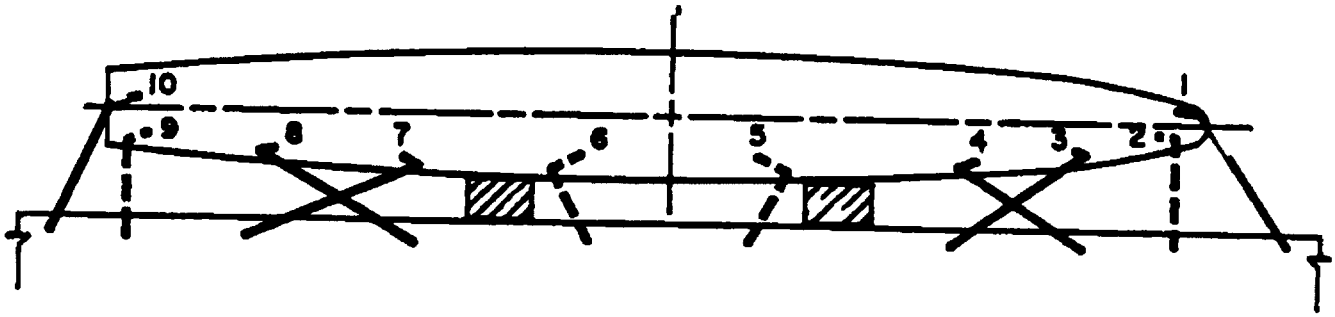
582-3.1 HEAVY WEATHER MOORING GUIDELINES

582-3.1.1 PURPOSE. The purpose of this section is to provide guidance in mooring ships for heavy weather (winds in excess of 50-knots) when it is not possible for ships to get underway for storm avoidance. It is not possible to completely guarantee the safety of a moored ship during heavy weather such as a hurricane or typhoon. The best way to guarantee safety is to avoid the storm by putting out to sea and avoiding the track of the storm. If the ship is unable to get underway, special preparations and considerations must be made/taken to help the ship survive the extreme weather. Wind prediction is not a perfect science and the wind may reach such a force that the ship's gear or pier fittings will not be able to handle the load. All that can be done is to prepare as completely as possible, covering as many contingencies as the ship's gear allows. Early planning to determine the best strategy to ride out a given storm and preparation to implement that strategy will yield the best chance of surviving the storm with minimum possibility of injury to personnel or damage to the ship or shore facilities. Figure 582-3-1 shows arrangements used for heavy weather conditions in comparison to arrangements used for normal weather conditions. The following guidance should be considered in developing any heavy weather mooring plan.



LINE NO.	NAME
1	BOW LINE
2	AFTER BOW SPRING
3	FORWARD BOW SPRING
4	AFTER QUARTER SPRING
5	FORWARD QUARTER SPRING
6	STERN LINE

MOORING LINE ARRANGEMENT USED FOR NORMAL WEATHER CONDITION



LINE NO.	NAME
1	BOW LINE
2	BOW BREAST LINE
3	AFTER BOW SPRING
4	FORWARD BOW SPRING
5	FORWARD WAIST BREAST
6	AFTER WAIST BREAST
7	AFTER QUARTER SPRING
8	FORWARD QUARTER SPRING
9	STERN BREAST LINE
10	STERN LINE

MOORING LINE ARRANGEMENT USED FOR HEAVY WEATHER CONDITION
ADDITIONAL MOORING LINES IN PLACE

Figure 582-3-1 Mooring Lines for Normal and Heavy Weather Conditions.

582-3.1.2 RESPONSIBILITIES. Commanding Officers are responsible for using all means available and weather information to avoid or minimize loss or damage to their ships. General planning for destructive weather in port and at sea is covered in OPNAVINST 3120.32 (Ships Organization and Regulations Manual), and various instructions issued by area, base, and shipyard commanders.

582-3.1.3 HARBOR LIMITATIONS. All harbors have different characteristics that affect their suitability to provide hurricane anchorages. References 26 and 27, in Appendix A, are compilations of ports and their suitability for anchoring during hurricanes and typhoons covering the Atlantic, Pacific, and Indian Oceans, as well as the Gulf of Mexico and the Caribbean Sea. Each port description contains information on frequency and intensity of hurricanes and typhoons, holding ground in anchorages, topographical features that affect wind speed from various wind directions, tides, expected wave heights within the harbor areas, pier characteristics, and storm mooring facilities, if any. This information is invaluable for planning to evade or to ride out a hurricane at anchor or next to a pier. The harbormaster's office is also an important source of information for naval and commercial ports. The term ″harbormaster" is used generically to describe the person in charge of harbor operations. Terminology varies depending on each location, and whether that person is a naval officer or a civilian. Equally important are the locations and telephone number for local ship handlers and rigging companies that can supply additional mooring lines or make up wire rope mooring lines on short notice if the ship requires them.

582-3.1.4 SHIP CHARACTERISTICS. All ships have characteristics, which must be considered when setting up a hurricane or typhoon mooring. Most of this information is contained in the Ship Information Book (SIB), equipment technical manual, and mooring plan for each ship. These are:

Amount and distribution of wind in the hull, superstructure, and deck equipment

Number, size, arrangement of bitts, chocks, towing pads, and other fittings that can be used to help moor the ship in heavy weather

Power and location of anchor windlass(es) and mooring capstans

Availability of storm mooring lines in addition to normal weather mooring lines

Size, type, and arrangement of anchoring gear

582-3.2 MOORING COMPONENTS.

582-3.2.1 FITTINGS. Both pier and ship fitting capacities must be considered when planning for heavy weather mooring.

582-3.2.1.1 Pier Fittings. Whenever possible, heavy weather mooring lines should be spread out to fittings (bollards preferred) across the pier to maximize the horizontal component of line pull. Limiting the use of a pier fitting to a single ship is recommended wherever practical. The use of extra lines to minimize surging will require caution to ensure the fittings are not overloaded. Information on their strength may be obtained from the harbormaster for naval bases. Information on the strength of fittings in commercial ports may be more difficult to obtain, and an estimate should be made based on their size and condition. In general, bollards on navy piers are designed to handle mooring the largest ship that will use the pier in a 64-knot (hurricane level) wind according to the berthing plan for the pier. Like the ships bitts, these bollards may handle the loads imposed by the moored ships in more severe conditions, but with greater risk of failure or damage to the pier and the ship. The more redundancy that can be obtained in mooring the ship with balanced loads fore and after, the greater the probability that the moor will succeed.

582-3.2.1.2 Ships Bitts and Bitt Capacity. Every bitt on a Navy ship has a safe working load as defined by references 45 and 46 in Appendix A. The design factor may be infringed in preparing to meet storm loads, but in no case should the breaking strength of all of the parts of wire or rope attached to the bitt exceed the yield

strength of the bitt. Every effort should be made to obtain information about the strength of pierside mooring fittings. This information should be available from the harbormaster for Navy bases, but may be more difficult to determine in commercial ports. If this information can not be found, then a calculated estimate must be made from available information. Where practical, as in a slip mooring, lines should be spread out to bitts and bollards across the finger pier assuming they are not in use by another ship. Pierside cleats are generally intended for use by small service craft and should not be used for mooring ships. In some cases, solid deck fittings such as masts and crane pedestals may be used to secure lines to avoid overstressing bitts. The more redundancy that can be achieved in mooring the ship, the better the probability of success.

582-3.2.2 LINES. Wire or fiber ropes (aramid, nylon, and polyester) can be used for heavy weather mooring. Wire and traditional synthetic fiber rope must not be mixed as primary load carriers in a heavy weather mooring system. Similarly, in an all fiber rope system, nylon or polyester lines must not be mixed with low stretch aramid (UHMWPE) mooring lines. In a mixed wire and polyester/nylon fiber system, the wire lines will take virtually the entire load because of the wide difference in elasticity between the wire and fiber ropes. They may fail first, leading to a cascading failure in which lines fail in succession as each comes under load.

582-3.2.2.1 Wire Rope. Wire ropes are very strong for their diameter, but have an extremely high modulus of elasticity and very low elongation until failure (one to two percent). Wire lines can provide better positioning of the ship because of their low stretch characteristics. Properly rigged and tensioned wire rope mooring lines will keep the ship from moving significantly and therefore will prevent the ship from building significant kinetic energy. Wire lines are a good solution for mooring alongside a pier using camels, especially where little storm surge is expected. However, wire rope mooring lines should be avoided if significant storm surge is expected. They must be attended constantly to ensure that all lines are taking an equal load (no catenaries), because the low available stretch prevents the lines from adjusting themselves and redistributing the load as the water level changes. If only one line is under tension, it will take the brunt of the wind load and will likely fail before the other lines come under tension and begin to share the load. This results in a cascading failure. Another undesirable trait of wire rope is the load placed on the ship and pier bitts. If the ship is moving at its mooring, the mooring lines at the end of its travel must absorb the kinetic energy of the ship. Because of extreme stiffness of wire lines, the energy is absorbed in a very short distance, which means that the induced forces are very high. If wire rope lines are used, installing an energy absorbing link such as the Seward International ″SEALINK” can greatly reduce the shock load on bitts and the wire rope while maintaining the full strength of the wire rope. Shock absorbing links should be a part of shore based mooring lines, as units with the required capacity are massive. Special means of adapting the link with single load-carrying wire to the pier and ship butts are also required.

582-3.2.2.2 Aramid Rope. Aramid mooring lines have characteristics similar to wire rope and require the same setup and tending. Chafe protection is even more important as aramid lines are particularly vulnerable to chafe. However, their light weight and ease of handling compared to wire rope offers a significant advantage when tending the lines during a storm, and they wrap around bitts and capstans much more easily than wire rope.

582-3.2.2.3 Nylon and Polyester Rope. Nylon and polyester mooring lines are the best choice where high storm surge is expected, and especially where the ship can be breasted out into the middle of a slip. The elasticity of these materials provides excellent load sharing and shock absorbing as the ship moves within its mooring.

582-3.2.2.4 Backup Mooring Lines. Wire or aramid ropes may be used to provide a backup to nylon or polyester lines, but they must be left with enough slack that they will not come under tension until the more elastic lines are near their breaking points. The overall strength of the bitts on both the ship and the pier must be considered before using this mooring line configuration.

582-3.2.2.5 Guidance on Mixing Lines. Wire and fiber rope should not be mixed as the primary load carriers in a heavy weather mooring setup. One exception is wire and aramid may be used together if the wire lines are used for the longer mooring lines and the aramid is used for the shorter mooring lines. Another exception is using polyester or nylon for short breast lines and wire or low stretch fiber for long spring lines. In an all fiber rope systems, nylon or polyester should not be mixed with aramid lines. Wire or aramid ropes may be used to back up nylon or polyester lines, but must be left with sufficient slack such that they will not come under significant tension until the more elastic synthetic lines have stretched to store as much of the load as safely possible without parting. This will allow the primary lines to absorb and dampen a significant amount of the dynamic energy created by the motion of the ship in the wind before any significant load is placed on the backup lines. A number of additional factors must be considered in developing a mooring plan with mixed lines: strength of bitts, bollards and cleats; estimated residual strength of lines to be used (e.g., nylon will lose approximately 15 percent of its strength when wet); estimated magnitude and direction of the sustained and gusting wind; expected current; and height of the storm surge. Using these considerations, the length of the wire rope or aramid backup storm line should be determined (including length of energy absorbing link if used) so that they will become taut when the primary mooring line reaches a load of approximately 50 percent of estimated breaking strength. To determine the correct amount of slack (i.e., additional length of rope to be payed out after the line is taut) for each wire rope or aramid storm line, multiply the following factors times the taut length (ships bitt to the pier bollard):

0.20	nylon 3-strand, nylon double-braid, nylon 8-strand plaited
0.04	polyester double-braid
0.07	polyester 8- and 12-strand plaited
0.10	polyester 3-strand
0.14	polypropylene 3-strand

If the wire rope or aramid backup line cannot be run in the same direction or have the same length as the primary line, then the relative geometry will be different and the required additional slack will be different from that derived above

582-3.2.2.6 Chafe Protection. Chafe is a severe problem for both wire and fiber ropes used in heavy weather moorings. Wire is the least vulnerable. Chafe is combated in several ways:

Distance between the bitt and the chock through which the line is led should be at a minimum. The greater the distance between bitt and chock, the more stretch that will take place allowing the rope to saw back and forth on the mooring chock.

Chocks and any other surface over which the rope may be pulled under tension should be ground smooth to remove burrs and other irregularities that could abrade the line more quickly.

Fit antichafing gear such as leather or canvas covers, or sacrificial whippings to absorb abrasion and protect the integrity of the mooring lines. Monitor the condition of the antichafing gear during the storm and replace it as necessary.

Marine energy absorbing links, such as the Seaward International Corp. Sealink or equivalent may be available in some ports. When used as part of the mooring, a properly sized energy-absorbing link in the line load path can greatly reduce line chafing and the peak dynamic load on bitts, bollards, wire rope, aramid rope, and anchor chain.

582-3.3 WIND AND CURRENT FORCES

582.3.3.1 FORCES GENERATED BY HIGH WINDS. The loads in the ships mooring lines increase approximately as the square of the wind speed increase. For example, if the wind speed doubles, the mooring line loads

will quadruple. Their magnitude is also dependent on the direction of the wind and the configuration of the ship above the waterline. The following table provides an estimate of the resultant total force generated on several classes of ship to help develop a heavy weather mooring plan appropriate for the conditions anticipated. Only the highest forces (lbs) and the corresponding relative wind bearing are shown. For Navy ships not shown in this table, choose the type that is most similar in size and configuration to get an approximate mooring force that can be expected during a storm.

Table 582-3-1 FORCES GENERATED BY HIGH WINDS

		50 KTS	**70 KTS**	**100 KTS**	**150 KTS**
Ship Class	**Wind Bearing**	**Load (lbs)**	**Load (lbs)**	**Load (lbs)**	**Load (lbs)**
MHC 51	(120°/240°)	19,300	37,800	77,200	174,000
DDG 51	(105°/255°)	116,000	227,000	463,000	1,040,000
CG47	(105°/255°)	224,000	439,000	895,000	2,010,000
AD 41	(90°/270°)	362,000	709,000	1,450,000	3,250,000
LHD 1	(100°/260°)	421,000	825,000	1,680,000	3,790,000
CVN 68	(100°/260°)	459,000	899,000	1,830,000	4,130,000

582-3.3.2 FORCES GENERATED BY CURRENTS. If a current exists at the mooring site and is moving in the same direction as the wind, it will add to the total force on the ship. The force due to current is dependent on the hull form and draft of the ship, the depth of the water, and the direction of the current. For many surface ships, the force due to a 2-knot beam current is double (or more) the 50-knot wind forces in the table above. With all mooring lines properly doubled-up in the Mooring Service Type (MST) II design conditions, 64-knot wind and 2 knot current, both the mooring lines and the bitts have a design factor of 3:1. For MST III, 90-knot winds and 2 knot current, the design factor is 2.5:1 for the lines while the design factor remains 3:1 for the bitts.

582-3.4 PREPARATIONS

582-3.4.1 MISCELLANEOUS PREPARATIONS. When preparing to ride out a hurricane or typhoon in port, there are a number of preparations that should be undertaken to improve the ship's readiness:

a. A duty roster should be prepared to ensure the availability of sufficient crew and officers of appropriate ratings and training to provide for the operation of essential systems, tend mooring lines, and fill damage control stations.

b. Nonessential personnel should be evacuated to a safe area.

c. Any hazardous material should be removed from the ship to a safe land -based storage and disposal area, as practical.

d. Nonessential deck gear, such as canvas awnings, officer-of-the-deck shelters, fire hoses, and similar wind-vulnerable equipment should be removed and stored below. Equipment that cannot be stored below, such as ship's boats, should be provided with extra lashings to prevent them from breaking loose. Any steps that reduce windage will ease the loads on the mooring lines and reduce the possibility of wind-driven material that could cause damage to the ship or injury to the crew.

e. Where practical, fuel beyond that required to provide electrical power and other ship services for the expected duration of the storm plus a reasonable margin should be pumped off to reduce the threat of oil pollution in the event of a hull breach. Fuel remaining on board should be stored in central tanks, which will be least likely to sustain damage.

f. If the ship's brow is to be left in place, it must be secured with extra gripes and any canvas panels must be removed from the rails to reduce windage. If the event that the ship's movement is too great and the brow is in danger of being pulled off the dock, there must be a contingency plan in place to either jettison or recover the brow before it damages the ship.

g. Properly double-up mooring lines. Figure 582-2-14 shows the correct method for doubling-up lines. In addition to the single part of a mooring line at each bitt, pass a bight of the line to the bollard on the pier, resulting in three parts of the line holding the ship at that point. To ensure that the three parts of the line take an equal strain, take a simple round turn to the first barrel of the ships bitt closest to the chock before passing the bight to the pier. After the slack is taken out of the bight, and the three parts are under equal tension, fairlead the standing part to the second barrel and then figure-eight the line. Communications to the line stations should be established with consideration of the high background noise generated during hurricane force winds.

582-3.5 HEAVY WEATHER MOORING STRATEGIES.

582-3.5.1 ALTERNATIVES. A variety of alternatives exist for ships that must ride out storm conditions. Some of these options are obviously more suitable than others. Listed below are some of the strategies available, followed by expanded information for some of the most common approaches to heavy weather mooring.

ALTERNATIVE MOORINGS

- Anchor out in harbor using a hammerlock moor
- Relocate to a calmer harbor
- Connect to a Fleet moor using ship's anchor chain or heavy duty mooring chain
- Relocate to a wharf with minimal current loading; enables higher wind load than at pier
- Drydock the ship
- Move to a bigger pier; install chain or wire rope to high strength fittings
- Moor in a slip

PIERSIDE MOORING ENHANCEMENTS

- Properly tend lines to maximize load sharing
- Utilize recessed shell bitts (lines must be correctly installed to avoid cascading failure)
- Supplement mooring stability with harbor tugs
- Improve line angles to allow higher load efficiency (place barges or camels between ship and pier and/or utilize fairleads)
- Locate ship on side of pier where loading is into pier vice away from pier during peak winds
- Utilize mid-pier storm bollards
- Implement ship to ship cross pier mooring arrangements
- Ballast down to reduce wind load
- Further ballasting to produce intentional grounding (must be at proper water depth)
- Option for LHA's and Fleet oilers only, if at proper water depth
- Watch for broadside current which could result in extreme current load

AS A LAST RESORT

•Tow ship to sea

•Beach ship (risky but may be possible for amphibious ships given ballasting capability and relatively flat bottom hulls)

•Sink ship

582-3.5.1.1 Use Have the Pierside Anchor Chain. The anchor may also be removed from the pierside anchor chain and the chain used as part of the mooring system. The chain should be connected to a high capacity fitting, and can be particularly effective if used in conjunction with an energy-absorbing link. Anchor chain is commonly used for inactivated ships as part of their moor.

582-3.5.1.2 Use of the Harbor Tugs. If the storm is not expected to be extremely severe within the harbor, tugboats may be available to assist the moored ship during the storm. If the ship is at anchor, the tugboat(s) may be tied up hard alongside to provide ahead thrust to help counter the wind force if the ship's propulsion plant is dead. Alongside a pier, the tugboat(s) may be used to hold the ship on or off the pier, as required, to help relieve the strain on the mooring lines or camels.

582-3.5.1.3 Intentional Grounding. Intentional grounding can be an effective strategy under certain conditions, particularly when the water is relatively shallow next to the pier, or when there is relatively shallow water in a protected area of the harbor. The bottom must be sand or mud, with no large rocks or other features that could puncture the hull. The bottom of the ship must be flat or have only moderate deadrise, and be free of appendages such as sonar domes, propellers, or rudders extending below the baseline. For this technique to be effective, the ship must be able to ballast down to a free floating draft that is deeper than the normal high tide of the water plus the expected storm surge. Amphibious assault ships with wet well decks are capable of using this technique, as are fleet oilers. This technique is used at the Naval Amphibious Base at Little Creek, Virginia with mooring lines tied from ship to ship across the pier.

582-3.5.2 HURRICANE AND TYPHOON MOORINGS. In several major Navy bases, there are special hurricane or typhoon moorings that have been designed by the Navy Facilities Command (NAVFAC). Where this is the case, the harbormaster for the base should be consulted for the proper tie-up procedures and to arrange for use of the required facilities and equipment. A number of large commercial shipyards also have hurricane preparedness plans. Although a commissioned Navy ship is the responsibility of her captain, the repair yard can offer guidance for effectively using the piers and camels, and can help provide necessary services and materials. Specific information on safe havens for hurricane and typhoon moorings can be found in Brand, Samson and Jack W. Blelloch, Typhoon Havens for the Western Pacific and Indian Oceans. Naval Environmental Prediction Research Facility, Technical Paper 5-76, Monterey; and Turpin, LCDR Roger J.B., RN and Samson Brand, Hurricane Havens Handbook for the North Atlantic Ocean, Naval Environmental Prediction Research Facility, Technical Report TR 82-03

582-3.5.2.1 Anchoring Out. Where the storm is not expected to be very severe, the holding ground is good, and there is good shelter from wave action, the best course of action may be to anchor. If possible, the anchorage should also provide gradual shoaling of a sand bottom over as wide a range of bearings as possible to minimize damage to the ship should it drag ashore. The anchorage should also be selected with an eye to other ships in the anchorage that may drag down onto the ship or foul the ship's ground tackle. Navy anchors are designed to withstand a wind of 70-knots with a current of 4-knots in 40 fathoms of water, in a firm sand bottom, includ-

ing a ″Z factor” that accounts for dynamic loads as the ship moves at anchor. The effective holding power of the anchor can be improved in a number of ways. One way is to use a ″hammerlock” or foul weather moor.

582-3.5.2.2 Hammerlock Moor. In the hammerlock one anchor is deployed on short scope at a right angle to the other anchor (figure 582-3-2). This prevents the ship from sailing back and forth at the anchor and reduces the dynamic loads experienced by the ship. It also simplifies using tugboats to relieve the strain on the anchor. Properly executed, the hammerlock mooring will adjust itself to the shifting wind of a hurricane or typhoon by allowing the short scope anchor to drag as it comes under increasing load. To accomplish this, the short scope anchor should be deployed on the side toward the expected wind shift. In other words, if the wind is backing (shifting counterclockwise), the short scope anchor should be placed to the port side of the ship. If the eye passes over the ship during the storm, there will be a reversal of wind direction. In this case, the short scope anchor of a hammerlock moor should be hauled in until the anchor is just underfoot as the eye passes over. In this way, the ship will be free to swing to the new wind direction without twisting the anchor chains. More chain can be veered out on the short scope anchor as the ship yaws to its maximum point towards the wind shift to return to a hammerlock moor. Clearly, this is an inherently risky operation in high winds, and all appropriate precautions must be taken to minimize risk to the crew. If the ship does begin to drag its long scope anchor, more chain may be veered out to both anchors until the short scope anchor also holds solidly. If the ship’s propulsion system is available (which is unlikely if the ship is still in port) it may be used to reduce the load on the anchor. Tugboats, if available, can provide the same service.

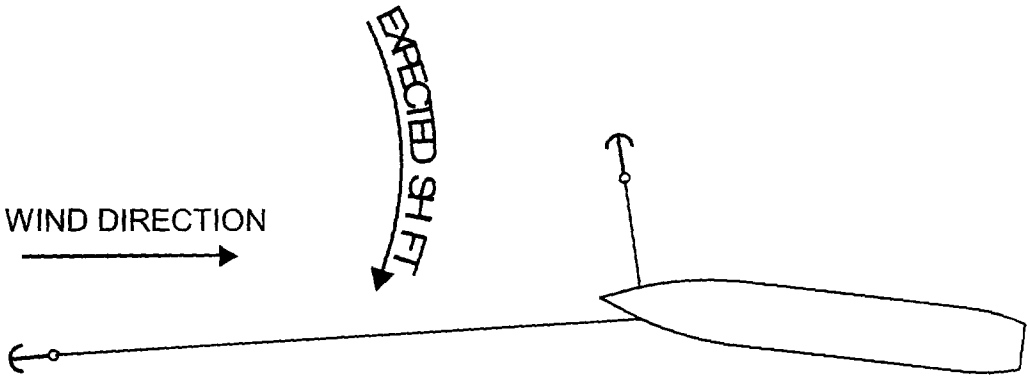


Figure 582-3-2 Hammerlock Moor.

582-3.5.2.3 Single Anchor Moor. Another technique is to swing from one anchor and keep the other anchor dragging underfoot on a short enough scope that the anchor does not dig in. This will reduce the violent swaying and yawing of the ship associated with the hammerlock moor and reduces the dynamic loads on the anchor and chain. Although it is not as effective as the hammerlock moor, the ship will be able to swing more easily with the wind.

582-3.5.2.4 Mooring within a Slip (Between Finger Piers). Mooring within a slip with solid finger piers on both sides of the ship (figure 582-3-3) is an excellent way to ride out a severe storm. There are several advantages to a slip mooring:

a. The ship can be breasted out into the middle of the slipway, eliminating the need for camels, which are a significant hull puncture risk, if the ship is forced onto the camel too hard.

b. The mooring loads are shared among more ship and pier bitts and bollards, reducing the chance of failure.

c. Mooring loads are shared among more dock lines, reducing the probability of line failure.

d. The ship has room to move without contacting the piers, allowing optimum use of the shock-absorbing qualities of nylon or polyester lines.

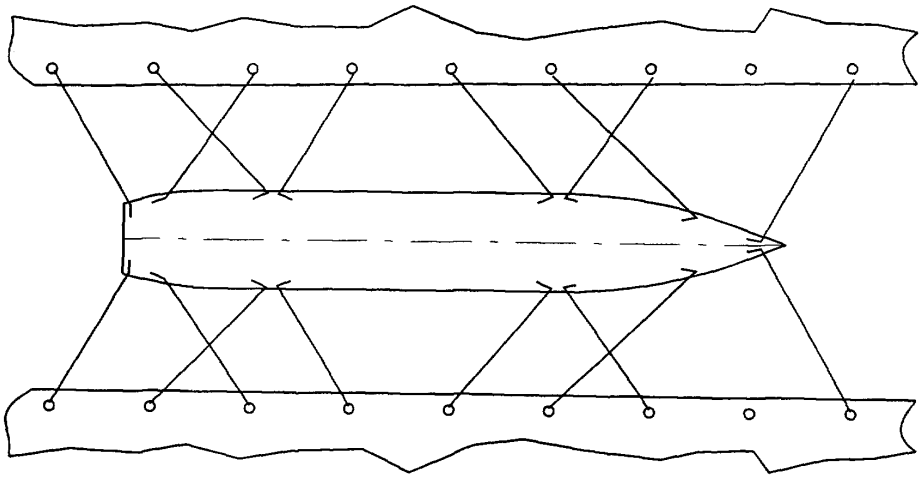


Figure 582-3-3 Typical Extreme Heavy Weather Mooring in a Slipway.

582-3.5.2.5 Mooring Alongside a Pier. Mooring alongside a pier can be difficult, particularly if a wind reversal is expected. Most Navy ships are moored using large camels to hold the ship off the pier and spread the load along the ship. In a storm, it is important that these camels be maintained in position to prevent the ship from hitting the dock. The camel can endanger the ship if it is capsized during the storm. Subsequent surges can result in damage to the ship's hull from hitting the pier or the capsized camel. It is extremely important to prevent, as far as possible, the ship from surging either parallel or normal to the pier because shock loads and chafe will be increased and camels may be damaged, capsized, or sunk. This implies the use of low stretch lines, either aramid or wire rope, to hold the ship in position. These lines must be tended during changes in water level and wind direction to ensure that there is never significant slack. Any slack in one wire or aramid mooring line will cause excess stress in others, and will likely result in a cascading failure. If nylon or polyester is used, special attention must be given to providing extra breast and spring lines to minimize the movement of the ship. The practice of deploying a ship's anchors underfoot to help damp any motions provides no real resistance to movement. It is of doubtful value and should not be applied on ships with sonar domes unless the anchor is keel mounted. Deploying an anchor well away from the dock to help hold the ship off the pier with the catenary taken up as much as possible is a much more effective use of the anchor. Some crews remove the anchor from the pier side anchor chain and use the chain as part of the mooring system, generally as a failsafe if the ship breaks its mooring lines and is blown away from the dock.

582-3.5.2.6 Nested Mooring. Not all ports offer pierside berthing accommodations to each ship. When port loading is congested, ships may be required to moor outboard to similar ship hulls (nested). Prior to periods of gusting winds and inclement weather, the following measures are recommended to augment ships mooring arrangements to reduce possible damage. (However, nested mooring should be avoided if at all possible during heavy weather.)

a. The pierside ship should be placed on sea cushions vice metal or wooden camels to aid in mooring line shock loading and decreasing possible hull damage from a rigid fendering system.

b. The pierside ships mooring arrangement should conform to that depicted in figure 582-48. The addition of bow and stern breast lines in conjunction with waist breast lines will provide the best holding power for both ships when nested, inasmuch as the dynamic forces on pier fixtures are greatly increased during this situation.

c. The outboard ship should be resting on a minimum of two sea cushions positioned to provide best load distribution.

d. The outboard ships mooring arrangement should include as many lines as possible consistent with own ships bitt and chock design specifications. All lines should have a moderate strain to prevent sea cushions from shifting and ships fore/aft movement. If possible, additional lines should be run from the outboard ship(s) to the pier or wharf.

SECTION 4.
MOORING LINES

582-4.1 MOORING LINE SIZING

582-4.1.1 GENERAL INFORMATION. Mooring lines and associated equipment are used to secure a ship to a wharf, pier, dock or another ship. The size of the mooring equipment that should be used is derived from ship characteristic data such as length, draft, gross tonnage, and wind presentment area. Ships are outfitted with the quantity of lines and fittings needed to securely hold the vessel in place up to a pre-established maximum storm condition. The size and strength of the mooring lines increases as the size of the ship increases. Using nylon mooring lines as an example, seven inch circumference or smaller mooring lines are used by cruisers, destroyers, minesweepers, tugs, and other small ships. Ships, such as large auxiliaries, and aircraft carriers, use eight inch circumference or larger mooring lines. Synthetic fiber rope eight inches or greater in circumference normally will require handling by capstans or warping winches.

582-4.1.2 MOORING LINE LENGTH. Mooring lines are typically supplied in 200 to 600 foot lengths. A mooring line can be used in a single line configuration, or can be formed into a multiple-part configuration of two or three parts. A standard 600 foot mooring line is normally long enough to be used in a three part configuration. The Navy has historically referred to a three part mooring line as a doubled up mooring line.

582-4.1.3 MOORING LINE STRENGTH. Size and strength of mooring lines varies significantly depending on the material used and the specification to which the line was produced. Consult the ship's Coordinated Shipboard Allowance List (COSAL) when ordering new or replacement mooring lines. Mooring lines are listed under Federal Stock Class (FSC) 4020. Ship's deck fittings are sized to ensure adequate strength and safety for the size of mooring line to be used. By design, the overall load of a mooring line in a one, two or three part configuration should be less than the yield or breaking strength of the deck fitting. This practice is employed to ensure that the ″easy to replace" mooring line fails before damage to ship's structure would occur. Hence, the maximum size and strength of mooring lines is limited by size and strength of the deck fittings.

582-4.2 MOORING LINE NOMENCLATURE

582-4.2.1 NUMBERING OF MOORING LINES. Mooring lines are traditionally numbered from forward to aft according to the position where they are secured aboard the ship. A ship may use extra mooring lines under heavy weather conditions, in which case the numbering may not be sequential. Figure 582-4-1 shows the numbers for seven mooring lines used for a typical pierside moor.

582-4.2.2 NAMING MOORING LINES. The forward most lines on the ship are referred to as bow lines. Mooring lines at the aft of the ship are called stem lines. On smaller surface combatant ships, the bow line is usually run through the bull nose. Because they can be led from the fittings on the ship furthest from the pier, the bow and stem lines are important lines for holding the ship in position against the pier or wharf. Mooring lines are considered to be breast or spring lines, depending on the angle the line makes with the pier (as viewed from overhead). Breast lines are run perpendicular to the centerline or keel of the ship and hold the ship next to the pier (less than 45 degree angle from perpendicular). Spring lines lead diagonally from the ship to the dock and limit forward and aft movement of the ship (greater than a 45 degree angle). The mooring lines are also named according to their position on the ship and how they lead from the ship. For example, in figure 582-4-1 the number two line is called an after bow spring line because it is located on the bow and it is a spring line leading aft.

