National Defence / Défense nationale

B-GN-181-105/FP-E00

CANADIAN FORCES CFCD 105

SEAMANSHIP RIGGING and PROCEDURES MANUAL

CFCD 105 Fleet Seamanship Rigging and Procedures Manual

FOREWORD

2000

1. *CFCD 105 Fleet Seamanship Rigging and Procedures Manual* is an unclassified publication issued under the authority of the Chief of the Maritime Staff.

2. It is permissible to make extracts or photocopies from this document.

3. Suggestion for amendments should be forwarded by letter to CMS Ottawa Attention: DMPPD 3-5 Seamanship, with information copies to the MARLANT/MARPAC Formation Seamanship Authorities as appropriate (CANSEATRAINLANT/ CANSEATRAINPAC). DMPPD 3-5 will issue message amendments to CFCD 105 under my authority whenever appropriate. These shall take the form of sequentially numbered AIG 1861 messages. (messages). A file of current AIG 1861 shall be maintained by all units holding CFCD 105. Annual reviews of this publication, including messages in effect, will be conducted by DMPPD 3-5 to maintain currency.

4. This document is in the process of being translated into French and will be distributed in bilingual format in due course.

AVANT-PROPOS

2000

1. *La DCFC 105 Manuel de matelotage - Gréage et procédures* est un document sans classification et est publié avec l'autorisation du Chef d'état-major des Forces maritimes (CEMFM).

2. Il est permis de tirer des extraits ou de faire des photocopies du présent document.

3. Prière d'envoyer les propositions de modification par écrit au CEMFM (Ottawa) à l'attention du Directeur - Politique et élaboration de projets maritimes 3-5 (DPEPM 3-5) et d'acheminer des copies pour information aux autorités en matelotage de la formation FMAR(A)/FMAR(P), selon le cas (Commandant - Entraînement maritime (Atlantique) / Commandant - Entraînement maritime (Pacifique) (CANSEATRAINLANT/CANSEATRAINPAC). Le DPEPM 3-5 publiera les modificatifs à la DCFC 105, s'il y a lieu, avec mon autorisation. Ces modificatifs prendront la forme de messages AIG 1861 numérotés suivant un ordre séquentiel. Un dossier de tous les messages AIG 1861 en vigueur sera tenu par toutes les unités qui détiennent des DCFC 105. Le DPEPM 3-5 vérifiera annuellement la pertinence de cette publication, y compris les messages en vigueur, afin d'en assurer la pertinence.

4. Le présent document est à l'étape de la traduction et sera diffusé en format bilingue dès que possible.

Le chef d'état-major des Forces maritimes
le vice-amiral
G.R. Maddison

G.R. Maddison
Vice-Admiral
Chief of the Maritime Staff

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CHAPTER 1
Introduction

1.1 Aim

The aim of *CFCD 105 - Seamanship Rigging and Procedures Manual* is to provide fleet officers and seamen with the direction and guidance required to safely and professionally conduct all seamanship tasks associated with putting Canadian warships to sea.

1.2 Scope

The modernization of the Canadian Navy, which stemmed from the introduction of the HALIFAX, improved IROQUOIS and KINGSTON Class ships to the fleet, and the retirement of the steam-powered destroyers, resulted in many changes that directly affected the conduct of seamanship evolutions. CFCD 105 incorporates those changes, and as such, is intended as the Canadian Navy's primary source document on all aspects of seamanship. CFCD 105 is not limited to depictions of rigging arrangements and procedures for use, but also includes much general seamanship information and guidance. The primary reference from which the general seamanship material was compiled is the Royal Navy's *Admiralty Manual of Seamanship* (BR 67), May 1995.

1.3 Format

CFCD 105 commences with a description of the seamanship organizations in place at all levels of the Canadian naval chain of command. General concepts, terminology, safety procedures, and generic equipment and rigging are introduced next. The rigging for, and conduct of, all major seamanship evolutions are then described, with specific guidance and details for each ship class being provided in chapter sub-sections. Specialist material is covered in the final chapters. The annexes comprise lists of current seamanship references, Class drawings, and AIG 1861 Seamanship messages.

1.4 Measurements

The majority of measurements in CFCD 105 are metric. The only significant exceptions are the imperial measurements used when referring to sizes of blocks and shackles e.g., 12" block secured with a 3/4" shackle. Lengths, diameters, circumferences, distances and weights are all metric.

1.5 Drawings

CFCD 105 includes several original drawings of the rigging arrangements for seamanship evolutions in all ship classes. In most cases, class drawings provided by DGMEPM//DMSS 4 and FMF(CB) have been used as the base from which this book's drawings were built. In the event that a discrepancy is noted between CFCD 105 and approved class drawings, the approved class drawings shall take precedence, and the Formation Seamanship Authority shall be advised.

1.6 Review and Amendments

CFCD 105 was researched and written by a group that included several seaman staff officers, and more importantly, eighteen Chiefs and Petty Officers of the Boatswain trade, representing both Maritime Forces Atlantic and Pacific. Every effort was made to validate the material during the drafting process while always bearing safety and the junior seaman in mind. Undoubtedly, there will be requirements for amendment in the future stemming from regular fleet-wide review of the material, as well as the introduction of new equipment and procedures. For this purpose, all naval personnel involved in seamanship, especially ships' Deck Officers and Chief Bosn Mates, are strongly encouraged to submit recommendations and observations to CMS/DMPPD 3-5 through the chain of command whenever appropriate. In this way, CFCD 105 will continue to evolve and improve along with the Fleet.

CHAPTER 2
Seamanship Policy and Organization

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CHAPTER 2
Seamanship Policy and Organization

2.1 Introduction

a. It is important that all seaman officers and boatswains possess a comprehensive understanding of the lines of communication and the means by which decisions affecting seamanship equipment and policy are made at all levels of the Canadian naval chain of command. In this way, personnel at all levels will be better able to effect changes when necessary.

b. It is particularly important for officers and senior NCOs to know where the interfaces between operational and technical staffs occur so that initiatives, especially those pertaining to Unsatisfactory Condition Reports (UCR), Engineering Change Proposals (ECP), and maintenance can be moved efficiently through the staffing process. The key, as always, is effective communication — keeping staffs both up and down the chain of command well informed.

2.2 National Defence Headquarters

The Canadian Forces are commanded by the Chief of the Defence Staff (CDS) from his Headquarters in Ottawa (NDHQ). Among the many staffs reporting to him are two that are integrally involved in the conduct of seamanship. First is the Maritime staff, which defines the operational requirements for seamanship; and second is the Matériel staff, which is key to converting operational requirements into technical realities. Although these two staffs follow independent chains of command to the CDS, constant horizontal matrix-type staffing of common seamanship issues occurs. Critical to this process is the professionalism and co-operation of all involved.

2.3 Chief of the Maritime Staff

a. The Chief of the Maritime Staff (CMS), a Vice-Admiral, is the overall commander of the Navy. His staff is located at the National Headquarters in Ottawa, and is fully engaged with all issues pertaining to Canadian naval operations. One of the Directors subordinate to the CMS is the Director Maritime Policy and Project Development (DMPPD). This Captain (N) is served by several Commanders, one of whom is responsible for Fleet Support - DMPPD 3.

b. One of the DMPPD 9 primary areas of responsibility is seamanship. As such, he has on his staff the key officer who is responsible for developing fleet-wide operational criteria and policy for seamanship - DMPPD 3-5 (Seamanship). This post-XO LCdr is assisted by a CPO2 Bosn who provides operational expertise, and a civilian who is responsible for staffing approved equipment procurements.

c. The DMPPD 3 section liaises horizontally with their engineering counterparts in the ADM (Mat) organization concerning all technical issues affecting seamanship in the fleet, and with their DMPPD counterparts concerning all operational issues affecting seamanship. They also liaise vertically with the staffs of the Formation and Fleet Commanders, collating reports and recommendations on improving fleet seamanship practices, and then preparing new seamanship policies for DMPPD/CMS approval.

d. DMPPD 9-3 is the custodian of *CFCD 105 - Seamanship Rigging and Procedures Manual*. As such, he co-ordinates the regular review of this publication, and manages the implementation of amendments. As well, all AIG 1861 messages originate with DMPPD 3-5.

2.4 ADM (Mat)

a. On the staff of the Associate Deputy Minister (Matériel) is the Director General Marine Engineering Personnel and Maintenance (DGMEPM). This naval engineer, a Commodore, is the technical authority on all issues relating to the review, approval and implementation of seamanship-related Engineering Changes (ECs), also called configuration changes.

b. As a Director within the ADM(Mat) Group, DGMEPM does not have formal reporting responsibilities within the naval chain of command. However, constant liaison occurs between the DGMEPM staff, and the staffs of the Chief of Maritime Staff and the Formation Commanders. Essentially, seamanship operational deficiencies (UCRs/CCPs) are raised and prioritized through the naval chain of command, and then forwarded to DGMEPM. Within DGMEPM are Class Desks which are staff offices organized to deal specifically with technical issues pertaining to either individual ship classes or equipment groups. Project teams are assigned to research and finalize the design of ECs, keeping technical imperatives and operational requirements in mind. Once complete, the EC is returned through the naval chain of command to the Formations, where its physical implementation on board individual ships is managed via the Fleet Maintenance Facilities.

2.5 Formation Commander

a. The three formations are Maritime Forces Atlantic, Pacific and Naval Reserves. Commanders MARLANT and MARPAC are rear-admirals while NAVRES is commanded by a commodore. Traditionally, seamanship issues requiring action were staffed by those officers responsible for Operational Readiness - N 34, who report to their respective Assistant Chiefs of Staff (Plans & Operations) - N 3 on both coasts and N 1 in NAVRES. The process was disadvantaged by the fact that it did not include the two Commanders Sea Training (Atlantic/Pacific) (CST A/P) who, along with their staffs, are the officers with the most accurate view of formation seamanship concerns. This is owing to the fact that they are frequently at sea conducting workups in all classes of ships, and often are the first to recognize potential seamanship problems that may have an impact fleet-wide. This changed in 1996, when responsibility for staffing seamanship issues in the two formations was re-assigned to CST (A/P), who have been appointed the Formation Seamanship Authorities. Although CST (A/P) report formally through the Fleet Commanders (see below), they also ensure that the formation N 3s are made aware of all key seamanship developments.

b. The Formation Seamanship Authority's (FSA) responsibilities range from developing operational criteria and policy for seamanship to reviewing seamanship-related Matériel Authorization Change Requests (MACR), ECPs and UCRs (see Section 2.7). The STS Executive Officer (XO) and Chief Bosn's Mate (CBM) are normally delegated these tasks.

c. Also reporting to the Formation Commanders are the Commandants of the Naval Operations School in Halifax and the Fleet School in Esquimalt. Both schools include Seamanship Divisions that are responsible for the shore-based training of all Bosns, as well as the formal training of Deck Officers. The Sea Training Commanders also acts as Chairman of the annual Formation Seamanship Symposium. In addition, the Seamanship Divisions are responsible for instructing Sea Environmental courses (OSQ AB/AN), Naval Boarding Parties, Demolition Teams, and Small Arms. All course curricula are based on Qualification Standards and Plans (QSP) that reflect the Occupational Specifications that have been developed for each rank level. Close liaison between the schools and the FSAs ensures that training continues to meet ship requirements. A healthy dialogue in this regard, especially with respect to the introduction of new fleet seamanship practices, will prove invaluable to Boards which are convened to review Bosn course QSPs.

d. Also reporting to the Formation Commanders are the Commanding Officers of the Fleet Maintenance Facilities (FMFs) Cape Scott and Cape Breton. The FMFs are responsible for the critical functions of ship engineering support and maintenance. In terms of seamanship, this relates to second- and third-line maintenance of deck fittings, cranes and other seamanship equipment. Although the greater part of shore-based repair and maintenance occurs in support of marine and combat systems, seamanship remains a vital component of the FMF mandate. To that end, a CPO2 Bosn works at each FMF and champions seamanship issues. Close liaison with the FMFs ensures that technical support is meeting fleet seamanship requirements.

2.6 Fleet Commander

The two Fleet Commanders are Commodores who command all ships and submarines based in Halifax and Esquimalt. They report directly to the Formation Commanders on all issues affecting the waterfront. Ships' Commanding Officers report to their Fleet Commander on all shipboard matters, including those that pertain to seamanship. CST (A/P) also report to the Fleet Commanders, and so it follows that Fleet Commanders are kept abreast of, and consulted on, all important seamanship developments.

2.7 The Ship

a. The composition of the Deck Department and its roles within the ship's Fighting and Functional Organizations are well defined in Ship's Standing Orders (SSOs).

b. The Deck Department is unique in some respects, in that it relies on the participation of other departments through the Watch and Station Bill and Special Party Boards to conduct many of its key tasks. Examples are part ship hands, husbandry and maintenance. It is therefore very important for the Deck Officer (DECKO) and CBM to establish positive interdepartmental working relationships, keeping the XO and Coxn fully apprised of changing circumstances. Weekly planning meetings chaired by the XO provide a key forum for the DECKO and CBM to table any concerns and solicit the support of the other Heads of Department and Departmental Chiefs in resolving all-ship seamanship issues, and establishing Command priorities for the completion of tasks.

c. Of critical importance to the ship's overall effectiveness in completing seamanship tasks is a healthy working relationship between the Deck and Engineering Departments. This is owing to the fact that the Engineering Department, and particularly the Hull Section, is responsible for administrating (via the FMFs) all second- and third-line maintenance and repair of deck equipment. All Maintenance Action Forms (MAFs), commonly referred to as work orders, are generated by the Engineering Department, normally through the Senior Hull Technician, to the Engineering Maintenance Co-ordinator to the Engineering Officer. Care must be taken to ensure that MAFs relating to work on deck equipment are assigned a priority commensurate with their importance. The same process applies to the staffing of UCRs and ECPs. Although UCRs and ECPs initiated by the Deck Department typically comprise only a fraction of the total leaving the ship, it behooves the DECKO and CBM to follow the staffing route closely, maintaining a tight relationship with their engineering colleagues. In addition, copies of all seamanship related UCRs and ECPs are to be forwarded to the FSAs so that trends can be monitored and operational priorities assigned.

d. DECKOs and CBMs must make every effort to avoid any tendencies to respond to seamanship problems in isolation, or to accept the status quo whenever there is a risk that safety of equipment and personnel may be compromised. It is vital that concerns be quickly passed to Command, so that an accurate determination of acceptable risk in relation to the ship's mission can be made. Similarly, it is very important that an active professional seamanship dialogue be pursued between ships, keeping the Fleet Commander and FSA fully apprised of concerns and recommendations for improvement.

e. Of particular importance is the requirement for ships to resist any tendency to unilaterally implement rigging changes, no matter how expedient, unless exceptional circumstances exist such as those which might occur during hostilities, necessitating immediate change in order to fulfill mission objectives. Ships are to be in full compliance at all times with the baseline rigging and procedures promulgated in CFCD 105.

2.8 The Staffing Route - An Example

The following is a hypothetical scenario designed to demonstrate the staffing route for seamanship issues as described in the previous sections.

a. A warship is in the process of coming to a single buoy when the picking-up rope suddenly parts. The CBM reports to the DECKO that the cause was a sharp edge on the forward edge of the bullring that cut the rope when it was under strain with a lead aft. They both agree that a UCR and ECP should be raised.

b. The UCR and ECP are drafted in the Deck Office and forwarded to the CO for approval via the DECKO, MSEO and XO. Essentially, the UCR describes the current design shortcoming of the bullring, while the ECP incorporates a recommended design change to eliminate the problem.

c. They are then mailed to the Formation/Fleet Configuration Management Officers (CMO) with information copies to the Formation Seamanship Authorities - FSAs (CST A/P). In MARPAC, the CMO is F4 while in MARLANT, this task is carried out by LN-37. These officers are engineers who assess the technical viability of the ship's recommendations, discuss any concerns with the FMF Naval Architect Officers, and then forward the UCR/ECP to the FSAs for operational assessment.

d. The FSAs (XO/CBM Sea Training) review the recommendations, and make comments with respect to safety issues associated with the bullring, and the overall effect that implementation of the EC will have on seamanship readiness. It is then returned to the CMOs for review.

e. The CMO mails the UCR/ECP to the appropriate desk within the DGMEPM//DMSS organization. Horizontal liaison occurs between DMSS and DMPPD staff officers in order to further refine the EC design and ensure that technical and operational authorities are working towards the same aim — in this case, an improved and safer bullring.

f. Once complete, direction to implement the EC is forwarded to all concerned i.e., the FSAs, CMOs, FMFs, and most importantly — the ships. The ships (through the MSEO) then liaise with the FMF to ensure that the bullring work is scheduled during the next available work period.

2.9 Seamanship Organizational Chart

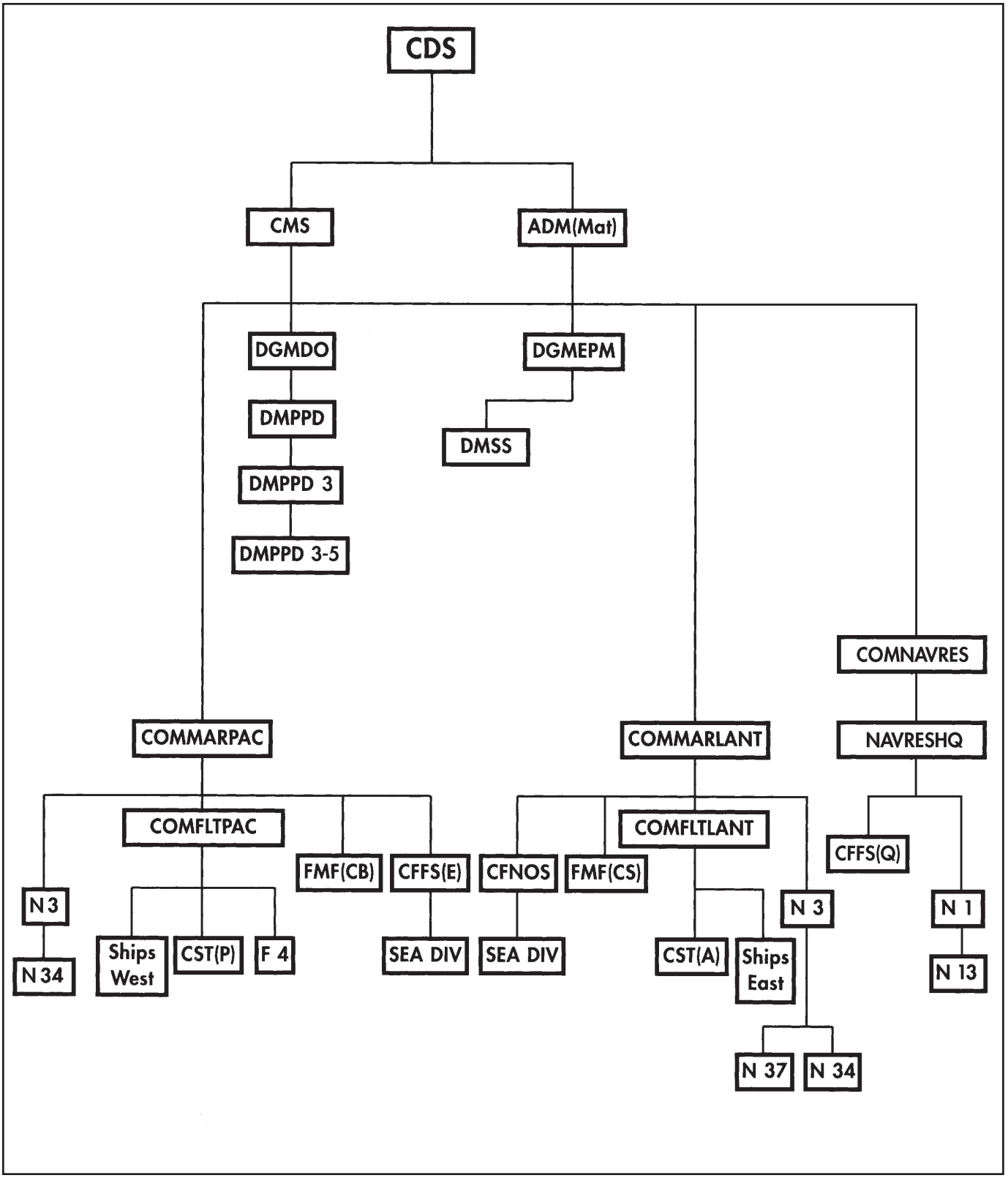

Figure 2.9-1 - Seamanship Organizational Chart

2.10 The Seamanship Working Group

a. **Introduction.** The Seamanship Working Group is a standing working group established to review, co-ordinate and guide action items from the Seamanship perspective for the fleet. It provides a forum for discussion of Seamanship matters and a focus for staff action. It also provides advice and recommendations through the Seamanship Working Group Chairman to DMPPD on seamanship matters. Although the Seamanship Working Group usually meets semi-annually, it must meet at least annually. To ensure the Fleet on both coasts has an equal opportunity to participate in meetings, a concerted effort is made to alternate meeting locations between east and west coasts venues.

b. **Membership.** Membership of the Seamanship Working Group is as follows:

CMS/DMPPD 3-5 (Chairman)
CMS/DMPPD 3-5-2/DMPPD 3-5-3
XO's Sea Training East/West
Chief Boatswain Mates Sea Training East/West
Seamanship Division Commanders East/West
Seamanship Div CPO East/West
OIC MCDV East/West
MCDV STS Chief Boatswain Mates
Secretary (to be supplied by STS)

Additional members as required for a particular situation. Meetings will not normally be held without participation from CMS/DMPPD, both Seamanship Divisions, and both Sea Training Staffs.

c. **Conduct Of Work.** A message/E-mail convening a Seamanship Working Group meeting is sent to the Fleet, all members and all observers at least one month before the scheduled meeting. This message promulgates meeting dates and location, and request confirmation of attendance and agenda items no later than two weeks in advance. All members are to provide updates and a summary of actions taken to the chairperson no later than two weeks before the meeting. The chairperson will forward a draft agenda to all members at least one week prior to the meeting of the Seamanship Working Group. Seamanship Working Group meetings will concentrate on Seamanship policy, doctrine, procedures, training, publications and equipment. The Seamanship Working Group does not discuss operational plans or tactical doctrine and procedures. When a consensus cannot be reached on any particular issue, and further investigation of the issue is not practical, the issue will be submitted to a vote by the Members listed above. The Seamanship Working Group must render a report of its proceedings (minutes) to the chairperson of the

Seamanship Working Group (CMS/DMPPD). The chairman of the Seamanship Working Group will forward copies of the minutes, including an executive summary or action/decision list, to all members of the Seamanship Working Group, all Seamanship Working Group members and observers. Members of the Seamanship Working Group will be given one month to raise concerns with decisions reported in the minutes. If concerns are not raised, all Seamanship Working Group recommendations/decisions will be considered accepted (silent procedure will apply).