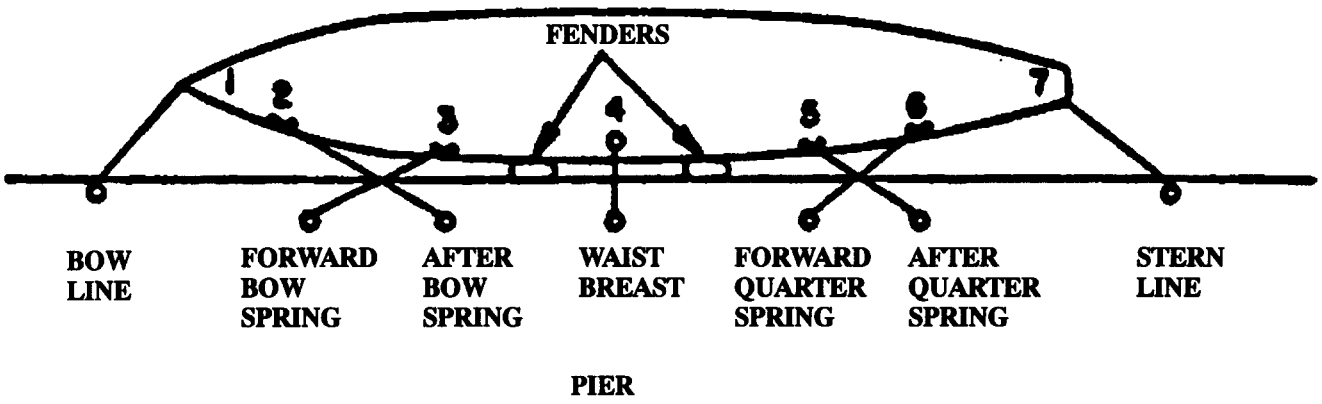


Figure 582-4-1. Mooring Line Nomenclature.

582-4.2.3 MARKING AND IDENTIFYING MOORING LINES. Navy sailors splice new mooring lines using accepted practice, forming eyes at both ends of the mooring line. A practice that has sometimes been followed has been to place a cloth marker in the eye of the mooring line to provide historical information about the line. This can be most helpful since we have evolved from MIL SPEC's for natural, nylon, polyester, to aramid lines, and more recently to commercial specifications for mooring lines. Per NSTM Chapter 582 revision 2 guideline for mooring lines, the following marker practice will be implemented for Navy mooring lines:

A marker shall clearly designate:

Manufacturer

Year assembled

Listed breaking strength of line

Type of line and construction

582-4.3 MOORING LINE MATERIALS, CONSTRUCTION AND SPECIFICATIONS

582-4.3.1 GENERAL INFORMATION. Mooring lines should have adequate strength, be of adequate length to support planned operations, and be practical to handle manually or using ships mooring equipment. Mooring line material and construction must be varied to meet all ship design and handling requirements. The available range of mooring lines is not limited to those listed herein. New combinations of materials and construction types are developed regularly to meet specific requirements. These newly developed lines sometimes gain popularity within the operating fleet. As new lines and ideas evolve, they are evaluated by the technical community and may become widely used because of valuable new properties. This is what happened with aramid mooring lines. They have inherent safety features that brought about a sweeping change in the way the U.S. Navy uses mooring lines.

582-4.3.2 MATERIALS. Synthetic ropes composed of industrial fibers (polypropylene, nylon, polyester) and high performance fibers [aramid or ultra-high-molecular-weight-polyethylene (UHMWPE)] fibers are used extensively for mooring and towing operations. Navy applications tend to use nylon, polyester, aramid and UHMWPE fibers because of certain advantages they offer over other fiber choices for mooring and towing lines. In some instances wire rope is used. The use of natural fiber manila or sisal mooring lines is no longer authorized. Ropes with standard Polypropylene fibers have beer. replaced by combination fibers (polyester/polypropylene and

polypropylene/polyethylene) in many industrial marine applications, and may be used on smaller craft. Mooring line performance can be enhanced through the application of special treatments such as a Marine Overlay finish.

582-4.3.3 CONSTRUCTION. Double braid and three strand ropes are commonly used constructions for nylon and polyester mooring lines, due to their relatively low cost. However, four strand aramid fiber ropes have more recently been used to replace other synthetic ropes, because their high strength to weight ratio makes them easier and safer to use by deck personnel.

582-4.3.3.1 Three Strand Or Twisted Rope. This rope consists of three strands of nylon, twisted together. It is suitable for mooring and warping applications. Three strand ropes should be stored on hawser reels to prevent unlaying. While this type of rope has seen performance improvements thorough application of a Marine overlay finish, its performance and durability is still below the other alternatives discussed below, so this type of line has fallen out of favor.

582-4.3.3.2 Plaited Rope. This rope consists of eight rope strands in a square braid pattern. Plaited rope is non-rotating and is widely used in heavy marine, mooring and towing applications. It is often used in lieu of double braid lines for ease of splicing and because of its lower cost. Because it is non-rotating, it is it does not require any special handling procedures.

582-4.3.3.3 Double Braided Rope. This rope consists of one hollow braided rope within another. This construction is non-rotating and is also used for a wide range of mooring and towing applications. Double braid has the best strength to weight ratio of ropes made with industrial synthetic fibers. Double braid with a Marine overlay finish is particularly durable and easy to handle.

582-4.3.3.4 Twelve Strand Rope. This rope consists of twelve strands, in a twill pattern. It is best suited for Navy towing applications, and for ship assist lines used by tugboats.

582-4.3.3.5 Four Strand Rope. This rope consists of four strands and each strand is fabricated in a similar fashion to a wire rope strand. These four strand ropes will stretch less than other synthetic rope. They can be used for pier side mooring, tending lines and ship assist lines. This rope is designed with a safety feature to give line handlers an advanced warning of failure. Stowage and handling are similar to three strand rope.

582-4.3.4 SPECIFICATIONS. Table 582-4-1 lists the type of construction and the associated military and commercial specifications for synthetic ropes commonly used in Navy mooring lines. Refer to NSTM Chapter 613, Wire and Fiber Rope and Rigging, for additional information on rope properties.

Table 582-4-1 FIBER ROPE SPECIFICATIONS

TYPE OF ROPE CONSTRUCTION	CIRCUMFERENCE (inches)	MILITARY SPECIFICATIONS	COMMERCIAL SPECIFICATIONS
Nylon Three Strand	Up to 12	MIL-R-17343	CI 1303
Nylon Plaited	Up to 16	MIL-R-24337	CI 1303
Nylon Double Braid	Up to 21	MIL-R-24050	CI 1310
Polyester Double Braid	Up to 21	MIL-R-24677	CI 1311
Polyester Twelve Strand	Up to 15	MIL-R-24750	CI 1305
Aramid Four Strand	Up to 8 3/16	CID-A-A-50435	CID-A-A-50435B
Spectra Four Strand	Up to 8 3/16	CID-A-A-50435	CID-A-A-50435B

582-4.4 MOORING LINES IN THE SHIPBOARD ENVIRONMENT

582-4.4.1 EFFECT OF LINE COMPOSITION ON MOORING OPERATIONS. Moorings which incorporate wire and aramid ropes are considered stiff moorings and allow relatively little movement of the moored ship under applied loading. This is advantageous at some mooring facilities where unloading operations require minimal ship motion. Wire ropes are more difficult to tend than synthetic lines. Variations in tide levels can dramatically increase line loads and stiff moorings may respond poorly to dynamic loads. Moorings which incorporate synthetic lines composed of nylon or polyester fibers permit relatively large movement of the ship under applied loading. Synthetic lines are easier to handle than wire rope. Also, an increase in line load caused by a variation in tide level is not as severe in a traditional synthetic line as it is in a wire or an aramid line. In general, lines of differing material and/or construction should not be mixed, unless specifically called for in the mooring plan.

582-4.4.2 USE OF FOUR STRAND MOORING LINES. Because of their low stretch characteristics, low stretch, high performance mooring lines require more tending than traditional nylon or polyester lines; particularly for shorter line lengths and locations with significant tidal changes. This rope shall be spliced in accordance with NSTM Chapter 613, Wire and Fiber Rope and Rigging, for plain laid rope except that the tucks should go with the lay of the strands. To educate ship's crew about the characteristics, handling, splicing, maintenance, safety precautions, and inspection of four strand aramid lines, the Navy has prepared a training video called ″Aramid Fiber Rope Safety Guidelines" , Production Identification Number (PIN) 805494. See paragraph 1.4.3 of this NSTM for ordering information.

582-4.4.3 MOORING LINE ABRASION. Abrasion occurs when the rope contacts and passes across rough surfaces. The outer filaments of the rope break to form a fuzzy surface appearance and texture. This fuzzy surface forms a protective cushion and shields the fibers underneath. This, in turn, tends to help retard further abrasion and damage to the sub-surface fibers. With very rough surfaces excessive abrasion and cutting will take place and line strength will be lost. The outer jacket of aramid mooring line is more highly susceptible to chafing. Always use chafing gear where the line passes through chocks and in the eye of the line.

582-4.4.3.1 Types of Chafing Protection. Traditional Navy chaffing material has included old or discarded fire hose. Fire hose can consist of the outer slick jacket over a rubber interior, or could be just the outer jacket. Commercially produced chaffing gear is also available. Chaffing material is sometimes installed on mooring lines by the manufacture during the production process. As an alternative, crews can make chaffing gear from smaller rope such as fancy knot webbing made of 6 thread or similar line. Navy developed and commercial chaffing products were under evaluation at the time of release of NSTM chapter 582, Revision 2. Further information is not yet available on performance of these products.

582-4.4.3.1 Installing and Using Chafing Gear. To properly protect mooring lines, chaffing gear should be installed the following areas. Chaffing material must be of adequate length to protect a mooring line throughout the range of ship movements. Ships watch crew should inspect mooring lines at high and low tide intervals and during periods of adverse weather, to ensure the chaffing gear remains properly installed.

- In spliced eyes where eye makes contact with the mooring fitting
- Around the rope where mooring line passes through a chock
- Attached to fixed objects, along (sharp) edges that are in contact with a mooring line, or around the rope when it is not possible to attach chaffing gear to the object
- Around the rope where contact is possible with concrete pier edge during tidal changes

582-4.4.4 MOORING LINE EXPOSURE. Mooring lines normally retain a high percentage of their strength as they get older. However, exposure to excessive Ultraviolet Light and harsh chemicals will lead to accelerated degradation. Nylon is subject to reduced strength when wet, and long duration water immersion could substantially weaken certain fibers. Care should be taken to preserve mooring line life by limiting exposure to harsh environments.

582-4.5 MOORING LINE ACCESSORIES

582-4.5.1 TATTLETALE. A tattletale may be used to determine when the tension in a synthetic hawser is approaching the danger point. Do NOT use a tattletale with natural fiber or wire ropes. Figure 582-4-2 shows a tattletale attached to a line when slack and then when stretched. Table 582-4-2 lists the dimensions of tattletales for the different types of fiber. Tattletales are most effective when use on short mooring line runs, and when only a single part of mooring line is in use.

582-4.5.1.1 Traditional Tattletale. A tattletale for a traditional high stretch mooring line (nylon or polyester) is a piece of 6 thread manila rope of predetermined length secured to the hawser at two points a specified distance apart. When the hawser is straight but not under tension, the tattletale hangs down. As the hawser stretches under load, the distance between the attachment points on the hawser increases, and the tattletale begins to straighten. At the point when the tattletale becomes taut the working load limit of the hawser has been reached. Further loading on the mooring line will break the tattletale, indicating that the mooring line has become overloaded and could also be in danger of breaking.

582-4.5.1.2 Tattletales for low stretch mooring lines. Although four strand aramid and spectra fiber rope stretches only six percent at minimum breaking strength, tattletale cords can be used to determine the strain on the mooring line. Using 1/4 inch polyester fiber, a tattletale can be fashioned similar to a traditional tattletale. However, because of the low stretch property of the mooring line, the tattletale is not intended to part. At the point when the tattletale becomes straight. The load on the mooring line should be close to the working load limit and the crew must take appropriate action to relieve strain. Detailed procedures for installing tattletales on low stretch mooring lines are contained in Appendix D.

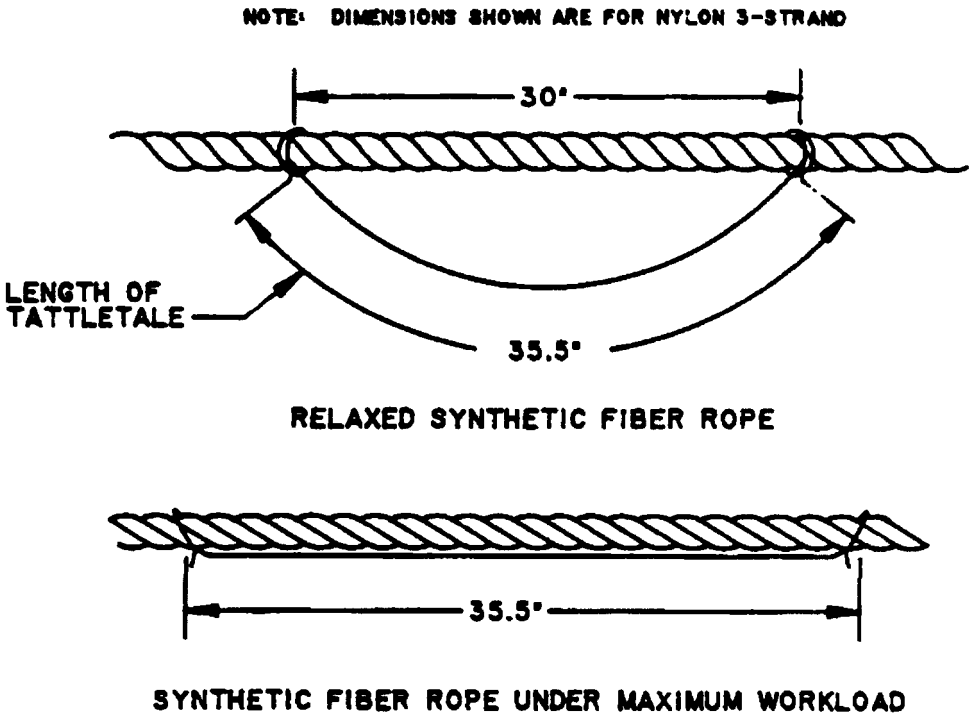


Figure 582-4-2. Tattletale.

Table 582-4-2 DIMENSIONS FOR TATTLETALE LINES

TYPE OF ROPE CONSTRUCTION	LENGTH OF TATTLETALE (inches) Note 2	DISTANCE BETWEEN CONNECTION POINTS (inches)
Nylon Three Strand	35-1/2	30
Nylon Plaited	43-1/2	40
Nylon Double Braid	43-1/2	40
Polyester Three Strand	63-1/2	60
Polyester Plaited	62-1/2	60
Polyester Double Braid	62	60
Four Strand Aramid/Spectra	Note 1	

Notes:
1. Four strand aramid and spectra fiber rope stretches only six percent at minimum breaking strength. Tattletale cords can be used to determine the strain on the mooring line by using 1/4 inch polyester fiber.
2. Length of tattletale is arc length only (see figure 582-4-2). Add extra rope length as required to tie to the main line.

582-4.5.2 HEAVING LINE. Heaving lines are 3/4-inch circumference light weight floating synthetic lines that are attached to mooring lines or messengers and are used to pass the mooring lines to the pier. Refer to paragraph 582-2.4.4.1 for details of their use.

582-4.5.3 MESSENGERS. Messengers are 1 1/2-inch circumference synthetic lines that are sometimes used as an intermediate between heaving lines and mooring lines. Refer to paragraph 582-2.4.4.2 for details of their use.

582-4.5.4 LINE THROWING DEVICES. Line throwing devices are used to pass mooring lines to the pier or another ship. For centuries the Navy employed a device called a monkey fist which consisted of large knots made on the end of a heaving line. The use of weighted monkey fists is no longer allowed on Navy ships. NAVSEA has approved an alternative described below.

582-4.5.4.1 Line Throwing Gun and Projectile. Larger ships may be outfitted with line throwing guns to assist when docking at large distances from the pier or another ship. The Mk 87, Mod 1 line throwing rifle adapter kit, SW350-A1-MMO-010, is used on M14, M16, and M16A1 rifles to propel a rubber projectile. The shot line is attached to the projectile. Line throwing gunners must be properly trained, must be given permission from the pilot or dockmaster, and must provide adequate warning to individuals pierside prior to using the gun. The NAVSEA approved projectile is a four and one half inch diameter fluorescent orange heaving ball made of soft vinyl latex. Figure 582-4-3 shows the end of a standard heaving line passed through the heaving ball and secured. The ball is listed in the Safety Center's Shipboard Safety Equipment Shopping Guide, March 1995, NAVSAFCEN 5100/35-395, page 8. NSN 4020-01-387-8795, reference number NIS-G-0213, fiber rope assembly - single leg - applies for ordering these heaving balls with 100 feet of line and NSN 4220-01-384-7047, reference number NIS-G-0212, is for the ball only.

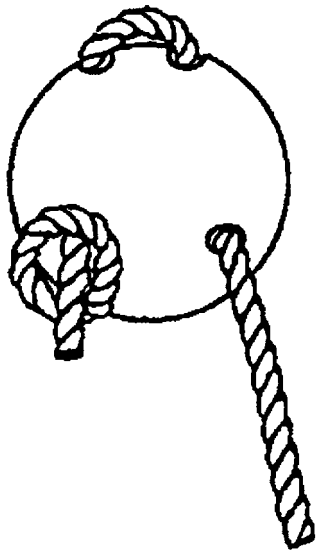


Figure 582-4-3 Line Throwing Device - Heaving Ball

582-4.5.5 RAT GUARDS. Rat guards are intended to prevent rats from boarding ships by way of the mooring lines. Rat guards shall be in accordance with ASTM: F1099-90. There are three types of rat guards listed in this specification. Original Navy rat guards are Type III. These are conical shaped with a tapered, slotted sleeve. They are effective, but they are cumbersome to work with and have sharp pointy ends that can cut into the mooring line or flesh. When ordering, specify material (aluminum or galvanized steel) and size (3, 5, or 8 inch). Newer rat guard designs are covered under Type I and Type II. These are more compact designs that eliminate the handling concerns with Type III rat guards. These rat guards can be adjusted to fit the size and shape of the mooring line.

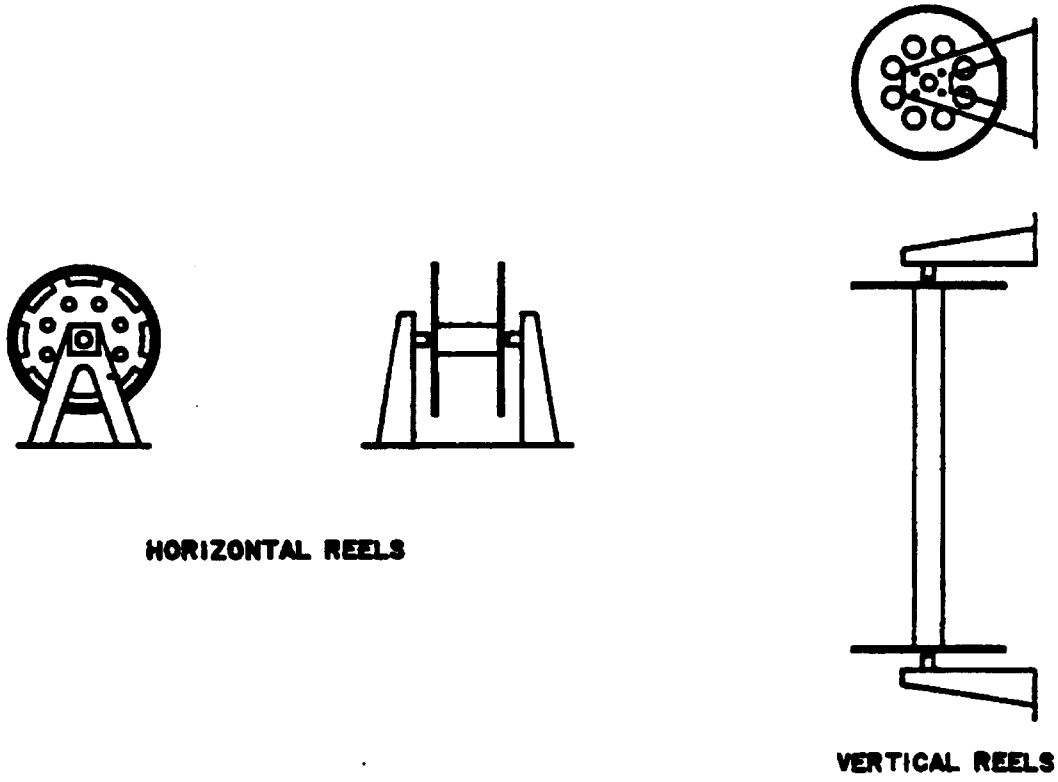


Figure 582-4-4 Hawser Reels

582-4.5.6 HAWSER REELS. Vertical and horizontal hawser reels for storing mooring lines and towing hawsers are provided according to rope size and rope length. Hawser reels are designated as vertical or horizontal according to the orientation of their reel shafts as shown in figure 582-4-4. Design guidance details on the size and construction of horizontal reels are found on NAVSEA Drawing Number S2604-921841. Design guidance details on the size and construction of vertical hawser reels are found on NAVSEA Drawing Number S2604-921842.

SECTION 5.
MOORING FITTINGS AND ACCESSORIES

582-5.1 SHIPBOARD FITTINGS

582-5.1.1 DESCRIPTION. Shipboard mooring fittings are various structures and appliances attached to the hull to assist in handling the ship or performing the ship's work. Fittings may be found in any part of the ship but the most common and useful fittings are generally found around the weather decks. They may be affixed solidly to the hull or may be capable of a limited amount of motion. Retractable fittings may be operated by hand or by power. This allows them to be retracted down or rotated about their axis into the hull or ship's structure. The retracted bitts, cleats, or chocks are stowed in a flush position with ships hull or weather deck, so that ships can perform underway or special missions unrestricted by these ship fittings. While in the unstowed or operating position for mooring, the fittings meet the same requirements in appearance, function and strength as standard or fixed bitts, cleats, and chocks. Inspection and testing requirements for retractable ship fittings are the same as for fixed ship fittings, except for the addition of operability testing for the retracting mechanism.

582-5.1.2 CONFIGURATION. Ships are outfitted with fittings of sufficient strength and quantity for safe mooring under all design conditions. There is at least one chock associated with each bitt. In some cases, there is a chock both forward and aft of the bitt, which provides greater flexibility in setting a proper mooring arrangement. Bitts should be oriented such that mooring lines make no greater than a 90 degree turn to capstans or other handling machinery. When required, fairleaders are provided to direct mooring lines around obstructions.

582-5.1.3 MOORING CHOCKS. Closed chocks are generally welded to the edge of the deck for fair-leading mooring lines. On ships with bulwarks, the chocks consist of heavy rings welded into the bulwark and are called mooring rings. The riding surface of chocks should be maintained smooth with a roughness of 125 micro inches or less (surface roughness is defined in ANSI B46.1). Chocks are located so that lines leading through them to capstans or winches will not chafe on sharp edges or equipment. If contact with sharp edges and equipment still occurs, chafing plates or pipes shall be installed. Besides the Navy standard closed mooring chock, the following paragraphs cover the Panama Canal chock, roller chocks, and retractable chocks.

582-5.1.3.1 Navy Standard Closed Mooring Chocks. Figure 582-5-1 shows the Navy standard closed mooring chock used on a surface ship. Table 582-5-1 provides the dimensions for Navy standard closed mooring chocks and various sizes of mooring lines. NAVSEA Drawing Number 804-1843363, Chocks For Synthetic Rope, has dimensions and strength data for Navy chocks. NAVSEA Drawing Number S1201-921623 shows details of a 16 inch, dual roller chock.

582-5.1.3.2 Mooring Ring. A mooring ring is, for all intents and purposes, a standard chock built into a bulkhead. They are usually found in larger ships that have the forward mooring station in the anchor chain handling room.

582-5.1.3.3 Panama Canal Chocks. For transiting the Panama Canal, commercial and large Navy ships are fitted with chocks designed in accordance with the Panama Canal regulations.The requirements for Panama Canal chocks (figure 582-5-2) are found in Title 35 of the Code of Federal Regulations (CFR). The size 20 chock, as shown on NAVSEA Drawing Number 804-1843363, is designated as a Panama Canal chock.

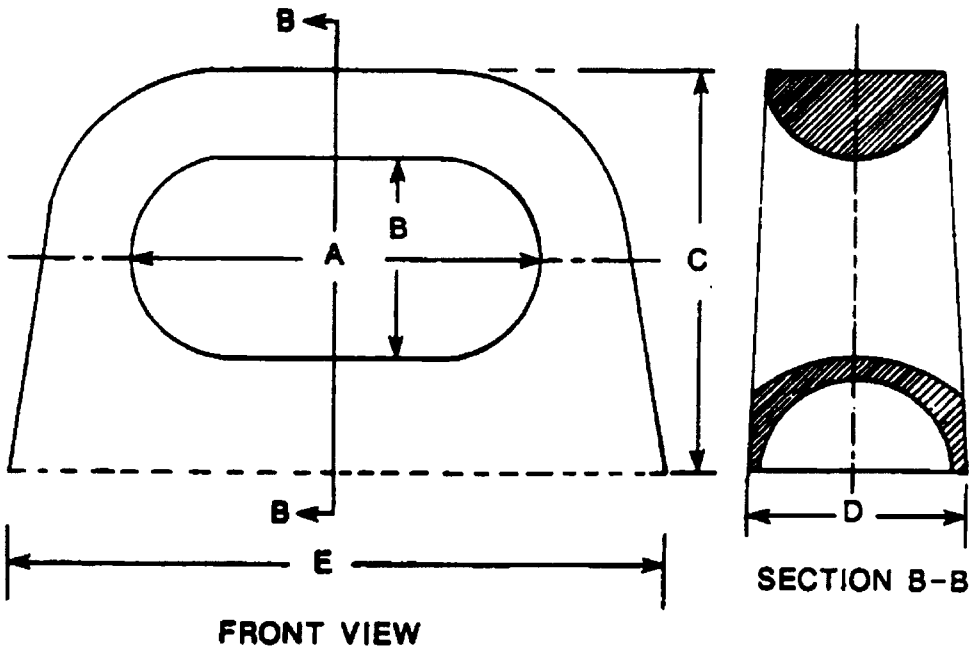


Figure 582-5-1 Navy Standard Closed Mooring Chock

Table 582-5-1 DIMENSIONS FOR NAVY STANDARD CLOSED MOORING CHOCKS

Nominal Fitting Size	Max. Rope Circumference (inches)	Breaking Strength Of Rope (lb.)	Dimensions (inches)				
			A	B	C	D	E
6	3	26,800	6	3	8-1/8	5-1/4	13
10	5	73,000	10	5	11-1/4	6-1/2	19
13	6-1/2	123,000	13	6-1/2	13-7/8	7-1/2	23
16	8	181,000	16	8	16-3/4	9	28
20	10	277,000	20	10	25-3/4	16	38-3/4
24	12	417,000	24	12	25-1/4	13-1/2	40

Note that the dimensions are different for lines of the same material but of different construction.

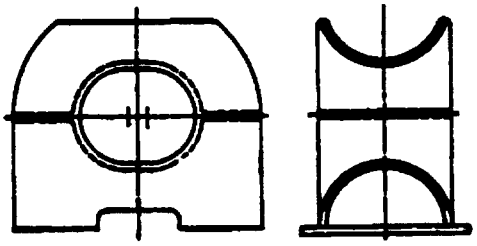


Figure 582-5-2 Panama Canal Chock

582-5.1.3.4 Roller Chocks. When warping into a pier, roller chocks (figure 582-5-3 and table 582-5-2) are sometimes provided to reduce wear on the mooring lines. Roller chocks must be lubricated frequently to keep

them moving freely.

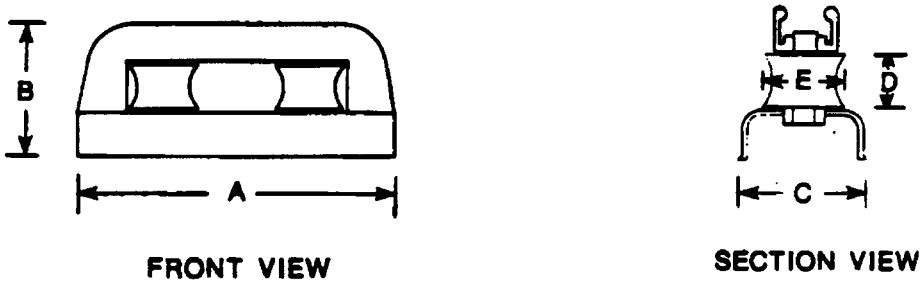
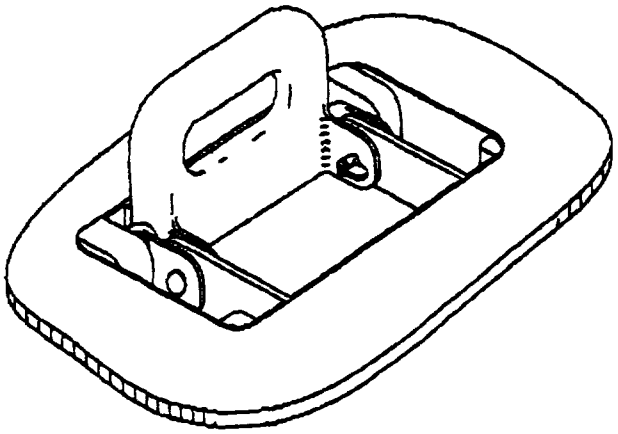


Figure 582-5-3 Roller Chock

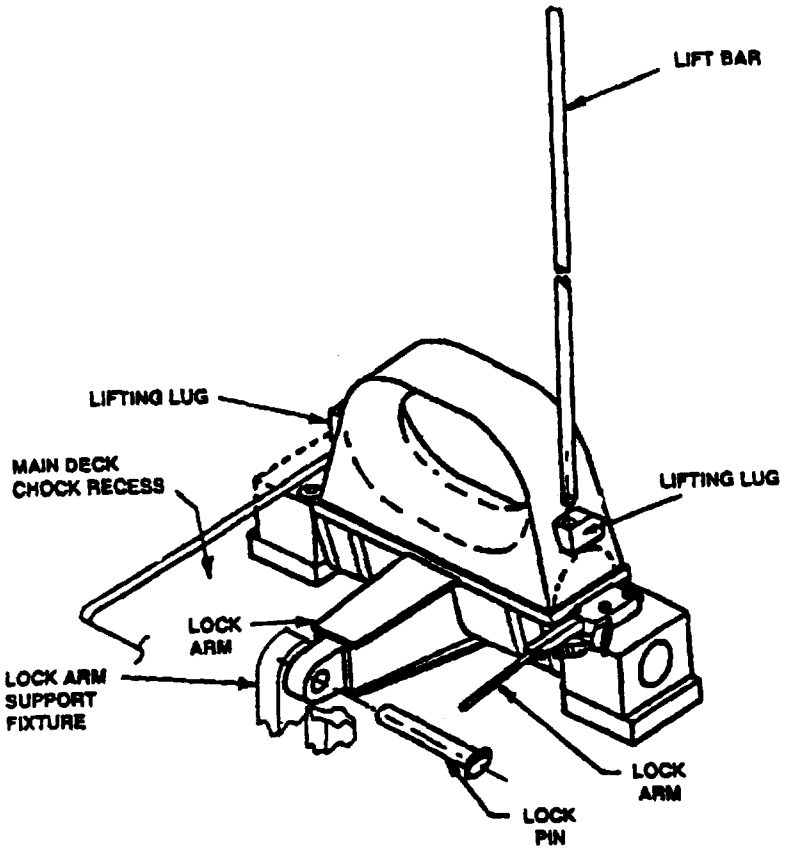
Table 582-5-2 ROLLER CHOCK DIMENSIONS

Nominal Fitting Size	Max. Rope Circumference (inches)	Max. Load (lb.)	Dimensions (inches)				
			Assembly			Roller	
			A	B	C	D	E
12	7	TBD	55-3/8	22-3/4	18-1/4	8-1/8	12

582-5.1.3.5 Retractable Chocks. To eliminate possible interference with helicopter operations, retractable chocks are used on DDG-51 class ships. They are also used on submarines. They are shown in figure 582-5-4



Submarines



Surface Ships

Figure 582-5-4 Retractable Chocks

582-5.1.4 BITTS. Bitts are made of vertical cylinders, called barrels, usually arranged in pairs, which are used for securing mooring lines. The bitt barrel is fitted with a top plate and in certain designs, a rope guard to keep lines from riding up the barrel. Since bitts are required to take very heavy loads, extra frames are added to their foundations to distribute the strain. Bitts can be standard fixed, retractable, recessed shell type, or low profile.

582-5.1.4.1 Standard Fixed Bitts. The most common bitt in use is the double barrel fixed bitt. Most bitts on Navy ships were built to NAVSEA Drawing Number 804-1843362 (Rev 0). In 1987, this drawing was revised (Rev B) to strengthen the load capacity of the bitts. Some newer ships (LHD-1/5 and AOE-6 classes) have bitts built to Rev B. Figure 582-5-5 shows a typical double barrel bitt. Table 582-5-3 and Table 582-5-4 give dimensions and strengths for Rev 0 and Rev B respectively of the standard drawing. Another version of the double barrel bitt is the low radar cross section bitts. These have the same overall size and strength, but are shaped slightly different. They are usually installed on combatants (DDG-51 class).

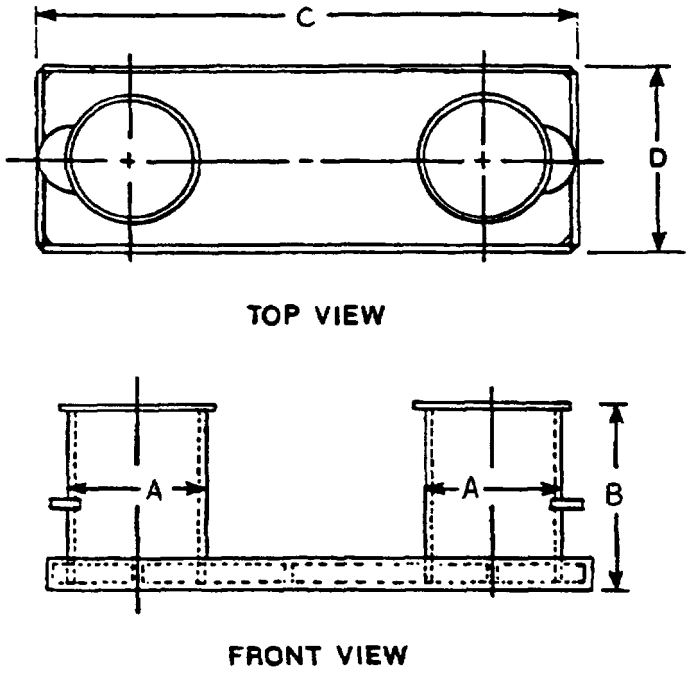


Figure 582-5-5 Fixed Bitt.

Table 582-5-3 FIXED BITT (Rev 0) DIMENSIONS

Nominal Fitting Size	Max. Rope Circumference (inches)	Max. Load (lb.)	Dimensions (inches)			
			Barrel		Base	
			A	B	C	D
4	3	76,000	4-1/2	11-1/2	16-1/2	7-1/2
6	4-1/2	152,000	6-5/8	15-1/4	24-1/8	11-1/8
8	5-1/2	230,000	8-5/8	16-1/2	30-5/8	13-5/8
10	6-1/2	312,000	10-3/4	20-1/4	39-1/4	17-1/4
12	7	420,000	12-3/4	24-3/4	45-1/4	20-1/4

Table 582-5-4 FIXED BITT (Rev B) DIMENSIONS

Nominal Fitting Size	Max. Rope Circumference (inches)	Max. Load (lb.)	Dimensions (inches)			
			Barrel		Base	
			A	B	C	D
4	3-1/2	94,000	4-1/2	13-5/8	16-1/2	7-1/2
8	5-1/2	245,000	8-5/8	16-11/16	28-5/8	13-5/8
10	7	385,000	10-3/4	20-13/16	36-3/4	17-1/4
12	8	490,000	12-3/4	26-5/8	44-1/4	20-1/4
14	10	870,000	14	31-15/16	52-1/2	22-1/2
18	12	1,280,000	18	38-1/4	64	28

582-5.1.4.2 Retractable Bitts. Retractable bitts are used on submarines to minimize drag and noise. Retractable bitts are also used on DDG 51 class ships due to helicopter flight operational requirements. A typical submarine retractable bitt is shown in figure 582-5-6.

582-5.1.4.3 Recessed Shell Bitts. Recessed shell bitts are designed for use with 3 inch circumference, 3 strand nylon line (maximum BS 23,200 lbs.). Dimensions and other pertinent design information for recessed shell bitts is found on NAVSEA Drawing Number 805-1841948. It is also shown in figure 582-5-7.

582-5.1.4.4 Low Profile Bitts. Low Profile bitts feature reduced radar cross section through an angular design; refer to figure 582-5-8. They are used as needed on the weather decks of ships requiring low radar signature. Low Profile bitts should meet the requirements of NAVSEA Drawing Number 803-6983490.

582-5.1.4.5 T-Bitts. Used for small boat handling as in well decks for moving landing crafts into position.

582-5.1.4.6 H-Bitts. Towing or H-bitts are heavy castings or weldments secured to the deck structure and are generally located near the tug's pivot point where they provide the hard point that sustains the athwartship loads imposed by the towline when it sweeps the fantail. In tugs fitted with a towing machine, the H-bitts prevent transverse strain on the level wind mechanism and are used to stop-off the tow wire when necessary. See figure 582-5-10.

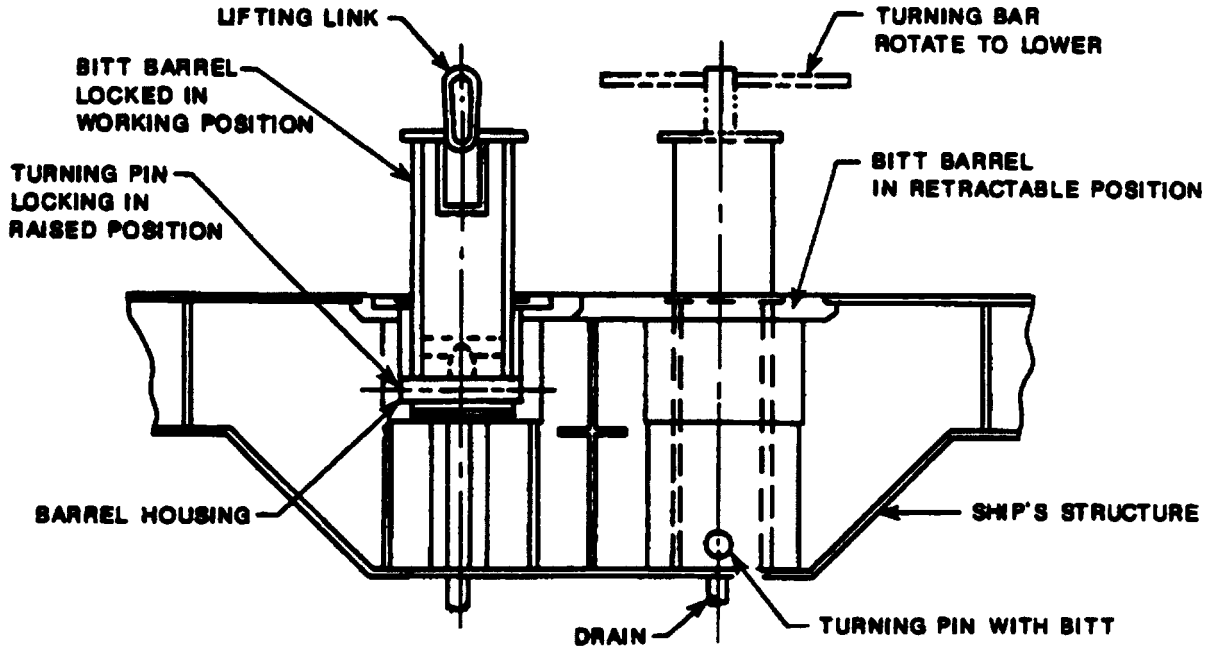


Figure 582-5-6 Retractable Bitt

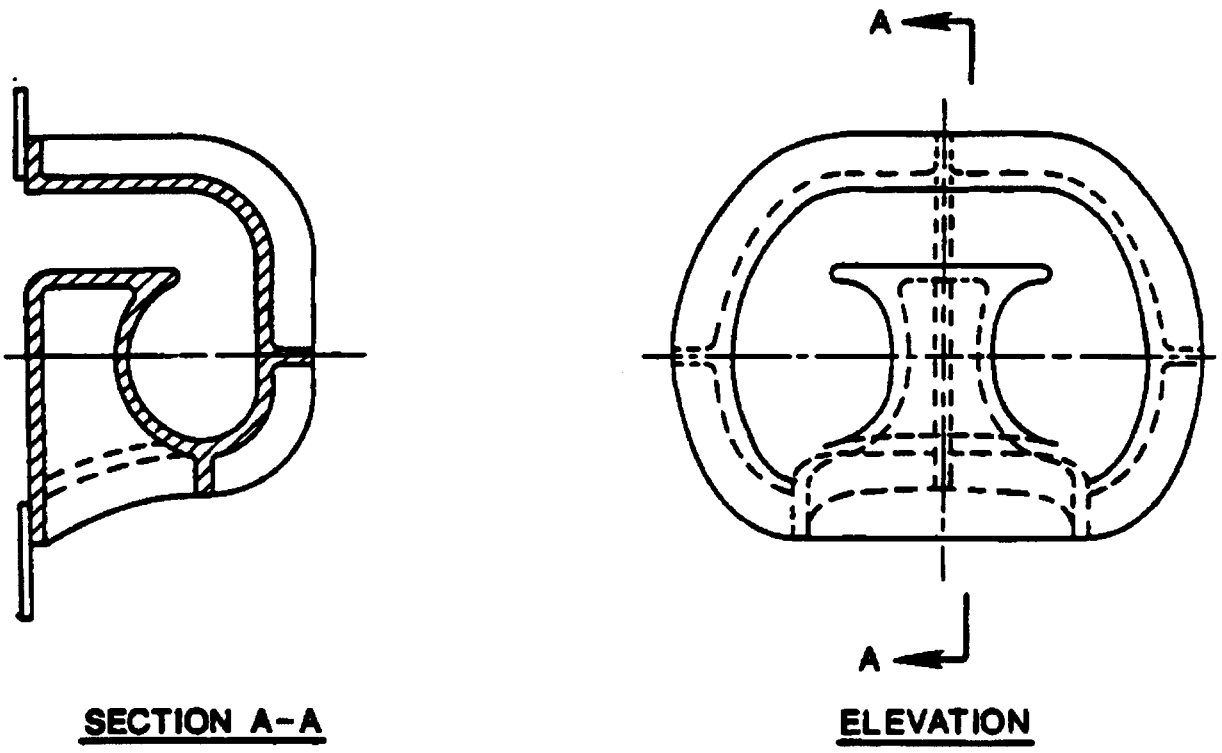


Figure 582-5-7 Recessed Shell Bitt

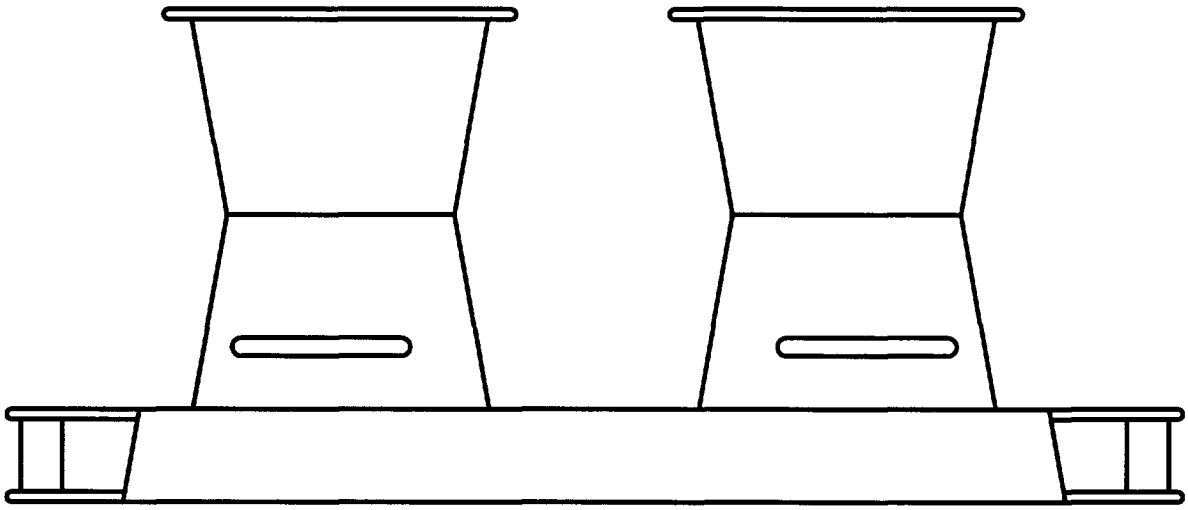


Figure 582-5-8 Reduced Radar Cross Section Bitt

582-5.1.5 CLEATS. Cleats are twin horned shaped devices used for securing lines. Figure 582-5-9 shows a typical welded horn type cleat. Details of the cleat size and strength can be found on table 582-5-5 and NAVSEA Drawing Numbers 804-860099 and 804-2276338. Most cleats are welded to ship structure.

582-5.1.5.1 Hinged Cleats. Hinged or retractable cleats are usually found on submarines. Figure 582-5-10 shows a typical hinged cleat.

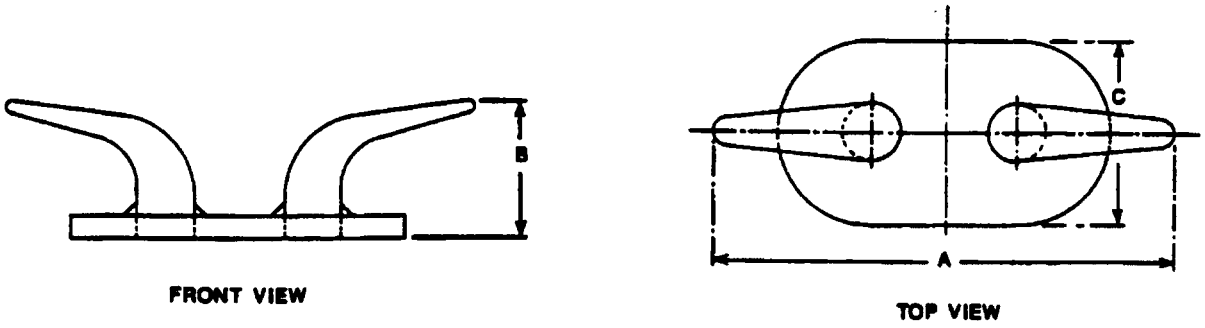


Figure 582-5-9 Cleat

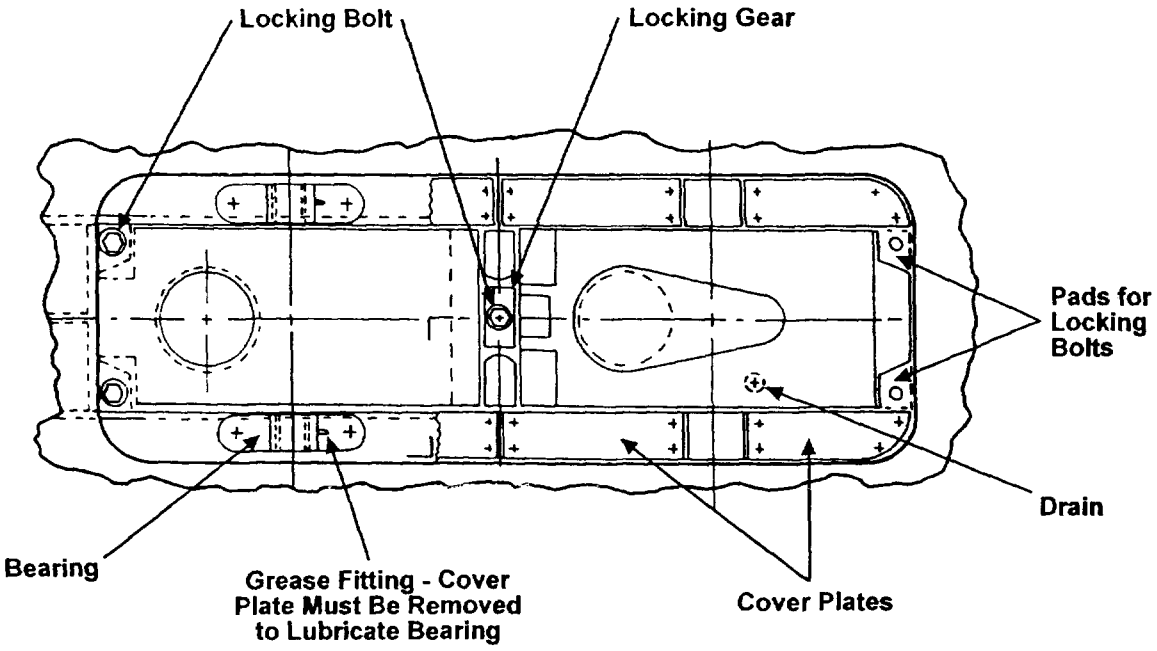
Table 582-5-5 DIMENSIONS AND TEST LOADS FOR WELDED HORN TYPE CLEATS

Nominal Fitting Size	Nylon Rope Circumference (inches)	Test Loads (lb.)	Dimensions (inches)		
			A	B	C
8	1	2,650	8	2-7/16	3
10	1	4,100	10	2-15/16	4
12	1-1/2	5,000	12	3-1/2	5
14	1-3/4	8,000	14	4-1/8	6

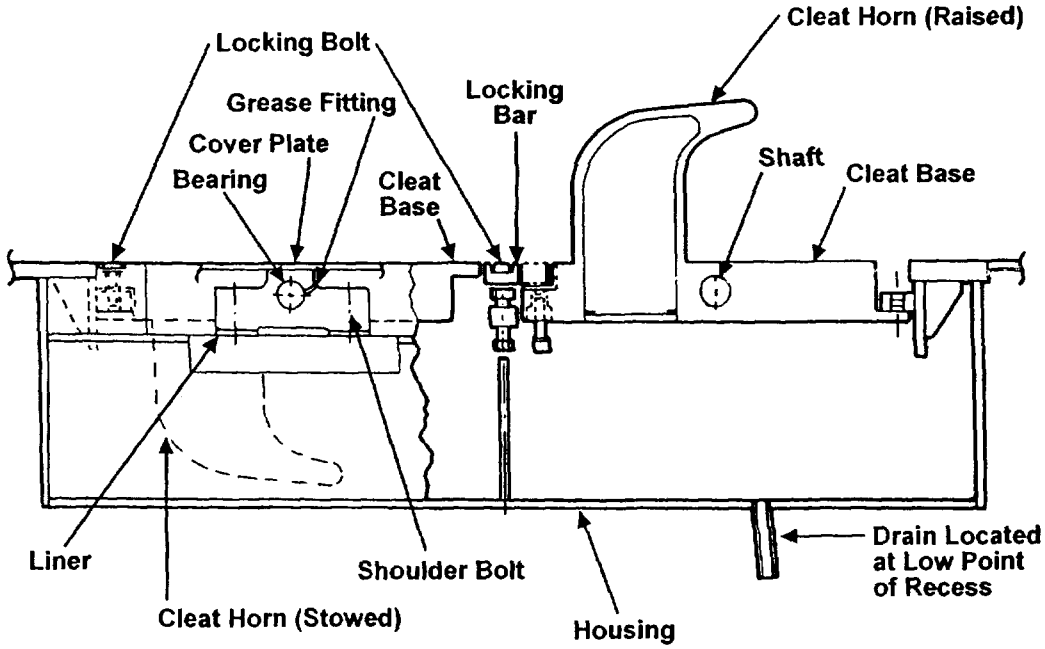
Table 582-5-5 DIMENSIONS AND TEST LOADS FOR WELDED HORN

TYPE CLEATS - Continued

Nominal Fitting Size	Nylon Rope Circumference (inches)	Test Loads (lb.)	Dimensions (inches)		
			A	B	C
16	2	9,000	16	4-3/4	6-1/2
18	2-1/4	13,000	18	5-5/16	7
20	2-1/2	16,000	20	5-15/16	7
22	2-3/4	20,000	22	6-9/16	8
24	3	23,000	24	7-1/8	9
26	3	27,000	26	7-3/4	10
30	3-1/2	36,000	30	8-13/16	11



Plan View



Section View

Figure 582-5-10 Hinged Cleat

582-5.1.6 FAIRLEADERS. Fairleaders are used to lead mooring lines around obstructions and provide proper alignment with winches or capstans. Fairleaders (figure 582-5-11) are located to accommodate lines from either side of the ship. Fairleaders usually have rollers to reduce line wear.

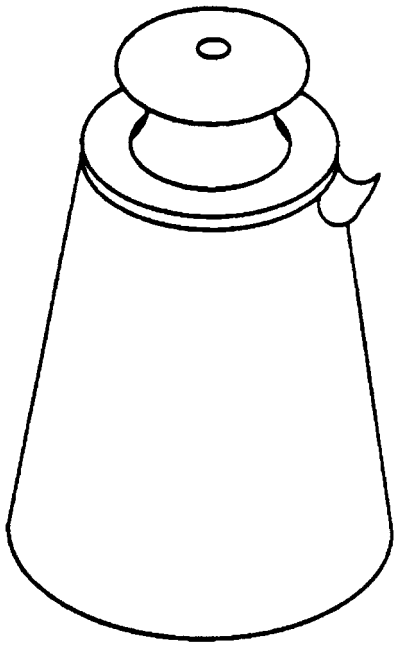


Figure 582-5-11 Fairleader

582-5.2 PIER FITTINGS

582-5.2.1 DESCRIPTION. Piers utilize a combination of cleats, double bitts and bollards of various shapes, sizes and strengths. Typical pier fittings are shown in figure 582-5-12. Some of the fittings most commonly used on U.S. Navy piers are summarized in Table 582-5-6. Pier fittings are the technical responsibility of NAVFAC.

582-5.2.2 CONFIGURATION. There is no standard way of orienting fittings on piers. In general, fittings are arranged to accommodate the types of ships that are expected to be berthed at that pier. Guidance for placing pier fittings in pier/wharf design is given in MIL-HDBK-1025/1.

582-5.2.3 CLEATS. Cleats on piers (figure 582-5-12) are similar in function and appearance to shipboard cleats, but they differ in size and strength. Pier cleats are bolted in place, whereas shipboard cleats are welded to the ship structure.

582-5.2.4 DOUBLE BITTS. Double bitts (figure 582-5-12) have the same basic barrel construction as shipboard bitts. They differ in that their caps are more one sided.

582-5.2.5 BOLLARDS. A bollard (figure 582-5-12) is a strong, cylindrically shaped, upright fitting found on a pier or wharf. The eye of a ship’s mooring line is placed around it during mooring.

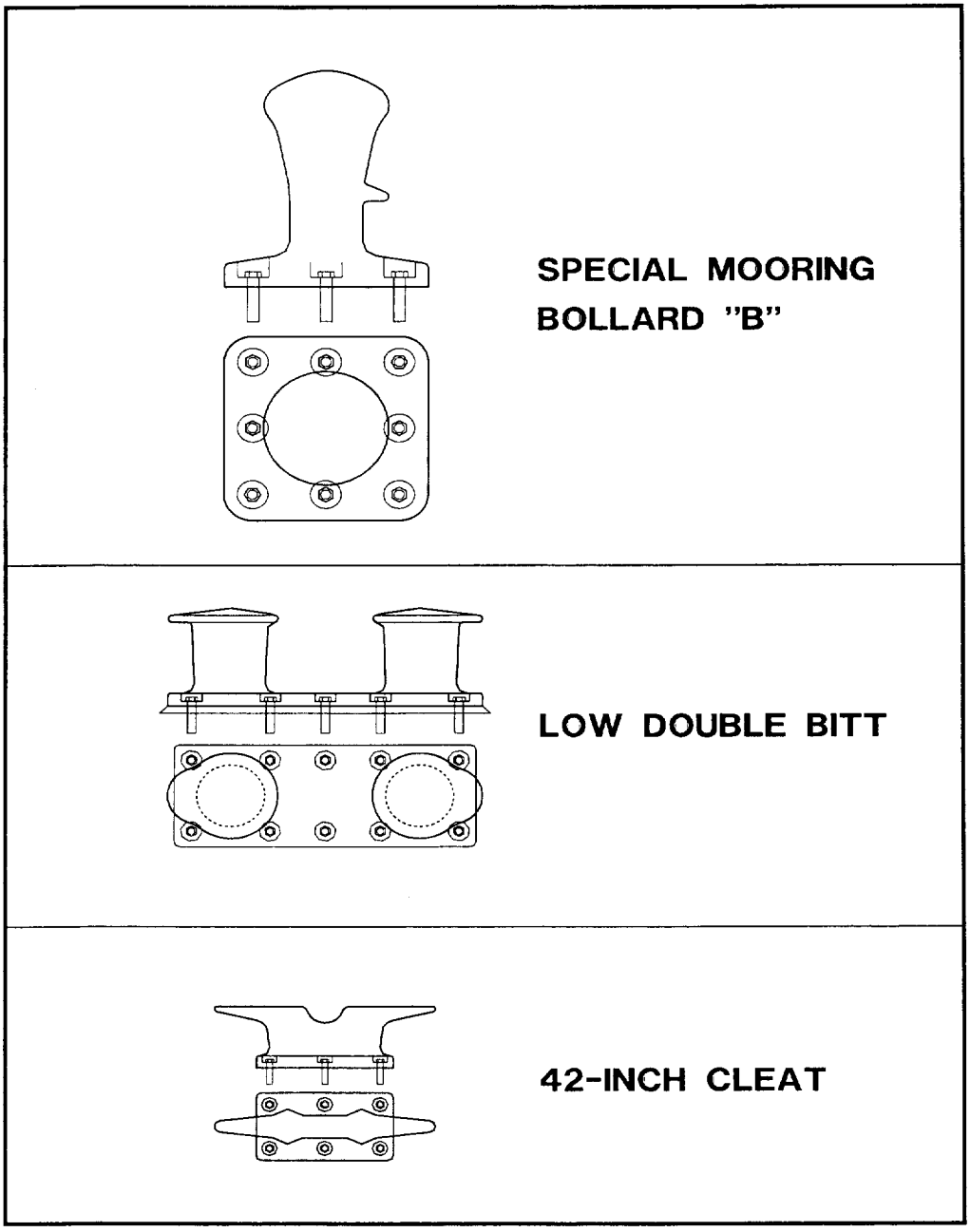


Figure 582-5-12 Pier and Wharf Fittings

Table 582-5-6 COMMONLY USED U.S. NAVY PIER MOORING FITTINGS

Description	Size	Bolts	Working Capacity (lbs.)
SPECIAL MOORING BOLLARD ″A”	Height=48 in. Base 48x48 in.	12 x 1-in. dia.	Horz. = 660,000 @45 deg = 430,000 Nom. = 450,000
SPECIAL MOORING BOLLARD ″B”	Height=44.5 in. Base 39x39 in.	8 x 2.25-in. dia.	Horz. = 270,000 @45 deg = 216,000 Nom. = 200,000
LARGE BOLLARD WITH HORN	Height=44.5 Base 39x39 in.	4 x 1.75-in. dia.	Horz. = 104,000 @45 deg = 66,000 Nom. = 70,000
LARGE DOUBLE BITT WITH LIP	Height=26 in. Base 73.5x28 in.	10 x 1.75-in. dia.	Nom. = 75,000 *
LOW DOUBLE BITT WITH LIP	Height=18 in. Base 57.5x21.5 in.	10 x 1.625-in. dia.	Nom. = 60,000 *
42-INCH CLEAT	Height=13 in. Base 26x14.25 in.	6 x 1.125-in. dia.	Nom. = 40,000
30-INCH CLEAT	Height=13 in. Base 16x16 in.	4 x 1.125-in. dia.	Nom. = 20,000

*Working capacity per barrel; after NAVFAC Drawing No. 1404464

SECTION 6.

CAPSTANS AND OTHER MOORING MACHINERY

582-6.1 CAPSTANS

582-6.1.1 DESCRIPTION. A capstan is a piece of deck equipment used for handling mooring lines. Capstans are generally designed to rotate in both directions. Figure 582-5-1 illustrates a typical capstan installation. All capstans consist of a capstan head, drive machinery, and operator controls. Note that a vertically mounted capstan is referred to as a capstan while a horizontally mounted capstan is typically referred to as a warping head.

582-6.1.2 CAPSTAN/WARPING HEAD. The capstan/warping head is sized to accommodate the largest mooring line which must be handled. Refer to NAVSEA drawing number 52601-860303, Capstan and Warping Heads, for capstan/warping head dimensions. The operating surface of the capstan/warping head is machined smooth and should be kept free of paint, nicks, and burrs to avoid damaging the mooring lines.

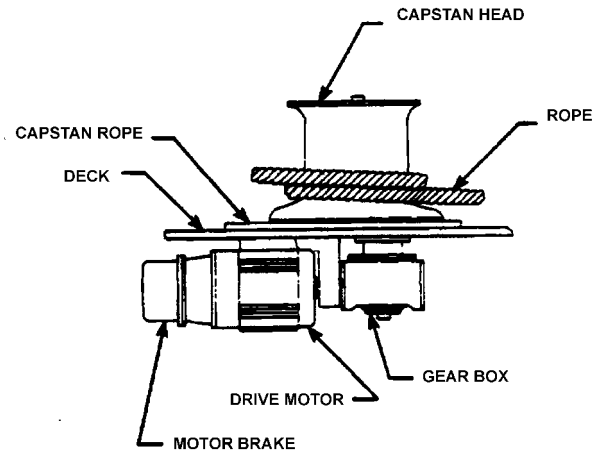


Figure 582-6-1 Capstan

582-6.1.3 DRIVE MACHINERY. The drive machinery for the capstan is frequently located below deck, often times in the overhead. On some capstans part of the machinery is located within the hollow of the capstan head and is hidden from view. On anchor windlass systems equipped with capstans the drive machinery for the capstan is integrated with the machinery that drives the windlass. The anchor windlass drive machinery will not be described further here. For additional information consult NSTM Chapter 581, NAVSEA S9086-TV-STM-000. Often a capstan is classified by its drive machinery. This can be either electromechanical or electrohydraulic. Electromechanical capstans have are normally built to comply with military specification MIL-C-17944 unless commercial specifications are invoked.

582-6.1.3.1 ELECTROMECHANICAL CAPSTANS. For electromechanical capstans, the capstan head is driven through a reduction gear by a multiple speed, reversible electric motor. An electric friction brake mounted on the electric motor housing and attached to the electric motor shaft facilitates stopping the capstan during operation.

582-6.1.3.2 ELECTROHYDRAULIC CAPSTANS. For electrohydraulic capstans, the capstan head is driven through a reduction gear by a hydraulic motor. An electric friction brake may be attached to the hydraulic motor output shaft to facilitate stopping the capstan during operation. A hydraulic power unit provides hydraulic fluid, under pressure, to operate the hydraulic motor. The hydraulic power unit consists primarily of a hydraulic pump operated by a single speed, unidirectional electric motor. A hydraulic reservoir/sump supplies hydraulic fluid for

use by the hydraulic pump. For most electrohydraulic shipboard capstans, a closed loop hydraulic circuit is employed; varying the output of the hydraulic pump the speed of the hydraulic motor, and therefore the capstan, can be controlled. An exception would be YTB capstans that utilize an open loop hydraulic circuit.