CHAPTER 3
General Seamanship Terminology

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CHAPTER 3
General Seamanship Terminology

3.1 Introduction

Every profession and trade uses its own technical terms to describe the more specialized parts of its work. Nowhere is this more evident than in the language of the seaman. To learn seamanship, the seaman must first understand the general nautical terms and expressions which are explained in this chapter. The more technical terms are included in the chapters specific to the aspects of seamanship to which they apply[1].

3.2 Terms Relating to Parts of a Ship

a. **Parts of the Hull.** From the German (hula), meaning a cloak or covering, the main body of a ship is called the hull. The hull is divided into three parts - the fore part, the midship part and the after part. The fore part begins with the stem, which is the foremost steel member forming the bow of the vessel (bow) and the after part ends in the stern (from stem to stern).

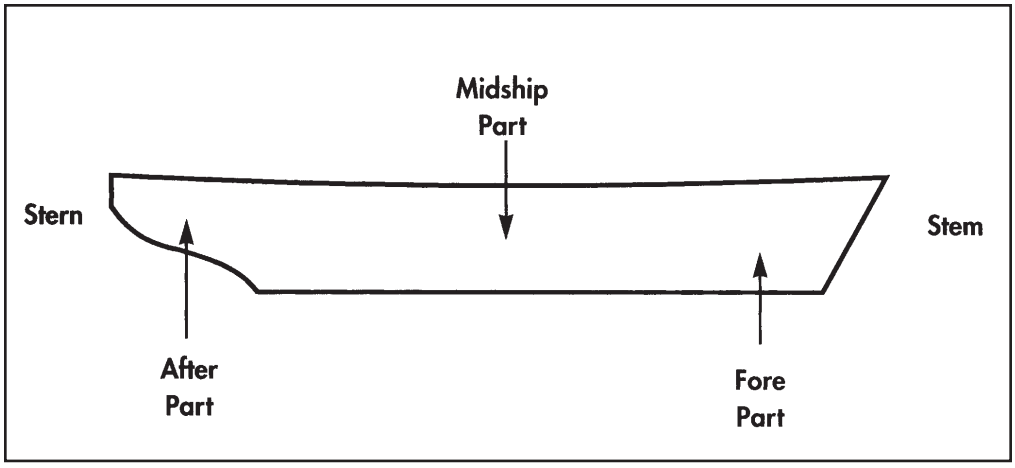


Figure 3.2-1 - Parts of the Hull

b. **Fore-and-Aft**. If you are standing anywhere inside the hull facing the stem you are facing forward. The reverse direction is aft. Any line which runs lengthways in the ship is said to run fore-and-aft and the line joining the middle of the stem to the middle of the stern is called the fore-and-aft centre line.

[1] Much of the material in this chapter has been taken directly from BR67 and has been modified for the Canadian Navy wherever appropriate.

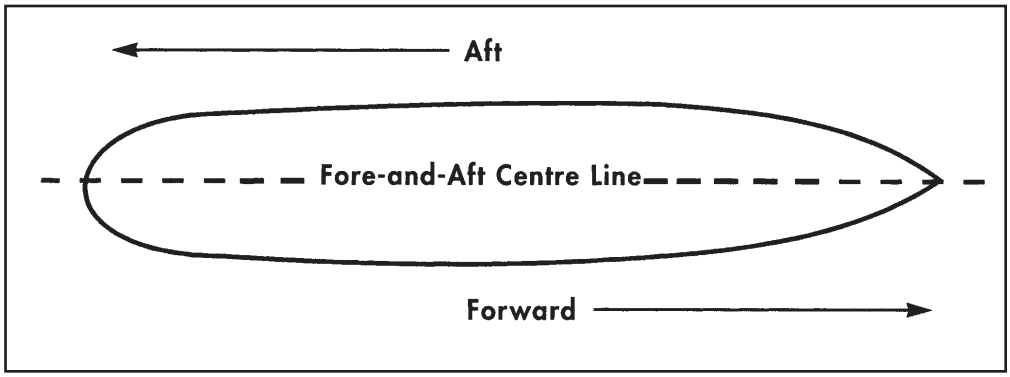


Figure 3.2-2 - Fore-and-Aft

c. **Port and Starboard**. Port and starboard are the terms used to divide a ship into left and right sides When you are facing forward, starboard is on the right side and port is on the left side. It is customary to give stations or compartments odd numbers on the starboard side and even numbers on the port side. Starboard is generally accepted to have originated from steerboard, the board or oar which projected into the sea from the after right-hand side of a Viking long ship. Port derives from the custom of berthing the ship on the side opposite to the steerboard, and embarking stores via ports cut into the hull.

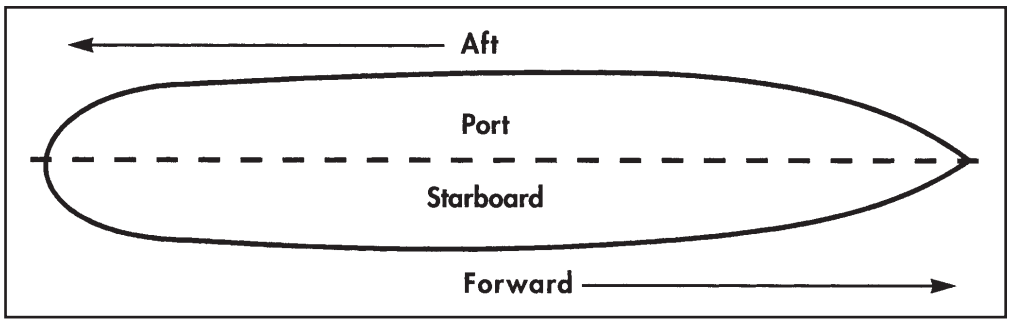


Figure 3.2-3 - Port and Starboard

d. **Hull Surfaces.** The sides of a hull can be described generally as starboard or port, meeting under the bottom of the ship at the **keel**. The curved surface of the fore part is called the bow (port or starboard) and the curved surface of the after part is called the quarter (port or starboard); the centre part is referred to as **midships**. When a ship is **afloat**, the **waterline** divides the sides into **ship's side** above the waterline, and **bottom** below it. These terms are used in a general sense, for example, when painting a ship's side or conducting diving operations. A more precise definition of an area can be achieved by referring to the side, the part and the waterline, for example, "the ship was holed on the starboard bow two metres below the waterline". The continuous horizontal surfaces of a ship are called **decks**. If exposed to the outside, they are called **weather decks**. Those that are not continuous are called **flats** or **platforms**.

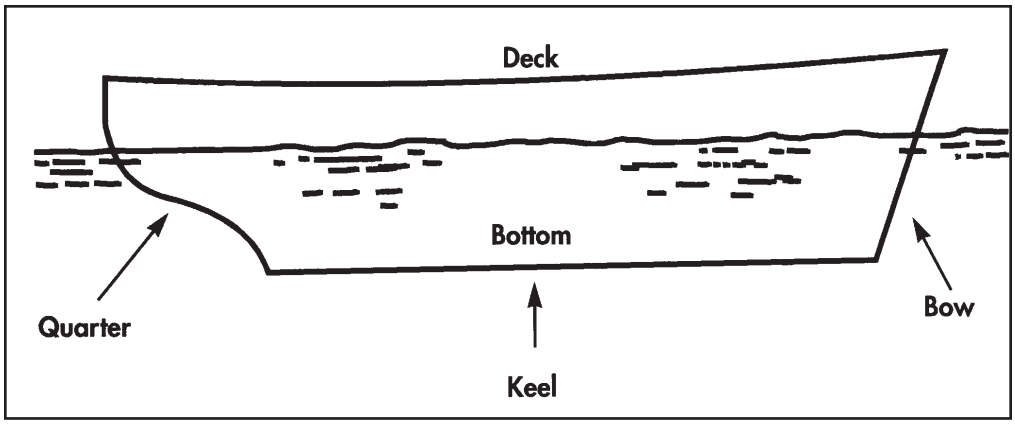


Figure 3.2-4 - Hull Surfaces

e. **Freeboard and Draught.** The height from the uppermost continuous deck or upperdeck to the waterline is known as the freeboard. Depth of the keel below the waterline at any point along the hull is known as the draught. When we refer to a ship's draught, we usually mean its deepest draught.

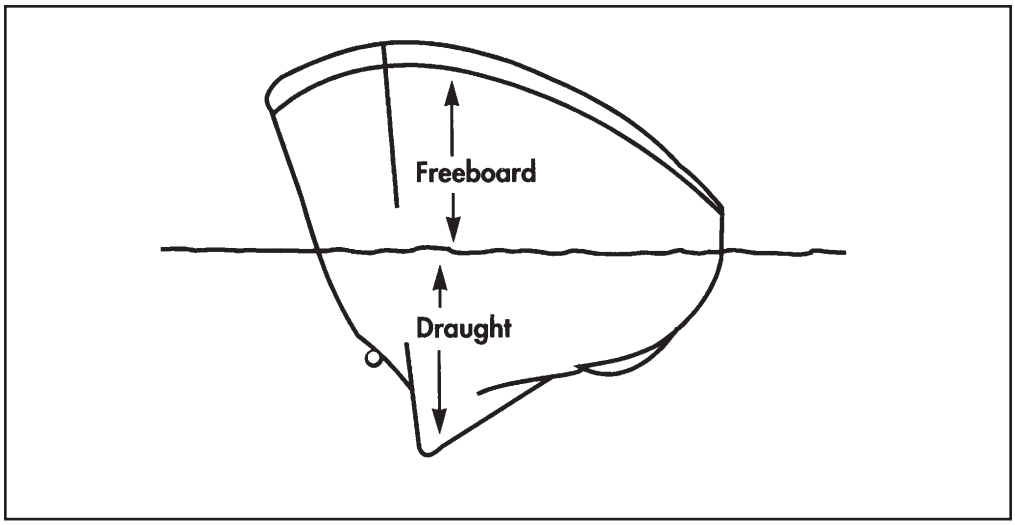


Figure 3.2-5 - Freeboard and Draught

f**. Beam, Camber and Bilge.** The length overall is the distance from the most forward point to the aftermost point. The greatest width of the hull is known as the beam. The curve given to the surface of a deck so that water will drain away to the ship's side is called the camber. The flat part of the hull's bottom is known as the bilge. The bilge may also refer to water, waste oil and any number of other liquids which collect at the bottom of the ship, or in the bilge. The bilge keel is a long projecting fin designed to decrease the rolling of the ship.

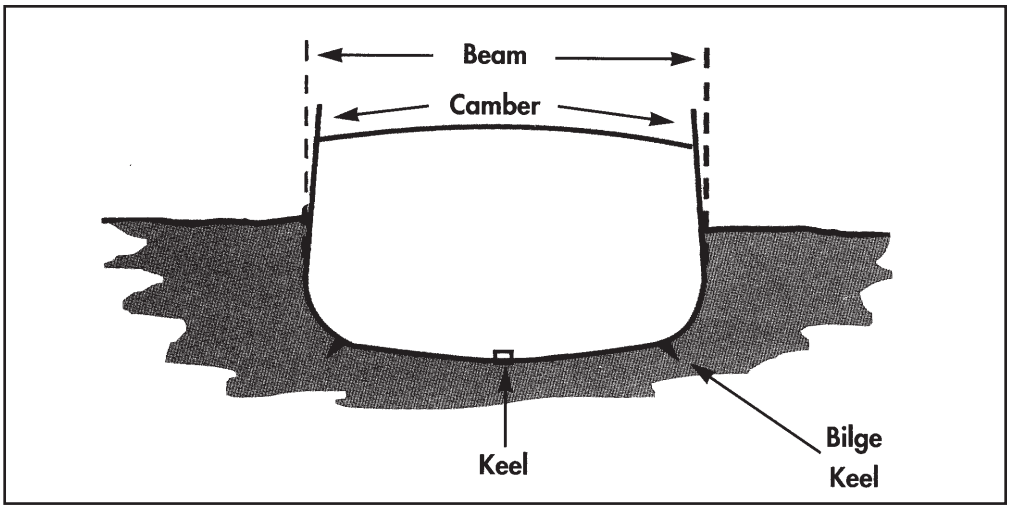


Figure 3.2-6 - Beam, Camber and Bilge

g. **Decks: A Brief History**. The arrangement of decks dates back several centuries. The ends of the upper deck were built up to form castles to house soldiers for defensive purposes. The lower portion of deck between the fore and after castles was known as the waist. The after part of the waist was known as the quarterdeck. The common tactic of boarding fell into disfavour with the advent of improved and longer range guns. Because of this, more space was required on the upper deck for guns. The castles were replaced with long, level deck housings with many guns each. The forward part of the ship retained the name forecastle, the pronunciation and spelling of which were eventually shortened to focsle and often abbreviated as FX. The aftercastle was eliminated and the quarterdeck became the after part of the upper deck and is still abbreviated as AX.

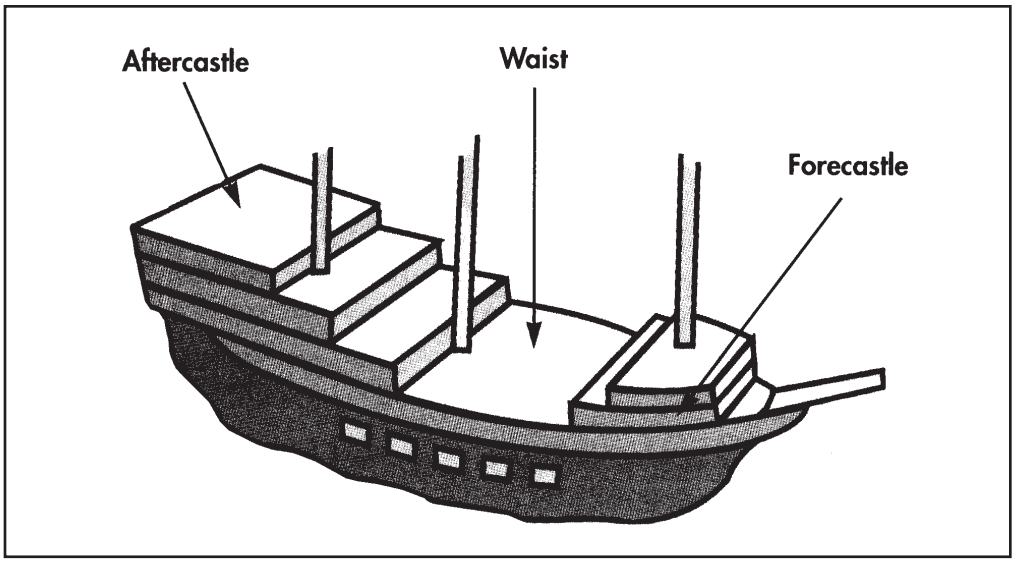


Figure 3.2-7 - Decks: A Brief History

h. **Contemporary Deck Naming**. The decks below the upper deck were named the main, lower, platform and orlop decks. Orlop is the name given to the lowest deck in a ship. It was the platform laid over the beams of a ship below the turn of the bilge. In modern warships, names have been retained as a quick reference (e.g. Sesame Street in the IROQUOIS Class, and Canadian city main street names in the HALIFAX Class) but the official and correct method of identifying decks is by number. Decks from the weather or uppermost continuous deck are numbered downwards in sequence (e.g., No. 1, 2, 3 deck). Decks above the weather deck are numbered upwards in sequence (e.g., No. 01, 02, 03).

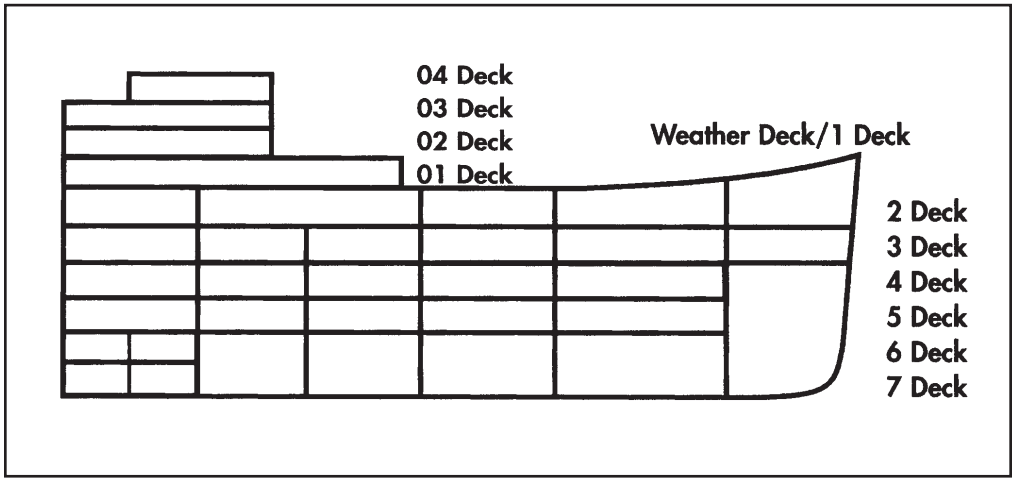


Figure 3.2-8 - Contemporary Deck Naming

i. **Parts of Decks**. Certain parts of any of these decks may also have special names. Below the upper deck a **flat** is a platform that does not run the length and breadth of a ship. A **lobby** is a space giving access to one or more compartments. These flats or lobbies may be named according to the principal adjacent compartments or equipment installed — for example, wardroom flat, Captain's lobby, capstan machinery flat — or they may be referred to by deck numbers and positions in the ship relative to the bow and the centre line.

j. **Weather Decks and Superstructure of a Ship**. The arrangement of the weather deck and superstructure of a ship is shown in Fig.3.2-9.