582-6.1.4 OPERATOR CONTROLS. Operator controls are provided to energize the capstan and to connect power to the appropriate electric motor coils to permit the capstan to be operated at different speeds in either direction. The operator controls are conveniently mounted on deck near the capstan head or are portable hand held controls. All capstan controls (fixed or portable) must have spring activated dead man features installed. The controls used for electromechanical capstans differ from those used for electrohydraulic capstans.

582-6.2 CAPSTAN CAPACITY AND USE

582-6.2.1 CAPACITY. The capstan is capable of developing a line pull of up to 15K pounds at slow speed. The capstan is also capable of operating at high speed, for taking up slack in the lines. The capstan is designed to withstand the original DDG 51 Class storm line breaking strength of 137K pounds applied at the mid-height of the capstan head, when used as a bitt. It is important to note, when using a 300K pound BS single part mooring line, the capstan should never be used as a bitt.

582-6.2.2 USE. Capstans provided forward (on the windlass) and aft can overcome the combined forces of wind and current to ″warp” or pull the ship to pier during mild weather mooring evolutions (up to 33 knots wind and 1 knot current). The capstans are also used to tension designated mooring lines before they are tied off on a bitt. The capstans are furnished with a spring set brake that holds the capstan head when it is ″stopped” . As load increases beyond the capability of the brake, the capstan brake will slip, allowing the line to pay out.

582-6.3 CAPSTAN VARIATIONS

582-6.3.1 SELF CONTAINED CAPSTAN. A self contained capstan consists of the capstan head, the drive machinery, and the operator controls in a single unified assembly. The drive machinery is enclosed in a watertight casing with access openings for inspection, adjustment, and maintenance. The self contained capstan can be installed or removed from the ship without disassembly.

582-6.3.2 RETRACTABLE CAPSTAN. Retractable capstans are usually found on submarines. Figure 582-6-2 shows a typical retractable capstan.

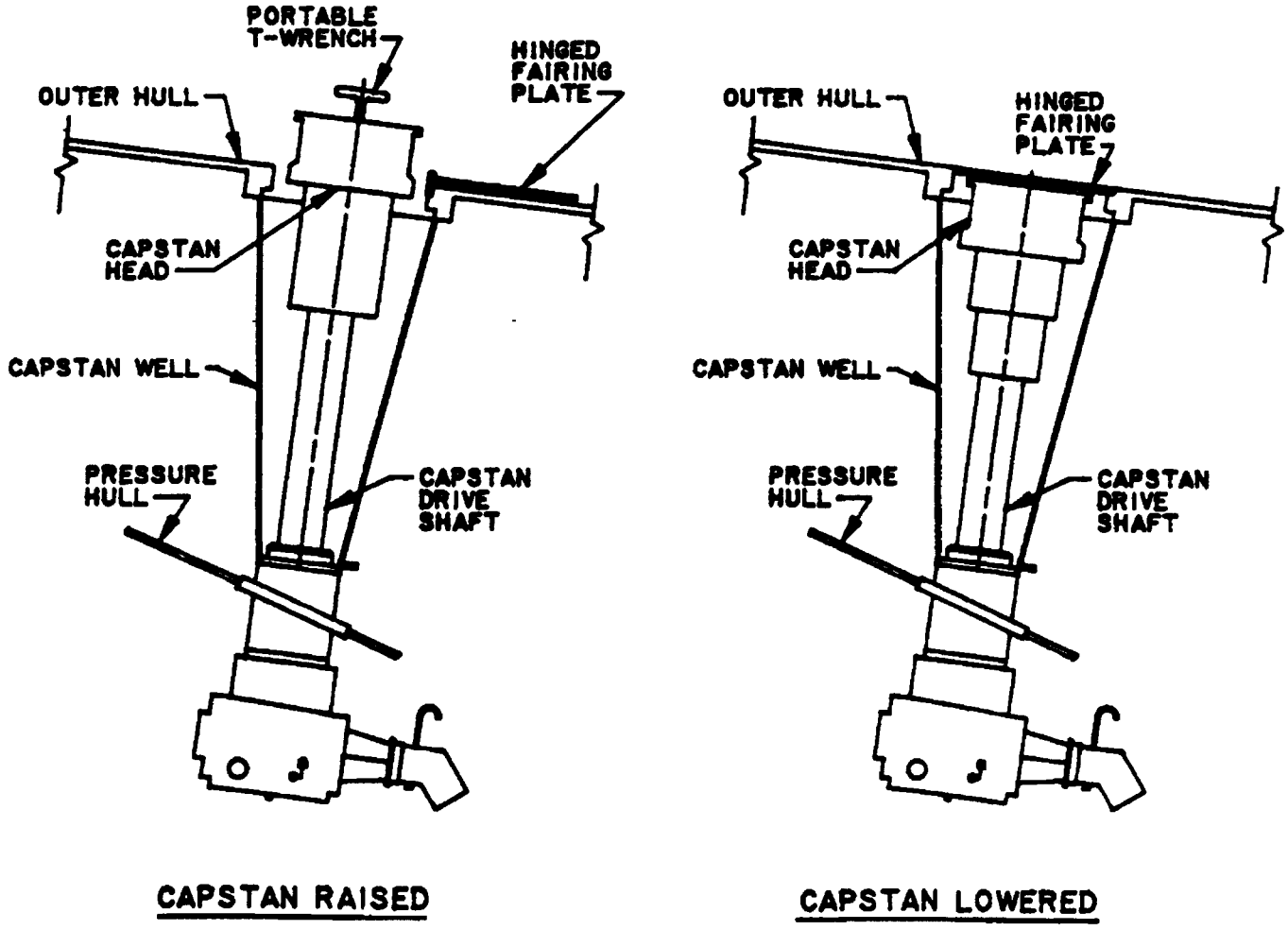


Figure 582-6-2 Retractable Capstan

582-6.3.3 CONSTANT TENSION MOORING WINCH. A constant tension mooring winch is a device used to maintain a preset tension in a mooring line after the ship has been tied up to a pier or wharf. The constant tension feature automatically adjusts for changes in tide or ship's draft by paying out or hauling in the mooring line while maintaining a constant tension in the line. When constant tension mooring winches are used, two or more are installed forward and two or more are installed aft.

582-6.3.4 NAVY CONSTANT TENSION MOORING WINCHES. The Navy uses wire rope for the mooring lines on their constant tension mooring winches. Two slightly different winch configurations are used. Both configurations employ a simple winch with a drum for tensioning the line. One configuration also includes a warping head for handling synthetic line. Constant tension mooring winches are installed on various classes of ships operated by the Military Sealift Command (MSC).

SECTION 7.
FENDERING SYSTEMS

582-7.1 GENERAL INFORMATION

582-7.1.1 PURPOSE. Fenders and fendering systems are designed to absorb or dissipate the energy of impact that occurs during berthing and mooring of ships. Fenders provide a load dampening interface, protecting ship hulls and berthing facilities (piers, wharfs, etc.) from excessive damage, which could otherwise occur in the absence of proper fendering between ships and piers. Fenders are used:

- To separate ships moored at sea or in a nested mooring arrangement in port
- To separate ships from berthing facilities (piers, wharfs, etc.) during docking, undocking, and while the ship is moored
- As a cushion on tugs when they are assisting larger ships during docking and undocking operations
- To provide protection to ship hulls from small boats, barges, or floats alongside
- To protect ship hulls and wharves in circumstances such as transit through canals, etc

582-7.1.2 SHIP, SUBMARINE, AND BOAT FENDERS. This section provides the description, maintenance, and repair information for marine fenders used with ships, submarines, and boats in the US Naval Fleet. Also covered is the use, handling, and stowage of fenders and fendering systems. Only those fenders that protect the hulls of ships, submarines, or boats when moored at sea or in a nested mooring arrangement in port are covered.

582-7.1.3 OTHER SOURCES. See MIL HDBK 1025/1, Piers and Wharves for information on fenders used to protect the hulls of ships, submarines, or boats when moored to a pier or a wharf. This section does not cover fenders for accommodation ladders, structural fenders in floating drydocks, fenders in the well deck areas of amphibious assault ships, or camels. For information on fenders for accommodation ladders, see applicable ships drawings. Applicable ship's drawings also describe structural fendering in floating drydocks or in wells of amphibious assault ships. MIL HDBK 1025/1 also contains information on camels.

582-7.1.4 FENDER AND SEPARATOR TYPES. This section covers the types of fenders and separators used between the hulls of ships, submarine and boats moored together at sea or in a nested mooring arrangement in port. These fenders and separators are used in a variety of arrangements and manufactured to meet specific mooring requirements, and can be either portable or fixed.

582-7.2 CAMELS, SEPARATORS AND FENDERS

582-7.2.1 DESCRIPTION. The terms camels, separators, and fenders have been used interchangeably for years. Fenders in one form or another have been in use since the early sailing days. Varying application requirements, along with fender modifications and improvements, has led to the development of a fairly wide range of fender system alternatives. Following are some key terms to help ensure clarity in fender discussions.

582-7.2.1.1 Camels. Floating structures, known as camels (figure 582-7-1), provide proper clearance between a ship and a wharf or pier. Camels by definition are fenders; however, they are merely a solid fender with little capability to absorb berthing energy, unless they are also outfitted with resilient fenders or fendering material.

Camels often have a fixed fender system attached, or they could rely on portable fenders between the wharf or pier and the ship.

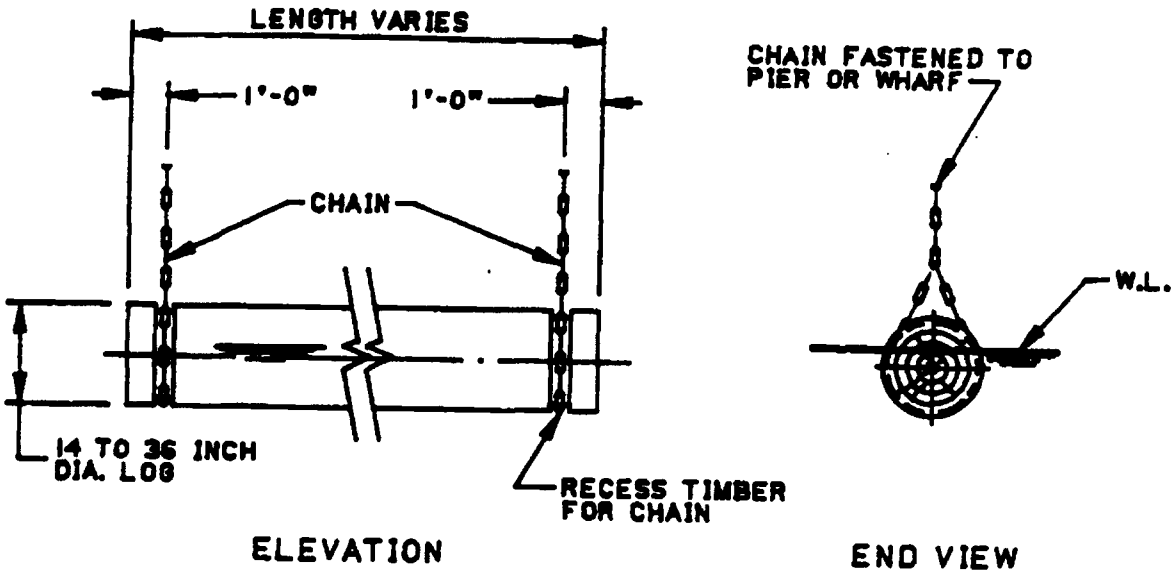


Figure 582-7-1 Camel

582-7.2.1.2 Separators. Separators (figure 582-7-2) are portable floating steel structures that operate either by an associated float device or a buoyancy chamber. They have energy absorbing material (fixed extruded rubber fenders) attached that protect the hulls by absorbing berthing and environmental loads applied between two or more mooring vessels.

582-7.2.1.2.1 Separator arrangement. Separators are portable floating structures that are more than just fenders. The also provide a pre-determined standoff which is normally dictated by the planned mooring arrangement. Separators normally have an associated float device or a buoyancy chamber that allows positioning at an appropriate elevation for two ships to be safely moored together. They have their own fenders attached to protect the hulls by absorbing berthing and environmental loads applied between two or more mooring vessels. The fender material could be an energy absorbing extruded rubber fenders, or a highly resilient floating foam or pneumatic fender.

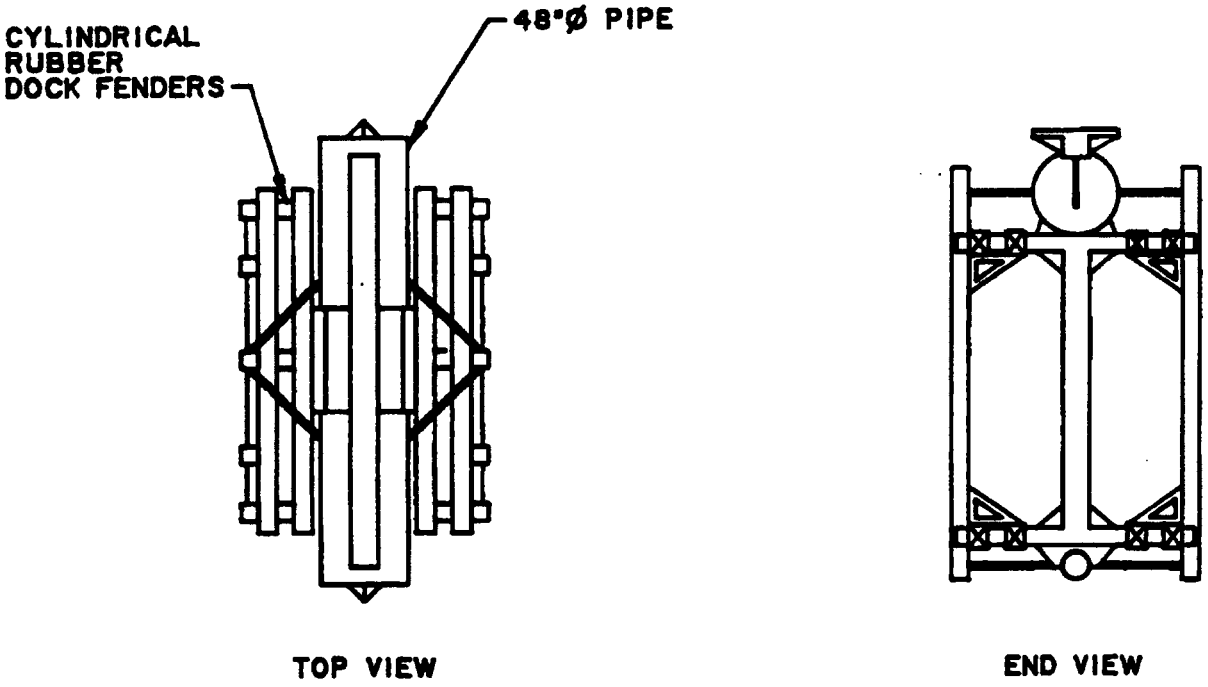


Figure 582-7-2 Separator

582-7.2.1.3 Fenders. Fenders (figure 582-7-3) are frequently obtained as self-contained units, which are often portable. Fenders can be constructed from resilient rendering material combined with structural members to form separators.

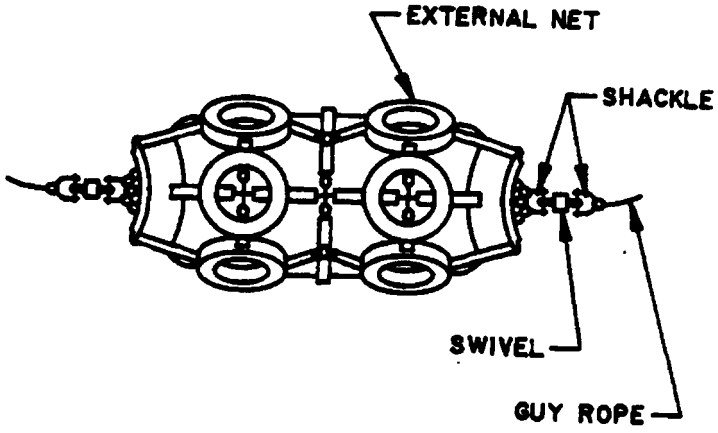


Figure 582-7-3 Fender

582-7.2.1.3.1 Fender arrangements. A portable arrangement reflects fenders secured alongside the ship, submarine, or boat by floats or support lines, as they are needed. A fixed arrangement reflects fenders that are rigidly attached to the separator, ship or boat hull. These fenders are classified as resilient, having the inherent ability to absorb large amounts of impact energy without causing damage to the ship or to the fender or separator itself.

582-7.3 CLASSIFICATIONS

582-7.3.1 TERMINOLOGY. Three additional ways to classify fenders are described herein: solid vs. resilient; engineered vs. non-engineered; and fixed vs. portable (floating).

582-7.3.1.1 Solid/Resilient. Marine fenders are classified as either solid or resilient. The solid type, which have minimal capacity to absorb impact energy, may be timber facing on a flexible pier structure or mounted on the face of a rigid pier or wharf structure that is not subjected to large docking forces. Resilient fenders have the ability to absorb sizable amounts of impact energy without causing damage to the ship, the pier, or the fender. They are designed to meet specific load and deflection requirements.

582-7.3.1.2 Engineered/Non-Engineered. Fenders are either engineered or non-engineered for a given application. Fenders that have been engineered are selected based on detailed engineering review of the specific application. Fenders, which are non-engineered, are selected based on availability of commercial off the shelf (COTS) units that have characteristics estimated to meet operational requirements

582-7.3.1.3 Fixed/Portable (Floating). Fenders are classified as either fixed or portable (floating). Fixed fender systems could be comprised of floating fenders attached to a quay, or could be non-floating fenders attached to a pier, wharf or quay. Fixed fender systems are engineered for a specific site, to provide the desired protection from impact loads. Floating fenders are normally easily portable, so they can be deployed in a wide range of situations to meet ever changing mooring requirements. Floating fenders can be:

- Pneumatic (including hydro-pneumatic),
- Foam filled [closed cell (water-resistant), other cellular foam structure]
- Light-weight composite
- In combination with other wood/steel structures (camels, separators)

582-7.4 FENDER CHARACTERISTICS.

582-7.4.1 GENERAL INFORMATION. All fender types can be measured against the same standards regardless of the type of fender employed. Fender characteristics are provided as follows to help readers obtain a better understanding of fenders.

a. Working Energy @ v (WE) ft-lbf (J) The working energy is a fender's required minimum energy absorption, which the fender must obtain at or before it reaches 60 percent compression.

b. Working Energy Compression A fender's compression when the working energy is attained.

c. Reaction Force lbf (kN) The force produced by a fender reacting to a compressive force.

d. Reaction Pressure lbf/in ^{2} (kPa) The reaction pressure is the reaction force, divided by the fender's contact area with a compressive surface.

582-7.4.2 FENDER TYPES. The primary types of fenders are listed below, along with key functional characteristics:

a. Buckling

b. Extruded Rubber Energy absorption occurs through solid rubber deformation, in combination with built-in dampening of structural members; the rubber will then resume its original shape.

c. Wrapped rubber (low energy absorption)

d. Shock absorber (Hydraulic or Pneumatic) Energy absorption occurs based on the restricted flow of a shock absorbing cylinder/chamber; may utilize spring return to original state.

e. Compression (Foam filled) Energy absorption occurs as foam cells compress; foam cells then have a natural tendency to return to original state.

f. Pneumatic & hydro-pneumatic & vinyl air filled & shear.

582-7.4.3 CHARACTERISTICS. Fenders are made from various materials that either absorb or dissipate impact energy. A fender protects by providing a standoff between objects that would otherwise come in contact, and by absorbing impact energy. There are four general types of marine fenders in common use:

- foam
- hydro-pneumatic
- shear
- buckling

a. Foam Fender A foam fender is a marine fender composed of a closed cell polyethylene flexible foam. The fender may have a core, which is encased in a flexible protective skin, or the skin may be densified core material. End fittings are attached to both ends of the fender. The core and skin may be made of different or similar materials. Foam fenders can come in either of two configurations: ″netless” or ″netted” .

b. Percent Compressed and Percent Compression These terms describe the fender diameter reduction extent due to a single radial compressive force exerted perpendicular to the fender’s longitudinal axis. This is expressed as the fender’s original diameter minus the fender’s compressed diameter, divided by the fender’s original diameter, times 1 00. A fender that has been compressed to forty percent of its original diameter is 60 percent compressed, or underwent 60 percent compression.

c. Rate of recovery:
   1. Short term (deformation) must return to normal shape nearly instantaneously
   2. Long term (compression set) must return to normal shape in reasonable timeframe

d. Fender Skin The skin is the external surface of the fender. It encases the flexible foam core and protects the core from abrasion and tearing. The skin can be made either from a different material than the core or from core material that has been compressed to a higher density.

e. Fender Core The core is the body of the fender. It consists of the mid-body and two ends.

f. End(s) An end is that portion of the fender that begins where the cylindrical mid-body ends and extends to the end fitting(s). An end can be conical or hemispherical.

g. End Fitting(s) The end fittings are the hardware installed at both ends of the fender. They allow the fender to be secured as needed for a given application.

h. Netless configuration This is the standard fender configuration, without an external net.

i. Netted configuration Netted fenders have a chain net or tire-and-chain net around the fender external to the skin. This protects the fender from damage and increases the standoff without changing the fender’s safe working load, energy absorption or reaction force. These fenders and separators used in a variety of arrangements and manufactured to meet specific mooring requirement are classified as being either portable or fixed.

582-7.5 FENDER AND SEPARATOR SELECTION

582-7.5.1 GENERAL INFORMATION. This section provides guidance for the selection of fenders or separators that protect the hulls of navy ships, submarines and boats moored together in a nested arrangement. The fenders and separators discussed in this chapter are designed to be carried onboard ships. Tenders carry and handle the large fenders and separators or the shore activity can provide this service. Fenders and Separators are used to protect the ship's hull from damage caused by impact loads between ships and submarines moored at sea or in a nested mooring arrangement in port. When selecting a particular fender, separator type for a mooring arrangement, factors such as the ship's length, weight, and hull strength and appendages must be considered. Mooring velocity, the angle of approach, and the required stand-off distance between the ships and submarines should also be included in consideration, to determine the fender, separator sizes (length and diameter requirement. The stand-off distance is the minimum separation between the hulls of the moored ships or submarines and provides the necessary clearance to allow for movement under various sea conditions and ensure no interference with hull appendages, superstructure, or installed equipment outboard of ships hull. The fender information in this chapter is typical and should be used as a guide.

NOTE

Fenders manufactured according to the obsolete NAVSHIP DWG NO. 805-1340571 and NAVSHIP DWG NO. 805-1363949 are not recommended for use with boats or ships of the U.S. Navy. Replacement for these types of rubber-filled and pneumatic fenders respectively will be the foam-filled substitute.

582-7.5.2 SEPARATORS (FENDERS AND CAMELS). Berthing facilities and ships are subjected to impact loads during docking, undocking and while the ship is moored alongside a pier or wharf structure. Such impact loads may cause damage to the ship and dock structure if suitable facilities are not provided to de-crease their harmful effects by absorbing or dissipating the energy of impact.

Marine fender systems are classified as either fixed or resilient. The fixed type, which have minimal capacity to absorb impact energy, may be timber facing on a flexible (timber) pier structure or mounted on the face of a rigid pier or wharf structure that is not subjected to large docking forces. Resilient fenders have the ability to absorb sizable amounts of impact energy and are generally designed for specific loads and deflections. With the exception of the fenders carried by the ship, fenders and camels are the responsibility of NAFAC.

582-7.5.2.1 Camels. Camels are used to protect a fender system from damage due to the motion of moored ships and, where necessary, to provide proper clearance between a ship and a wharf or pier. Camels are floating separators, which can be attached to a fender system, the wharf pier, or the ship itself.

582-7.5.2.2 Fenders. Fenders are also made of compressible material like rubber, but they can also be a framed system placed against the edge of a dock to take the impact from a berthing or berthed ship. See NSTM Chapter 611, Fenders for more information on fenders.

582-7.5.2.3 Separators. Separators can be a combination of camels, fenders and structural members. See figure 582-7-2 for an example.

SECTION 8.

MAINTENANCE, INSPECTION, AND TESTING

582-8.1 MOORING LINES

582-8.1.1 INSPECTION AND MAINTENANCE INTERVALS (PMS). The Planned Maintenance System (PMS) requirements should be carried out in accordance with instructions provided on the applicable Maintenance Requirement Cards (MRC's).

582-8.1.2 INSPECTION OF SYNTHETIC MOORING LINES. Synthetic mooring lines should be inspected prior to use or storage. Consult NSTM Chapter 613, Wire and Fiber Rope and Rigging for rope inspection guidelines.

582-8.1.3 SURFACE INSPECTION OF ROPE SUPPORT HARDWARE. Inspect surfaces that the rope passes over for roughness and sharp edges.

582-8.1.4 BREAKING IN NEW SYNTHETIC ROPE. When new synthetic rope is first put into service, abrasive surfaces will cause the outer filaments of the rope to form a fuzzy appearance and texture. This fuzzy appearance is not detrimental to the strength of the rope but actually forms a protective cushion and a shield for the fibers underneath. This condition should stabilize, not progress. If the surface roughness continues to increase, this is an indication that there is excessive abrasion and the rope is losing strength. Rusting iron, when it reacts with seawater, can cause a nylon rope to lose considerable breaking strength. Nylon ropes exposed to iron rust reacting with seawater have been reported to lose a significant amount of strength in a one-month period. Rope subjected to rust exposure for more than a month should be repaired or replaced.

582-8.2 MOORING GEAR

582-8.2.1 INSPECTION AND MAINTENANCE INTERVALS (PMS). Deck fittings with movable parts should be lubricated per PMS requirements.

582-8.3 CAPSTAN AND RELATED EQUIPMENT

582-8.3.1 INSPECTION AND MAINTENANCE INTERVALS (PMS). MRC's (Maintenance Requirement Cards) for deck equipment used for mooring are provided for each ship. The following inspection and maintenance intervals are taken from a typical set of MRC's for a mooring system. The actual MRC's for a particular ship should be consulted for details of the inspections/maintenance to be performed and the recommended intervals:

a. Inspect and lubricate rollers and fairleads (monthly).

b. Lubricate capstan deck seals (monthly).

c. Lubricate capstan (semi-annually).

d. Provide lube oil sample for visual inspection (annually for combatants, 18 months for all others).

e. Lubricate hawser reels (annually).

f. Inspect and adjust capstan brake (annually).

g. Inspect and lubricate the flexible coupling (24 months).

h. Clean and inspect capstan motor and lubricate motor bearings (24 months).

i. Clean and inspect towing rig (prior to and after each tow).

j. Clean synthetic rope (after each use, prior to stowage).

k. Inspect aramid lines (after each use, prior to stowage).

582-8.3.1.1 Inspection and maintenance intervals for floating drydock grip hoists. Recommended maintenance intervals are as follows:

a. Clean, inspect and lubricate grip hoist (quarterly).

b. Clean, inspect lubricate grip hoist wire rope (annually).

c. Weight test grip hoist-rated load (every 15 years).

582-8.3.2 CAPSTAN INSPECTION AND TESTING REQUIREMENTS. Capstans shall be inspected and tested to ensure safe and proper operation.

582-8.3.2.1 Overview of Inspection and Testing Requirements. Capstan test criteria is as follows:

a. **Static test** Following repair or modification of structural members the capstan shall be subjected to a static test by placing a loop of line over the capstan head at midheight and 90 degrees to its axis to produce bending moment only. Using the capstan head as a bitt, a load equal to the breaking strength of the largest line size the capstan is designed for shall be applied. Replacement of capstan foundation bolts is to be in accordance with the installation drawings. Fitted bolts are required if stated on installation drawings. No static test of the capstan is required if the foundation bolts are replaced with the required bolt size and with the same material strength for bolts.

b. **No load test** The capstan shall be run without load at each rated speed for five minutes in each direction to determine that no abnormal heat, wear or noise develops. Note, when brake repair has been accomplished an inspection of brake assembly is to be accomplished after no load test to ensure proper installation.

c. **Load test** The capstan shall be capable of developing the specified line pull and speed in both directions of rotation. The capstan shall be run at rated load(s) and rated speed(s) for a period of one half hour in each direction (ten minute each direction for submarines). Approved methods of testing include; line and weight, static line arrangement and prony brake.

NOTE

For electrohydraulic capstans, allow the hydraulic fluid in supply tank to warm to at least 100 degrees Fahrenheit prior to testing. Testing may be conducted in ten minute increments, allowing sufficient time between operating periods for the hydraulic fluid to cool. The temperature of the hydraulic fluid at the discharge flange of the pump shall not exceed 180 degrees Fahrenheit.

582-8.3.2.2 Operational Tests. The General Specifications for Overhaul (GSO), Section 582, and The General Overhaul Specifications For Deep Diving SSBN/SSN Submarines (DDGOS), section 9200-1, identify the specific

testing requirements for capstans, which generally includes no-load, rated load and brake testing. Some of these tests are prescribed by applicable PMS requirements, and may also be required during Underway Material Inspections.

582-8.3.2.3 Inspection and Test Stages. Listed below are the three major testing and inspection stages for the life of the capstans. These stages correspond to inspection and test requirements identified in matrices shown in table 582-8-1. When using the matrices, tests shall follow in sequence from left to right across the appropriate row. It should be noted that, load testing is only required after each new installation and after major repairs or modifications to load bearing components.

a. New Installation Equipment Inspection and Testing: New equipment shall be inspected and tested in accordance with the documents referenced in applicable ship equipment and/or work specifications. This testing proves out alignment, structural integrity, and adequacy of operation.

Table 582-8-1 TEST MATRIX

Equipment/ Component Repaired/Overhauled	**Static (Bitt) Test (1)(4)**	**Torsion Test (3)**	**Hydro Test (1)(4)**	**No Load Test (4)**	**Rated Load Test (1)(4)**
Electric Motor				X	X
Motor Controller				X	
Master Switch				X	
Electric Brake		X		X (2)	X
Electric brake lining		X		X (2	
Gear Train				X	X
Bushing/Bearing	X			X	X
Coupling				X	X
Shaft	X			X	X
Capstan head Deck seal				X	
Capstan Head	X			X	
Hydraulic Pump/Motor			X	X	X
Hydraulic Valves			X	X	X

(1) Test loads as stated in applicable equipment manual.

(2) Post no load inspection required to inspect lining for scoring or misalignment.

(3) With the capstan rigged as for developing normal line pull each capstan brake shall be subject to a static test for at least 10 minutes. The load shall be applied using several turns of line around the head to produce a torque with the capstan shaft as the axis. The brake shall hold the load and be tested as follows;

d.

(a) For non-overhauling capstans (worm gear set), the load shall be equal to 150 per cent the specified line pull.

(b) For overhauling capstan gearing the load shall be equal to the specified line pull.

(4) Test per GSO.

b. Shipboard Inspections and Testing: For in-service equipment, periodic inspections and tests shall be performed by ship's force in accordance with Planned Maintenance System documents which include Maintenance Requirement Cards (MRC's). Additional inspections and tests e.g. Assessment of Equipment Condition (AEC) conducted by outside activities on an as needed basis for purposes of work package definition and troubleshooting.

c. Post Overhaul and Repair Inspections and Testing: The inspection and testing requirements presented herein shall apply to equipment installed following shore based overhaul and repair. The test matrix provided in Table 582-7-1 specifies the applicable tests required to demonstrate satisfactory workmanship and operation for overhauled/repaired components.

582-8.4 SEPARATORS (FENDERS AND CAMELS)

582-8.4.1 GENERAL INFORMATION. The NFESC criteria document, MO-104.1, Maintenance of Fender Systems and Camels, can be used as an aid in performing maintenance. Some specific maintenance procedures follow.

582-8.4.2 FOAM FILLED FENDERS. Foam filled fenders include the Navy style foam filled fender and the netless foam filled style fender. Periodic inspection of the end connections, nylon support net, and elastomer skin to check for cuts and tears is required. Refer to the manufacturer's repair procedures when minor repair is needed. Foam filled fenders will acquire some degree of permanent set when first placed under a significant percentage of compression for an extended period. This set will cause some loss of energy absorbing capacity but should not affect fender performance.

582-8.4.3 SUBMARINE FENDERS. Submarine fenders include submersible fenders, submerged triangular and cylindrical fenders, and submarine to combatant buoyant fenders. These fenders are continuously submerged in seawater during mooring operations resulting in algae and barnacle. Scrape clean using a scraper or wire brush and paint the buoyancy chamber when signs of corrosion are present. Inspections of the fender structure, rubber surfaces, chain, fittings, and buoyancy chamber or floating barrel type buoy are required before and after each use.

582-8.4.4 PNEUMATIC FENDERS. Pneumatic fenders require a pressure check at least once a month. This is done with a combination inflation gage connected to the low pressure air system of the ship. Punctures can be repaired by vulcanizing or by using plugs similar to those for making repairs to tubeless automobile tires.

582-8.4.5 VINYL AIR FILLED FENDERS. Vinyl air filled fenders are filled with air to the specified pressures and are then permanently sealed.

582-8.4.6 EXTRUDED RUBBER FENDERS. Periodically tighten the bolts in fixed fender installations. Refer to the applicable fender installation drawing for the proper torque. If bolts or studs are missing, replace them with galvanized steel bolts or stainless steel studs, respectively. When replacing extruded rubber fenders on a ship's hull, refer to the applicable ship's drawing for the fender arrangement and to the bill of material, which specifies the proper material. Non- marking rubber compounds are specified to reduce the streaking of ship hulls during tug handling or when coming alongside. However, streaking can also occur because of fender contamination by embedded rust and/or paint particles and by oil and muck picked up by the fenders as they pass through dirty water. These fenders can be cleaned using a scraper or wire brush and common cleaning solvents. On those occasions when marking a hull is totally unacceptable, temporary canvas covers may be draped and secured over the fenders. Temporary covers are usually destroyed or fouled to such an extent that they are not reusable. The expense, time, and labor incurred by using these covers must be weighed against the acceptance of some streaking of the ship's paint.

PART 2 — TOWING

SECTION 9.
GENERAL TOWING INFORMATION

582-9.1 PLANNED VERSUS UNPLANNED OR EMERGENCY TOWS

582-9.1.1 DEFINITION. Navy towing missions fall into one of two categories, planned or unplanned tows. Planned tows are scheduled in advance and they normally involve deactivated ships, or ships undergoing scheduled repairs. Unplanned tows normally occur in an emergency situation where a ship runs aground or loses propulsion/steering control. Towing of targets falls into planned tows.

582-9.1.2 NAVSEA RESPONSIBILITY FOR PLANNED TOWING. The Director of Ocean Engineering (OOC) of the Naval Sea Systems Command (NAVSEA) is responsible for planned towing. An example of a planned towing procedure can be found in NAVSEAINST 4740.9, Towing of Unmanned Defueled Nuclear Powered Submarines.

582-9.1.3 NAVSEA RESPONSIBILITY FOR EMERGENCY TOWING. The Deck and Underway Replenishment Systems Division (SEA 05P8) of the Naval Sea Systems Command (NAVSEA) and the Ship and Aircraft/Vehicle Handling Systems Engineering Section (SSES 9732) of the Naval Surface Warfare Center, Carderock Division provide the technical authority for emergency ship-to-ship towing.

582-9.2 TOWING SYSTEMS

582-9.2.1 EMERGENCY SHIP-TO-SHIP TOWING. Navy ships have provisions, in an emergency, for being towed and for towing another ship, except carriers and submarines, which are only outfitted to be towed. The subject of this chapter is emergency towing. Anticipated or planned tows are discussed in detail in the U.S. Navy Towing Manual (SL 740-AA-MAN-010) and are not covered here.

582-9.2.2 TOWING EQUIPMENT. Navy combatant surface ships have a towing pad and stern chock aft and a chain stopper pad (towing pad) and bow chock forward. Sometimes, because of equipment interference, the stern chock and towing pad at the stern are located on the quarter. In addition to these deck fittings, Navy surface ships carry a towing hawser, chafing chain, pelican hook, shackles and other appendages needed for emergency towing operations. Towing hawsers are designed to absorb energy during the tow by stretch in the synthetic hawsers or by vertical movement in the heavier wire rope hawsers.

582-9.3 TOWING CAPABILITIES OF INDIVIDUAL SHIPS

582-9.3.1 GENERAL INFORMATION. The requirement for towing disabled ships by other ships in an emergency is referred to as tow-and-be-towed or emergency ship-to-ship towing. The General Specifications for Ships of the United States Navy has provisions in section 582 for providing arrangements for being towed and for towing another ship. The specifications require that the arrangements be in accordance with applicable NAVSEA standard drawings. This requirement means that the ship is capable of towing another ship in an emergency, with each ship carrying half the tow line.

582-9.3.2 NAVY TUGS AND SALVAGE SHIPS WITH A TOWING CAPABILITY. The Navy has ocean tugs, which are capable of long-range tows and other missions. They are the ARS 50 Class of salvage ships, and the T-ATF 166 Class of fleet tugs. All are equipped with automatic towing machines/winches except for the T-ATF 166-168, which use a SMATCO Type 1 towing winch. For more information on the capabilities of these Navy ocean tugs, consult the U.S. Navy Towing Manual (SL 740-AA-MAN-010).

582-9.3.3 SUBMARINE TOWING EQUIPMENT. Submarines generally do not carry a towing hawser and associated gear. The towing ship shall provide this equipment. Submarines are built with the necessary towing pads, cleats and chocks for being towed. When not in use, the cleats and chocks are arranged to retract and house inside the faired lines of the hull. There are two basic types of emergency towing systems used in past US submarines. The bridle towing system, used on SSN 688 and SSN 637 submarines, is made up of a set of towing lines that are manually attached to two cleats located aft of the bow dome. An alternate system, the SSN 21 and SSN 774 towing pendant system, is operated remotely from the top of the sail via a line buried under the hull coating to the tow point.

582-9.3.4 AIRCRAFT CARRIER TOWING EQUIPMENT. Aircraft carriers are only equipped to be towed. They do not have a padeye or other towing equipment located aft for towing another ship. Carriers are equipped with 2 1/2-inch diameter 6 x 37 galvanized wire rope towing hawsers, 900 feet long. Some carriers are equipped with two 900-foot towing hawsers, while some have only one towing hawser. The towing hawsers are stored in the anchor handling compartment on a horizontal storage reel.

582-9.4 TOWING INFORMATION ONBOARD NAVY SHIPS AND SUBMARINES

Each ship in the Navy is provided with a towing drawing that shows how to rig the ship for being towed or for towing another ship. This drawing also shows such details as the size of the towing hawser, chafing chain and other appendages. For surface ships and some submarines, the Ship's Information Book (SlB) has details on the towing gear and also contains diagrams that illustrate how to rig for being towed or for towing another ship. For the later classes of submarines, the Ship System Manual (SSM) can be consulted for towing details. The SlB, SSM and towing drawing(s) should be consulted for the required towing gear and hookup for a particular ship. Figure 582-9-1 shows how to rig ships for emergency towing. It is provided to be used in the absence of ship's drawings and instructions. Figure 582-9-2 shows the towing hawser arrangement to be used for an emergency tow.

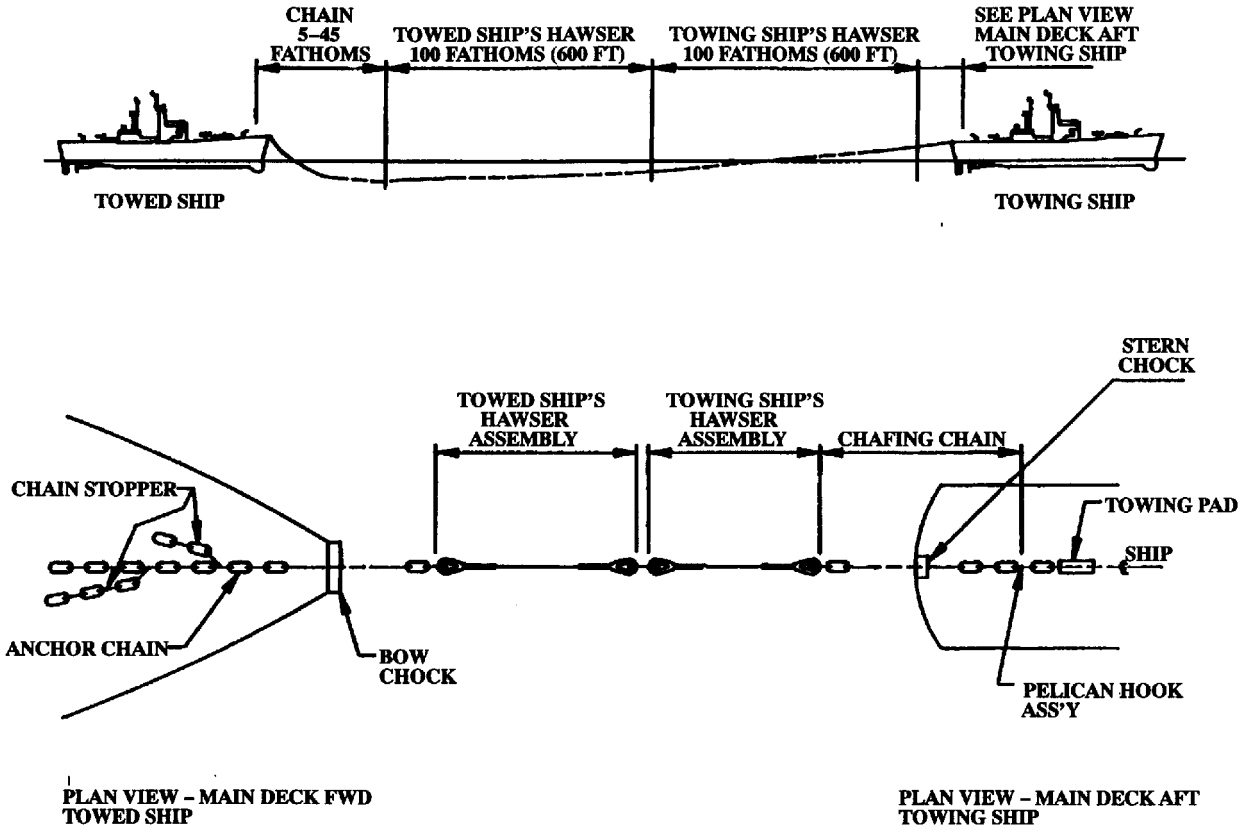
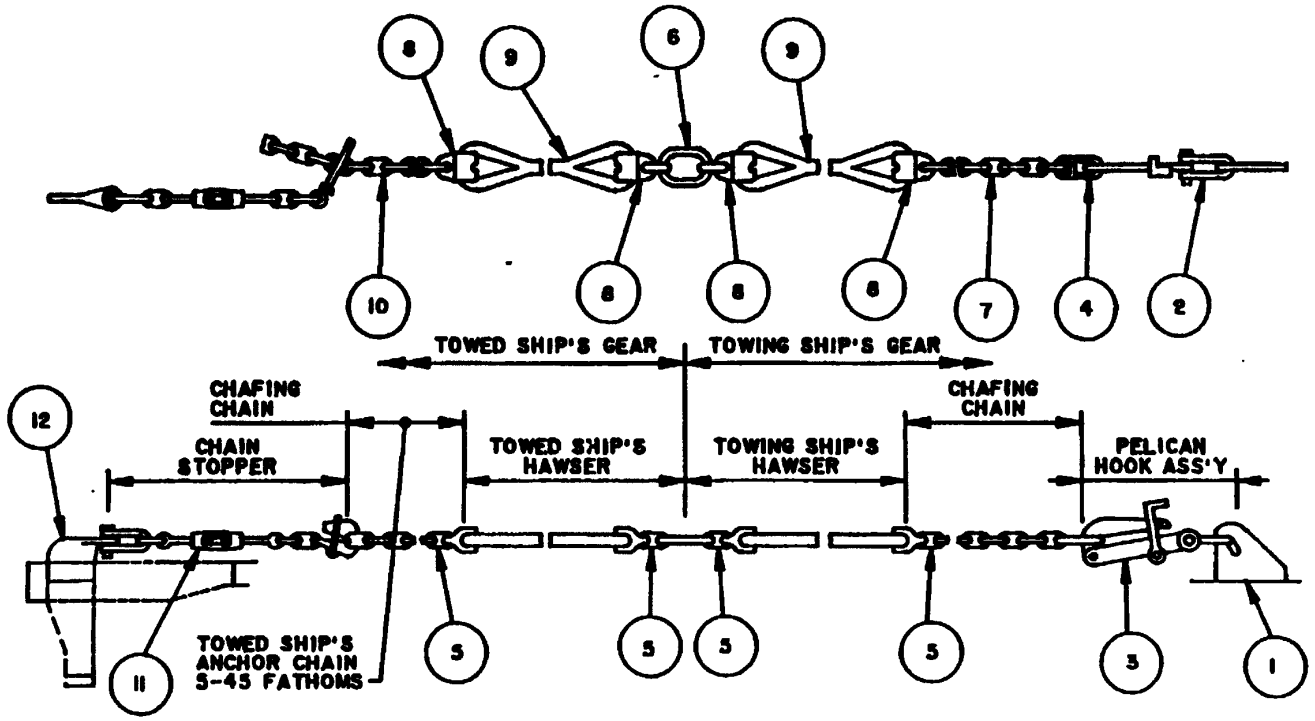


Figure 582-9-1 Emergency Towing Arrangement.



ASSEMBLY OF TOWING GEAR

PIECE	DESCRIPTION	PIECE	DESCRIPTION
1	TOWING PAD	7	CHAIN
2	SHACKLE	8	TOWING THIMBLE
3	PELICAN HOOK	9	TOWING HAWSER
4	END LINK	10	ANCHOR CHAIN
5	DETACHABLE LINK	11	CHAIN STOPPER
6	NATO LINK	12	CHAIN STOPPER DECK PADEYE

Figure 582-9-2 Towing Hawser Arrangement.

NOTE

Figure 582-9-1 and Figure 582-9-2 do not show the size and exact type of emergency towing gear used for the various ship classes. If the ship's towing drawings are not available for this Information, consult NAVSEA standard Dwg. No. 803-4759441, which show emergency towing gear assemblies using the Navy standard towing thimble for use with 5-inch through 14-inch circumference synthetic rope towing hawsers. The actual configuration may be different from the type drawing if the thimble and link or rope connector fittings are used.

SECTION 10.

DESCRIPTION OF TOWING EQUIPMENT

582-10.1 TOWING COMPONENTS

The following paragraphs provide a brief description and discussion about the equipment used for towing. Towing systems are comprised of three primary components; the towline or hawser; fittings; and machinery.

582-10.1.1 TOWING HAWSER. The towing hawser is the primary load-carrying element of the towline. It is usually made from galvanized wire rope or synthetic fiber rope such as nylon or polyester. Twelve strand, plaited or double-braided polyester, in accordance with MIL-R-24750, MIL- R-24730 or MIL-R-24677, listed here in order of preference, are currently the recommended types of rope to be used for new construction ships equipped with synthetic fiber rope towing hawsers. The synthetic fiber rope hawsers are usually 100 fathoms (600’ feet) long with eye splices at each end. The final length of new, assembled towing hawsers, bearing point to bearing point (relaxed), is dependent on the length ordered minus the lengths require for the eye splices on each end. The wire rope towing hawsers found on aircraft carriers are 150 fathoms (900 feet) long and are made from 6 x 37 galvanized wire rope cable with eye splices and solid thimbles at each end. There are various types of end fittings. The types that are normally used as part of the synthetic fiber rope towing hawser are discussed below. Observing the catenary is the most practical way to determine when the tension in a synthetic hawser is approaching the danger point. Optionally, a tattletale may be used. Refer to 582-5.3.1 for a description of how to rig a tattletale.

582-10.1.2 END FITTINGS FOR TOWING HAWSERS. Synthetic lines are all terminated with hand spliced eyes and a variety of end fittings are used on them to protect the line from chafing. The recommended end fittings for towing hawsers made of synthetic rope (nylon and polyester) given here in order of preference are:

a. Towing thimble (NAVSEA Dwg. No. 803-6397321) shown in figure 582-10-1.

b. Rope connector is shown in figure 582-10-2 (commercially available).

c. Thimble and link (NAVSEA sketch No. 56W41-14A with manufacturing requirements) is shown in figure 582-10-3.

d. Rope coupling (NAVSEA Dwg. No. 803-5000916) is shown in figure 582-10-4. Rope couplings are fitted in the eye splices at each end for attaching the hawser to the towed ship’s towing hawser or anchor chain at one end and the chafing chain of the towing ship at the other end.

The manufacturing requirements for the thimble and link assembly are shown on NAVSEA sketch No. 56W41-14A. Newco thimbles (figure 582-10-5) should be replaced with the above approved fittings at the earliest availability. Boston thimbles are similar to towing thimbles (figure 582-10-1) except they are made of aluminum bronze alloy. The Boston thimbles should also be replaced with the recommended fittings whenever convenient.

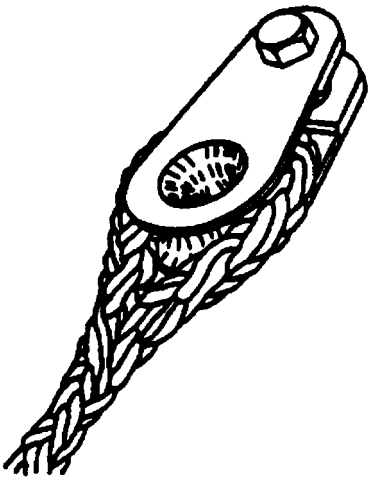


Figure 582-10-1 Towing Thimble.

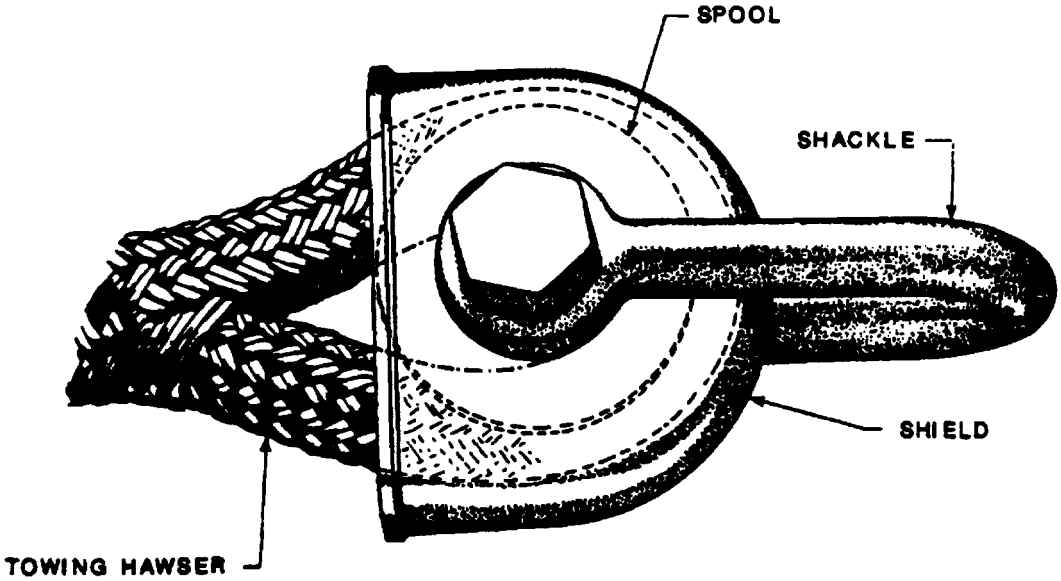


Figure 582-10-2 Rope Connector.

Figure 582-10-3 Thimble and Link.

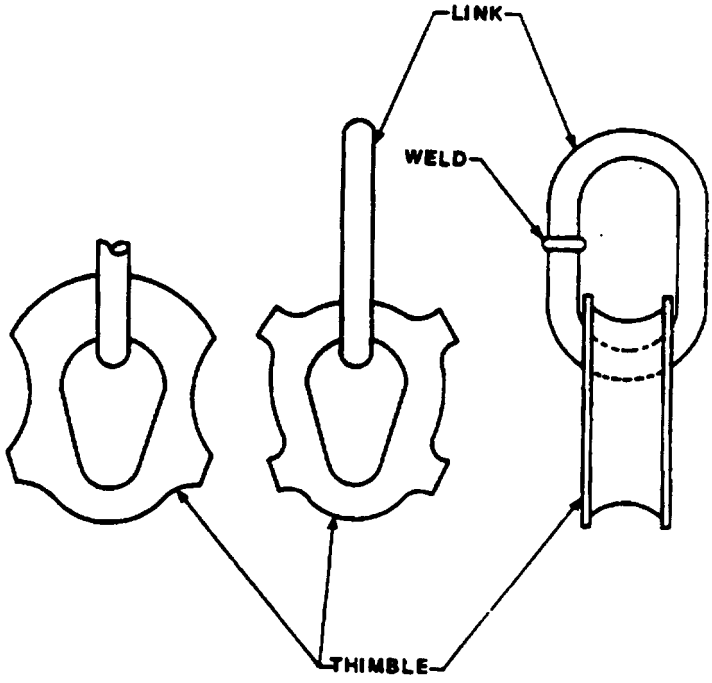


Figure 582-10-4 Rope Coupling.

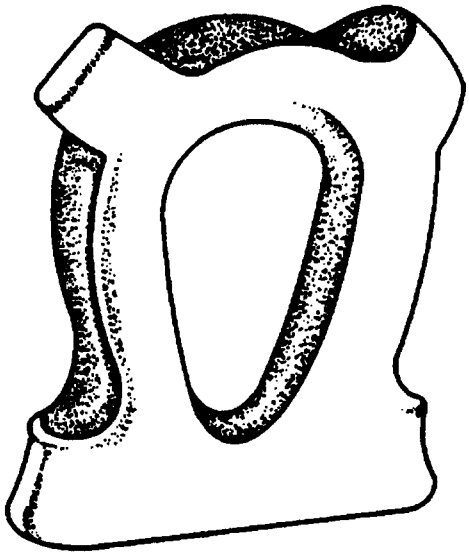


Figure 582-10-5 Newco Thimble.

582-10.1.3 TOWING MACHINERY. As mentioned in paragraph 582-9.3.2, Navy tugs and salvage ships have towing machinery. Although wire rope is somewhat easier to handle than wet manila line of equal strength, it cannot be faked out on the deck when hauled in. Powered winches and towing machines were a natural evolution, providing the in-haul and storage features for wire rope hawsers and eliminating the use of bitts and hooks. As synthetic fiber line towing hawsers were being introduced in Navy towing, the multi-sheave traction winch was developed. In addition to providing a hard point for attachment, the winch has payout and heave-in features for adjusting the towline scope. Because reel-type storage is not practical for synthetic line, the hawser is fairled into a stowage bin located below decks as it comes off the traction winch.

The principle functions of towing machines are:

a. Acts as a hard point or attachment point for securing the towline to the tug.

b. Pays out and heaves in the towline during towing operations.

c. Transports or stows the towline as it is heaved in.

d. Acts as a quick-release device for disconnecting a towline if necessary during an emergency.

e. Acts as an automatic tension control device to limit or relieve peak dynamic loads in a towline system, thereby enhancing life and utility of the equipment, increasing maximum speed, and increasing safety.

f. Monitors and displays tow hawser conditions such as tension and scope.

582-10.2 RECOMMENDED TOWING HAWSER MATERIAL AND CONSTRUCTION

582-10.2.1 GENERAL INFORMATION. The present recommendation for towing hawser material and construction is to use 12-strand polyester rope made to MIL-R-24750, plaited polyester rope made to MIL-R-24730, or double-braided polyester rope made to MIL-R-24677. Current towing hawsers on board need not be replaced unless they are no longer usable.

NOTE

Towing fittings (all appendages) for mine sweepers shall be non-magnetic.

582-10.2.2 HAWSER MATERIAL. Synthetic fiber and wire ropes are used to make towing hawsers. The primary synthetic fiber ropes used by the Navy for towing hawsers are nylon and polyester. The demands of the situation determine which type of construction and fiber will be used. Tables showing comparative minimum breaking strengths for plaited and double braided nylon and polyester ropes are found in NSTM Chapter 613, Wire and Fiber Rope and Rigging.

582-10.2.2.1 Nylon rope. Nylon rope has good strength, elasticity, and resistance to weather and is available in braided and plaited construction for towing applications. Nylon loses 15 percent of its strength when wet but regains that strength after drying out.

582-10.2.2.2 Polyester rope. Polyester rope can be as strong as nylon rope depending on the type of construction, but does not have the stretch and elasticity of nylon rope. Polyester rope does not have the wet strength loss that nylon does. Polyester rope is also available in braided and plaited construction for towing applications.

582-10.2.2.3 Wire rope towing hawsers. Wire rope is also used for towing hawsers. However, for emergency towing, its use is limited mostly to aircraft carriers and older submarines. The wire rope hawsers used for emergency towing are the 6 X 37 class type, Improved Plow Steel (IPS) galvanized.

582-10.2.2.4 Spring lay rope 6 x 3 x 19. This type of rope is used in harbor towing by service craft. This type of wire rope is more flexible than wire rope, but not as strong. It is stronger than fiber rope of the same diameter. It is made of six (3 X 19) main strands laid around a fiber core. Each main strand consists of three fiber strands and three preformed steel wire strands of 19 wires each, laid alternately around a fiber center. The fiber portion provides a cushion for the wire strands and results in a rope having good flexibility and elasticity.

582-10.2.3 HAWSER CONSTRUCTION. A non-rotating rope is best suited for towing; hence the following three construction types are commonly used. Figure 582-10-6 shows the three types of rope construction used by the Navy for towing. Their construction types and characteristics are, in preferred order:

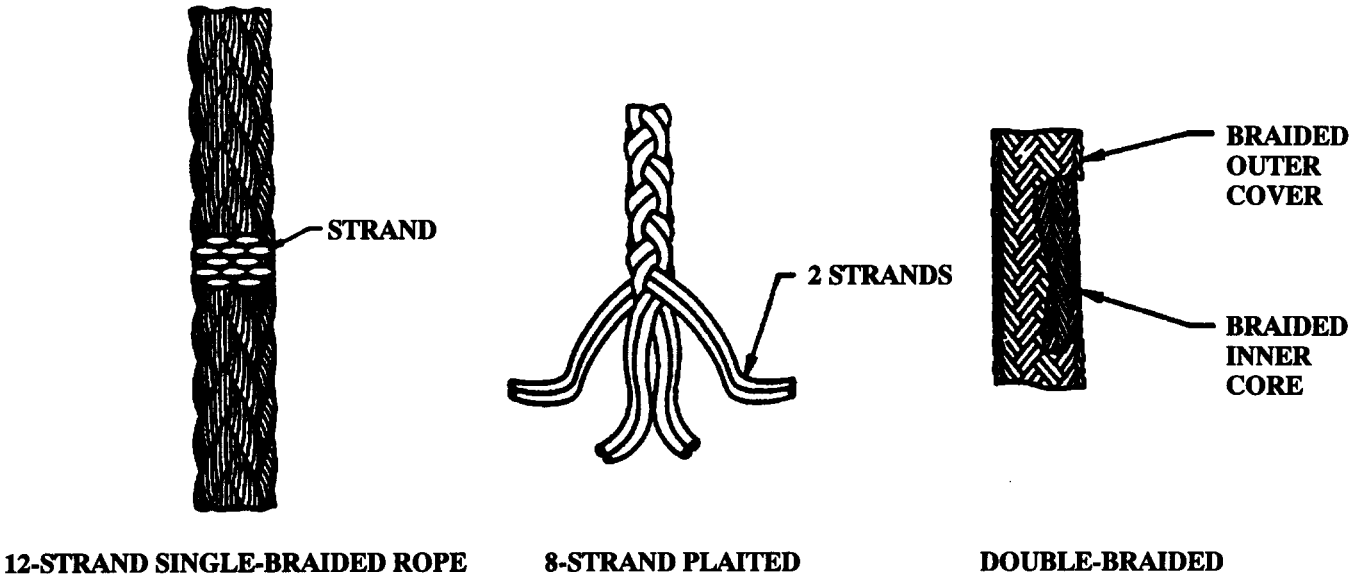


Figure 582-10-6 Rope Construction

582-10.2.3.1 Twelve strand plaited rope. Twelve strand, single braided rope provides ease in inspecting and splicing, is non-rotating, and has maximum bearing surface.

582-10.2.3.2 Eight strand plaited rope. Eight strand plaited rope provides ease in inspecting and splicing and does not rotate.

582-10.2.3.3 Double braided rope. Double braided rope is acceptable but less desirable because it is more difficult to splice. This line is non-rotational. Double braided ropes also have a firm, round cross section that provides a maximum bearing area. This results in more gripping surface and an ability to disperse heat and abrasion over a larger area to reduce wear.

NOTE

Three-strand twisted rope has high-stretch characteristics and good abrasion resistance and splicing characteristics. However, since it rotates under load, a number of instances of cockling (line kinking when the load is released, see figure 582-10-7 Cockle) during towing operations have been produced. Three stranded twisted lines are not recommended for use as towing hawsers.

Figure 582-10-7 Cockle

582-10.3 TOWING HARDWARE

582-10.3.1 PADEYE. A towing padeye is securely welded to the ship's main deck structure at the stern and serves as the attachment point for the towing hawser when the ship is towing. There are three types of towing padeyes commonly found on naval combatants: two vertical types (see figure 582-10-8) and a horizontal type (see figure 582-10-9).

Figure 582-10-8 Vertical Towing Padeyes

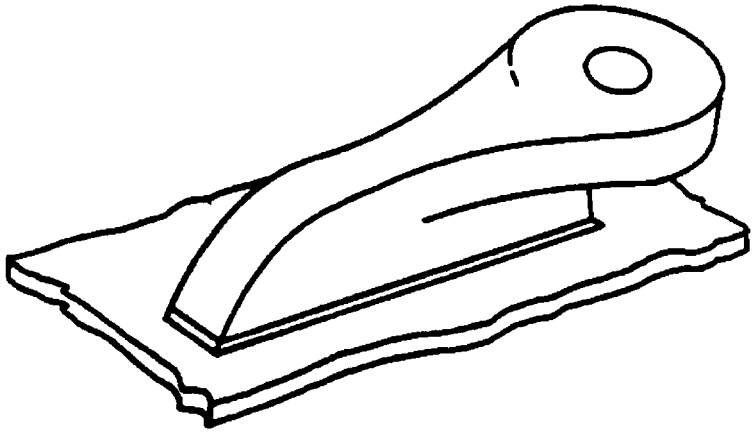


Figure 582-10-9 Horizontal Towing Padeye

582-10.3.2 CHOCK. A stern chock, usually located on the centerline, is used when towing another ship. When the ship is being towed, a bow chock sometimes called a bullnose, is used for the lead of the towing gear.

582-10.3.3 CHAFING CHAIN. A chafing chain is a length of chain lead from the towing hawser to the attachment point (padeye) on the towing ship. For a towed ship, the anchor chain serves as the chafing chain and is usually lead out through the bow chock and attached to the towing hawser. The length of chain lead out from the bow ranges from five to 45 fathoms (30 to 270 feet). Chain is used primarily to provide a catenary to the towing hawser for keeping the ships in step and to withstand chafing.

582-10.3.4 CONNECTING APPENDAGES. Connecting appendage items include shackles, detachable links, end links, as well as specially sized and arranged lengths of chain. This hardware is used to connect the various long, flexible portions of the tow line system to each other and to the tow. Figure 9-2 shows a chafing chain and some of the connecting appendages.

582-10.3.5 NATO TOWING LINK. A NATO towing link is a special link to facilitate connection of the towing rig with ships of other nations. Figure 582-10-10 shows a NATO towing link. The details of the NATO towing link are shown on NAVSEA standard Dwg No. 803-5959315. The towing ship passes its NATO link to the towed ship. The NATO towing link is available from SPCC Mechanicsburg, PA. NICN 4010-LL-HAL-6707 applies when ordering the NATO link.