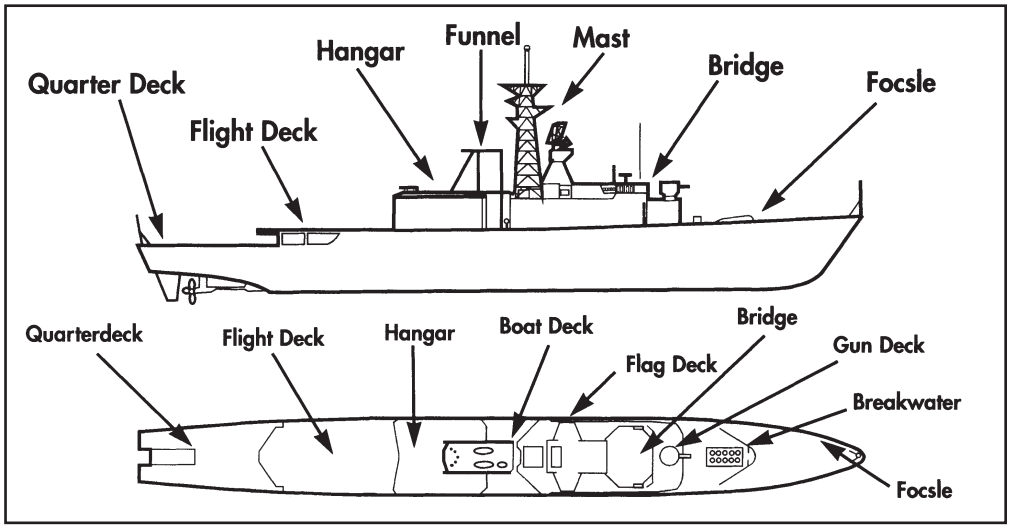


Figure 3.2-9 - Weather Decks and Superstructure of a Ship

k. **Machinery Placement**. In most cases, the main propulsion machinery and associated equipment are located amidships and low in the ship. This machinery is situated in individual water-tight compartments called engine rooms and auxiliary machinery rooms (or boiler rooms). Fuel and water are stored in tanks built into the lower parts of the hull.

3.3 Terms Defining Position and Direction in a Ship

a. **General Position**

(**1**) A landsman lives in a house, therefore a seaman speaks of living **in** a ship not on a ship. If a seaman arrives by boat he goes up an **accommodation or jumping ladder** which is secured **outboard** (board is the old name for a ship's side), he comes over the **side**, and he is then **on board**. If the ship is lying against a dock wall it is **alongside**. The seaman crosses a **brow** from the dock to the ship and he is then on board and **on deck**.

(**2**) Having "pegged" himself on board, he then goes **below** by a **ladder** which gives access to the deck below through an opening in the deck called a **hatch**. He then reaches his living quarters (**mess**) which is in a space of the ship called a **mess deck** of which the walls are called **bulkheads**, the ceiling is called the **deck head** and the floor is **the deck**.

b. **Position Fore-and-Aft**. In a ship, the bow is **forward** and the stern is **aft**. Amidships describes the position roughly in the middle of the ship; it also describes any position on the fore-and-aft line. **Midships** is used also when defining an object. For example, a midship hatch could be either the one that is in the middle of the ship or, if there are two or more hatches, the one which is nearest the middle. Comparing positions of objects with one another, the hangar is abaft (aft of) the bridge, the bridge is abaft the focsle but forward of the hangar.

c. **Position Athwartships**. A position athwart or across the ship can be described relative to either the centre line or to the sides. The centre line divides the ship into port and starboard, while the ship's side gives an **inboard** and **outboard** position. For example, a ship is carrying three boats; one is swung outboard to port, the other two are stowed inboard to starboard. When comparing the position of the two boats stowed on the starboard side, the black boat can be described as lying inboard of the white boat, or the white boat outboard of the black.

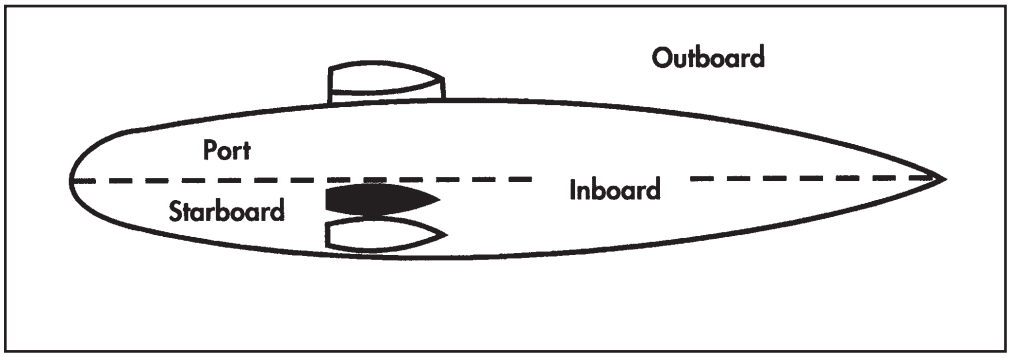


Figure 3.3-1 - Position Athwartships

The position of an object can be clearly described by combining the two methods.

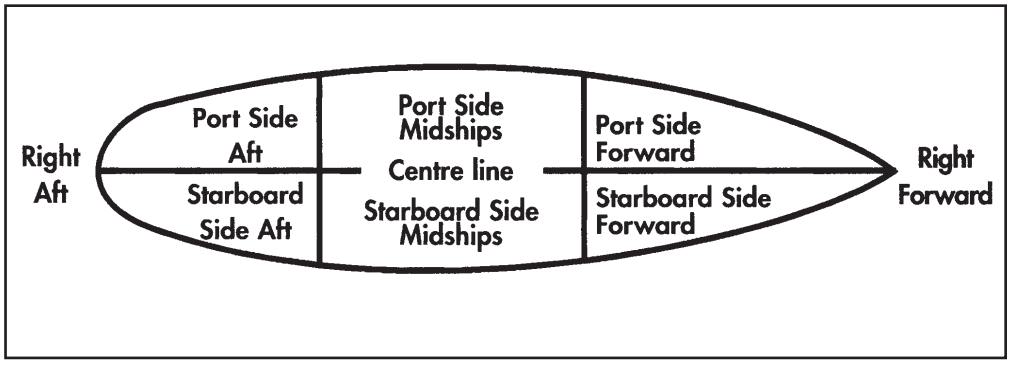


Figure 3.3-2 - How Positions Are Described

d. **Movements of Objects On Board.** A seaman speaks of going **forward**, **aft, below, up top** (on deck) and **aloft** (i.e., anywhere in the rigging of a mast). He uses the same expression for shifting an object; thus he may shift something aft, or further forward, to port or starboard, or nearer to the ship's side.

3.4 Terms Defining Ships in Motion

a. A vessel is **under way** when she is not anchored, secured to a buoy, made fast to the shore, nor aground. When actually moving through the water, a vessel is said to be **making way**.

b. When moving ahead, a vessel is said to be **going ahead** or **making headway**. When moving astern, a vessel is said to be **going astern, making sternway** or **making a stern board**. A vessel **gathers way** when she begins to move through the water, and she has **steerage way** when her speed is sufficient for steering (i.e., the rudder is effective).

c. A vessel being blown sideways by the wind is said to be making **leeway**. When the wind is blowing from one side of the vessel, that side is called the **weather or windward side**. The other more sheltered side is called the **lee side**.

d. A ship is said to be **adrift** or **not under command** when broken away from her moorings and without means of propulsion.

3.5 Terms Defining Direction and Position Outside a Ship

a. **Relative Bearings**. **Ahead, astern** and **abeam** are relative bearings. In addition, when an object is midway between ahead and abeam it is said to bear **on the bow**, and when midway between abeam and astern it is said to bear **on the quarter**. The expressions **fine** and **broad** may also be used relative to ahead or astern; for example, an object may be fine on the port bow, broad on the starboard quarter (or abaft the starboard beam). These terms, however, are not exact and there is a more precise way of reporting relative bearings.

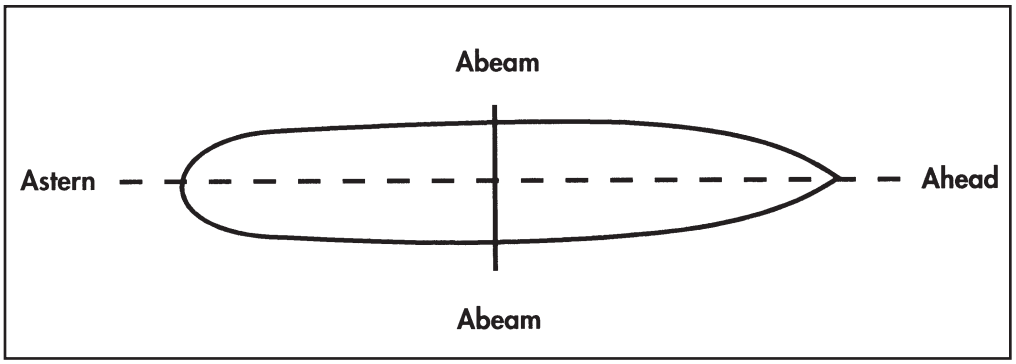


Figure 3.5-1 - Ahead, Astern and Abeam

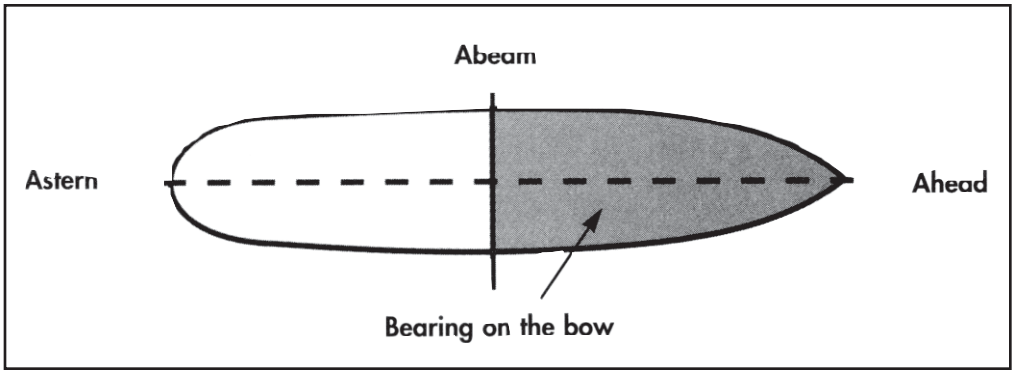


Figure 3.5-2 - Bearing on the Bow

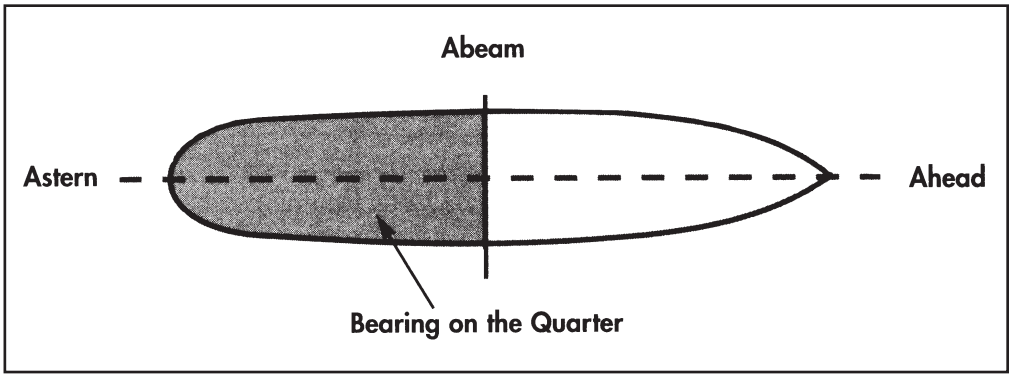


Figure 3.5-3 - Bearing on the Quarter

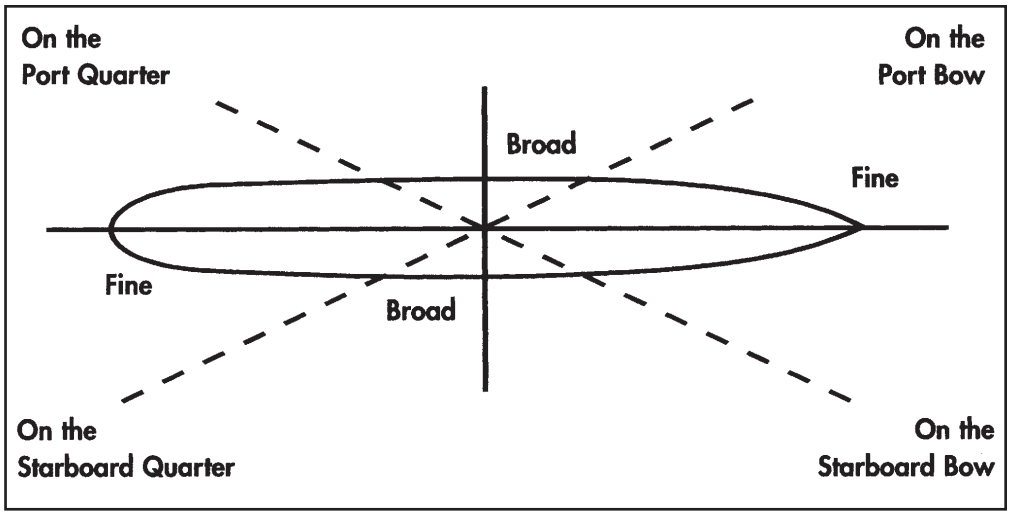


Figure 3.5-4 - Fine and Broad

b. **Directions in Degrees**. Reporting relative bearings by this method is based on the compass and uses an actual number of degrees. The system uses the ship's head as a reference of 0º. The ship's head, for the purposes of this system, is always 0º (dead ahead) regardless of the compass course being steered. The horizon is divided into degrees of arc, from 0º dead ahead to 180º astern. Those to port are called red while those to starboard are green. For example, an object 45º on the port bow is said to bear red four five.

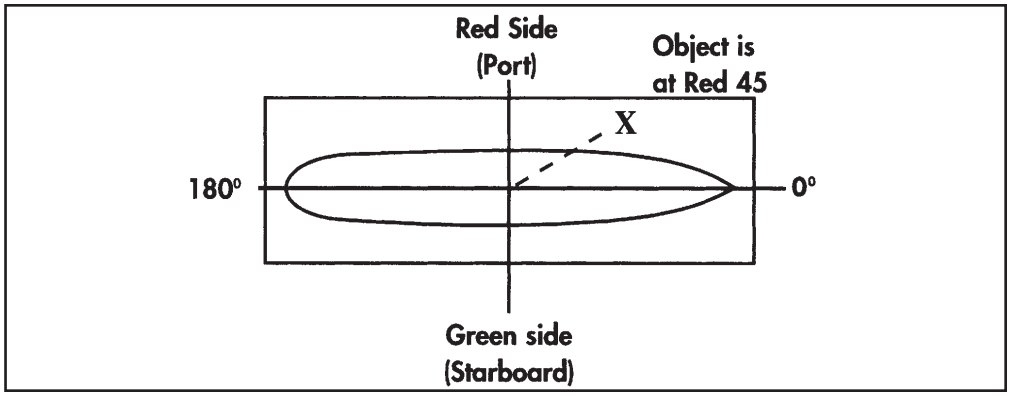


Figure 3.5-5 - Directions in Degrees

Note.

The word "degrees" is not used and numbers are given individually. As well, there are no preceding zeros.

c. **Compass Bearings**. The bearing of an object from the ship may be given relative to **true** or **magnetic** North. If it is a gyro compass bearing, the horizon is divided into 360 degrees from true North. If it is a magnetic compass bearing, the horizon is divided into 360 degrees from magnetic North.

d. **Magnetic Compass**. The **magnetic compass card** is divided into 360 degrees from North (0º), through East (090º), South (180º), West (270º), and back to North. The card may be divided into 32 points of 11.25 degrees. The principal points of North, South, East and West are called **cardinal points**. The **intercardinal points** are North-East, South-East, South-West and North-West. The **intermediate points** are North-North-East, East-North-East, East-South-East, South-South-East, South-South-West, West-South-West, West-North-West and North-North-West. The remaining 16 points are known as **by-points**.

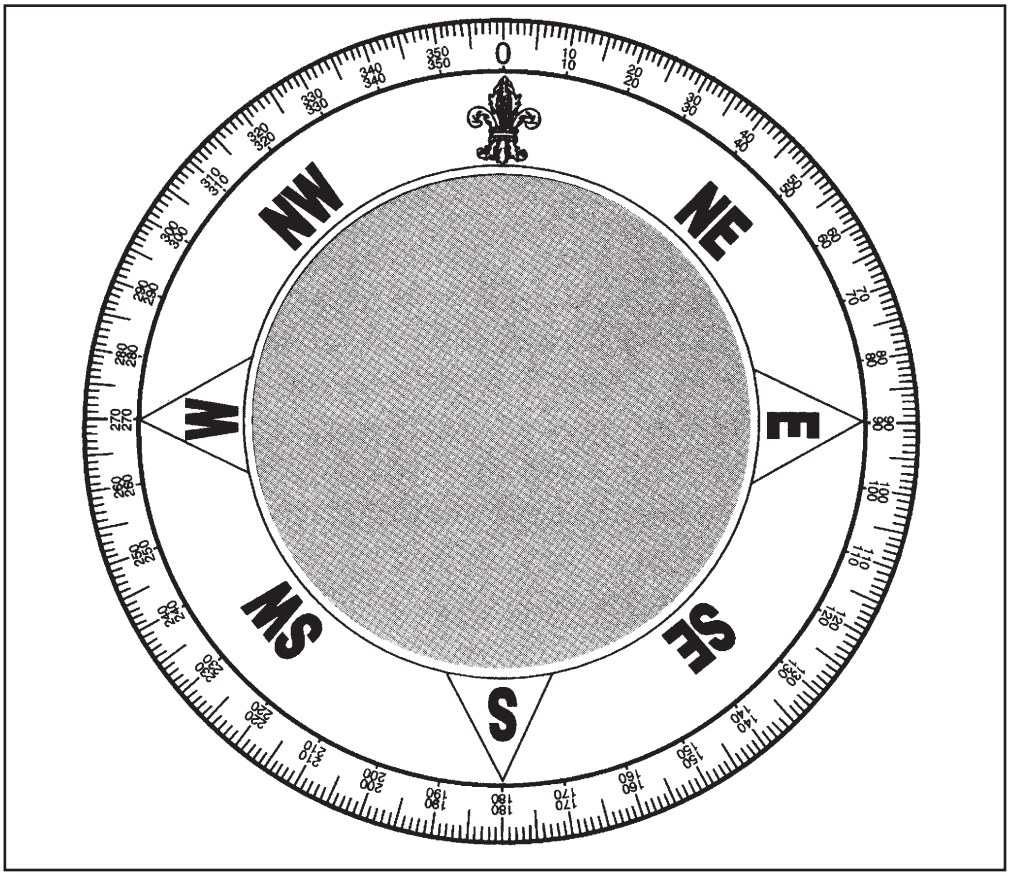


Figure 3.5-6 - Compass Card

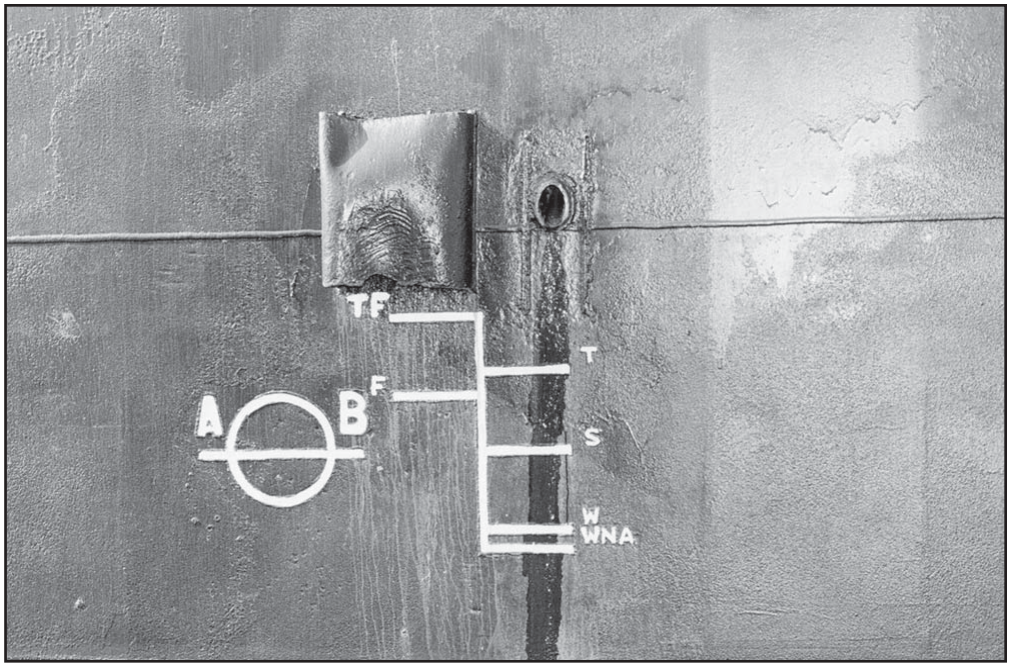
3.6 Terms Relating to Measurement

a. **Draught Marks**

(**1**) Draught marks show the draught of the ship, measured in decimetres, and are usually positioned at the bows, stern and midships. The marks are Roman numerals, one decimetre high and one decimetre apart. Only even numbers are used. Above the waterline they are generally engraved on plates welded to the hull and below the waterline they are painted in a contrasting colour.

(**2**) When a ship is drawing 42 dm forward and 45 dm aft, the waterline touches the lower edge of the 42 mark at the bow and the upper edge of the 44 mark at the stern.

b. **Load Line Disc and Load Lines**. These marks on the sides of merchant ships indicate the greatest depth to which they may safely be loaded under various conditions in accordance with international regulations.



TF	Tropical fresh water	**WNA**	Winter, North Atlantic, for vessels under 100 metres in length
F	Fresh water		
T	Tropical sea water	**AB**	These letters indicate the registration society
S	Summer, sea water		
W	Winter, sea water		

Figure 3.6-1 - Load Line Disc and Load Lines

c. **Load Waterline.** Load waterline is a term chiefly used in HMC ships to denote the position of the waterline when the ship is fully loaded with crew, stores, water, fuel, etc. The ship is then said to be in the deep condition.

d. **Tonnage Measurements.** The tonnage of a ship can be expressed in terms of weight or volume. When expressed by weight, the unit of measurement is the tonne (one tonne equals 1000 kilograms), and when expressed by volume it is the ton of 2.83 cubic metres. This latter measurement is derived from the earlier "tun" which indicated the capacity of a wine cask.

e. **Displacement.** Displacement is the actual weight of the vessel measured by the weight in tonnes of water she displaces when loaded with fuel, water, stores and with the crew on board. It is seldom used for merchant ships because of the great difference in their displacement when fully and lightly loaded. It is, however, the usual method of describing the tonnage of warships. HMC ships displace the following:

Table 1 Displacement

CLASS	DISPLACEMENT in Tons
IROQUOIS	5155 light - 5106 loaded*
HALIFAX	4316 light - 4770 loaded
AOR 509/510	8380 light - 24700 loaded
KINGSTON	726 light - 932.61 loaded
UPHOLDER	2030 surfaced - 2410 dived

*IROQUOIS Class ships are lighter in the loaded condition due to the water-compensated fuel system (water is heavier than fuel).

3.7 Docks, Slips and Launching

A ship is built on a **slipway**, which is a sloping platform erected on the foreshore of a deep river or estuary and extending well beyond and below the water's edge. The ship is launched in a **cradle**, which slides down the slipway until the ship becomes waterborne. With the trend toward modular construction of ships, as was the case with the HALIFAX Class, ships are not launched, but rather are floated up in dry dock once the modules have been connected.

The main structure of the hull up to the upper deck is completed before launching. In some cases, the main machinery and other large equipment may be installed and some parts of the bridge and other superstructures may be erected.

After launching, the ship is taken to a **fitting-out berth** in a **basin** where machinery not already fitted, internal fittings, armament, radar equipment, funnels, masts and external fittings are secured in position and the rest of the superstructure is completed. Finally the ship is ready for equipment trials and to proceed to sea for sea trials.

Periodically during a ship's life, it is necessary to inspect her hull below the waterline to clean the bottom, change propellers, etc. For this, special docks or slips are built. The process is called **docking** followed by **undocking**.

a. **Dry Dock or Graving Dock**

(**1**) A dry or graving dock is an excavation faced with solid masonry, connected with a harbour, river or basin. The entrance is closed by a sliding **caisson**, a floating caisson, or **dock gates**. Water is admitted through valves (penstocks) until the level in the dock is the same as that outside. The entrance is then opened and the ship floated in. When the ship is inside, the entrance is closed and the water pumped out, thus leaving the ship resting on **keel blocks**, supported by **breast shores** (from the side of the dock to the ship's side), and bilge shores which give additional support. Side keel blocks and occasionally **cradles** are also used for heavier ships.

Figure 3.7-1 - Dry Dock at Esquimalt

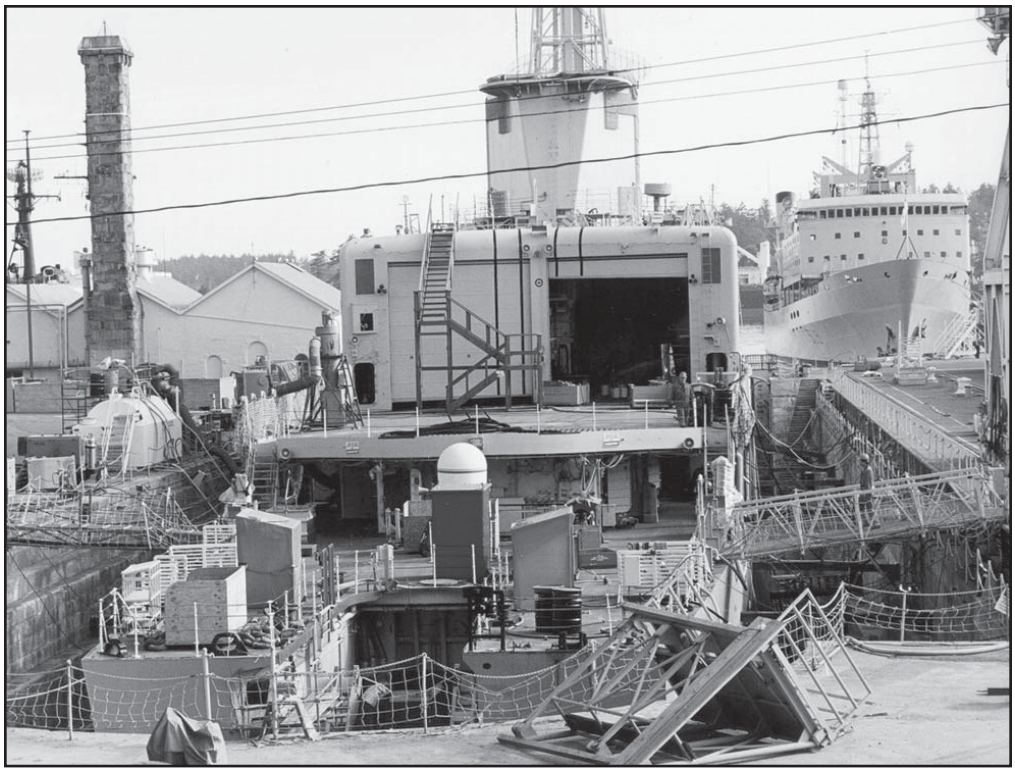


Figure 3.7-2 - IROQUOIS Class Undergoing Docking Work

(**2**) Some small dry docks depend on the tide for flooding and draining. The vessel is floated in at high water, the gates are closed and, as the tide falls, the water is drained out through valves, which are shut when the dock is dry.

b. **Hydraulic Synchro Lift**. This is a platform, on which a craft is positioned, capable of being raised or lowered by hydraulic power. Its use is thus independent of the state of the tide and it permits work to progress continuously. These are now built to accommodate ships of up to 60 m in length.

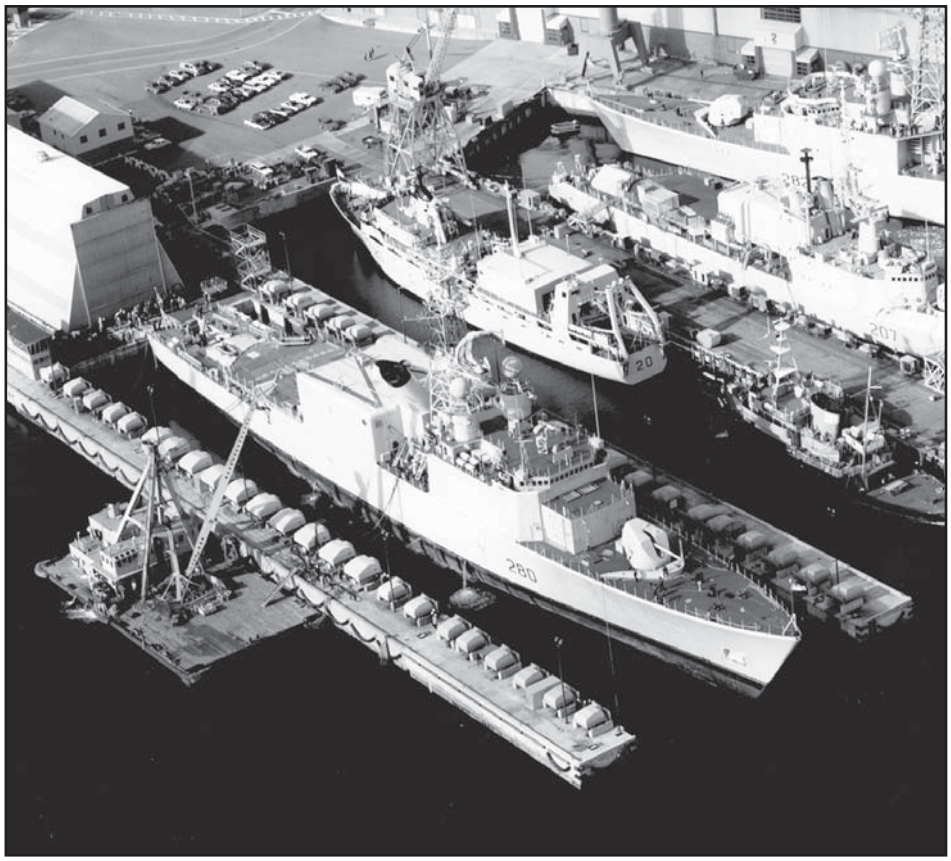


Figure 3.7-3 - IROQUOIS Class (pre trump refit) Preparing to Be Lifted in Hydraulic Synchro Lift at HMC Halifax Dockyard

Figure 3.7-4 - Hydraulic Synchro Lift After Ship Has Been Lifted

c. **Floating Dock**. A floating dock is a floating watertight structure which can be submerged sufficiently to receive a ship by flooding the **pontoon tanks** which form the bottom of the dock. When the ship has been floated into the dock and secured, the pontoon tanks are pumped out until the pontoon deck and the ship are dry. The ship rests on a line of blocks under the keel and in some cases blocks are positioned under the bilges. Because of the flexibility of a floating dock, it is essential that the ship be supported by breast shores between the ship and the dockside. This is necessary to prevent the sides of the dock deflecting inwards due to the weight of the ship resting on the blocks.

d. **Marine Railway**. A marine railway consists of a sloping runway of masonry or concrete, extending some distance below the low-water mark, on which rails are laid. A cradle, fitted with a wheeled carriage, is run out to receive the vessel when there is sufficient water. The vessel and cradle are hauled up the runway by winch or capstan until they are clear of the water.

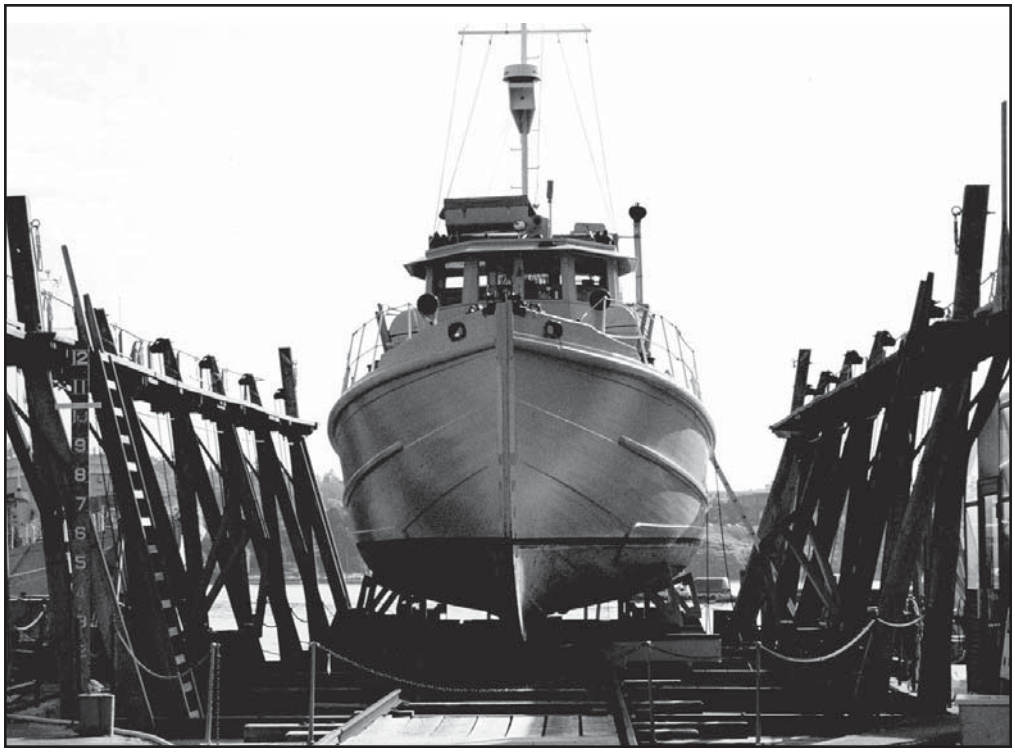


Figure 3.7-5 - Small Marine Railways in HMC Esquimalt Dockyard

3.8 Sea Measures

a. **International Nautical Mile**. The International Nautical Mile is a standard fixed length of 1852 m .

b. **Sea Mile**. A sea mile is the distance equivalent to one minute of arc measured along the meridian at the latitude of measurement. Since the earth is flattened at the poles and not a true sphere, this distance is not a fixed length; it varies between approximately 1843 m at the equator and 1862 m at the North and South Poles. The sea mile is used for the scale of latitude on large-scale charts because distances are measured using the latitude graduation on the chart borders.

c. **Cable**. The cable is a unit for measuring short distances and equals one-tenth of a nautical mile, approximately 200 yards. This term was derived from the fact that the length of a ship's anchor cable was once 101 fathoms (606 feet). The length of a modern ship's anchor cable bears no relation to the cable measure (see Chapter Seven).

d. **Fathom**. The fathom was the traditional nautical linear measure for ropes, hawsers, depths of water and soundings. It is now superseded for all these purposes by the metre. The conversion is as follows:

1 fathom = 1.8288 metres
1 metre = 0.5468 fathoms

e. **Knot**. A knot is a unit of speed equal to one nautical mile per hour (1.852 kilometres per hour). For example, a ship may be **steaming at 15 knots**, meaning that she travels at a speed of 15 nautical miles per hour. (The expression 'knots per hour' is incorrect and should never be used to describe speed). The term is derived from a method of measuring speed in the days of sail, when a piece of wood attached to a line was thrown overboard. The number of equally spaced knots in the line that passed over the taffrail in a specified time gave the speed of the ship in **knots**.

3.9 Glossary of Terms

Abaft	Further aft than; never use the term "aft of."
Access	Usually describes a door, hatch or other large opening, permitting entry into a compartment.
Accommodation Ladder	A portable set of steps fitted to a ship's side for the accommodation of people boarding from small boats or a pier.
A'Cockbill	When the anchor is clear of the hawse pipe, and hangs vertically by its ring.
Aft	In the direction of the stern.
Ahoy	A seaman's way of attracting attention.
Aloft	Above.
Anchor	A heavy hook-shaped device fastened to the outboard end of a ship's chain cable. Together they are used to secure the ship to the sea bottom.
Angel Fairlead	Fairlead located on the top of the bull ring.
Athwart	Running from side to side.
Athwartships	Across the ship at right angles to the centre line.
Awash	Level with the surface of the sea.
Avast	An order to stop.
Back Up	To assist in holding.
Ballast	Any weight or weights used to change a ship's trim or to keep the ship from becoming "Top Heavy".
Ballast Tank	Watertight compartment to hold ballast.
Barge	A flag officer's boat.
Batten Down	To secure closed or shut.
Bear a Hand	An order to assist.
Below	Down; below a deck or decks.
Berth	A place to sleep or a ship to secure to.
Bilge	The inner "flat" part of the hull's bottom. Also refers to waste oil, water and all liquids that collect in the bottom of the ship.

Bilge Keel	A long projecting fin designed to decrease the rolling of a ship. It is normally secured to the hull or the turn of the bilge.
Bilge Pump	Pump for removing bilge water.
Binnacle	A case or stand containing a ship's or boat's magnetic compass, adjusting magnets, and a lamp for use at night.
Bitt	A vertical post used for making fast lines; a bollard.
Bitter End	Inboard end of ship's cable.
Boat Deck	A deck on which boats are stowed.
Bollard	A single or double post for making fast lines (see bitt).
Boom	A long, heavy spar capable of being pivoted at one end, usually used for handling cargo.
Boot Topping	The black band around the waterline.
Bosn's Call	A whistle device used to pass orders.
Bow	The forward end of the ship.
Bravo Zulu	Well done.
Breakwater	A braced guard plate which prevents water from sweeping the decks.
Brightwork	Polished metal fittings such as brass tally plates.
Brow	A narrow platform placed between ship and shore for embarkation and disembarkation, sometimes called a gangway.
Buffer	Chief Boatswain's Mate.
Bulkhead	The term for a "wall" in a ship.
Bullring	The large fairlead at the bows.
Cable Holder	Designed solely for working cable; consists of a sprocket with lugs to carry links of cable; mounted on a vertical shaft. Usually combined with a capstan to work lines as well.
Cable Locker	A compartment in the forward portion of a ship in which anchor cable is stowed (chain locker).
Cant	To incline away from the upright.
Capsize	To overturn.

Capstan	Revolving drum, mounted on a vertical shaft, used for working lines.
Cast Off	To let go.
Centre Line	The middle line of the ship, extending from stem to stern.
Check Away	To ease out a rope or wire under control.
Chock	A block or wedge, so placed as to prevent or limit motion or to rest a boat on.
Cleat	A fitting having two arms to which ropes may be made fast.
Clam Shell	A very large oval-shaped porthole to enclose the Jungle Deck on AOR 509/510.
Coxswain	Designated Chief Senior or Petty Officer in a ship, responsible to the XO. He exercises command over all non-commissioned crew on board. One who has charge of a ship's boat and crew. Abbreviated: Coxn.
Crest	The highest point of a wave.
Deadweight	The total weight of fuel, water, stores, ammunition, crew and their effects, which a ship can carry.
Deck	The part of the ship corresponding to the floor of a building.
Dip	To lower temporarily; to pass under, as in dip a line.
Dog	A small bent metal fitting used in closing doors, hatch covers, manhole covers.
Dolphins	Mooring posts, usually composed of groups of piles driven into the bottom of a harbour.
Door	Allows horizontal access to spaces and passageways.
Double Bottom	Compartments at the bottom of a ship between inner and outer bottoms, used for ballast tanks, water, fuel oil, etc.
Draught	The vertical distance of the lowest point of the ship below the surface of the water when afloat.
Drag	To pull along the seabed.
Easy	Carefully or slowly.