CAUTION

The U.S. Navy NATO standard towing link has a breaking strength of 700,000 pounds. The breaking strength of the towing links provided by other member nations is their responsibility and may be of greater or lesser strength than the U.S. Navy NATO towing link.

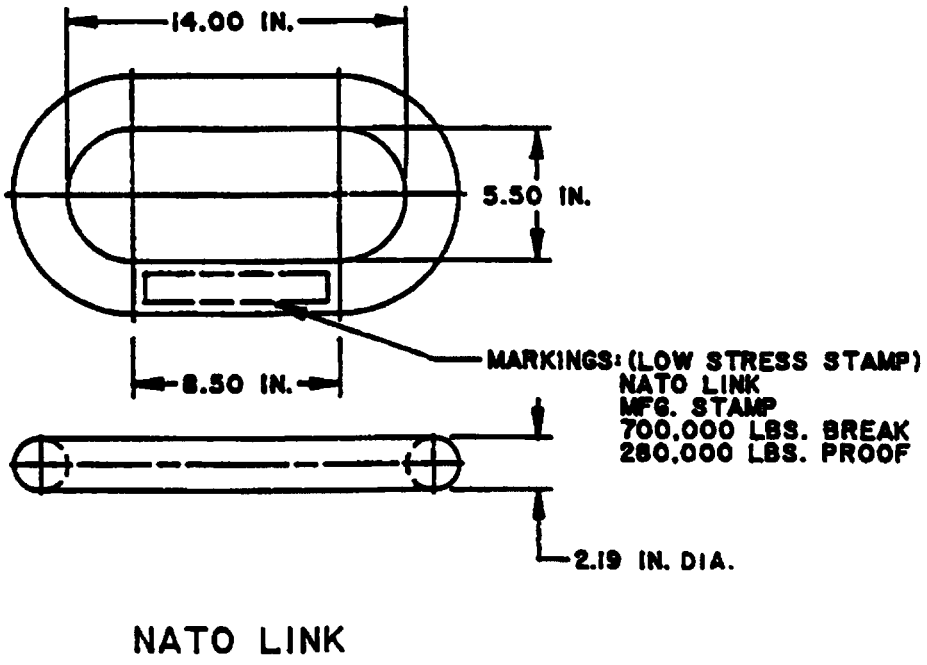


Figure 582-10-10 NATO Towing Link.

582-10.3.5.1 NATO Towing Link Exceptions. The minesweepers (MCM's and MHC's) do not carry NATO towing links because of their requirement to carry no ferrous material. Also, the only submarines to carry the NATO towing link are the SSN 21 and SSN 774 Classes.

582-10.3.6 CHAIN STOPPERS. Chain stoppers are used in groups of two or more to secure the ship's anchor chain. They eliminate the strain on a windlass, which would otherwise be caused by towing loads. The Navy uses the pelican hook chain stopper as shown in figure 582-10-11. The pelican hook has a strong back and bill that is passed on a link of chain and held in place with a bail and pin. Typically the pelican hook is connected to a turnbuckle by a detachable link. The pelican hook is used if the tow must be dropped in an emergency. Another detachable link connects the other end of the turnbuckle to a shackle that attaches to a padeye welded to the deck. Towing chain stoppers are the same as housing chain stoppers, except that they have modified eyebolts that accept a locking plate and cotter pin. These locking plates prevent the chain stopper turnbuckle from backing off when subjected to the shock loading of the towing hawser. No turnbuckle is used on the pelican hook aft.

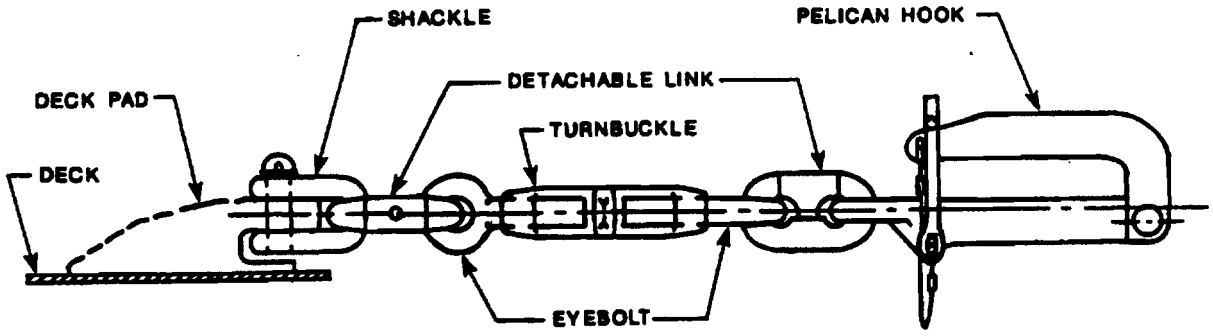


Figure 582-10-11 Pelican Hook Chain Stopper

SECTION 11.

TOWING GUIDELINES AND PROCEDURES

582-11.1 SAFETY PRECAUTIONS

582-11.1.1 The following safety precautions are basic and should always be followed during towing operations:

a. During heavy weather life jackets will be worn by all personnel topside.

b. Personnel involved in rigging and un-rigging towing gear and handling lines shall wear life jackets, safety helmets, and safety shoes. Personnel handling messengers and synthetic tow lines may wear gloves. Personnel handling wire rope shall wear gloves. Rings, loose clothing, etc. should not be worn.

c. Be careful when handling towing hawsers and observe the precautions for using synthetic fiber ropes as stated in using synthetic fiber ropes as stated in NSTM Chapter 613, Wire and Fiber Rope and Rigging. A training video, available from the Naval and Education and Training Support Centers, titled ″Synthetic Line Snapback” (Order No. 82971DN, 1982), shows the hazards associated with synthetic towlines.

d. When rope is used in towing operations without a towing engine, the towing hawser must have a scope of at least 200 fathoms (1200 feet) especially for long tows and in heavy weather. However, the urgency of the situation or navigational hazards may dictate the use of a single hawser rig, [100 fathoms (600 feet)], even in heavy weather, in order to get the tow under way. A second hawser can be added when conditions permit.

e. Never let the hawser be sprung so much that it straightens out clear of the water or be allowed to drag on the bottom.

f. Inspect the towing hawsers thoroughly during overhaul periods. Replace the hawsers if inspection reveals any unsatisfactory conditions.

g. Take the following precautions before disconnecting the anchor chain on the forecastle for towing and rousing out the anchor chain:

CAUTION

Make sure the wildcat is engaged and the steel bar is removed before operating the wildcat.

1. Use a wire rope preventer of adequate size to support the weight of the anchor, to back the housing stopper and to prevent the accidental dropping of the anchor.
2. Use a preventer, if available; otherwise insert a steel bar through a link across the upper lip of the chain pipe or lash with rope.

h. Make provisions for emergency release of the tow line. (An ax, large bolt cutters, cutting torch, release stopper, or pelican hook may be used).

i. When getting underway, build up turns slowly; never go from dead-in-the-water to standard speed.

j. Ensure that the tow line and the appendages are in good condition. Never use a hawser that is kinked. See NSTM Chapter 613, Wire and Fiber Rob and Rigging, section 2, on the care of synthetic fiber rope hawsers, especially what to do with a hawser that has a severe kink or cockle.

k. If the tow is sinking, disconnect the tow line immediately.

l. Unless sinking of the tow appears imminent, do not abandon the tow. It is the towing ship's duty and responsibility to prevent the loss of the tow.

m. During favorable weather and seas, ensure that a sufficient catenary exists to absorb shock loading. Never tow at short stay in rough weather.

n. Ensure that all rigging is adequate. If questionable, always over-rig.

o. Keep a lookout for small weather fronts. A sudden unexpected weather front can cause great damage.

p. Keep all unnecessary personnel away from the vicinity of the tow line.

q. Set a towing watch on both ships.

r. If the towing ship losses power, the course of the towing ship should be altered immediately to prevent being overrun by the towed ship.

582-11.2 COMMUNICATIONS BETWEEN SHIPS DURING TOWING OPERATIONS

582-11.2.1 COMMUNICATION. When towing, a means of communicating between the towing ship and the tow is essential. The best way of communicating is usually by radio or electric powered megaphones (bull horns). When radio or bull horns are not available, or practical, alternate means of communication are needed.

582-11.2.2 SOUND SIGNALS. A fast means of communications is by sound signals, which also may be used to supplement any of the other means. Table 582-11-1 lists the sound signals used by the Navy during towing operations.

Table 582-11-1 NAVY TOWING SOUND SIGNALS

SIGNAL	MEANING
1 short blast	I am putting my rudder right
2 short blasts	I am putting my rudder left
2 short, 1 prolonged blast	Haul away
2 prolonged, 5 short blasts	Let go
2 prolonged blasts	Go ahead
1 short, 2 prolonged blasts	Pay out more line
1 prolonged, 2 short blasts	Stop
3 short blasts	Avast hauling
2 prolonged, 1 short blast	All fast
3 groups of 5 short blasts	I am letting go

582-11.2.3 FLAG SIGNALS. Flag signals may be obtained from Allied Tactical Publication, ATP1, volume II, section 3007 (for naval ships), or National Imagery and Mapping Agency, NIMA, publication 102, International Code of Signals (for merchantmen).

582-11.3 PROCEDURE FOR RIGGING AND PASSING A TOW LINE

582-11.3.1 GENERAL INFORMATION. Procedures for rigging and passing a single pendant tow line for a ship to ship emergency tow are the same, regardless of ship class. The following general procedure lists the steps for preparing and passing the tow line between two surface ships. Figure 582-11-1 shows a typical tow line rigged

for passing to a disabled ship and figure 582-11-2 shows a ship rigged to be towed using chain stoppers and anchor chain.

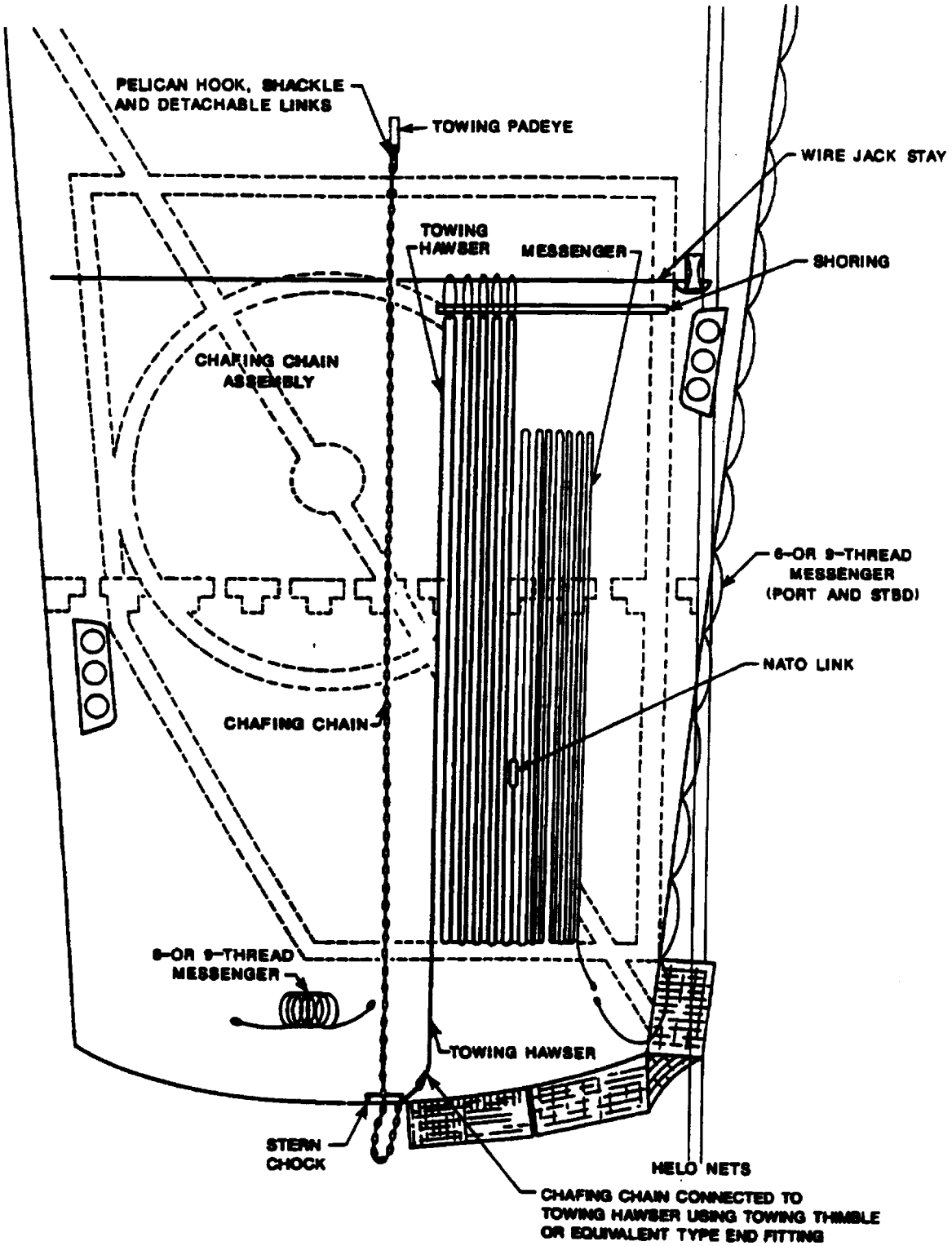


Figure 582-11-1 Ship Rigged to Tow

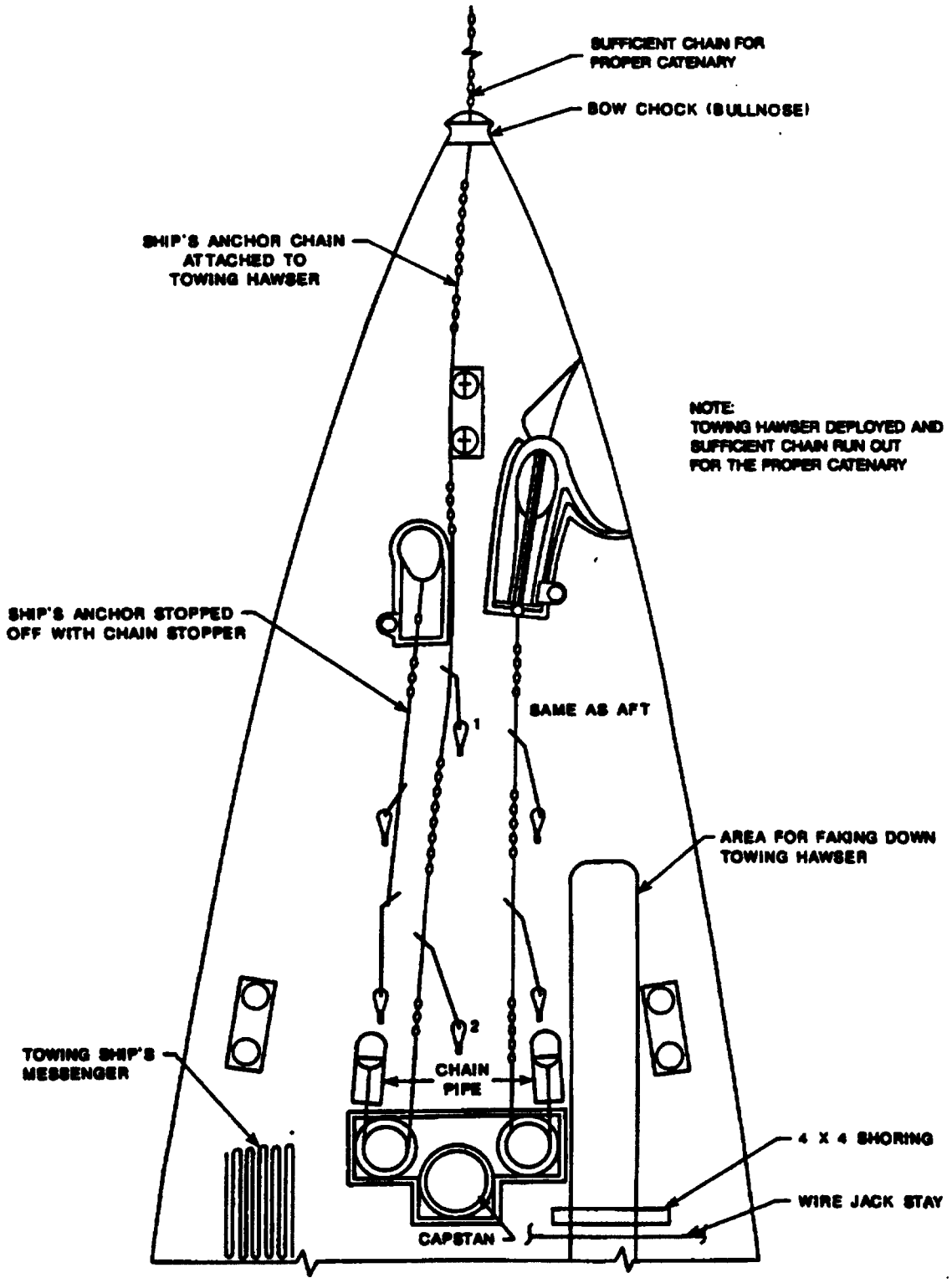


Figure 582-11-2 Ship Rigged for Tow

582-11.3.2 PROCEDURE FOR THE TOWING SHIP.

a. Connect the pelican hook to the after towing pad with a shackle.

b. Connect the chafing chain with an end link to the pelican hook. Lead the chafing chain through the stern chock.

c. Connect the towing hawser end fitting to the chafing chain with a detachable link.

d. Fake down the towing hawser clear for running fore and aft. Stop off each bight of the towing hawser to a jack stay with 21-thread. Place shoring under the stops for ease in cutting.

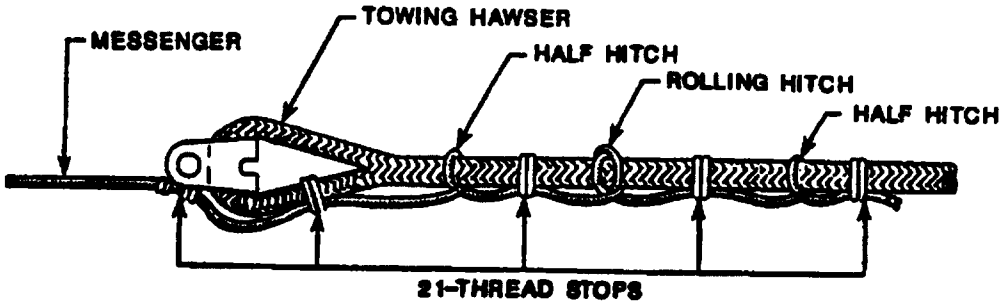
e. Connect the NATO towing link to the free end of the towing hawser; see paragraph 582-9.3.5 for a description and availability of the NATO towing link.

f. Connect a messenger composed of approximately 100 fathoms (600 feet) of three inch circumference line (four inch circumference line for a 10 inch circumference or larger hawser) and 50 fathoms (300 feet) of 1 1/2-inch circumference line to the outboard end of the towing hawser. Fake down the towing hawser messenger clear for running fore and aft. Lead the free end of the messenger through the stern chock.

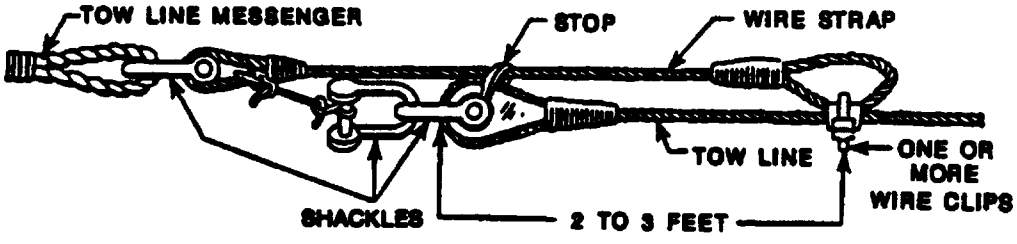
g. Stop off a 6-thread or 9-thread messenger outboard on both sides of the ship from the fantail to the forecastle with sail twine, clear for running. Coil a 600 foot length of 6-thread on the fantail for a third messenger. These messengers are rigged to permit the conning officer greater maneuvering freedom when approaching the ship to be towed.

h. When close enough to the ship to be towed, pass the port, starboard, or fantail, 6 or 9-thread messenger with a heaving line bob or line throwing gun. The forecastle will notify the fantail by telephone as to which side the messenger is being passed so that the appropriate 6 or 9-thread messenger may be connected to the towing hawser messenger. Two methods for connecting a messenger to the tow line are shown in figure 582-11-3.

i. Pay out the tow line messenger and hawser, cutting the stops of the towline hawser at the 4 x 4 inch to control the speed of paying out, as the ship to be towed takes in the 1 1/2-inch circumference messenger and hawser. The tow line messenger and hawser should be payed out gradually to ease handling of the tow line by the towed ship and to avoid fouling the propellers of the towing ship.



CONNECTING MESSENGER TO SYNTHETIC FIBER ROPE TOWING HAWSER



CONNECTING MESSENGER TO WIRE ROPE TOWING HAWSER

Figure 582-11-3 Connecting a Messenger to the Tow Line

582-11.3.3 PROCEDURE FOR THE TOWED SHIP.

a. Stop off the anchor (port or starboard) of the anchor chain to be used. Set up on the anchor windlass brake. Pass a pinch bar through the chain, letting the bar rest on the lip of the chain pipe, or pass a preventer to prevent the chain from backing down into the chain locker and a preventer on the anchor to back up the stopper. Break the anchor chain at the detachable link inboard of the swivel. If power is available, haul out the desired length of chain using the anchor windlass. If power is not available, the chain will have to be hauled out manually.

b. Shackle the towing chain stopper to the designated (towing) padeye on the forecastle for stopping off the anchor chain after the tow is properly adjusted.

c. Fake out the towed ship's hawser on deck, fore and aft, on the forecastle for clear running, prior to connecting it to the anchor chain. Use the towing ship's messenger to haul the towing hawser from the towing ship on board through the bullnose. Connect it to the towed ship's hawser secured to the end of the anchor chain. If the towed ship's hawser is not to be used, connect it to the anchor chain. Use a detachable link to connect the free end of the towed ship's hawser to the NATO link.

d. Pay out sufficient anchor chain [5 to 45 fathoms (30 to 270 feet)] to provide a substantial towing catenary when the towing hawser has been payed out. Synthetic rope has a very small catenary.

e. Set the brake on the wildcat and pass and equalize the chain stoppers, one outboard and one inboard of the detachable link, to take the strain on the towed ship's anchor chain. Disengage the wildcat.

582-11.3.4 GETTING UNDERWAY WITH TOW. Implement the following steps when the towing hawsers are connected and both ships are ready to start the tow:

a. Start the towing ship's engines ahead as slowly as possible and stop them when the hawser begins to take strain. Increase turns slowly until the inertia of the tow is overcome and both ships are moving slowly with steady tension in the hawser. Increase speed slowly until the desired speed is reached. At no time should an additional amount of strain be placed on the tow hawser to cause it to lift completely out of the water. The course of the tow may be changed gradually, as necessary.

b. Pay out or haul in (assuming power is available to the anchor windlass) anchor chain as desired to keep the ships in step (that is, taking wave crests at the same time). When a comfortable distance is found, the chain stoppers are passed on the anchor chain and the strain is equalized between the stopper and wildcat. Locking plates are installed and set on both chain stoppers.

582-11.3.5 QUICK RELEASE OF TOWED SHIP. Procedure for quick release(time permitting) of towed ship:

CAUTION

In case of emergency, for quick release, tripping the pelican hook on the towing ship is faster than the following procedures.

a. Pay out the anchor chain connected to the tow line on board the towed ship so that a detachable link is just forward of the anchor windlass.

b. To prevent the chain from returning to the chain locker when detached, pass the chain stoppers on the anchor chain and lash the anchor chain just aft of the detachable link or apply the chain compressor where fitted.

c. Disconnect the anchor chain between the anchor windlass and the chain stoppers so that only the chain stoppers are holding the anchor chain and the tow line. This arrangement allows quick release of the towing hawser and chain.

582-11.4 SUBMARINE TOWING

582-11.4.1 GENERAL INFORMATION. The procedure for emergency towing of submarines is not as well developed as the emergency towing procedure for surface ships. Surface ships also conduct emergency towing drills to practice their towing skills; submarines, however, do not generally engage in emergency towing drills.

582-11.4.2 CONSIDERATIONS WHEN RIGGING A SUBMARINE FOR TOWING. Rigging the towing gear on a submarine is dangerous. Because of a submarine's limited freeboard and circular hull, the sea sweeps completely over the deck in weather which would be considered relatively calm by the crew of a surface ship.

582-11.4.3 TOWING GEAR PROVIDED ON VARIOUS CLASSES OF SUBMARINES. If the submarine is provided with onboard towing gear, such as the SSN 688 Class, it may consist of a wire rope towing bridle, a wire rope chafing pendant, a flounder plate or pelican hook and link fittings, and a fiber rope towing hawser. The assembled gear is designed to allow towing by means of a forward pair of cleats, which are hinged design on later model submarines (SSN 688 and SSBN 726 Classes). The SSN 637 Class has towing eyes welded to the ship's hull at the base of the leading edge of the sail. In this case, the towing gear consists of two shackles, a pelican hook, and a link. One shackle connects the pelican hook with the towing eye and the other holds the tow line. The towing shackle is connected to the pelican hook by means of a link. The pelican hook permits the tow line to be released quickly and safely in an emergency.

582-11.4.4 PERSONNEL SAFETY. The main deck of a submarine is usually inaccessible and dangerous to board in a seaway. There is very little freeboard, and if there is any sea running, the decks are most likely awash. Use a tether or safety line when moving about the deck. Normally a safety track is provided for attaching personnel restraining safety lines. The necessary fittings and harnesses are carried on the submarine for use with the track.

582-11.4.5 PERSONNEL EXPERIENCE. Personnel on the towing ship may have little or no experience with submarines and may lack familiarity with the peculiar fittings, equipment, and limitations of the submarine. Submarine personnel may not be familiar with the deck seamanship evolutions common to surface ship personnel. Good communication between the submarine and the tow ship's crew is essential.

582-11.4.6 SAFETY EQUIPMENT FOR WORK ON THE DECK. All personnel working on the deck when connecting to a submarine in open sea, should wear full wet suits, survival gear or similar dress which will provide thermal protection, as well as flotation, should they be washed overboard. No one should be permitted to work without proper life preservers and other safety equipment appropriate for the task.

582-11.4.7 HANDLING OF TOWING EQUIPMENT. In some cases, especially on older submarines, the available towing gear may have to be modified. Handling emergency towing gear can be required when the submarine is at sea, possibly in heavy weather. Handling gear and preparing the hinged cleats on the rounded water-swept deck is difficult and hazardous. For this reason, assembly of the towing gear and all possible preparation should be done below deck if the towing gear is provided on the submarine or on the towing vessel if it is providing all the towing gear.

582-11.4.8 SUBMARINE TOW LINE CONNECTION POINTS. All U.S. Navy submarines have a plan for being towed that is described in each Ship's Information Book (SIB). The arrangements are similar for all submarines built prior to the SSN 688 and SSBN 726 Classes and are described as a group. The SSN 688 and SSBN

726 Class arrangements are described separately. Table 582-11-2 contains relevant technical data concerning towing equipment on several classes of US Navy submarines.

582-11.4.9 PRIOR 688/726 CLASS SUBMARINES. Most submarines prior to the 688/726 Class have tow pads at or near the base of the forward end of the sail or attached to the forward escape trunk. Lateral strength is considerably reduced, so a tow fairlead must be used. The hole in the padeye is 2 9/16-inches in diameter. Most of these submarines have retractable mooring cleats, forward fairlead chocks, and capstans. Many have after capstans and fairlead chocks as well. Inside dimensions of the chocks are 10 1/2 X 16 1/2-inches, except for the 594 Class (8 inches in diameter) and the 598 Class (7 1/2 X 12 inches). The very oldest SSN's (578 and 585 Classes) have fairleads of insufficient strength for towing. For these submarines the towing pendant will either have to be centered laterally by using the mooring cleats or, as an alternative, a tow connection will have to be made. For all other submarines, the fairlead can and should be used. The smaller fairleads must be carefully checked to confirm that the towing appendages and the chafing chain will pass through the small dimensions provided. Most of the non-688/726 Class submarines carry designated towing gear onboard. This gear includes shackles, a pelican hook and a wire chafing pendant of 1-inch diameter or larger (figure 582-11-4). The proof test of the rig is 80,000 lbs.

Table 582-11-2 SUBMARINE TOWING EQUIPMENT

SHIP CLASS/DISPLACEMENT	TOW HAWSER	TOW PAD OR CLEAT STRENGTH	PENDANT OR BRIDLE LENGTH
SSN 585 CL 3,500 tons	2 3/4-in cir, synthetic, 22,500 lbs; not carried onboard	22,500 lbs pad	10-ft wire rope pendant
SSN 594 CL 3,800 tons	3 3/4-in cir, nylon, 42,000 lbs; not carried onboard	42,000 lbs pad	None
SSBN 616/640 CL 8,300 tons	1-in dia, wire rope, 73,400 lbs; not carried onboard	80,000 lbs pad	None
SSBN 627 CL 7,300 tons	1-in dia, wire rope, 73,400 lbs; not carried onboard	80,000 lbs pad	None
SSN 637 CL 4,000 tons	3/4-in dia, wire rope, 41,800 lbs; not carried onboard	80,000 lbs pad	None
SSN 688 CL 6,900 tons	5-in cir, 450 ft long, double-braided nylon with a 5 1/2-inch rope coupling at each end, 73,000 lbs; carried onboard	70,000 lbs cleat (strength of single cleat)	15-ft (1 3/8-in dia, 6 X 37 galvanized IPS) wire rope bridle 31-ft (1 3/8-in dia) wire rope pendant
SSBN 726 CL 18,700 tons	8 1/2-in cir, nylon, 218,000 lbs; not carried onboard	70,000 lbs cleat (strength of single cleat)	14-ft (2 in dia) wire rope bridle

CAUTION

This towing rig is intended for emergency towing. The shackles shown in the submarine towing plans are 1 3/4-inch screwpin anchor shackles and should not used unless the pins are moused. Safety shackles are the preferred shackles to be used for emergency towing. The standard tow pad will accept the pin of a standard 2-inch safety shackle. The towing ship should substitute appropriate safety shackles with the required bolt-locking fitting.