Eyes of the Ship	The extreme forward end of the ship.
Even Keel	A ship is said to be on an even keel when the keel is level or parallel to the surface of the water
Fairlead	A fitting through which a rope or line may be led so as to change its direction without excessive friction.
Fair	Favourable or unobstructed.
Fake Out	To lay a wire or rope on the deck so that it is free for running.
Fathom	Nautical measure, 1.83 metres or 6 feet.
Fender	A portable device to protect a ship from damage when touching a pier or another ship. Most common are pneumatic fenders but they may be made of wood, rope, etc.
Flare	When the ship's sides curve outwards above the waterline commonly at the bow.
Flat	A small partial deck (built level) without curvature.
Forepeak	The compartment or tank at the bow of a ship.
Forward	In the direction of the focsle.
Foul	To entangle or obstruct.
Foundations	Supports for boilers, engines, and auxiliary machinery.
Freeboard	The vertical distance from upper watertight deck to waterline.
Furl	To fold or roll up an awning or sail.
Gaff	Pole.
Galley	Ship's kitchen.
Galvanizing	Coating metal parts with zinc for protection from rust.
Gangplank	A narrow platform placed between one ship and another for embarkation and disembarkation.
Gangway	The opening in the bulwarks or position in the ship's side by which the ship is entered or left. The term is also used to describe a passageway in a ship, and sometimes used to describe the platform between ship and shore (see brow).

Grapnel	A pronged hook for retrieving gear.
Grommet	A reinforcing eyelet of metal, rope or other material through which a rope, cord or fastening may be passed.
Gunwale	The junction of the upper deck and the hull at the top of the sheer strake.
Gypsy	Sprockets used for taking up chain cable in a windlass.
Handsomely	Slowly, carefully.
Hanging Judas	A fall, whip, or halyard hanging loose. Most commonly used to refer to the bridle hanging freely from the bullring when securing to a buoy.
Hatch	An opening in a deck for passage.
Haul Taut	To pull tight by hand.
Hawse Pipe	Casting, or castings, through deck and side of ship at bow for passage of anchor chain.
Hawser	A large rope used in towing and berthing.
Heel	The inclination of a vessel to one side.
Hull	The body of the ship which forms its outer watertight skin.
Inboard	Inside of the ship; toward or nearer the centre line.
Irish Pennants	Rope yarns or stray rope ends hanging.
Jack Staff	A flagstaff at the bow of a ship.
Jungle Deck	Tank deck on a replenishment ship.
Junk	Old rope.
Jury-Rig	Temporary, make-shift.
Keel	The principal fore-and-aft member of a ship's frame to which all weight is ultimately transmitted. The keel runs along the bottom connecting the stem and stern to which are attached the frames of the ship.
Knot	Measurement of speed (not distance) - one nautical mile per hour.
Ladder	Steps used on board ships in place of stairs.
Landfall	First sight of land after a sea passage.
Lee	Opposite side of the ship to that upon which the wind is blowing.

Length Over All	The length of a ship measured from the extreme forward end to the aftermost point of the stern.
Lie to	To be as stationary as possible in a gale.
Lighter	A vessel used for transporting cargo or stores to or from a ship.
Lines	The form of a ship as represented by its moulded surface.
List	To lean over to one side.
Mess	Communal or living areas.
Messmates	Those living together, comrades; "messmate before shipmate, shipmate before stranger".
Midships	At or near the middle point of the ship's length.
Mooring	Securing a ship in position by several lines or cables, so that she cannot move or swing.
Naval Pipe	A pipe for passage of anchor cable from deck to cable locker.
Overboard	Outside; over the side of a ship; into the water.
Palm	Device fitted to the hand to assist in sewing.
Piles	Baulks of steel-pointed timber or lengths of ferroconcrete which are driven into the harbour bottom and used as the foundations for the platforms of piers and jetties.
Porthole	A circular opening in the ship's side.
Quarterdeck	The after part of the upper deck of the ship.
Range	To lay out rope or cable.
Refit	To repair.
Rigging	Ropes, wires, lashings, masts, boom's tackles.
Roll	The motion of the ship from side to side, alternately raising and lowering each side of the deck.
Roundly	Rapidly or fast.

Rudder	A flat piece or structure attached upright to the sternpost which can be turned, causing the vessel's head to turn in the same direction.
Rudder Stock	The shank of a rudder which extends through the hull upward to the steering motors.
Rudder Stop	Lug to limit the swing of the rudder.
Scotchman	Material used to prevent chafing.
Scran Locker	Stowage for kit left lying about.
Scruffy	Untidy, messy.
Sculling	To leave lying about or unattended.
Scupper	A hole or drain along the side of a ship's deck to allow water to run off.
Scuttle	A round port hole.
Sea Legs	The ability to maintain balance when a ship is rolling.
Secure	To make fast; to stop work.
Shepherd's Hook	A pole with a large hook for recovering boat's falls, wires, lines.
Shipshape	Neat and tidy.
Shot Mat	A heavy rope mat used to protect.
Slue	To cause to move sideways, as if some portion were pivoted.
Snub	To suddenly stop a rope or cable.
Snug	Properly secured; tight.
Staging Planks	Scaffolding on which to stand when working over the side or on the upper decks.
Stanchion	A supporting post.
Stay	A guy line.
Steering Gear	Apparatus for controlling the rudder.
Stem	The bow end of a ship.
Stern	The after or back end of a vessel.
Stow	To put away.
Strike	To haul down.
Tarpaulin	Waterproof covering.
Taut	Tight; to haul taut.
Teebar	A tool with a structural shape with cross-section resembling the letter "T".
Template	A mould or pattern.

Tiffy (sickbay)	Slang for medical assistant carried on board Canadian ships.
Transom	The main frame at the stern of a ship.
Transverse	Athwartships; at right angles to the keel.
Trim	To shift ballast, cause a ship to change its position in the water over its length.
Veer	To pay out a line, wire or cable under power.
Walk Back	To pay out, by walking, keeping the line in hand.
Warp	A rope extending between ship and shore, for moving (warping) the ship without using her engines.
Warping Drum	A contoured barrel fitted horizontally on a windlass to work lines.
Waterline	Any one of certain lines of a ship parallel with (and at various heights above) the base line.
Watertight	So riveted, caulked, or welded as to prevent the passage of water.
Waterway	A narrow passage along the edge of a deck for drainage; a gutter.
Weather Deck	A deck exposed to the weather.
Weep	To leak slightly.
Winch	A small hoisting engine, used in pulling lines.
Winding	The action of turning a ship the other way round in her berth (turning end for end).
Windlass	A revolving drum, mounted on a horizontal shaft, used for heaving in cable; usually combined with a warping drum to work lines as well.

CHAPTER 4
General Shipboard Safety

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CHAPTER 4
General Shipboard Safety

4.1 General

Naval operations are inherently dangerous. Lines under tension, heavy equipment and hazardous substances all pose threats to personnel. Safety is the responsibility of everyone — anyone observing an unsafe condition is to take action to correct it and, at the very least, report it to his/her supervisor. Most accidents can be attributed to inattention and carelessness. Personnel involved in any and all seamanship evolutions must avoid skylarking and must pay close attention to their surroundings. Each chapter in this manual stresses safety points specific to the evolution being described. This chapter also describes fundamental safety rules which apply in every situation.

4.2 Safety during Evolutions

The following is a list of safety points that should be covered in briefings given by the station supervisor prior to a seamanship evolution. The list is not comprehensive and should only be used as a guide. Although the list pertains to evolution safety, it can be applied to everyday work on board a ship. Sample safety briefings for specific evolutions are found in Chapters 6, 7, 8 and 9.

a. **Rigging**. Prior to commencing rigging for an evolution, the station supervisor will examine all equipment to ensure it is in good condition and proper working order, i.e., check lines for potential damage by corrosive material. The supervisor will then check that the station is rigged in accordance with the approved Class drawings, and the layouts promulgated in CFCD 105 and the most recent applicable AIG 1861.

b. **Dress**. The weather, sea state, wind and duration of the evolution should be taken into consideration when choosing the dress for an evolution. The OOW and POOW will make recommendations to the XO and Deck O on what personnel should wear. The dress for evolutions will be announced in the closing-up pipe, but a warning pipe should be made to allow personnel to prepare. Some general guidance on dress is detailed in the following table.

<table>
<tr><th colspan="2">Table 1 Dress for Evolutions</th></tr>
<tr><td>Steel-toed boots must be worn by all personnel. An appropriate flotation device must be worn by all personnel.</td><td rowspan="2">Dump workers, station supervisors and all other personnel working in the immediate vicinity of lines under strain and/or open guardrails shall wear Hazardous Duty life jackets and safety helmets. All others shall wear Personal Flotation Devices (PFDs) and no helmets. (Ref: SSOs)</td></tr>
<tr><td>Safety helmets will be worn by personnel as required.</td></tr>
<tr><td colspan="2">All personnel must wear at least one full layer of clothing. There is no requirement for personnel working in a fuelling area to wear a second layer of clothing.</td></tr>
<tr><td colspan="2">All personnel in the vicinity and aft of the fuelling rig will wear safety goggles in order to protect their eyes in the event of a fuel spill. They will don the goggles prior to the probe being seated and will not remove them until the probe is clear of the station.</td></tr>
<tr><td colspan="2">A sharp knife is to be carried by all personnel.</td></tr>
<tr><td colspan="2">Gloves may be worn by line handlers at the discretion of the Station Supervisor. Normally, this would apply in cold winter conditions or when working with wire only.</td></tr>
</table>

Note.

Loose clothing, rings and jewellery etc., can be hazardous. Catching a finger or neck chain in running rigging could result in serious injury. Personnel are to remove such items prior to evolutions.

c. **Dump Areas and Guardrails**. It is often necessary to remove guardrails in order to conduct evolutions. When they are removed, a temporary guardrail must be rigged. Temporary guardrails consist of a length of line and chain strung across the gap. It can be lowered and raised quickly when required. When temporary guardrails are rigged, the station I/C must determine the requirement to wear safety harnesses with lifelines attached. Safety harnesses must be worn by dump and guardrail workers whenever guardrails are removed. Temporary guardrails are to be rigged prior to removing guardrails.

Note.

Never lean on guardrails: it is unseamanlike and dangerous. When breaking guardrails or working around temporary guardrails, follow the two-man rule — never do the job by yourself.

d. **Snap Back Zones**. Whenever a line comes under excess strain, the risk that it may part rises exponentially. When a line under strain parts, it snaps back to its normal unstrained condition. The speed at which it snaps depends on the construction of the rope. Ropes made of synthetic fibres, for example double-braided nylon, snap back at very dangerous speeds, presenting the risk of serious injury to anyone caught in its path. For this reason it is imperative that line handlers are ordered clear of snap back zones whenever excess strain comes on the line. Symptoms of excess strain are heat waves emanating from the line as the fibres begin to melt and visible smoke immediately prior to the line parting. The snap back zone is defined as an area 20 degrees from either side of potential snap points.

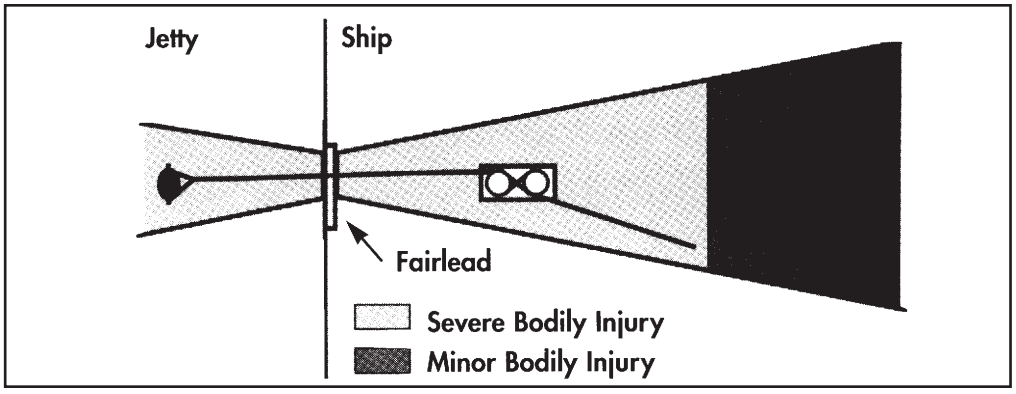


Figure 4.2-1 - Snap Back Zone

e. **Line Handling**

(**1**) Whenever handling lines, always heave in or pay out hand over hand.

(**2**) Never stand in a bight.

(**3**) Never wrap a line around your arm or waist.

(**4**) Fake or coil lines whenever receiving them so that they are free for running.

(**5**) Whenever possible, stand 2 m back from winches, capstans, bollards and or blocks when handling lines.

(**6**) Be aware of the snap back zone when working with synthetic lines, and remain clear whenever possible.

(**7**) Never straddle lines.

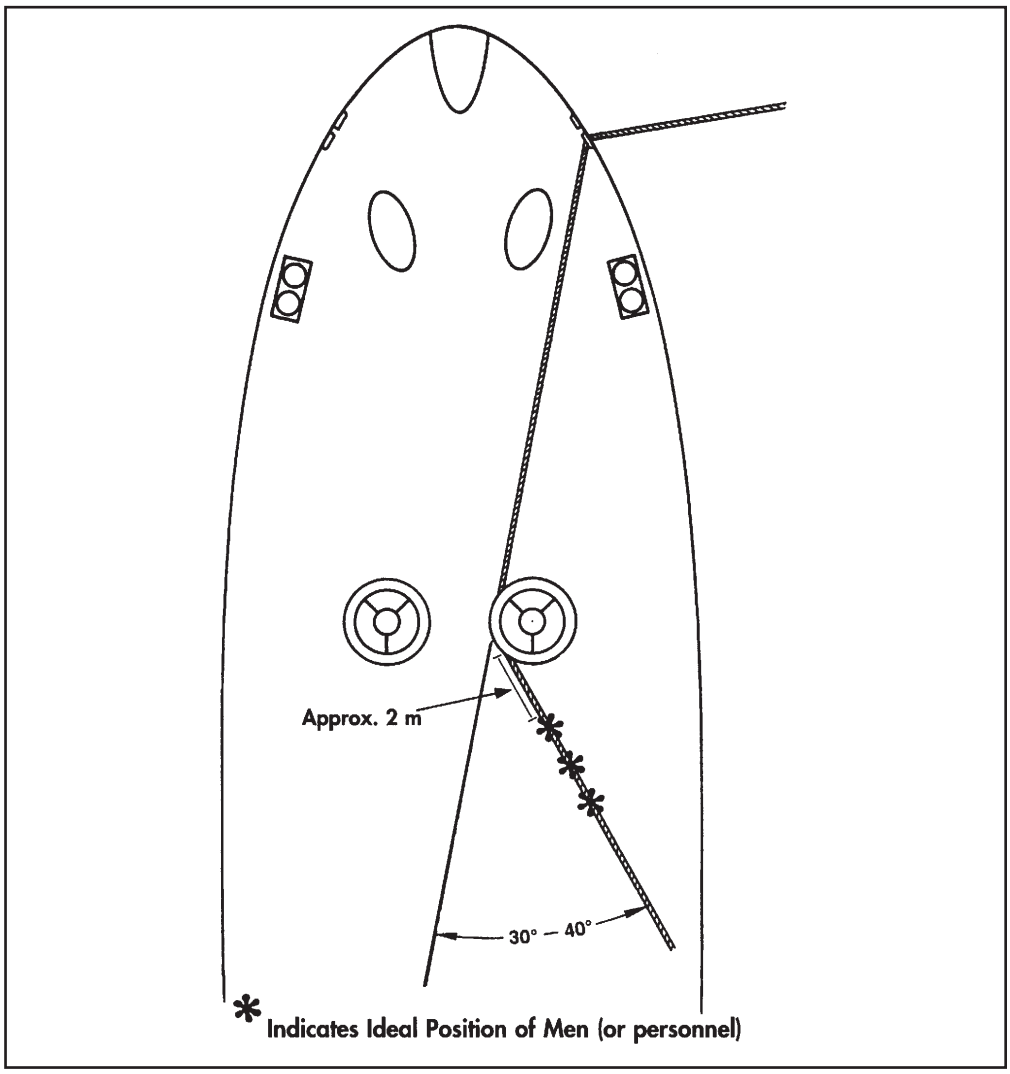


Figure 4.2-2 - Ideal Position when Working Capstans, Winches and Bollards

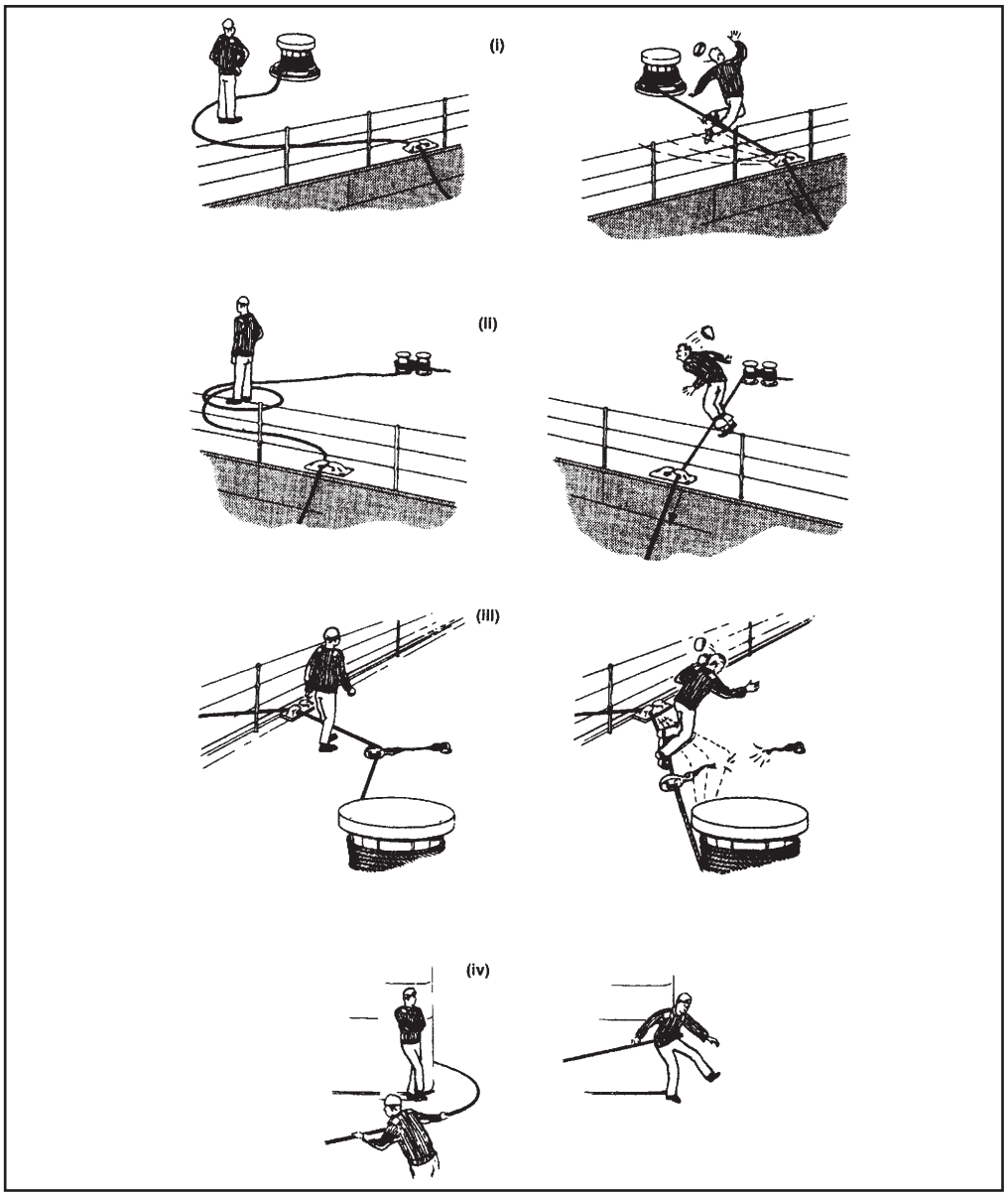


Figure 4.2-3 - Danger Zones when Working with Lines

f. **Loads**

(**1**) Do not stand between loads and the bulkhead.
(**2**) Do not stand between the rigging and bulkheads.
(**3**) Do not stand outboard of a load.

g. **Tensioned Rigs**

(**1**) Do not cross over or under rigging.
(**2**) Do not straddle or cross de-tensioned rigging.
(**3**) Do not turn your back to the rig.

h. **Winches/Capstans**. Riding turns are formed when a line on a winch or capstan drum crosses over itself. This creates a dangerous situation because the line jams and cannot be veered or heaved in.

4.3 Safety Equipment

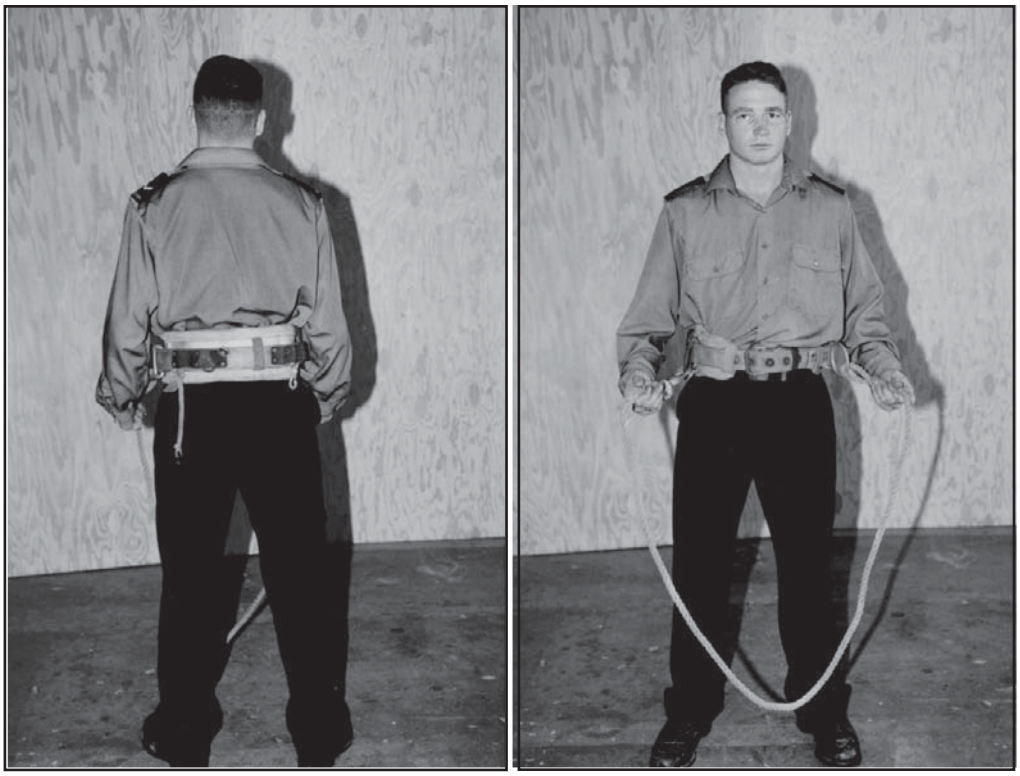
4.3.1 Safety Belt and Harnesses

a. The linesman type of safety harness with a lifeline attached is to be worn by personnel whenever they are working in an area outboard of the guardrails, or when guardrails are removed. The lifeline or tether is to be rigged such that the person can go no further than the edge. Safety harnesses are to be used judiciously; several personnel working in a dump area wearing harnesses with tethers can easily become entangled, thus creating a dangerous situation.

b. The Safety Harness is used to arrest a fall. Safety harnesses are to be worn at all times when working aloft or over the side.

Back **Front**

Figure 4.3-1 - Safety Harness



Back **Front**

Figure 4.3-2 - Safety Belt

c. A complete inspection of the belt or harness must be conducted prior to use, as described in the following table.

Table 2 Safety Belt and Harness Inspection
Belts and Rings. Beginning at one end, holding the body side of the belt toward you, grasp the belt with your hands placed 15 to 20 cm apart. Bend the belt in an inverted "U". The resulting tension makes damaged fibres or cuts easier to see. Follow this procedure the entire length of the belt/harness, watching for frayed edges, broken fibres, pulled stitches, cuts or chemical damage.
D-rings and D-ring metal pad (if any). Check for distortion, cracks, breaks, and rough or sharp edges. The D-ring bar should be at a 90 angle to the long axis of the belt and should pivot freely. The points of attachments for buckle and D-rings should be given special attention. Note any unusual wear, frayed or cut fibres, or distortion of the buckles or D-rings. Rivets should be tight and unmoveable. The body side rivet base and outside rivet burr should be flat against the material. Bent rivets will fail under stress. Inspect for frayed or broken strands. Broken webbing strands generally appear as tufts on the webbing surface. Any broken, cut or burned stitches will be readily seen.
Tongue or Belt Billet. These receive heavy wear from repeated buckling and unbuckling. Inspect for loose, distorted or broken grommets. Belts should not have extra punched holes.

Table 2 Safety Belt and Harness Inspection (cont)
Tongue Buckle. Buckle tongues should be free of distortion in shape and motion. They should overlap the buckle frame and move freely back and forth in their sockets. The roller should turn freely on the frame. Check for distortion or sharp edges. **Friction Buckle.** Inspect the buckle for distortion. The outer bars and centre bars must be straight. Pay special attention to corners and attachment points of the centre bar.
Lanyard Inspection. When inspecting lanyards, begin at one end and work to the opposite end. Slowly rotate the lanyard so that the entire circumference is checked. Spliced ends require particular attention. **Web Lanyard**. While bending webbing over a pipe, observe each side of the webbed lanyard. This will reveal any cuts or breaks. Swelling , discolouration, cracks, and charring are obvious signs of chemical or heat damage. Observe for any breaks in the stitching. **Rope Lanyard.** Rotating the rope lanyard while inspecting it from end to end will show any fuzzy, worn, broken or cut fibres. Areas weakened from extreme loads will appear as a noticeable change in original diameter. The rope diameter should be uniform throughout, following a short break-in period.
Snaps. Inspect snaps closely for hook and eye distortions, cracks, corrosion, or pitted surfaces. The safety latch should seat into the nose without binding and should not be distorted or obstructed. The safety latch spring should exert sufficient force to firmly close the latch.
Thimbles. The thimble must be firmly seated in the eye of the splice, and the splice should have no loose or cut strands. The edges of the thimble must be free of sharp edges, distortion, or cracks.

4.3.2 Cleaning of Safety Belts and Harnesses

a. Basic care of all safety equipment will prolong its life. Proper stowage and maintenance after use are as important as cleaning the equipment of dirt, corrosives, or contaminants. Storage areas should be clean, dry and free of exposure to fumes or corrosive elements.

b. Wipe off all surface dirt with a sponge dampened in plain water. Squeeze the sponge dry. Dip the sponge in a mild solution of water and commercial soap or detergent. Work up a thick lather, with a vigorous back and forth motion. Then wipe the belt dry with a clean cloth. Hang to dry but away from excessive heat. When hanging, hang from the D-ring.

If a fall occurs, all components of the belt/harness are to be condemned, due to the shock-loading on the apparatus. It is to be returned to FMF technical authorities who will test it to destruction in order to gather more data on the effects of shock loading.

4.3.3 Safety Helmets

a. Safety helmets, commonly referred to as hard hats, are worn by personnel employed in areas/environments where there is a danger of being struck on the head. The colour of the helmet is also used to identify key personnel during seamanship evolutions.

Table 3 Helmet Colour

Colour	Person
White	Safety Officer
Yellow	Station Supervisor
Green	Station Signalman
Red	Station Gunman
Blue	Station Worker
Orange	Storesman (Supply Dept.)
Grey	(Engineering Dept.)

b. The helmet consists of two parts: a tough, durable polyethylene shell and a suspended adjustable liner. The helmet has a slot on either side for accessories (goggles, defenders, etc.) and eyelets to attach a chin strap.

c. The helmet should not be left under the direct rays of the sun or left exposed to severe cold when not in use. It should not be thrown around or altered in any way and should not be painted or affixed with decals as they hide cracks in the helmet. They should fit properly, be inspected periodically for scratches and cracks and be replaced every five years.

Note.

If a safety helmet is subjected to a hard impact, it should be discarded.

4.3.4 Eye Protection

There are three basic types of eye protection: safety glasses, goggles and face shields. The correct type must be used, depending upon the hazard. Goggles and face shields offer good protection for most hazards. Safety glasses do not offer any protection from chemical splashes; therefore, goggles are to be worn during fuelling operations. The vent type is designed to prevent fogging and is used during all seamanship evolutions.

4.3.5 Hearing Protection

Extended exposure to sound levels above 97 decibels can cause permanent hearing damage. Personnel are to use approved hearing protection ranging from ear plugs to ear muffs when working with or around noisy equipment, e.g., grinding tools.

4.3.6 Hand Protection

There are a variety of gloves available to protect against various hazards, e.g., rubber gloves for working with paints and solvents, and leather gloves when working with ropes or power tools. The gloves being used must be matched to the hazard and inspected prior to use. Gloves must be used when working with wire and may be used when working with lines or hawsers, depending upon the weather.

4.3.7 Foot Protection

All seamen are issued steel-toed boots which are to be worn whenever there is danger of foot injury. The boots should be inspected periodically to ensure that there is sufficient tread left to prevent slipping.

4.3.8 Respiratory Protection

There are a variety of respiratory hazards that sailors face, ranging from common dust to toxic paint fumes. The appropriate mask, respirator or pressure breathing apparatus must be matched to the hazard.

4.4 Working Aloft

Personnel often go aloft to work on equipment or to paint. Many dangers exist if established safety procedures are not followed. Some of the hazards are listed in the following table.

Table 4 Man Aloft Hazards

Falling due to : - ship's movement - radar antenna rotation - loose clothes catching - poor foothold on wet or greasy metal - being startled by unexpected noises
Radiation hazards from transmitting equipment on board ship or adjacent ships.
Risk to personnel below from falling tools and equipment.
Exhaust gases from funnels

4.4.1 Procedure

a. Before going aloft, a Man Aloft Chit must be filled out by the person going aloft. These chits are maintained in the CSE office in each ship and are self-explanatory. They require the signatures of all key personnel involved, including the OOW/OOD, so that the safety of those personnel proceeding aloft is guaranteed. Figure 4.4-1 is a sample of a Man Aloft Chit.

National Defence / Défense nationale

MAN ALOFT/RF RADIATE/ANTENNA ROTATE CONTROL CHIT
FORMULAIRE DE L'HOMME DANS LA MÂTURE/RAYONNEMENT RF/ROTATION DE L'ANTENNE

VESSEL – VAISSEAU	SHIP'S STAFF SUPERVISOR SUPERVISEUR DU PERSONNEL DU NAVIRE	OOD/W – ODS/Q	DATE
ON-SITE CONTACT – CONTACT SUR PLACE	**UNIT – UNITÉ**	**TELEPHONE – TÉLÉPHONE**	**JOB NO – Nº DE TÂCHE**

ONE CONTINUOUS TIME PERIOD ONLY
UNE PÉRIODE DE TEMPS CONTINUE SEULEMENT

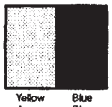
START TIME / DÉBUT _____ END TIME / FIN _____

MAN ALOFT
HOMME DANS LA MÂTURE

LOCATION – EMPLACEMENT

PURPOSE – OBJET

FLAG KILO
PAVILLON KILO



Yellow / Jaune — Blue / Bleu

SAFE EXHAUST/WHISTLES (Duty Tech)
ÉCHAPPEMENT/SIFFLETS NEUTRALISÉS (Tech de service) _____ Name – Nom _____ Signature

ADJACENT SHIPS (OOD Initials)
NAVIRES ADJACENTS (Initiales de l'ODS) _____

QHM INFORMED (OOD Initials)
CAPITAINE DU PORT INFORMÉ (Initiales de l'ODS) _____

FLAG KILO HOISTED, KEYS SECURED, MAN ALOFT INFO TAG
PAVILLON KILO HISSÉ, CLÉS NEUTRALISÉES, ÉTIQUETTE «HOMME DANS LA MÂTURE» _____

OOD/W SIGNATURE
SIGNATURE DE L'ODS/Q _____

ON-SITE CONTACT SIGNATURE
SIGNATURE DU CONTACT SUR PLACE _____

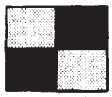
RF RADIATE
(may include rotate)
RAYONNEMENT RF
(peut inclure une rotation)

LOCATION – EMPLACEMENT

PURPOSE – OBJET

RADIATING PIPE EVERY 15 MINUTES and CHECK JETTY FOR CRANES
ANNONCE DE RAYONNEMENT À TOUTES LES 15 MINUTES ET VÉRIFIER S'IL N'Y A PAS DE GRUES SUR LA JETÉE

FLAG LIMA
PAVILLON LIMA



Black / Noir — Yellow / Jaune

CSEO/CSEC
OGSC/CGSC
Name / Nom _____ Signature _____

CURRENT MAN ALOFT (if required)
HOMME DANS LA MÂTURE (le cas échéant)
Name / Nom _____ Signature _____

ADJACENT SHIP OOD (if required)
ODS DU NAVIRE ADJACENT (le cas échéant)
Name / Nom _____ Signature _____

QHM INFORMED (OOD Initials)
CAPITAINE DU PORT INFORMÉ (Initiales de l'ODS) _____

WARNING SIGNS UP, FLAG LIMA HOISTED, ATTACH KEY TAG
PANNEAUX D'AVERTISSEMENT INSTALLÉS, PAVILLON LIMA HISSÉ, ÉTIQUETTE FIXÉE SUR LA CLÉ _____

OOD/W SIGNATURE
SIGNATURE DE L'ODS/Q _____

ON-SITE CONTACT SIGNATURE
SIGNATURE DU CONTACT SUR PLACE _____

ANTENNA ROTATE
(does not include radiation)
ROTATION DE L'ANTENNE
(n'implique pas l'émission de radiations)

LOCATION – EMPLACEMENT

PURPOSE – OBJET

FLAG SIX
PAVILLON SIX

White / Blanc — Blue (Shaded Area) / Bleu (espace foncé)

CSEO/CSEC
OGSC/CSCG
Name / Nom _____ Signature _____

CURRENT MAN ALOFT (if required)
HOMME DANS LA MÂTURE (le cas échéant)
Name / Nom _____ Signature _____

QHM INFORMED (OOD Initials)
CAPITAINE DU PORT INFORMÉ (Initiales de l'ODS) _____

FLAG SIX HOISTED, ATTACH KEY TAG
PAVILLON SIX HISSÉ, ÉTIQUETTE FIXÉE SUR LA CLÉ _____

OOD/W SIGNATURE
SIGNATURE DE L'ODS/Q _____

ON-SITE CONTACT SIGNATURE
SIGNATURE DU CONTACT SUR PLACE _____

SPECIAL CIRCUMSTANCES – The following special conditions/circumstances are in effect during the noted evolutions
CIRCONSTANCES SPÉCIALES – Les conditions/circonstances spéciales suivantes s'appliquent au cours des évolutions citées

_____
CSEO/CSEC SIGNATURE – SIGNATURE DE L'OGSC OU DU CGSC

MARK OUT NOT-APPLICABLE SECTION
MARQUER LES SECTIONS QUI NE S'APPLIQUENT PAS

REFERENCE NUMBER
Nº DE RÉFÉRENCE _____

COMPLETED **TRAVAUX COMPLÉTÉS**	ON-SITE CONTACT SIGNATURE – SIGNATURE DU CONTACT SUR PLACE	OOD/W SIGNATURE – SIGNATURE DE L'ODS/Q

DND 2145 (8–96)
NSN 7530–21–911–4739

THIS CHIT IS VOID WHEN EITHER THE OOD/W OR THE ON-SITE CONTACT CHANGES
CE FORMULAIRE N'EST PAS VALIDE SI L'ODS OU LE CONTACT SUR PLACE CHANGE

Design: Forms Management 995–3870
Dessin: Gestion des formules 995–2931 (fax)

COPY 1 TO OOD/W – COPIE 1 À L'ODS/Q

Figure 4.4-1 - Man Aloft Chit

b. The following actions should be followed before proceeding aloft to ensure that all precautions have been completed.

Table 5 Man Aloft Procedures
Have a completed and signed Man Aloft Chit.
Ensure all loose articles are removed from pockets.
Dress according to the weather
Follow the buddy system — never go aloft alone or without someone observing from below.
Don all applicable safety equipment (hard hat, goggles, ear defenders).
Attach safety lanyards to all tools.
Inspect safety harness before donning.
Ensure flag “Kilo” is hoisted. Figure 4.4-2

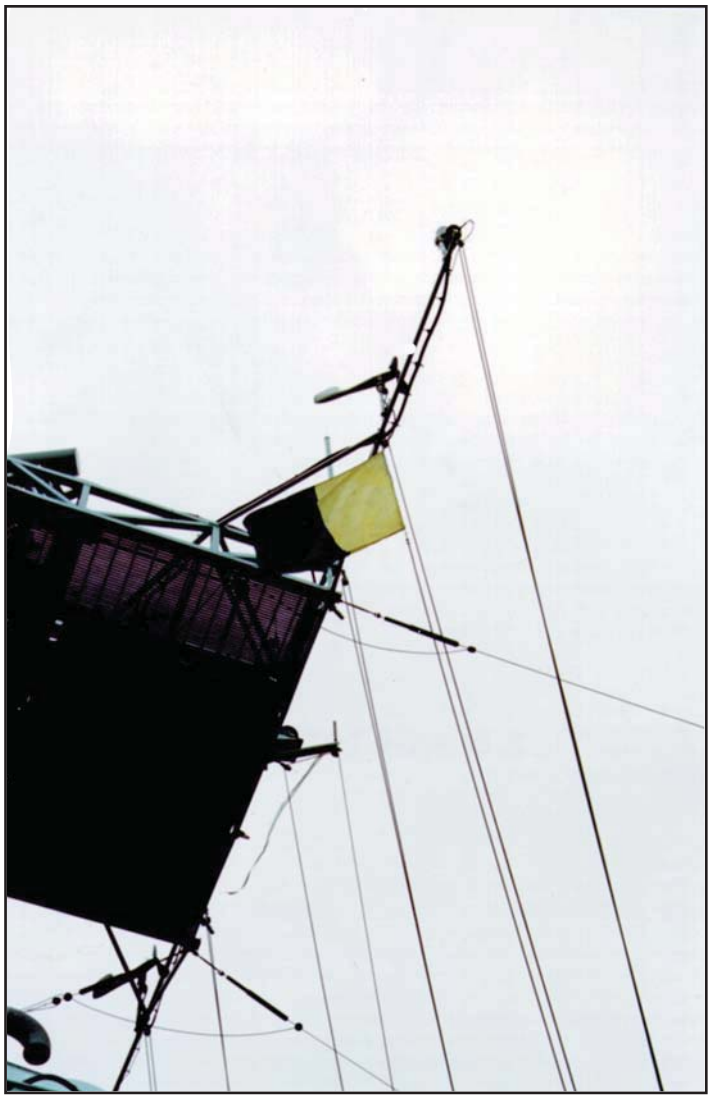


Figure 4.4-2 - Flag “Kilo”: Man Aloft

Note.

If there is potential danger to personnel below from falling objects, then the area must be roped off.

c. Upon completion of working aloft the OOD/OOW is to be informed. He/she will order flag "Kilo" hauled down. The Man Aloft Chit is to be returned to the CSE office.

4.5 Working Over the Side

a. Personnel need to go over the side to work on equipment or to prepare and paint the ship's side. Personnel working over the side use either a Bosn's Chair (Figure 4.5-1) or work off a Cat. Cats are small barges fitted with staging that come in various sizes. Personnel working over the side are exposed to several hazards. They may fall, but they may also be hurt by equipment dropped from above or electrocuted by electrical equipment dropped in the water. Overboard discharges may also present a hazard.

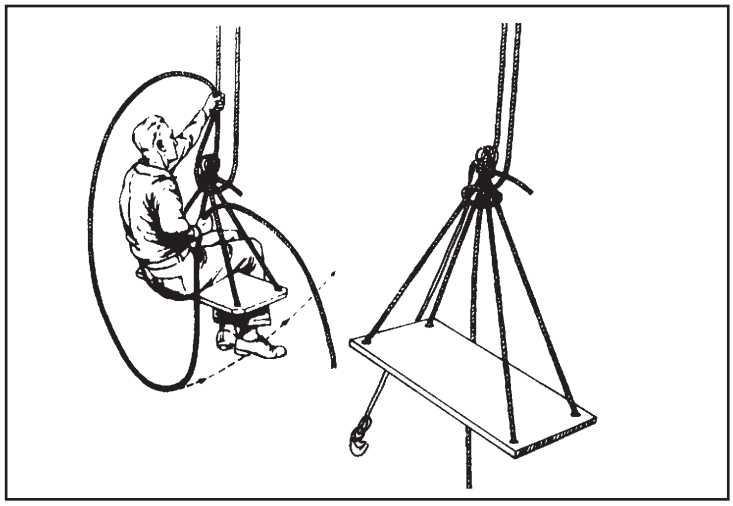


Figure 4.5-1 - Bosn's Chair

The procedures listed below are to be followed wherever there is a requirement for personnel to work over the side.