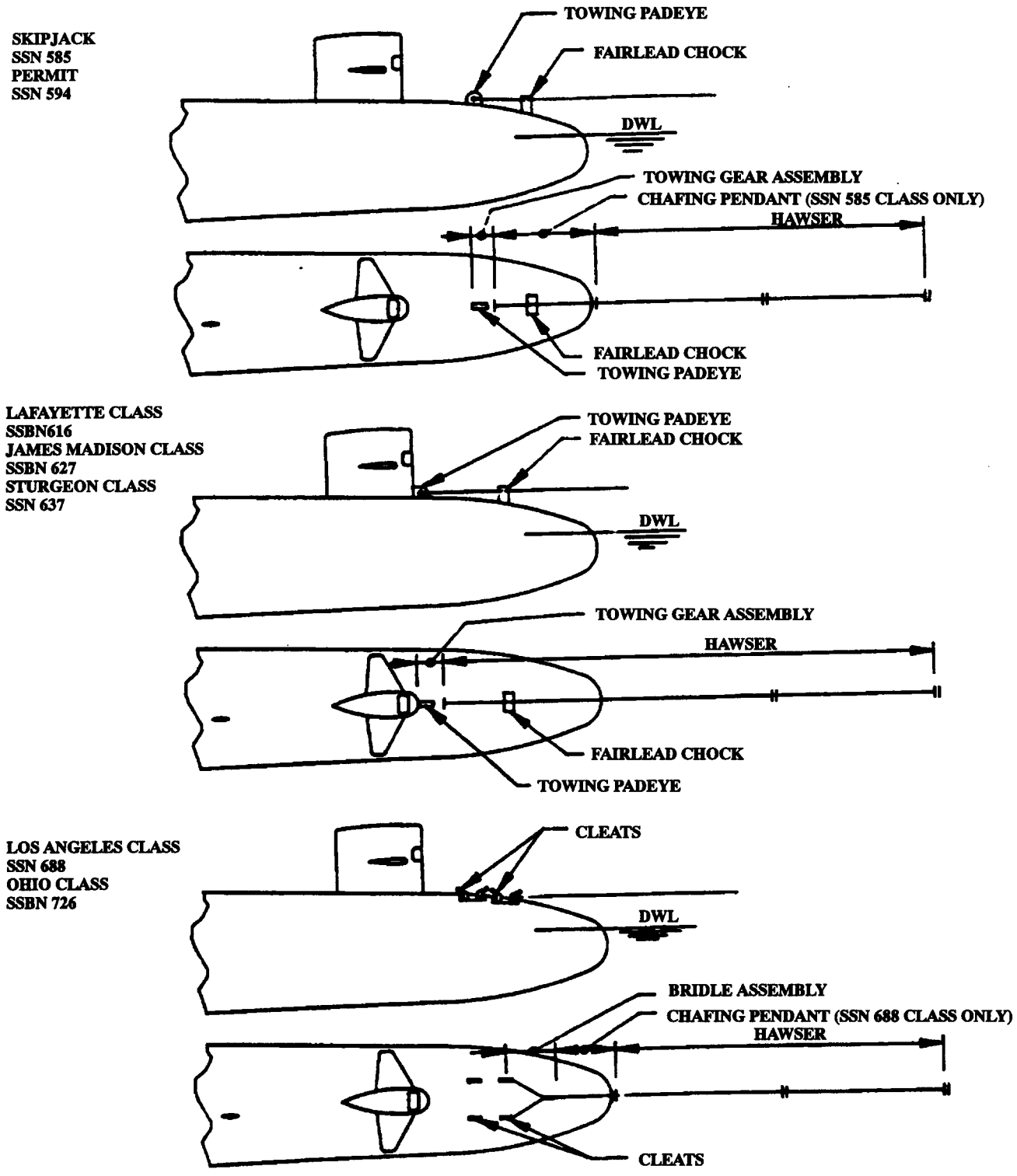


Figure 582-11-4 Submarine Towing Gear.

CAUTION

The submarine's own towing rig may include a short wire chafing pendant. The pendant, however, may only be 3/4-inch or 1-inch and may provide inadequate chafing protection for a long distance, deep catenary tow, especially in the fairlead chock. The towing ship should provide its own chafing pendant of sufficient length to make the final connection to the tow hawser on the fantail of the towing ship. The pendant should be made up to include a short length of chain to ride in the fairlead chock for chafing protection.

582-11.4.10 SSN 688 CLASS SUBMARINES. This submarine class has no tow pad or forward fairlead. It is designed to be towed by using a bridle attached to the forward pair of hinged mooring cleats. Figure 582-5-10 shows a hinged cleat and figure 582-11-5 shows a schematic of the towing rig carried onboard the SSN 688. Use the 1 3/8-inch bridle provided for this submarine. The soft eyes in the end of the bridle legs must be appropriately lashed to ensure they do not jump off the cleats.

CAUTION

Neither the pendant nor the hawser is recommended for ocean towing of this submarine except in an emergency. The towing ship should provide a 1 5/8-inch chafing pendant of sufficient length to make the hawser connection on its own fantail.

582-11.4.11 SSBN 726 CLASS SUBMARINES. These large submarines, like the SSN 688 Class, are towed with a bridle attached to the forward most pair of mooring bitts. The gear is more robust than for other submarines, but it is not carried on board the submarine. The number 1 and number 2 main ballast tank vent covers must be installed prior to rigging the SSBN 726 Class for tow.

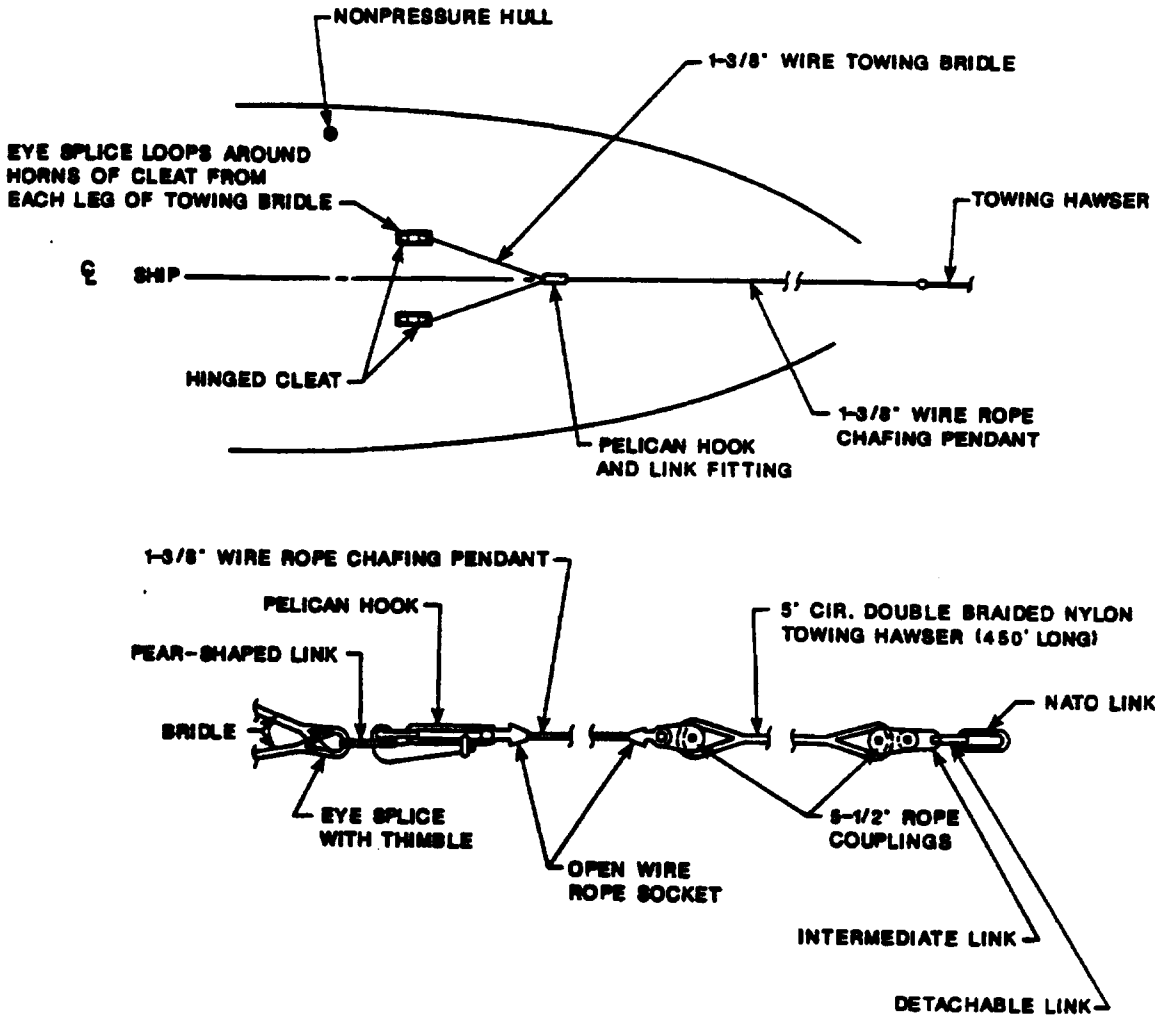


Figure 582-11-5 SSN 688 Towing Schematic

582-11.5 HARBOR TOWING

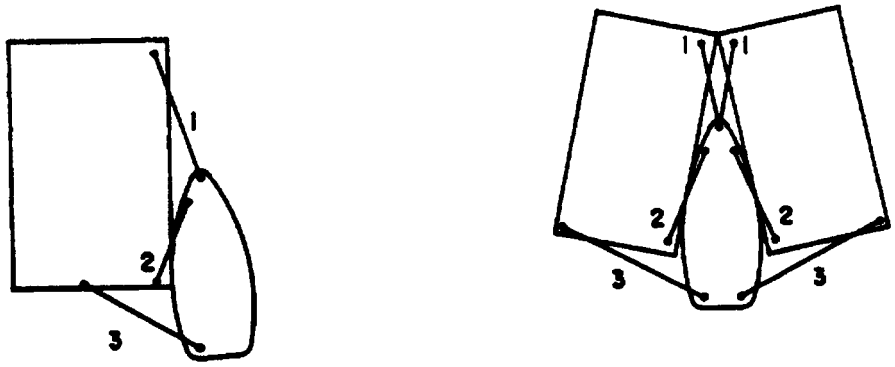
582-11.5.1 TOWING ALONGSIDE. Harbor towing is done by harbor tugs when moving ships, barges or other nonpropelled craft within the confines of a harbor. Navy harbor tugs (YTB's) are equipped with a synthetic towing hawser for single tows. However, most towing done by these harbor tugs is for short distances and on protected waters so they use the alongside or towing on the hip" method. Towing alongside offers excellent control over the towed ship or barge making it easier to maneuver in congested harbors. At least two or more harbor tugs are used for moving ships. When a submarine is towed using the alongside towing method, the tug's lines are secured to the deck cleats on the submarine.

582-11.5.2 LINES FOR TOWING ALONGSIDE. At least three lines are used when towing alongside. These is a bow line, a power line or tow line located amid ships on the tug, and a stem line.

582-11.5.3 TYPES OF LINES USED FOR TOWING ALONGSIDE. Synthetic lines of nylon, polyester or spring-lay wire ropes are used for towing alongside. Do not mix the lines. For example, if a spring-lay wire rope is used for the tow line, also use spring-lay wire rope for the bow and stern lines.

582-11.5.4 RIGGING FOR TOWING ALONGSIDE. When the tug is alongside the ship or barge to be towed the lines are passed to the tow. Sometimes a messenger line is used to pass the lines from the tug to the tow.

582-11.5.4.1 Line Passing Sequence. The tow line is passed first. Then the bow line or head line is passed. Then the stem line or stern breast line is passed. The lines are then secured to H bitts at the bow and the stern of the tug. Bow and stern capstans on the tug then take a strain on the lines and keep them taut during the operation. Figure 582-11-6 shows a typical towing alongside rig.



1. BOW OR BACKING LINE
2. TOWING LINE (POWER)
3. STERN BREAST OR TURNING LINE

Figure 582-11-6 Towing Alongside

582-11.5.4.2 Round Turns. Rope strength is best preserved on H bitts by use of round turns (figure 582-11-7). When round turns are properly used with no half hitch, the rope will retain 90 percent of its strength. When half hitches are applied for snubbing the load, effective rope strength is reduced by 40 percent because half hitches (just as knots) cause shearing of the rope.

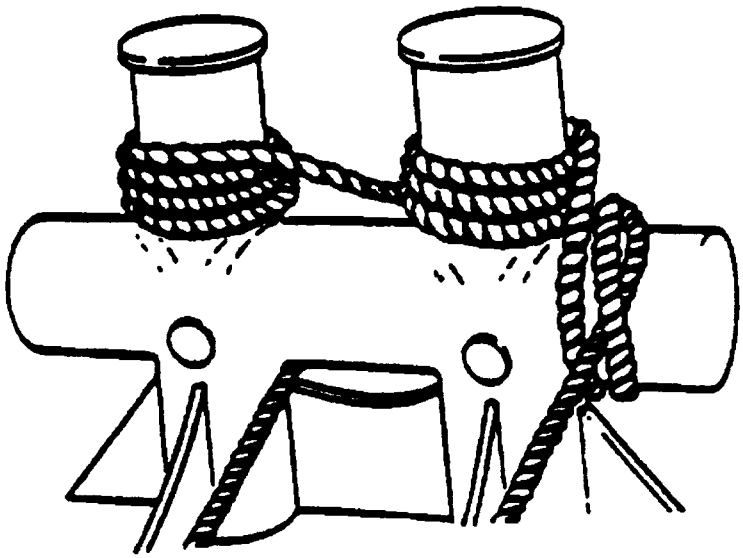


Figure 582-11-7 Correct Method Of Securing On H Bitts (round turns)

582-11.5.5 CASTING OFF THE TOW LINES. The lines are removed in reverse order after the tow has been moved to its destination. The stern line is cast off the tow first, followed by the bow line, and last, the tow line.

582-11.5.6 CONDITIONS TO BE OBSERVED WHEN TOWING ALONGSIDE. Local weather conditions, maneuvering space, wind direction, current forces, and tides should be considered when performing an alongside tow.

582-11.6 TOWING IN ICE

582-11.6.1 ARCTIC TOWING. In arctic operations it may be necessary to tow a damaged ship or expedite the movement of another ship through heavy or broken ice. For more information on towing in ice, consult the US Navy Towing Manual, 5L740-AA-MAN-010.

582-11.6.2 SHIPS FOR TOWING IN ICE. An icebreaker is best suited for towing in ice because it is capable of breaking a channel in the heavy ice and has a reinforced hull to withstand the forces of the ice. Navy ocean tugs can also tow in broken ice but are not well suited for towing in heavy ice. In a convoy with only one icebreaker, other ships in the convoy may be called upon to tow.

582-11.6.3 PROCEDURES FOR TOWING IN ICE. When towing in ice the tow should be close to the towing ship's stern to keep the ice passage ahead of the towed ship open. In ice conditions the tow catenary should be adjusted so that the hawser does not come in contact with the ice which will cause the hawser to wear and chafe. The saddle and short scope towing methods are best suited for towing in ice.

582-11.6.3.1 Saddle method for towing in ice. The saddle method can be used by icebreakers and tugs with reinforced sterns and towing machines. However, many of the U.S. Coast Guard icebreakers so equipped with towing machines and strengthened saddles have been decommissioned. A ship can be brought up and held firmly in the saddle by the towing machine. Sometimes it may be necessary for a ship without a saddle to tow by this method. If this is necessary, substantial fendering must be provided. Some steps that should be used when towing in the saddle or a variation of the saddle method are:

a. Use chafing gear.

b. Attach the tow line to the towing bridle or to both anchor chains of the tow.

c. Put the towing machine in the automatic mode to prevent the tow line from parting if the ships pitch or surge.

d. Two mooring lines can be passed from the towing ship's quarter bitts to the forecastle bitts on the tow to keep the tow following the towing ship.

e. The tow's engines can be used. If the tow starts to jackknife, the engines should be slowed until it is following properly.

f. A fire hose should be kept ready at the saddle when using the tow's engines since friction may cause fires in the chafing material.

582-11.6.3.2 Short scope towing in ice. The short scope method should be utilized by tugs and ships without stem saddles. Even for towing ships equipped with stern saddles, the saddle method may not be practical for towing a ship with a high or bulbous bow. Some steps that should be used when towing at short scope are:

a. Use both anchor chains and a towing bridle to provide extra weight in the short scope.

b. Maintain a scope of 150 to 300 feet.

c. Use the towed ship's rudder, If possible, to keep the tow in the towing ship's wake.

d. Use the towed ship's propeller to provide extra kick to help augment the rudder's force.

e. If possible, back the propeller of the towed ship if the propeller wash from the towing ship does not keep the bow of the tow from riding up on the towing ship's stern.

582-11.6.4 CONVOY TOWING IN ICE. In a convoy with only a single icebreaker, one or more of the convoy ships may have to tow. While in the ice, all ships should be prepared for towing and being towed. The time saved in rigging a tow reduces the chances of getting caught in the ice.

582-11.7 TOWING UNDER EMERGENCY CONDITIONS

582-11.7.1 CIRCUMSTANCES. The circumstances under which a ship may have to take another ship in tow are so varied that no definite rules can be set down. In view of this, it is important that officers and deck petty officers be well indoctrinated in this phase of seamanship.

582-11.7.2 INSTRUCTIONS AND PUBLICATIONS ABOUT EMERGENCY TOWING. There are several instructions and publications that discuss towing and salvage operations, which may be used to provide information and training for personnel involved with emergency towing. These documents include COMNAVSURFLANT Instruction 4740.1, COMNAVSURFPAC Instruction 4740.3, Military Sealift Command Instruction 4740.1, and Allied Tactical Publication, ATP43(A) (NAVY), a NATO unclassified publication for ship-to-ship towing. If the ship-to-be-towed normal towing arrangements are not available, a jury rig will have to be used. Examples of typical towing jury rigs can be found in ATP43.

582-11.7.3 EMERGENCY TOWING BILL. OPNAVINST 3120.32 (section 630.22) sets forth policies for assigning personnel to stations and duties in order to provide a basic organization when the ship is towing or being towed. Each ship is required to develop an emergency towing bill, which sets forth detailed towing procedures and responsibilities. The procedures should reflect the actual towing gear on the ship and how it should be

rigged when the ship is towing and when it is being towed. The personnel responsibilities list identifies the respective unit personnel and their duties when making up a tow. The weapons/deck officer is responsible for the bill. Example of tow line rigging procedures, communications during towing operations, towing personnel assignments, safety precautions, and equipment for towing operations, are listed in various sections of this chapter and can be used for guidance when preparing the ship's emergency towing bill.

582-11.7.4 EXAMPLE OF EMERGENCY TOWING DETAIL PERSONNEL ASSIGNMENTS. Table 582-11-3 shows a typical list of personnel assignments that are used during an emergency towing operation.

Table 582-11-3 EXAMPLE OF PERSONNEL ASSIGNMENTS DURING AN EMERGENCY TOW.

TITLE	NUMBER ASSIGNED	RESPONSIBILITY
Safety Officer	1	Ensure towing evolution is conducted safely
BMC/BM1	1	In charge of rigging and passing of towing hawser; reports to the first lieutenant
BM2/BM3	1	In charge of line handlers
BM3	1	Signalman STA/STA
SN/SA	1	(1JV) phone talker STA/Bridge
SN/SA	6	Towing hawser and messenger line handlers
PO (Eng)	1	Capstan operator
PO (Eng)	1	Cutting outfit
PO (Gunnery)	1	Line throwing gun
PO (HM)	1	First aid kit

NOTES:
(1) Special sea detail is set on the bridge, in main control, and after steering
(2) Line handlers will serve as towing watch as assigned
(3) Both ships are to provide their own towing hawser
(4) Anchor detail is set as required
(5) Assign personnel to cut the stops on the towing hawser as required

582-11.7.5 TOWING CASUALTY REPORT. A casualty report of the ship-to-be-towed should be made as soon as possible and reported to the ship making the tow. This report should include all relevant information on the conduct of the tow. General information such as vessel name and hull number; and ship characteristics such as length, beam, and displacement should be included. The state of the following items should also be included:

a. The propulsion system, including whether propellers are locked or unlocked, and if power is available to the anchor windlass.

b. Hull condition, including any weakened bulkheads or holes in the skin of the ship.

c. Condition (operable or inoperable) of the steering gear.

d. Condition (operable or inoperable) of deck machinery, including capstans, windlasses and winches.

e. Available towing equipment.

f. Crew condition regarding rigging for a tow and breaking out necessary equipment.

g. Will the crew remain aboard the towed vessel?

h. Communications between ships when making up the tow and during the tow.

i. General trim of tow.

NOTE

For a ship or craft to be in proper trim for towing it should draw, for each 100 feet of length, approximately one foot more water aft than it does forward. Deep draft tows use somewhat less than one foot for each 100 feet. Before trimming excessively, ensure that drafts obtained will allow sufficient clearing of the bottom at point of departure, transit, and point of delivery and that stability of tow is not impaired.

j. Will towed ship be in or require ballast? If so, what type of ballast?

k. Record forward and aft drafts of the towed ship after it is in proper trim.

l. Are all sea valves closed and wired shut?

m. Are all bilges free of oil and water?

n. Is hull damage and/or flooding under control?

o. Closely inspect all below decks' drain piping which originates above the waterline and terminates below the waterline. Check for loose connections or rusted out places in the piping.

p. The rudder(s) should be centered and locked by using a minimum of a four-inch angle iron from the ship's structural strong points to the rudder yoke, welded into place.

q. Are amber colored flooding alarm lights installed on the towed ship? This is desirable if the towed ship is unmanned and flooding is a possibility.

r. Are navigation lights installed for the towed ship?

s. If towing pads do not exist, bitts or cleats can be used but should be checked for handling the strain of towing. Ships should check their specific Towing Arrangement drawing for bitt and cleat towing capacities.

t. If bitts are used as bridle attachment points, the chain or wire should be figure-eighted with four or more figure-eights. Heavy channel iron must be welded across the bitts to prevent the chain from jumping out.

u. Are all watertight closures operable, functioning as designed, and is condition ZEBRA set throughout the ship? If the answer is unsatisfactory, list the exceptions.

v. Is the dewatering equipment in working order?

w. Is the firefighting equipment in working order?

x. Is there cargo or HAZMAT aboard?

y. For LST-type tows the following questions must have affirmative answers:
   1. Do the bow doors have hydraulic rams connected?
   2. Are mud flaps at the bottom of the doors secured?
   3. Are all dogs, heavy-weather shackle ratchet-type turnbuckles and strongbacks in place, tight and secure so that they cannot work free?
   4. Are bow ramp operating instructions posted in the hydraulic control room?

z. If the craft is equipped with a bow or stern ramp, is it secured in accordance with notes listed below?

NOTE

YFU/LCU's are inherently unseaworthy due to wide beams and flat bottoms. A lift of opportunity should be used whenever possible. If it is absolutely necessary to tow these craft, the following must be **strictly adhered to** .

1. The bow ramp will be secured with a minimum of four angle straps on each side, welded on the outside of the ramp. The size of these straps should be at a minimum of 4" by 3/8" and overlap the bow ramp and sides of the craft at a minimum of 10″.
2. All normal securing devices (i.e., ramp chains, dogs, and turnbuckles) are in place and in good mechanical order.
3. All hatches, scuttles, and doors have good gaskets and all securing devices are in proper operating condition.

aa. Submarine tows:

1. For most submarines it is not possible to use their anchor chain or fairleads for towing or for personnel to work with towing equipment on the submarine's open deck while it is at sea. It may be necessary for the towing ship to provide the towing rig and, in some cases, to connect its hawser to the submarine's equipment, which may be a special chain cable, wire rope pendant, or short synthetic towing hawser.
2. When towing a submarine the diving planes should be set at an angle of 20 to 25 degrees with their trailing edges up.

582-11.7.6 EXAMPLES OF TOWING EQUIPMENT

582-11.7.6.1 Sample List of Equipment Required for Towing. See table 582-11-4 for a typical list of equipment used by the towing ship.

582-11.7.6.2 Sample List of Equipment Required when being Towed. See table 582-11-5 for a typical list of equipment used by the towed ship.

Table 582-11-4 EXAMPLE OF TYPICAL EQUIPMENT USED BY THE TOWING SHIP

QUANTITY		ITEM
1		Pelican hook and shackle
1		Chafing chain (3 to 5 fathoms) with long link detachable links as required
1		Deshackling kit
1		600 ft tow hawser (with end fittings) and NATO link (see paragraph 582-9.3.5 for a description of the NATO link)
Messenger:	3 ea	6-thread or 9-thread manila line, 100 fathoms (600 ft)
	1 ea	1 1/2-in cir synthetic fiber line, 50 fathoms (300 ft)
	1 ea	3-in cir synthetic fiber line, 100 fathoms (600 ft) (Use 4-in cir synthetic fiber line for 10 in cir and larger towing hawsers.)
1		4 X 4 shoring timber
1		3/4-in dia wire rope pendant (jackstay) 21-thread stops (as required)
1		Sledge hammer

Table 582-11-4 EXAMPLE OF TYPICAL EQUIPMENT USED BY THE TOWING SHIP - Continued

QUANTITY		ITEM
1		Fire axe
1		Tool kit
1		Retrieving line (as required)
1		Line throwing gun/bolos
2		Heaving lines
1		Signal light/paddle

Table 582-11-5 TYPICAL LIST OF EQUIPMENT USED BY THE TOWED SHIP

QUANTITY		ITEM
1		Anchor chain
2		Chain stoppers (with locking plates)
1		Deshackling kit
4		Chain hooks
1		Cable jack
1		Detachable link (spare)
1		600-ft tow hawser (with end fittings) and NATO link
Messenger:	1 ea	1 1/2-in cir synthetic fiber line, 50 fathoms (300-ft)
	1 ea	3-in cir synthetic fiber line, 100 fathoms (600 ft) (Use 4-in cir synthetic fiber line for 10-in cir and larger towing hawsers.)
1		4 X 4 shoring timber
1		3/4-in dia wire rope pendant (jackstay) 21-thread stops (as required)
1		Sledge hammer
1		Fire axe
1		Tool kit
1		Chain bar
1		Cutting Outfit
2		Heaving lines
1		Retrieving line (as required)
1		Line throwing gun/bolos
1		Signal light/paddle

SECTION 12.

MAINTENANCE AND INSPECTION

582-12.1 TOWING GEAR.

582-12.1.1 INSPECTION AND MAINTENANCE INTERVALS (PMS). The towing rig should be inspected before and after each use. If doubt exists on the reliability, replace the tow line components.

582-12.1.2 INSPECTION PROCEDURES. The following inspection procedures for the various components of a towing rig are from a typical MRC:

a. Inspect towing pad, chafing chain, shackles and towing hawser thimble/couplings for cracks, corrosion, distortion, and uneven wear.

b. Inspect applicable towing gear accessories, such as retrieving lines, tackles, blocks, chain, pendants, preventers and grapnel hooks for deterioration, distortion, loose whippings, corrosion, and evidence of wear.

c. Lay out towing hawser and messenger; inspect for chafing, cuts, rust damage, cockling, and uneven wear.

d. Inspect stopper assembly and pelican hooks for cracks and distortion.
   1. Clean threaded and exposed working surfaces.
   2. Apply a light coat of grease, A-A-50433, to the threaded working surfaces.
   3. Apply oil to working surfaces not accessible for grease application.

e. Spread canvas tarpaulins in work areas.

f. Disassemble detachable link(s).

CAUTION

Detachable link parts are not interchangeable. Keep each link's parts together and separate from the others.

   1. Clean C-shaped link, coupling plate, taper pin, and lead plug with a wire brush dampened in solvent. Inspect for corrosion, cracks, distortion, and uneven wear.
   2. Apply a medium coat of A-A-50433 to the detachable link interior surfaces.
   3. Reassemble detachable link.

g. Repeat step 6 for each of the remaining detachable links.

582-12.1.3 INSPECTION OF WIRE ROPE BRIDLES. If wire rope bridles are used in the towing rig assembly, conduct the following inspections:

NOTE

Wear gloves when handling wire rope.

a. Flush wire rope that has been immersed in seawater with freshwater.

b. Clean wire rope bridles with a wire brush, cleaning solvent, and rags.

c. Inspect wire rope for corrosion and broken wires.

d. Measure wire rope diameter at six or more places with vernier calipers. (Figure 582-12-1 shows how to correctly measure the wire rope diameter.)

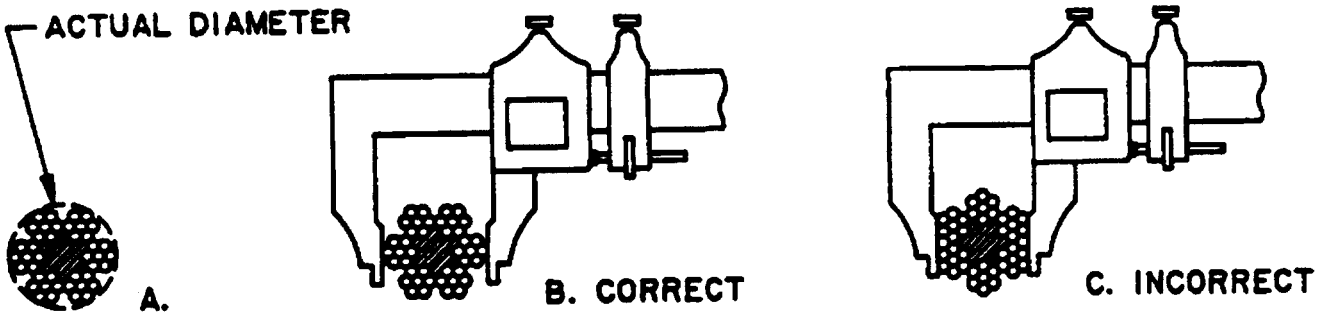


Figure 582-12-1 Wire Rope Measurement

e. Count the number of broken wires in each lay length and each strand lay length. Inspect the wire rope and replace when one or more of the following conditions exist:
   1. Evidence of pitting due to corrosion.
   2. Nominal diameter is reduced by more than the amount shown in table 613-1 of NSTM Chapter 613, Wire and Fiber Rope and Rigging. (Nominal diameter is the new wire rope diameter.)
   3. Wear of 1/3 of the original diameter of the outside individual wires.
   4. Six broken wires in one rope lay length, or three broken wires in one strand lay length
   5. One broken wire within one rope lay length of any end fitting.
   6. Kinking, crushing, birdcaging or any other evidence of damage resulting in distortion of the rope structure.

f. Clean and inspect the following wire rope end fittings for cracks, deformity, and tightness of fit, as applicable:
   1. Poured sockets -- inspect for deterioration of zinc.
   2. Fiege fittings -- determine that wires are visible through inspection hole.
   3. Swage fittings -- inspect for deterioration, cracks, and evidence of wear and looseness.

g. Apply a medium coat of grease, MIL-G-18458, to clean portion of wire rope.

h. Remove excess lubricant.

i. Touch up chafing chain, shackles, and stopper assembly with paint.

j. Allow all parts to air dry; then tag for identification and restow.

582-12.1.4 STORAGE AND CARE OF FIBER AND WIRE ROPE TOWING HAWSERS. The synthetic towing hawser should not be stowed where it will be exposed to direct sunlight or where it can contact bare iron surfaces. See NSTM Chapter 613, Wire and Fiber Rope and Rigging, section 1 and section 2, for the care, storage, and preservation of wire rope and fiber rope.

582-12.2 TOWING WINCHES AND RELATED EQUIPMENT

582-12.2.1 INSPECTION AND MAINTENANCE INTERVALS (PMS). Components of a towing winch are inspected at various intervals.

a. The zinc anodes in the hydraulic drive unit salt water cooler are inspected weekly or every 24 hours when the towing machine is operating.

b. The tow rollers are inspected and lubricated monthly and prior to each towing operation.

c. The towing machine is lubricated and test operated monthly.

d. The brakes and controller are inspected semiannually.

e. The towing gear accessories, winch control components, clutch brake compressor, and motor are inspected annually.

APPENDIX A

REFERENCES

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3. U.S. Navy Naval Shiphandling, R.S. Crenshaw, Jr., Captain, U.S. Naval Institute, Annapolis, Maryland

582-A.2 NSTM's

4. NSTM 581, Anchoring
5. NSTM 611, Fenders and Separators
6. NSTM 613, Wire and Fiber Rope and Rigging
7. NSTM 997, Docking Instructions and Routine Work in Dry Dock

582-A.3 SPECIFICATIONS

8. General Specifications for Overhaul of Surface Ships (GSO), NAVSEA S9AA0-AB-GOS-010
9. General Overhaul Specifications for Deep Diving SSBN/SSN Submarines (DDGOS)
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582-A.4 INSTRUCTIONS

11. OPNAVINST 5100.19, Navy Safety Precautions for Forces Afloat
12. OPNAVINST 5100.23, Navy Occupational Safety Health (NAVOSH) Program
13. NAVSEAINST 4740.9, Towing of Unmanned Defueled Nuclear Powered Submarines
14. OPNAVINST 3120.32, Standard Organization and Regulations of the U. S. Navy
15. NAVSAFECEN 5100/35-395, Shopping Guide
16. COMNAVSURFLANT Instruction 4740.1, Ocean Towing Instruction
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18. COMSC Instruction 4740.1

582-A.5 DESIGN MANUALS / DATA SHEETS / MIL-HDBK's

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20. MIL-HDBK-1026/4, Mooring Design
21. UFC 4-150-08, Inspection of Mooring Hardware
22. MO-104.1, Maintenance of Fender Systems and Camels

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24. Allied Tactical Publication, ATP 1, volume II, Section 3007, Flag Signals
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27. Turpin, LCDR Roger J.B., RN and Samson Brand, Hurricane Havens Handbook for the North Atlantic Ocean, Naval Environmental Prediction Research Facility, Technical Report TR 82-03

582-A.7 MILSPEC's

28. Capstans: MIL-C-17944
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30. Rope, Nylon Plaited: MIL-R-24337
31. Rope, Nylon: MIL-R-17343
32. Rope, Fibrous, Double-braided (Nylon): MIL-DTL-24050
33. Rope, Polyester: MIL-R-30500
34. Rope, Fibrous Polyester, Eight Strand Plaited: MIL-R-24730
35. Rope, Fibrous, Single-Braided 12 Strand Polyester: MIL-R-24750
36. Ropes (Aramid): CID A-A-50435
37. Guard, Rat, Ship; MIL-G-2767

582-A.8 DRAWINGS

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39. Coupling & Intermediate Connecting Link for Single Part Synthetic Rope: NAVSEA Dwg No. 803-5000916
40. Chain Stoppers (Tabulation of Sizes) for Chain Cable: NAVSEA Dwg. No. 804-860000 (2 sheets)
41. Detachable Links for Chain Cable: NAVSEA Dwg. No. 803-860062
42. Mooring Shackles for use with Permanent Moorings: NAVSEA Dwg. No. 803-92 1734
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44. Capstan and Gypsy Heads: NAVSEA Dwg. No. S2601-860303
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46. Bitts for Synthetic Rope: NAVSEA Dwg. No. 804-1843362
47. Recessed Shell Bitt: NAVSEA Dwg. No. 805-1841948
48. Horizontal Hawser Reels: NAVSEA Dwg. No. S2604-921841
49. Vertical Hawser Reels: NAVSEA Dwg. No. S2604-921842
50. Hull Type Drawing, Closed Chock, 16-inch Two Roller: NAVSEA Dwg. No. S1201-921623
51. Cleat: NAVSEA Dwg. No. 804-860099
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53. Thimble, Towing: NAVSEA Dwg. No. 803-6397321
54. Thimble and Link: NAVSEA Sketch No. 56W41-14A
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56. SW350-A1-MMO-010, Line Throwing Gun
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APPENDIX B

GLOSSARY

582-B.1 LIST OF TERMS

Abrasion. The wear of wire or fiber rope caused by sliding friction over fixed surfaces

Anchor windlass. Machine used to hoist and lower anchors

Automatic towing machine/winch. Winch-like machine which relieves tension on the tow line by automatically paying out and then reclaiming wire payed out when the tension is reduced; found on fleet tugs and salvage ships

Bail. The part of a pelican hook or chain stopper that holds the hook closed

Barrel. The rotating drum of a capstan or winch

Beam. The extreme width of a vessel, broadside

Bight. The middle, loop, or bent part of a rope, as distinguished from the ends.

Birdcaging. The flaring out of wires in wire rope around the full diameter of a rope, with resulting kinks in the wires; this can occur when there is a sudden release of a heavy load on a wire rope

Bird Nest. After reeving a mooring line around a bitt, neatly lay the free end of the line on top of the bitt.

Bitt. A pair of metal posts or barrels to which mooring or towing lines are made fast

Bitter end. The last part of a rope or chain, in contrast to the middle part or bight

Bollard. Single posts secured to a wharf or pier; used for mooring vessels by means of lines extending from the vessel

Bow line. The mooring line that runs through the bull nose or chock at or near the bow of the ship

Breaking strength. Ultimate or actual: The load require to pull a wire, strand or rope to destruction; Aggregate: The sum of the individual breaking loads of all the wires in a strand or rope

Breast line. A mooring line from ship to pier or ship to ship, perpendicular to the fore and aft axis or at right angle to the ship

Bridle. A two-legged towing rig of wire or chain attached to towing pads or a set of bitts on the tow; at the apex is a flounder plate or ring, dependent upon whether a chain bridle is being used (The two legs and the imaginary line between tile points of attachment should form an equilateral triangle.)

Bullnose. A closed chock in the stem of a ship

Bulwark. Section of a ship's side, continued above the main deck, as protection against heavy weather

Capstan. A revolving device with a vertical axis, used for heaving in mooring lines (mooring and warping)

Catenary. The curve of a rope suspended between two points

Chafing chain. A length of chain used to reduce chafing or wearing

Chain. A connected, flexible series of links, used for binding, connecting or other purposes

Chain bridle. A chain used in a bridle rig

Chain stopper. A device used to secure chain, thereby relieving the strain on the windlass; also used for securing the anchor in the housed position in the hawser pipe

Check. To slack slowly while keeping a strain on the line without parting the line

Chock. A heavy smooth-surfaced fitting usually located near the edge of the weather deck through which wire ropes or fiber rope hawsers may be led

Cockle (Hockle). Kinking of one or more strands of twisted fiber line, or of wires on a wire rope

Core (wire rope). The axial member of a wire rope about which the strands are laid; (It may consist of a wire strand, wire rope, synthetic or natural fiber, or solid plastic.)

Deshackling (detachable tool) kit. Used for assembling and disassembling detachable links (Included in these sets are hammers, punches, lead pellets, spare taper pins and hair pins.)

Detachable link. A joining link or chain link used to connect chain to anchors, chain or other pieces of mooring, towing or beach gear equipment

Eye splice. A loop formed at the end of a rope by joining the end of the rope with the body of the rope (Different techniques and tools are used to make eye splices depending on the type of rope construction, i.e. three-strand, plaited, or double-braided.)

Fairlead. Metal fittings which lead lines in the direction desired

Fake. To lay out a line in long, flat bights

Fast. To secure, as to make fast a line to a cleat

Fathom. A unit of length equal to six feet

Flounder plate. A triangular steel plate to which chain bridle legs are connected

Grapnel. A small anchor with several claws used to recover objects in the water

Gypsy head. The drum of the winch, around which a rope is turned, for heaving in

H bitt. A large structure mounted on the deck or in a bulkhead used to lead or stop off a tow hawser; may be used on tugs; a head point used for towing

Hawser. A heavy line or wire rope; any line over five inches in circumference

Heave around. To haul in

In step. An expression used to indicate that the towing ship and its tow are riding the crests and troughs of waves simultaneously

Jackstay. Horizontal wire or line rigged for a special purse to which articles such as seabags, tackles, cods of lines and small-cordage ropes can be lashed or hung

Knot. Nautical speed equal to 1.15 statute miles per hour

Lay. The direction of the twist of strands of a rope

Lay length. The distance, measured parallel to the axis of the rope (or strand), in which a strand (or wire) makes one complete helical convolution about the core (or center)

Line. A term frequently applied to a natural or synthetic fiber rope, especially if it moves or is used to transmit a force

Messenger. A light line used for hauling over a heavier rope or hawser

Monkey Fist. Weighted knot in the end of a heaving line

Padeye (horizontal, vertical). A metal structure with a hole for a shackle or pin (On a vertical padeye, the axis of the hole is parallel to the deck. On a horizontal padeye, the axis is perpendicular to the deck. Vertical padeyes are often referred to as free-standing padeyes.)

Pay out. To slack off on a line

Pelican hook. A hook which can be opened while under a strain by knocking away a locking bail which holds it closed; used to provide an instantaneous release

Pendant. A single wire or chain that leads from the apex of a towing bridle to the tow line

Preventer. Any line, wire or chain whose general purpose is to act as a safeguard in case some thing else carries away

Roller chock. A chock fitted with a roller

Rope. A group of strands of fibers or wires, twisted or braided together, to form a single pliable member

Roust. To rout, as from a place

Safety shackle. A connecting device similar to the common shackle except that a hole is drilled in the bolt to accommodate a cotter key for locking the nut on the bolt

Shackle (anchor, chain). U-shape metal fittings, closed at the open end with a pin; used to connect wire and chain to padeyes, etc. (The anchor-type has an exaggerated bow; the chain-type has parallel sides.)

Shot. A standard length of chain, nominally 15 fathoms (90 feet)

Slip. The space between adjacent piers

Spliced eye. A synthetic rope termination formed by unlaying the rope and intertwining the strands to form an eye

Spring line. A mooring or docking line leading at an angle less than 45 degrees with the fore and aft lines of the ship; used to turn a ship or prevent it from moving ahead or astern

Stern line. A mooring line leading from the stern of a ship

Stopper. A short length of rope secured at one end and used to stop it from running

Swage. To connect, splice or terminate wire rope by use of steel fittings, installed under extremely high pressure

Swivel. An anchor chain component fitted to turn freely and reduce twisting and kinking of the anchor chain

SWL (safe working load). The load that a rope or working gear may carry economically and safely

Synthetic tow line. A line or pendant used for towing; made from any of a group of synthetic long fibers

Tattletale. A length of light cord attached to a synthetic hawser in order to give warning when the load approaches the hawser's limit

Thimble. A grooved metal component fitted snugly into an eye splice

Towing hawser. The towing member which connects the towing ship to the towed ship

Towing pad. Large padeye to which a tow line may be attached

Towing padeye. A padeye designated or dedicated for connection to the tow hawser or bridle

Turnbuckle. A metal appliance consisting of a threaded link bolt and a pair of opposite-threaded screws, capable of being set up or slacked off; used for setting up standing rigging or stoppers

Unitas. Means unity. It is a joint naval exercise between the United States, Argentina, Brazil, Uruguay, and France

Veer. To pay out chain or line

Warping (winch). Moving a ship (normally sideways) by hauling on a line attached to some fixed object such as a buoy or dock (A warping winch is similar to a capstan except that the warping head or heads are mounted on a horizontal shaft.)

Wire rope. Rope made of wire strands twisted together, as distinguished from the more common and weaker fiber rope

Wire rope pendant. A long wire strap

APPENDIX C

DETAILED MOORING PROCEDURES

582-C.1 MEDITERRANEAN TYPE MOORING PROCEDURES FOR TENDERS.

Following is an example of a Mediterranean mooring/unmooring procedure used at NATO Santo Stefano, Italy. It is provided for information only.

A. PREREQUISITES FOR MOORING

1. Conduct a brief with the CO, XO, Ship's Control watchstanders and Deck Department Personnel/Boat Operations personnel and stage all equipment on the forecastle and fantail listed in Tables 582-C-1 and 582-C-2.
2. Test the forward and aft anchor windlasses and capstans.
3. Inspect line throwing gun, projectiles and spools.
4. Pier crane is ready to handle personnel brow.
5. Small boat and buoy party is standing by.
6. Communication circuits are determined for Deck Operations and Tug Control.
7. Weather and sea conditions at the moor (wind speed, current) are passed to the Officer of the Deck.

B. FORECASTLE PRELIMINARY MOORING PROCEDURES

1. Set the port and starboard windlass controls to neutral.
2. Set the port and starboard windlass brakes.
3. Direct anchor windlass room to light off and warm up port and starboard anchor windlass.
4. Test port capstan in all speeds in both directions.
5. Test starboard capstan in all speeds in both directions.
6. Trip and clear the port anchor chain riding stopper.
7. Release the port anchor windlass brake, ease the port anchor chain out under power and roust the anchor chain until enough slack is on deck to break the detachable link between the anchor chain and the outboard swivel shot.
8. Pass the chain preventer bar through the anchor chain at the chain pipe. Heave in the anchor chain until the chain preventer bar is resting firmly across the chain pipe. Set the port anchor windlass brake.
9. Break the detachable link between the anchor chain and the outboard swivel shot on the port anchor.
10. Remove the chain preventer bar.
11. Ease out the port anchor chain under power, using the capstan if possible, and roust the anchor chain until the anchor chain is at the port forward closed chock.
12. Pass the anchor chain preventer bar. Ease the port mooring chain in until the preventer bar is resting firmly across the chain pipe.
13. Set the port anchor windlass brake.

NOTE

Forward moor is ready. Starboard anchor is ready anchor for letting go.

C. FANTAIL PRELIMINARY MOORING PROCEDURES

1. Set the windlass control to neutral.
2. Set the windlass brake.
3. Direct the electrical and mechanical controllers to light off and warm up the anchor windlass.
4. Test the gypsy head in both directions in all five speeds.
5. Engage the anchor windlass.
6. Remove the hawse pipe cover.
7. Release the windlass brake. Heave around on the anchor chain until the strain is off the housing chain stoppers. Set the brake.
8. Trip and clear the riding/housing chain stoppers.
9. Release the brake. Ease out the anchor until the end link is clear for passing the 2 1/2” anchor shackles.
10. Pass the 2 1/2” anchor shackles through the end link of the outboard swivel shot. Attach the anchor shackles to the hard eyes of the anchor pendants.
11. Attach the plated anchor pendent messengers to the upper end of the anchor pendants. Ensure the plaited messengers are rigged through the hawse pipe.
12. Pass the respective bitter ends of the anchor pendent to the seaman positioned over the anchor pendent padeyes on the stern.
13. Release the brake. Ease out the anchor while ensuring that the anchor is held clear of the anchor chain.
14. When the anchor pendants are out far enough to be connected to the padeyes on the stern, set the brake.
15. Connect the anchor pendants to the pendent padeyes on the stern.
16. Release the brake. Lower the stern anchor until the anchor pendants have the weight of the anchor and the chain is starting to go slack. Set the brake.
17. Pass a wire rope prevented around the stud of a common link of chain and secure it around the elephant’s foot.
18. Pass the five inch chain rousing line through the chain on the deck.
19. Release the brake. Simultaneously ease out and roust the anchor chain until the wire rope preventer around the elephant’s foot is under strain and four links of slack chain are on the deck. Set the brake.
20. Pass two wire rope chain preventers through the anchor chain by the wildcat and secure them to a shackle in the towing padeye on the deck.
21. Break the detachable link joining the outboard swivel shot and the anchor chain.
22. Disengage the anchor windlass
23. Connect the 5” rousing line to the end of the outboard swivel shot and take it to power with five turns on the starboard gypsy head.
24. Heave in on the 5” rousing line until the strain is off the wire rope chain preventer at the elephant’s foot.

25. Remove the wire rope chain preventer.
26. Lower the outboard swivel shot under power until it is hanging down to the water's edge and the 5" rousing line is slack and clear of the hawse pipe.
27. Remove the 5" line from power; clear it from the hawse and fake it on the life rails.
28. Fairlead the bitter end of the 1 1/2" circumference heaving line out through the hawse pipe and temporarily secure it to the stern turntable life line.

D. NATO SITE SANTO STEFANO MOORING PROCEDURES

Step 1:

a. Ensure that the buoy party is in a workboat with buoy bag and all equipment necessary for mooring.
b. Approximately 300' from the buoy and with forward motion off the ship, have small boat take the Kevlar messenger and connect it to the buoy messenger.
c. With all way off, heave around on the messenger until the anchor chain is on deck. Pass a stopper. Keep personnel clear, watch the strain on the Kevlar line and ensure it does not become fouled on the capstan.
d. When chain is made up, engage the windlass, and heave around until all slack is on deck. Pass a stopper, set the brake, and disengage the windlass.
e. Pivot ship into center of the moor. Once centered, connect distance line to the pier.
f. Engage the windlass, remove port stopper, and pay out port anchor chain to 2 shots at the closed chock. Set the brake, pass the stopper and disengage the windlass.
g. Have the forward tug move the bow to the starboard buoy.

Step 2:

a. Trip and clear the starboard anchor chain riding stopper.
b. Release the starboard anchor windlass brake. Simultaneously ease out the starboard anchor chain under power and roust the anchor chain until enough slack chain is on deck to break the detachable link between the anchor chain and the outboard swivel shot.
c. Pass the chain preventer bar through the anchor chain at the chain pipe. Heave in the anchor chain until the chain preventer bar is resting firmly across the chain pipe. Set the starboard anchor windlass brake.
d. Brake the detachable link between the anchor chain and the outboard swivel shot on the starboard anchor.
e. Release the starboard anchor windlass brake. Ease the starboard anchor chain out under power until the preventer bar can be removed. Remove the preventer bar.
f. Simultaneously ease out the starboard anchor chain under power with rousing lines until the anchor chain is rusted to the starboard/forward chock.
g. Pass the anchor chain preventer bar. Ease the starboard mooring chain in until the preventer bar is resting firmly across the chain pipe.
h. Set the starboard windlass brake.
i. Send the Kevlar messenger to the workboat. Disengage the starboard windlass.
j. Connect the messenger and heave around until anchor chain is on deck. Pass a stopper and connect the mooring chain.

k. With both port and starboard mooring chains connected, disconnect stoppers and heave around on both chains until 2 shots are at the wildcat. Set the brakes and pass the stoppers.

Step 3:

a. With the ship backing to the pier and the distance line connected to the pier, the Tug Control Officer will maintain the ships stern in the “center” of the moor while passing the stern pier distances to the Officer of the Deck on the Bridge.

b. When the ship is Stationary and about 40’ from the pier and centered in the moor, have the fantail detail haul in on the 10” messenger.

c. Pass the heaving line down to the pier.

d. After the heaving line is attached to the 300’ 5” messenger, heave around and bring the messenger onboard.

e. Take the 5” messenger to power on the starboard gypsy head. Feed from the bottom.

f. Heave in until the 10” messenger is on deck. Take the 10” messenger to power and heave in on the slack line.

g. Continue heaving until the stern mooring chain is on deck and in position to be stopped off.

h. Pass the mooring chain housing stopper.

i. Slack the stern mooring chain and the 10” messenger until the mooring chain stopper is under strain and the 10” hawser is slack.

j. Disconnect the 10” messenger from the mooring chain and clear it from the gypsy head.

k. Connect the mooring chain to the ship’s anchor chain with a 2” detachable link.

l. Engage the anchor windlass.

m. Remove the wire rope chain preventer from the anchor chain.

n. Release the anchor windlass brake; heave in on the anchor chain until the strain is off the chain stopper. Set the brake.

o. Trip and clear the housing chain stopper.

NOTE

It is important to coordinate the ship speed with the anchor chain haul in speed to ensure that the windlass does not try to pull the ship toward the pier.

p. Release the anchor windlass brake. Heave in on the stern mooring chain at slow speed, so as not to foul the propeller, until the yellow link is at the towing bitt.

q. Pass the mooring chain housing stopper on the mark.

r. Pass the mooring chain riding stopper on the mark.

s. Adjust both chain stopper turnbuckles to take an equal strain on the mooring chain.

t. Release the brake. Ease out the mooring chain until it is slacked between the riding stopper and anchor windlass. Set the brake.

NOTE

Forecastle personnel will release and adjust port/starboard forward moors until equal amounts of chain are paid out on each. Once the bridge is satisfied that the ship is settled snug in the moor, set the brake, pass the housing, and riding stoppers. Release both brakes and ease out on the port/starboard mooring chains until it is slacked between the riding stoppers and anchor windlass.

E. UNMOORING Conduct an Unmooring brief with the Commanding Officer, The Executive Officer, Ship's Control Watchstanders, Deck Department and Boat Operations supervisory personnel. Perform unmooring procedures in step by step method similar to mooring procedures.

Table 582-C-1 FORECASTLE MOORING EQUIPMENT LIST AND WATCHSTATIONS

Amount	Item	Description
2	Detachable links (pear-shaped)	3" heavy die-lock detachable link used to attach mooring chain to the anchor chain.
2	Chain stopper assemblies	3 1/2' chain stopper assemblies attached towing padeyes. Used to secure mooring chain to deck. Forward chain stopper has been lengthened with 14 links of chain to reach the bullnose.
16	Personnel chain rousting lines	8' x 2 1/2" plaited line with the bitter an sized and burned. Used to roust the mooring chain.
1	Dip rope shackle	Dip rope shackle for 3" chain. Used to roust mooring chain.
1	3" Detachable link kits	3" detachable link kit. Used to assemble/disassemble detachable links.
4	Pry bars	5' pry bars used to work chain and chain stoppers.
2	Cable jacks	Cable jacks (chain jacks) used to move anchor chain and stoppers.
1	Sound-Powered	Sound-Powered phones with 100' salt/pepper line.
1	Hand-held radio	Used to communicate with the small boat and buoy party.
2	Spring lay wire	300'x2" with eyes spliced at each end.
2	Chain preventer bars	Stainless steel bars used to prevent chain from running back into the chain locker once it has been disconnected or deck.
4	Wood blocks	4″x4″x 12" wood blocks used to block chain stopper turnbuckles.
1	Chain stopper wrench	5' long turnbuckle wrench used to adjust chain stoppers.
1	Speed wrench	3' long turnbuckle wrench. Used to adjust chain stopper quickly.
1	Sledge hammer	8lb sledge hammer.
1	Maul	4lb maul.
1	Detachable link taper pin tool	Long-handled punch used to drive out detachable link taper pin.
1	Chain hook	Used to roust anchor chain and ground tackle.
1	General purpose grease	For lubricating turnbuckles.
1	4' wire rope	5/8″x4' wire rope with 12" soft eyes used to prevent anchor chain from running to chain locker.
1	White lead and tallow	Used to lubricate detachable links.
10	Rags	Used to clean excess grease from ground tackle.
2	Kevlar messengers	300'x5" Kevlar line used as a messenger to bring the spring lay on board.
2	Turnbuckle tools (Palenko's tool)	1/2″x 15" stainless steel bars used to turn turnbuckles.
2	35-ton anchor shackles	35-ton (SWL) anchor shackles used to connect the spring lay to the bitter end of the mooring chain.
1	Heaving line	100' heaving line used to pass plaited messenger to small boat.
1	Boat hook	12'boat hook.
1	Grappling hook	100' of 1/2" line attached to a Grappling hook.
1	Towing hawser	10" double-braided towing hawser used release and recover the after anchor mooring assembly
1	Kevlar messenger	300'x5" Kevlar messenger used to retrieve the 10" towing hawser
1	Plaited messenger	Used to recover mooring chain messenger on deck

Table 582-C-1 FORECASTLE MOORING EQUIPMENT LIST AND WATCHSTATIONS - Continued

Amount	Item	Description
1	Anchor chain rousting	200’x5” double-braided line used to roust outboard swivel shot on stern anchor

Table 582-C-2 FANTAIL MOORING EQUIPMENT LIST AND WATCHSTATIONS

Amount	Item	Description
2	Chain stopper assemblies	3 1/2’ chain stopper assemblies attached towing padeyes. Used to secure aft anchor chain to deck.
6	Personnel chain rousting lines	8’ x 2 1/2” plaited line with the bitter sized and burned. Used to roust the mooring chain.
1	Detachable link kits	2 3/4” detachable link kit. Used to assemble/disassemble detachable links.
4	Pry bars	5’ pry bars used to work chain and chain stoppers.
1	Cable jacks	Cable jacks (chain jacks) used to move anchor chain and stoppers.
1	Sound-Powered	Sound-Powered phones with 100’ salt/pepper line.
1	Hand-held radio	Used to communicate with the small boat and buoy party.
2	Sledge hammer	8lb sledge hammer.
1	Maul	4lb maul
1	Detachable link taper pin tool	Long-handled punch used to drive out detachable link taper pin.
1	General purpose grease	For lubricating turnbuckles.
3	Wire rope preventers	5/8″x4’ wire rope with 12” soft eyes used to prevent anchor chain from running to chain locker.
1	White lead and tallow	Used to lubricate detachable links.
10	Rags	Used to clean excess grease from ground tackle.
2	Turnbuckle tools (Palenko’s tool)	1/2″x15” stainless steel bars used to turn turnbuckles.
2	35-ton anchor shackles	35-ton (SWL) anchor shackles used to connect the spring lay to the bitter end of the mooring chain.
2	Heaving line	100’ heaving line used to pass plaited messenger to small boat.
2	Detachable links	3 inch HD detachable link used to attach mooring chain to the anchor chain
1	Boat hook	12’ boat hook.
3	Shackles	Shackles to be used in conjunction with wire rope preventers
1	Megaphone	Used to communicate with tugs and the pier.

582-C.2 MEDITERRANEAN TYPE MOORING PROCEDURES FOR COMBATANTS.

An example is provided below for Med-type moor for a DDG 51 Class ship for information only. Other combatants will use wildcats in lieu of a compressor for mooring as is the case for DDG 51 class ships. A tugboat is to be present for emergency.

A. DDG 51 Class Figure 582-C-1 shows the steps to be taken in a Mediterranean Moor. For a ship of DDG 51 Class, with a length overall of 504’-6″, using 75 fathoms of chain, the first anchor (bow) should be dropped about 320 yards from the mole or pier and about 50 yards short of a position abreast the berth. Hit a back one-third bell as ship comes to a stop and drop the anchor as soon as stern way is apparent.

CAUTION

Care must be taken when veering out anchor chain that it does not drag across the sonar dome.

B. The second anchor should be dropped about 50 yards past the berth. The second or port anchor should be let go from the chain compressor.

C. The stern can then be twisted toward the mole and the stern line run out. As the stern approaches the mole, it's advisable to shift the conn to the stern of the ship to position the ship accurately.

NOTE

The stern line holding the stern in close to the pier against the strain of the anchor chain must never be led from the aftermost chock straight down to the pier. A maximum of 25 degrees or less from the horizontal is required.

D. The stern is then secured to the mole using a stern line and two quarter lines. After the stern is secured, the moor should be made taut by heaving in and equalizing the anchor chains. When the ship is in its final position, both anchor chains should be taking a moderate strain and standing well out of the water.

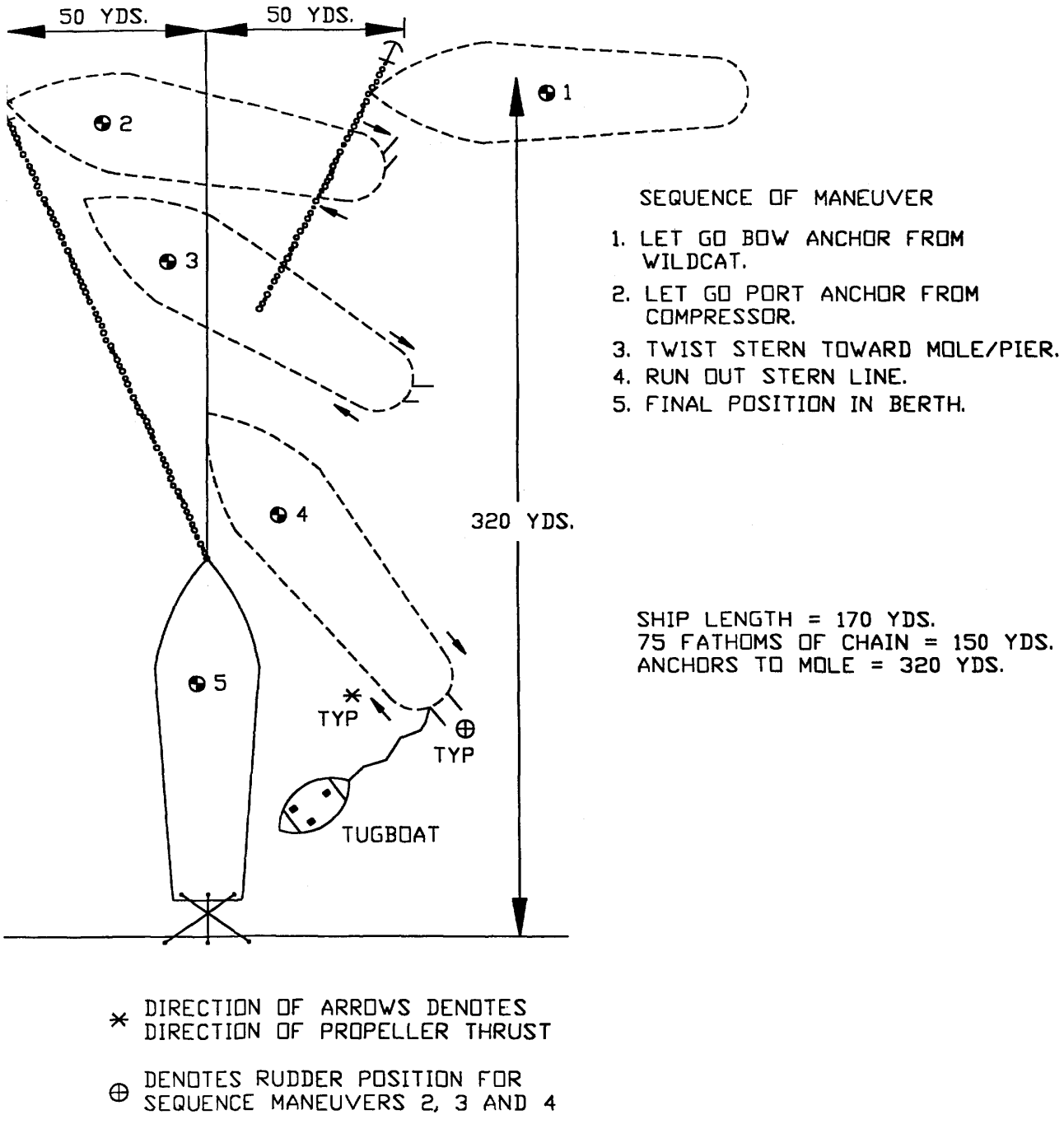

Figure 582-C-1 Mediterranean Moor for DDG-51 Class Ships

APPENDIX D

TATTLETALE INSTALLATION PROCEDURE

Tattletale Installation

1. Cut 92” segment of tattletale cord.
2. Mark off a 52” section in the middle of the tattletale, approximately 20” from each end. (Use a marker). Put an additional mark at the center of the marked off section, 26” from either reference point.
3. Mark off a 48-3/4” section on the mooring line (Again, use a marker). Put an additional mark at the center of the marked off section, 24-3/8” from either reference point.
4. At each reference point on the mooring line, thread one end of the tattletale around one strand and tie it off with a clove hitch followed by 4 half hitches.
5. Make sure that the marks on the tattletale line up with the marks on the mooring line.

Check Tattletale Length

1. Measure distance on mooring line between knots of tattletale. Distance should be 48-3/4” on New Rope. Distance should be 50” after rope has been used.
2. Pull tattletale taut in the middle. Measure the distance between the center point on the tattletale and the center point on the rope. Distance should be between 8-1/2” and 9-3/4” on new rope. Distance should be between 6-1/2 and 7-3/4” for used rope.

Tattletale Installation (Longer Option)

1. Cut 144” segment of tattletale cord.
2. Mark off a 104” section in the middle of the tattletale, approximately 20” from each end. (Use a marker). Put an additional mark at the center of the marked off section, 52” from either reference point.
3. Mark off a 97-1/2” section on the mooring line (Again, use a marker). Put an additional mark at the center of the marked off section, 48-3/4” from either reference point.
4. At each reference point on the mooring line, thread one end of the tattletale around one strand and tie it off with a clove hitch followed by 4 half hitches.
5. Make sure that the marks on the tattletale line up with the marks on the mooring line.

Check Tattletale Length

1. Measure distance on mooring line between knots of tattletale. Distance should be 97-1/2” on New Rope. Distance should be 100” after rope has been used.
2. Pull tattletale taut in the middle. Measure the distance between the center point on the tattletale and the center point on the rope. Distance should be between 17-1/2” and 19” on new rope. Distance should be between 13-1/2 and 15” for used rope.

APPENDIX E

TECHNICAL MANUAL DEFICIENCY/EVALUATION REPORT(TMDER)

NOTE

Ships, training activities, supply points, depots, Naval Shipyards, and Supervisors of Shipbuilding are requested to arrange for the maximum practical use and evaluation of NAVSEA technical manuals. All errors, omissions, discrepancies, and suggestions for improvement to NAVSEA technical manuals shall be reported to the Commander, NAVSURFWARCENDIV, 4363 Missile Way, Port Hueneme, CA 93043-4307 in NAVSEA/SPAWAR Technical Manual Deficiency/ Evaluation Report (TMDER), NAVSEA Form 4160/1. To facilitate such reporting, print, complete, and mail NAVSEA Form 4160/1 below or submit TMDERS at web site http://nsdsa.phdnswc,navy.mil/tmder/tmder.htm. All feedback comments shall be thoroughly investigated and originators will be advised of action resulting therefrom. Extra copies of NAVSEA Form 4160/1 may be requisitioned from DDSP Susquehanna Pennsylvania, 05 E Street, Mechanicsburg, PA 17055-5003. (S/N 0116-LP-019-5300)

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