Table 6 Over the Side Procedures
Inform the OOD/OOW.
Check with the Duty Tech/EOOW to confirm that no hazard from overboard discharge exists.
Don all applicable safety equipment (life jacket, hard hat, goggles, ear defenders). Attach safety lanyards to all tools.
Ensure "Code Romeo Yankee" is hoisted. Figure 4.5-2
Have a line tender if working from a Bosn's chair.

Figure 4.5-2 - Code Romeo Yankee

c. Upon completion of working over the side the OOW/OOD is to be informed. He/she will order "Code Romeo Yankee" hauled down.

4.6 Heavy Weather Precautions

a. Before encountering heavy weather, the ship should rig rough weather lifelines. These are wire rope lines rigged across open areas of the upper decks to facilitate the safe movement of personnel who have to move about the upper deck in the execution of their duties. The wires (13 mm dia GFSWR 6 x19) are shackled either to the superstructure or to removable stanchions that are rigged in conjunction with the lifelines. To move along the lifeline personnel use short lengths of manila line called lizards. The lizards have a thimble on one end through which the lifeline is rove and a Turk's head on the other end to provide grip.

b. If there is a requirement for personnel to work on the upper decks in rough weather, the following safety precautions must be followed.

Table 7 Heavy Weather Precautions
Obtain permission from the OOW.
Keep the team as small as sensibly possible (no less than two).
Don positive buoyancy life jacket and safety harness (mandatory), safety goggles (as required).
Inform the OOW upon completion.

4.7 Non-Ionizing Radio Frequency Radiation Hazard (RADHAZ)

The emissions from ship's radars and radio transmitters can pose significant danger to personnel. This is known as RADHAZ. With respect to seamanship, the risk occurs when equipment such as boat davits, cranes and kingposts become energized by transmissions coming from antennas in the immediate vicinity. In this case, simply touching them can cause severe burns. For example, in HALIFAX Class ships, the torpedo recovery area used to launch the Zodiac is very close to the 35-ft. HF antennas. If the ship is transmitting at high power while Rescue Stations is piped, the crane operator risks being burned if he/she attempts to operate the crane prior to transmissions ceasing. Therefore the crane will not be operated until RADHAZ safe has been piped twice on the upperdeck circuits. Each ship follows detailed instructions on out of bounds areas and procedures to be followed. All personnel must understand the regulations involved in using the affected equipment. When in doubt, the subject matter experts to consult are the members of the CSE Department.

4.8 Hazardous Material (HAZMAT) and Workplace Hazardous Material Information System (WHMIS)

a. Ships carry many types of hazardous materials which are used by Boatswains, such as paints and cleaning solvents. All precautions should be taken to ensure hazardous material is handled and stored properly. In the event that a HAZMAT spill occurs, vacate and confine the compartment while concurrently raising the alarm. The emergency pipe will be ordered made by the OOW/OOD. The HAZMAT Clean-up Team, consisting of CSE personnel, will close up and conduct the clean-up.

b. HAZMAT considerations are coupled with the Workplace Hazardous Material Information System (WHMIS). Members of the ship's supply department are the onboard WHMIS experts, but all personnel should receive WHMIS training. Information is given to the ships by the product suppliers in the form of product labels and/or accompanying Material Safety Data Sheets (MSDS). The information is passed to the ship's company through training, labels, and the MSDS. When in doubt about a product, clarification must be sought prior to use.

4.9 Safety Committee

a. All ships are to have a safety committee charged with the onboard implementation of Command safety directives and the resolution of any current safety problems that affect, or may affect, the safety of the ship's company. The committee shall be chaired by the Safety Officer, with the membership including Heads of Departments or their representatives. The committee shall meet at least once every month.

b. The ship's safety organization is responsible for organizing safety education and training. The training shall be designed to suit the work environment and to familiarize personnel with potential hazards, special work requirements, safety rules and protective equipment requirements. It is important for all Bosns to know that any safety concerns that they observe and report will be dealt with promptly by the Safety Committee.

4.10 Survival At Sea

4.10.1 Life Rafts

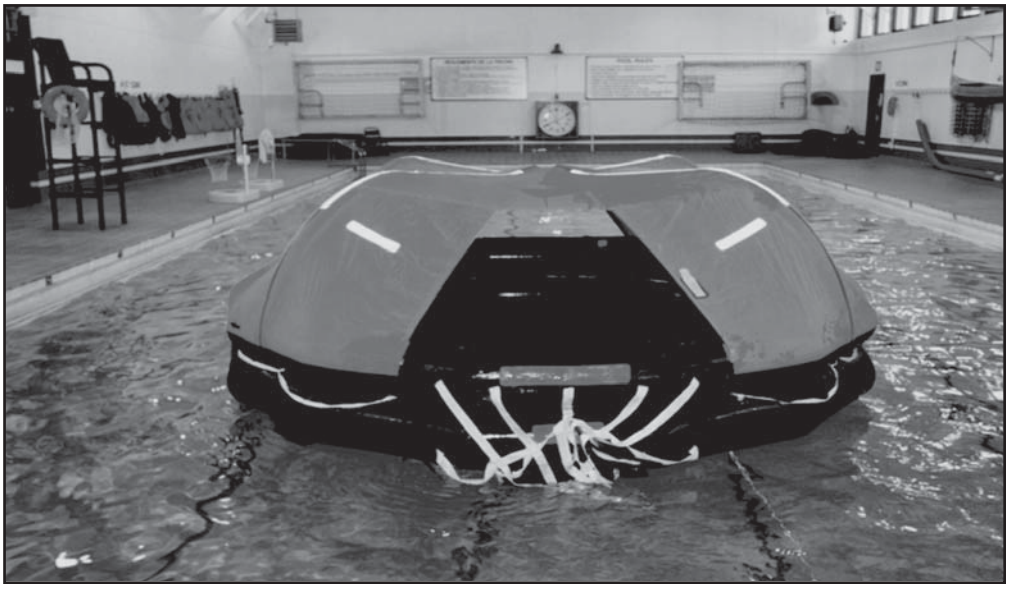


Figure 4.10-1 - Life Raft Inflated

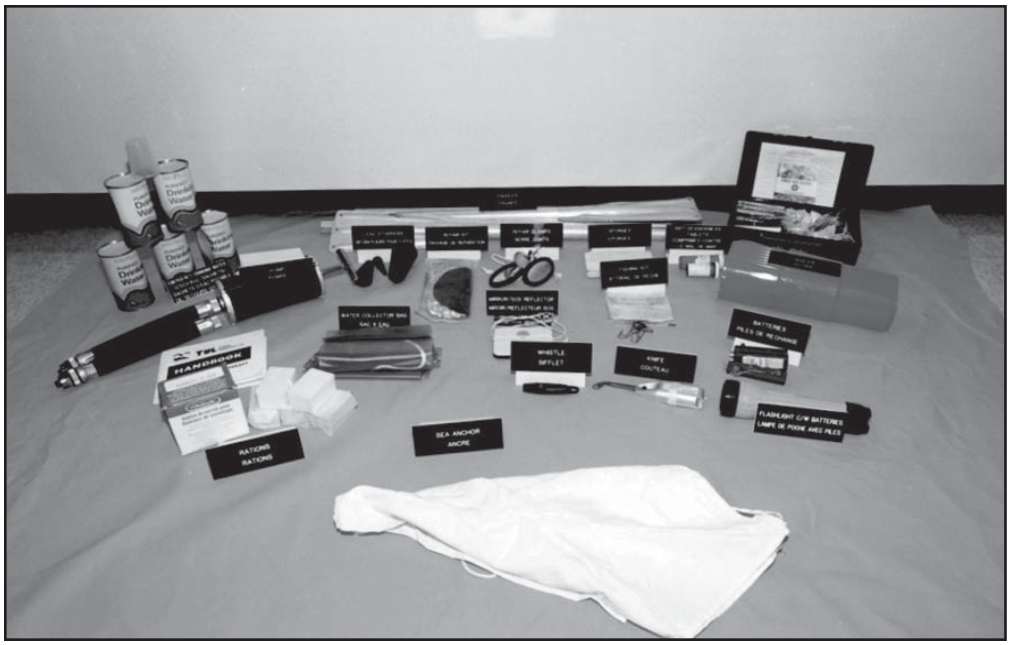


Figure 4.10-2 - Life Raft Survival Pack

Ships carry sufficient life rafts for the entire ship's company plus 10%. The life rafts are located on the upper decks and are held in their cradles by hydrostatic release devices. These devices will release when immersed in 1.5 to 4.6 m of water. The life raft can also be released manually by slipping the senhouse slip and launching the life raft overboard. The life rafts are designed to hold 20 personnel, with provisions for three to four days. Life rafts must be landed annually for inspection. The Boatswains are to conduct a visual check of the life rafts monthly to ensure that the containers are not cracked nor the seals broken, and that the life rafts are firmly secured in the cradles by the lanyards attached to the hydrostatic release devices.

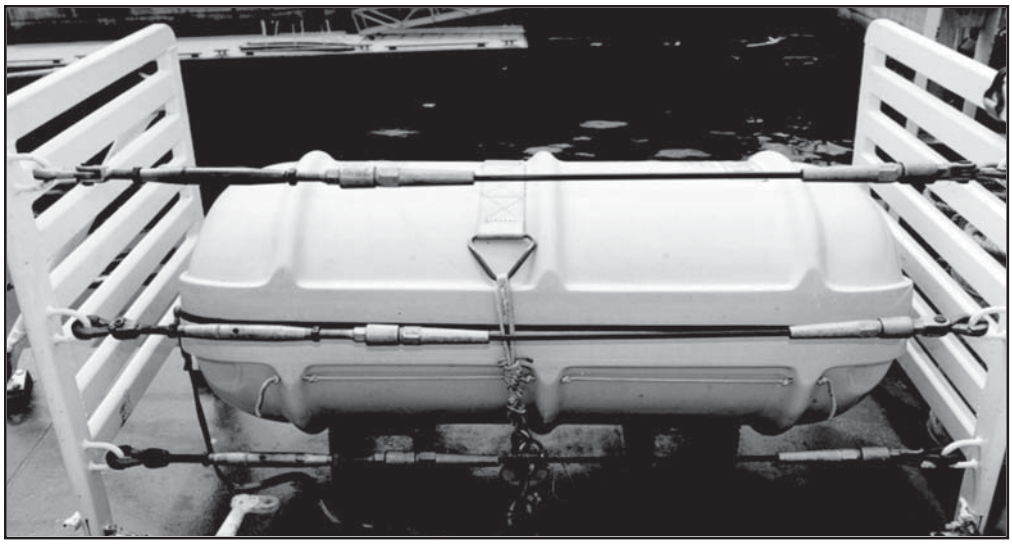


Figure 4.10-3 - Life Raft Container

Figure 4.10-4 - Hydrostatic Release Device

4.10.2 Life Jacket Container

Ships also carry life jacket containers which hold life preserver yokes (PFDs). Each life jacket container carries 40 life jackets.

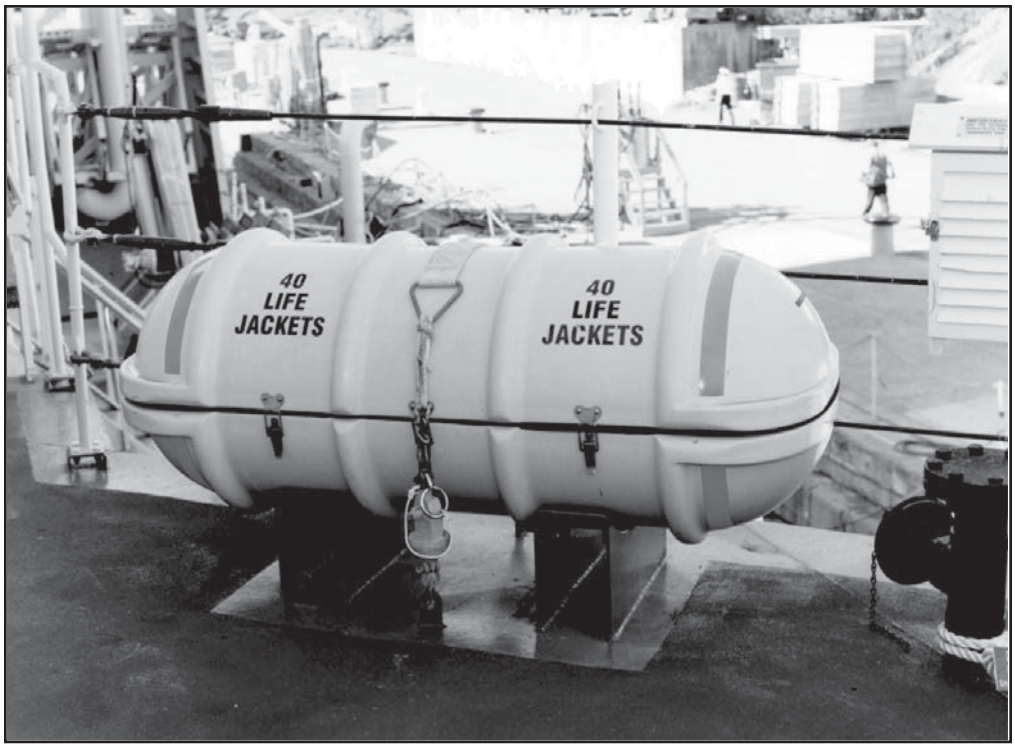


Figure 4.10-5 - Life Jacket Container

4.10.3 Flotation Devices - Definitions

There are a variety of flotation devices used in the Navy; the Mustang floater jacket/suit, the life preserver yoke (maritime pouch), the positive buoyancy life jacket and the hazardous duty life preserver. Whenever there is a danger of personnel falling into the water, one or a combination of flotation devices are to be worn. As with all other safety equipment, they must be worn properly and inspected prior to donning.

a. **Life Preserver.** A floatation device worn on the upper portion of the body that will turn an unconscious person upright onto their back within 5 seconds of entering the water. A life preserver may be inflatable or inherently buoyant.

b. **Personal Floatation Device.** Will maintain a person afloat in the attitude in which he/she entered the water. A PFD by definition is not a life preserver.

4.10.4 4220-21-903-1983 Life Preserver, Yoke, Maritime Pouch

Every member of a ship's company is issued his/her own PFD. This is a life preserver, containing 35 lbs of buoyancy. Inflated manually by activating the CO_2 cylinder. Has an oral inflation tube for increasing or decreasing air pressure. Accessories include skull cap, emergency light, sea dye marker, whistle, hand rescue loop, and buddy line. this LP is intended for general purpose use, and the PFD is worn, uninflated, over the head by line handlers during a tow, or by jackstay workers during a light jackstay.

Figure 4.10-6 - PFD (Life Jacket)

4.10.5 4220-21-911-8070 Life Preserver, Yoke, Hazardous Duty

Automatic inflation upon being immersed in water. Has the capability of being manually inflated by activating the $C0_2$ cylinder. Has an oral inflation tube for increasing or decreasing air pressure. This LP may be worn alone or it can be zipped to the floater jacket. This is also a life preserver and contains 35 lbs of buoyancy used when working in exposed positions when the foam-filled positive buoyant PFD (4220-221-860-2985) is too bulky to wear (RAS OPS, NBP). Accessories are the same as maritime pouch.

Figure 4.10-7 - Hazardous Duty Life Jacket

4.10.6 Positive Buoyancy Life Jacket

Positive Buoyancy Life Jackets (PBLJ) are worn by personnel working around open guardrails and by boat's crews and dump workers. The PBLJ must be fully fastened to work properly.

a. **4220-21-860-2985 Life Preserver Vest Buoyant Material.** Main feature: has toggle closures. contains 21 lbs of buoyancy. This is a PFD and not a life preserver. Use is general purpose. Limitation: bulky.

b. **4220-21-913-3414 Life Preserver, Vest, PFD, Buoyant Material, Model MVC10 CF.** This vest comes in 5 sizes: 34 inch chest to 54 inch chest. Contains 21 lbs of buoyancy. This is a PFD and not a life preserver. This vest is thinner and comes with zipper and Fastex buckle closure.

4.10.7 Mustang Floater Jacket and Floater Suit

a. **4220-21-904-1779 Jacket, Buuoyancy Aid (WX jacket or floater coat.)** Black in colour, available in different sizes, provides hypothermic protection and contains 16 lbs of buoyancy. This is a PFD and not a life preserver. It contains a special beavertail to protect the groin area from the effects of hypothermia. The life preserver, yoke hazardous duty, can be zipped to this jacket. Use is general purpose, used as protection during cold wet weather. Although rain resistant the jacket is not designed as a rain coat.

b. **4220-21-904-6265 Jacket, Buoyancy Aid (early version of WX jacket.)** Orange in colour (limited number still in supply system. Intended now for SAR Tech use.)

c. **8415-21-879-7912 Coveralls, Anti-Exposure.** Available in various sizes, flame orange colour, provides hypothermic protection and contains 15 lbs of buoyancy. This is a PFD and not a life preserver. Use is general purpose, used by boat crews and personnel during upper deck evolutions when the floater jacket does not provide adequate protection against hypothermia. The next generation will have the following improvements: enhanced waterproofing, neoprene wrist closures, Tug-Tites at thighs and ankles that cinch easily around boots, ergonomic insulated hood easily folds into the collar, two chest pockets, new slash hand warmer pockets and extra large pockets at hips.

Figure 4.10-8 - PB Life Jacket (Positive Buoyancy Life Jacket)

Figure 4.10-9 - Floater Suit and Floater Jacket

4.10.8 Personnel Light Marker

a. Chemlites come in many shapes, sizes and colours and are used for many purposes at sea. They all have two chemicals inside a sealed plastic container. One of the chemicals is in a small glass vial. When the Chemlite is squeezed or bent, the vial breaks, allowing the two chemicals to mix, producing light. The duration and intensity of the light is dependent on the type of Chemlite.

b. Personnel Light Markers are green Chemlites that have a metal clip and a cover. When activated they will last 8 to 12 hours. All personnel should have a Personnel Light Marker attached to their outer clothing when conducting upper deck evolutions. The Chemlite is activated by squeezing the handle, which breaks the vial and allows the two chemicals to mix, and removing the cover. This can be done with one hand if required.

Figure 4.10-10 - Personnel Marker Light

4.10.9 Ship Abandonment Suit (SAS)

The Ship Abandonment Suit is a one piece /one size suit designed to significantly delay the onset of hypothermia or other exposure hazards in the event that the ship must be abandoned. One is issued to each person in the ship's company. The SAS is to be donned prior to entering the water and may be worn under or over the PFD.

PFD Underneath **PFD Over Top**

Figure 4.10-11 - Ship Abandonment Suit (SAS)

Note.

All shipboard personnel receive regular refresher training from CFFS Esquimalt and CFNOS Halifax Seamanship Division on the operation, donning and care of the survival at sea equipment described in this chapter.

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Rigging and Deck Gear

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CHAPTER 5
Rigging and Deck Gear

5.0 Introduction

This chapter discusses the rigging used in the Canadian Navy.[1] Each section covers the minimum care and maintenance required for the equipment. Testing of all rigging is to be carried out every two years. Rigging used for lifesaving and personnel transfer is to be tested yearly. Rigging which has been exposed to excessive strain or shock loading is to be tested as soon as possible. It is the responsibility of the ship (CBM) to liaise with Fleet Maintenance Facilities (FMF) to ensure testing is done within the time requirements.

5.1 Introduction to Types of Rope

Most ropes can be described as belonging to one of three main types:

(**1**) Natural Fibre Cordage (NFC);
(**2**) Man-Made Fibre Cordage (MMFC); and
(**3**) Steel Wire Rope (SWR).

In the Canadian Navy, rope is described in terms of its diameter measured in millimetres (mm), the type of construction, and the material from which it is made (e.g., a 36 mm braided polyester).

5.2 Construction, Characteristics and Details of Supply of Natural Fibre Cordage

Use of natural fibre cordage in the Canadian Navy has dwindled in recent years, primarily because man-made fibre cordage is stronger, harder wearing, more cost-effective, and in most circumstances, more functional than natural fibre cordage. However, natural fibre cordage is still required for certain tasks, and this requirement is likely to continue for the foreseeable future.

5.2.1 Construction

a. Natural fibre ropes are made from fibres of varying lengths depending upon their source. The first process is to comb out these fibres into a long even ribbon as shown in Fig 5.2-1.

[1] Much of the material in this chapter has been taken directly from the Royal Navy's "Admiralty Manual of Seamanship" BR67.

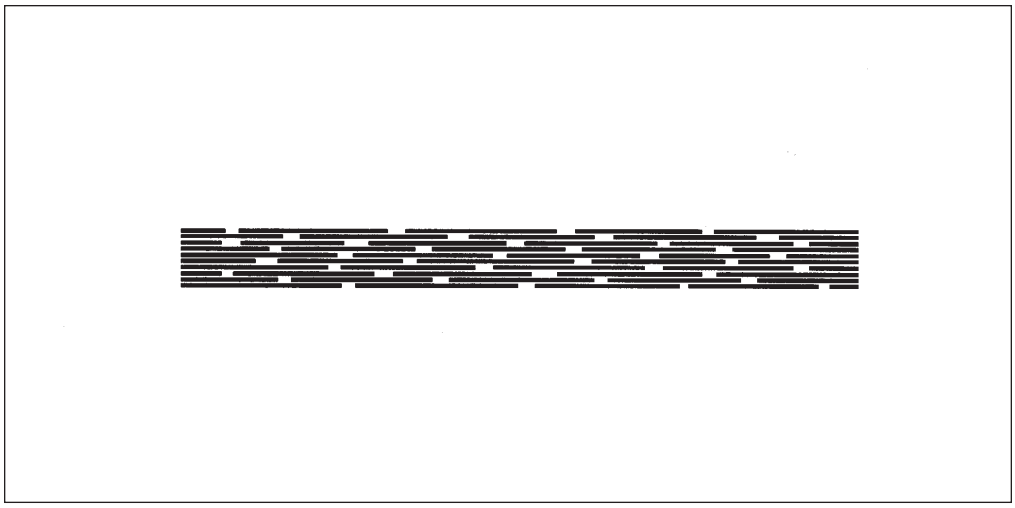

Figure 5.2-1 - Fibres of a Rope

b. The ribbons are then twisted up into yarns, and according to the twist given, it binds the fibres firmly together so that they hold by friction when the yarn is subjected to strain. This process is known as spinning, and the yarns are said to be spun left-handed or right-handed according to the direction of the twist.

c. Next, a certain number of yarns are twisted together to form strands. The number and size of yarn to make each strand depends on the size of the rope it is intended to make. This stage is known as twisting the strands and, again, the twist can be left-handed or right-handed.

d. Three or four strands are now made up into a left-handed or right-handed rope. This process is called laying or closing, and is always carried out in the direction opposite to that used in the previous stage of twisting the strands. It is distinct from the simple spin or twist and is two-fold in that:

(**1**) the strands are twisted up together to form the rope, and at the same time;

(**2**) the strands are rotated individually in the direction of the original twist.

Were this not done, laying the strands up together would tend to untwist the yarns in each strand.

e. As the rope is laid up, its length contracts like a coiled spring, giving it a certain elasticity. The harder the twist given to the strands in laying, the shorter will be the resultant rope. Thus, a rope is said to be hard-laid, ordinary-laid or soft-laid rope. In practice, three strands of 275 m in length lay up into a rope of about 220 m in length. Three strands so laid up constitute a hawser-laid rope (Fig 5.2-2). Right-handed hawser-laid rope is the only type of natural fibre cordage now used in the Canadian Navy.

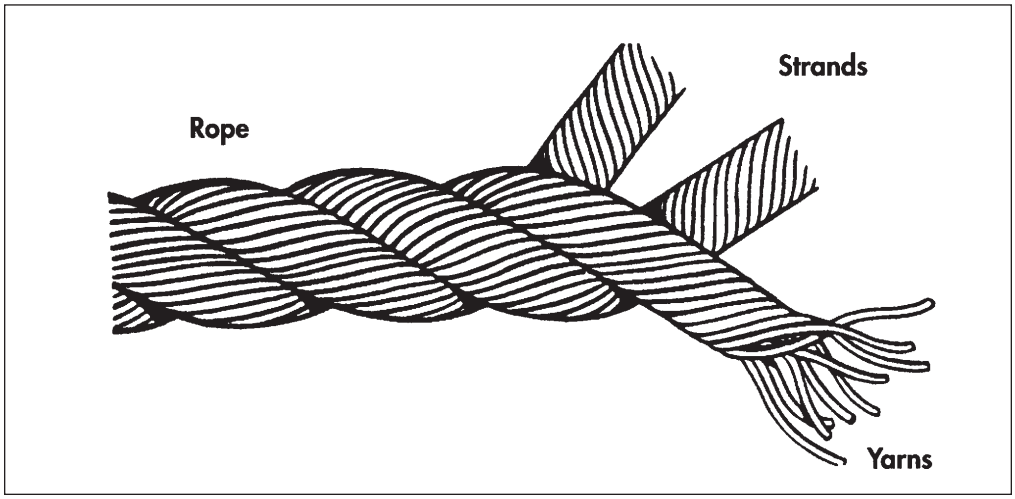

Figure 5.2-2 - Rope Construction

5.2.2 General Characteristics

a. The strands tend to unlay unless the end of the rope is whipped (i.e., firmly bound) with twine.

b. The rope will stretch under load and will not completely recover when the load is removed.

c. The rope acquires a permanent and irreversible set; the higher the load in relation to the breaking strength, the greater the set. The set may be observed by the extension in length and reduction in diameter when the rope is slack and will eventually render the rope unfit for service. The older and more worn the rope, the less elasticity it will possess and the weaker it will become.

d. Rope under load will tend to twist in the opposite direction to that of its lay and thereby tend to unlay itself, but it should regain its normal form when slack.

e. When wet, NFC will usually shrink in length in proportion to the amount by which it swells in diameter, but it will recover its original length when dry and after use.

f. Rope which is continually subjected to heat and damp will lose its elasticity and strength sooner than rope used under normal conditions of temperature and humidity.

5.2.3 Materials Used

Manila is the only natural fibre rope used by the Canadian Navy. The fibres of the rope are treated with a rot-resistant solution during the first stage of rope making when the fibres are combed into ribbons. Manila rope is made from the leaf fibre of the **abaca** plant which is grown in the Philippine Islands and shipped from the port of Manila (hence its name), as well as from Sumatra and Borneo. When new and untreated, it is deep golden-brown in colour. The rope is flexible, durable and strong when compared with other natural fibre ropes. It is impervious to salt water and stands up well to wear and tear. Its advantages over man-made fibre cordage are that it stretches less, will surge more readily around a winch or capstan, and does not fuse when heated. It is used primarily for lashing when securing for sea and as the easing out pendant when performing replenishment operations.

5.2.4 Strength

A method of finding the approximate Breaking Strength (BS) of manila cordage is to divide the square of the diameter of the cordage in mm by 200, the answer being in tonnes. This allows for a good margin of safety. To estimate the strength of a rope which is well worn but in good condition, apply the formula as for new rope, using the actual and not the nominal diameter. However, the only really reliable method by which the strength of a rope may be determined is to test a sample of the worst part of the rope to destruction.

Example: 25 mm line BS = 25 x 25 ÷ 200 = 3.125 tonnes

5.2.5 Care and Maintenance of Natural Fibre Cordage

a. Natural Fibre Cordage (NFC) does not have a permanent elasticity limit. The life of a rope depends on the frequency with which it is used under strain, since the fibres tend to slip a small amount under each load in spite of the twist given during manufacture.

b. NFC should not be stowed away while it is wet; if this is unavoidable, the rope must be brought out and dried at the first opportunity.

c. Although any rope in good condition can be confidently expected to bear its full working load with ease, allowance for wear must be made in assessing the full strength of used rope, particularly when it has been subjected to hard conditions.

d. Before estimating the strength of such a rope it should be examined for damage, chafe, rot and fatigue. Serious damage can be seen when the strands are distorted and bear unequal strain, or when the rope becomes opened.

e. Rot can be detected by the smell of the rope and by opening out the strands and examining their inner surfaces. Should they be healthy and strong, all is well; if they are powdery, discoloured, weak or can be plucked out, rot exists and the rope should be condemned.

f. Rope may also be subject to chemical attack. Many rust-removal compounds are based on phosphoric acid which has a disastrous effect on natural fibre and, for this reason, cordage should always be protected from contamination.

Note:

If doubt exists as to the serviceability of a rope, the rope should be condemned.

5.3 Construction, Characteristics and Details of Supply of Man-Made Fibre Cordage (MMFC)

a. Prior to 1939, natural fibres were the only materials available for cordage manufacture. In 1939 a new man-made yarn known as nylon became available to the cordage industry. From the outset it was evident that this synthetic fibre possessed such remarkable qualities that a great advance had been made in the cordage industry. The technical name for nylon is polyamide. Both names are interchangeable but the former is preferred in the Canadian Navy to distinguish it from other synthetic materials which were subsequently developed and are used for cordage manufacture. These latter materials are polyester and polypropylene. The most recently developed, Kevlar, is a derivative of nylon.

b. The various man-made fibre ropes have different characteristics which make them specially suited for specific tasks. For example, nylon has greater elasticity than polyester and is therefore suitable for use as towing hawsers. Polyester, because of its relatively low elasticity and excellent weather and abrasion resistance, is suitable for berthing ropes, replenishment lines and halyards. Staple spun polypropylene is appropriate when light, floating, easily handled ropes such as towing hawser messengers and swimmer recovery lines are required. Kevlar is at present used only for berthing lines. Cordage made from man-made fibre is naturally rot-proof and almost impervious to water.

c. Unless specially treated, man-made fibre cordage, except for Kevlar, will stretch far more than natural fibre cordage. This stretch ranges from 25-30 percent for polypropylene to 45-50 percent for nylon at breaking load. All man-made fibre ropes can be considered non-flammable in that they do not readily ignite or burn with a flame. In the molten state, these materials will burn but only at a temperature approximately twice that of their melting point.

5.3.1 Construction

Nylon, polyester and polypropylene all fall into the polymer group. Nylon is produced from coal whereas the remainder are produced from oil. Most man-made fibres are made from either continuous filaments, or yarns of staple fibres. However, polypropylene ropes can be manufactured from multi-filament, monofilament, staple or film-fibre. Details are as follows:

a. **Staple.** These fibres vary in length which is determined by the processing machine on which they are to be used. For rope making, the staple length varies between 150 mm and 1300 mm. Although weaker than continuous filament cordage of equivalent size and material, staple spun cordage is ideal in applications where a good grip is required.

b. **Multi-filament.** These yarns are composed of a number of very fine filaments of circular cross section twisted together, each filament being continuous throughout the yarn length.

c. **Monofilament.** These are usually circular in cross section and are continuous throughout their length. Micrometer-type gauges are used to measure their diameter which, for rope making, can range from 0.125 mm upwards.

d. **Film-fibre.** Film-fibre is composed of fibrils produced by longitudinal splitting when an extruded tape or ribbon is twisted into a yarn.

e. **Hawser-laid.** Hawser-laid, man-made fibre ropes are manufactured in the same manner as natural fibre ropes; that is, three strands laid up with a right-hand twist (Fig 5.2-2). Each strand is composed of a sufficient number of uniform filaments of specified polymer to give the rope the required strength. A higher twist is imparted to the man-made strands than to those of natural fibre, and the ropes are subjected to a form of heat treatment to stabilize the lay and thereby reduce the tendency of the strands to separate in service. It is important that the twist and balance of the lay should be undisturbed, especially when being spliced.

f. **Braided Rope.** This rope, known commercially as core/cover rope, is constructed by crossing and recrossing the yarns or strands in 'maypole' fashion such that each yarn or strand passes alternatively over and under one or more of the others to form a circular tubular sheath, which contains a core. All braided ropes in the Canadian Navy fall into this category: a braided sheath around a braided core (Fig 5.3-1).

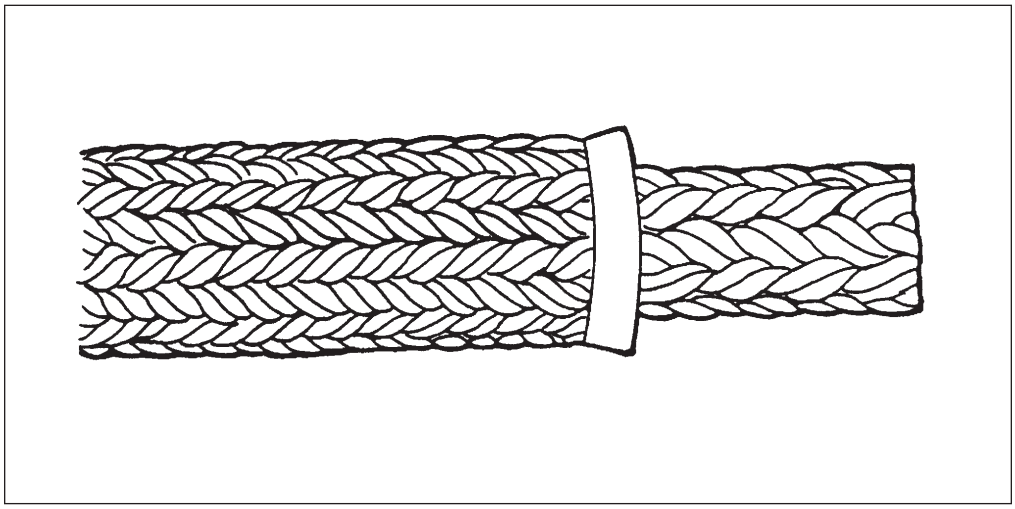

Figure 5-3.1 - A Braided Rope with Braided Core

Braided construction gives certain advantages over hawser-laid ropes. They have good flexibility and are easy to handle when wet or dry, new or worn, are non-rotating and will not kink. They provide more grip on capstans or warping drums because of the greater contact area.

5.3.2 Characteristics

a. **Nylon.** This multi-filament cordage is approximately two and a half times as strong as manila of equivalent size. It stretches by almost half its length before parting, but gives little, if any, warning that it is about to reach the limit of its stretch. Used within its safe working load, it will stretch approximately 25 percent of its length and still retain recovery. It does not float and it loses approximately 10 percent of its strength when wet. The melting point is 240-260 degrees C and it is virtually unaffected by temperatures of -80 degrees C. Nylon has good weather and abrasion resistance and a high resistance to alkalis, but low resistance to certain acids. For example, strong sulphuric acid will dissolve the fibres. The energy absorption qualities are excellent and are retained to a significant degree during repeat loading.

b. **Polyester.** This multi-filament cordage is nearly twice as strong as manila of equivalent size. It stretches approximately 35 percent before parting. Used within its safe working load, it will stretch 14 percent of its length and still retain excellent recovery. The strength is virtually unchanged when wet, it does not float, the melting point is 240-260 degrees C and it is virtually unaffected by temperatures of -80 degrees C. Polyester has excellent weather and abrasion resistance and high resistance to acids but not to alkalis.

c. **Polypropylene.** This cordage is nearly twice as strong as manila of equivalent size and is the lightest in weight of the man-made fibres. It stretches up to 44 percent before parting. Used within its safe working load, it will stretch 17 percent of its length. It retains its strength when wet and has a low water absorption. It will float indefinitely in water. The melting point is 160-170 degrees C. Polypropylene has high resistance to acids and alkalis. Multi-filament and monofilament Polypropylene is not normally used for load-bearing ropes.

d. **Kevlar.** These ropes are nearly six times as strong as manila and two times as strong as double-braided nylon of equivalent size. They require no maintenance and only have a 6 percent stretch vice nylon at 10-40 percent stretch. When used as berthing hawsers they must be left with slack in the line to prevent chaffing. Due to the limited amount of stretch, this will not allow ships to be blown off jetty in heavy winds. Deterioration due to sun, weather and chemicals is almost non-existent. Its lighter weight makes mooring lines easier to handle and safer due to reduced snap back.

5.3.3 Identification

All cordage supplied to the Canadian Navy comes with a test certificate and a certificate of conformity, on which are listed the date of manufacture, the standard to which the rope has been manufactured, and the guaranteed minimum breaking strength of the rope when new. To prevent confusion, particularly between nylon and polyester ropes whose external appearance is identical, where possible identification yarns are incorporated in man-made fibre ropes. However, with certain smaller ropes it is not possible for the manufacturer to include an identification mark, and so no common standard of identification exists. Therefore, the test certificate and certificate of conformity supplied with the rope should be regarded as the only reliable guide to the breaking strength of the rope. There is one test to determine the difference between nylon and polyester line. If the end of the line is burned and produces soot, the line is polyester. If the line does not produce soot, it is nylon.

5.3.4 Strength

The rule of thumb method of calculating the breaking strain of man-made fibre rope is to divide the square of the diameter by a known factor. Table 1 gives the approximate strength of new cordage according to its diameter (d) in mm. However, it is emphasized that the test certificate supplied with the rope is the only accurate guide to the breaking strength.

Table 1 Calculation for Approximate Breaking Strength of MMFC

Cordage	Formula for Calculating Breaking Strength
Kevlar	$d^2/40$ tonnes
Nylon (under 32 mm)	$d^2/50$ tonnes
Nylon (32 mm and over)	$d^2/60$ tonnes
Polyester (under 32 mm)	$d^2/64$ tonnes
Polyester (32 mm and over)	$d^2/66$ tonnes
Polypropylene	$d^2/77$ tonnes

5.3.5 Uses

The principal service uses of man-made fibre ropes are as follows:

a. **Nylon.** Because of its elastic properties, it is used for towing hawsers, berthing lines, and light and heavy messengers during replenishment operations.

b. **Polyester.** Because of its low stretch, high strength and excellent weather and abrasion resistance, it also can be used for light and heavy messengers.

c. **Polypropylene.** Being a floating rope, it is used in its staple form for towing and light jackstay messengers. It is also used for boat ropes and as the recovery line for the rescue swimmer.

d. **Kevlar.** This cordage is being instituted for use as berthing lines on all ships because of its high strength, negligible snap back, light weight, resistance to chemicals and excellent reliance during hot/cold weather conditions.

5.3.6 Care and Maintenance of Man-Made Fibre Rope

a. All ropes experience deterioration from unnecessary exposure to sunlight.

b. Avoid contamination by chemicals or fumes. If contaminated, wash with cold running water. Remove oil and grease with a mild soap solution.

c. Ropes must be stowed in bins or on raised boards to allow free circulation of air.

d. Ropes must not be stowed where there is excessive heat. Excessive cold makes the rope brittle.

e. Avoid unnecessary chaffing when possible by protecting the parts concerned with anti-chaffing material.

f. Normal wear is unavoidable and, if not excessive, is harmless. Replace lines if approximately 20 percent wear is evident.

5.4 Handling of Natural and Man-Made Fibre Cordage

5.4.1 Elementary Rules

The lessons which a seaman must learn before he handles a rope are explained below:

a. **The Seaman's Knife.** The seaman should regard his knife as his best friend. It should be worn on a belt around the waist. The seaman's knife is a tool not a weapon. The end of the blade should be rounded, not pointed, and the blade should be sufficiently deep and thick to cut without bending. The edge of the blade should be sharpened like a chisel to avoid wearing away the thickness and strength of the blade. Folding knives should be kept lightly oiled with special attention to the hinge.

b. **Rope Ends.** Before a rope is cut, a whipping should be applied to either side of the point at which the cut is to be made to prevent the rope from unlaying. The different methods of whipping are described later in this chapter.

c. **Coiling Down Ropes.** A heaving line, or any line or rope which is being hauled in, should be coiled either in hand or on deck as it is hauled inboard. This is an elementary precaution to ensure that the line or rope is immediately ready for further use.

5.4.2 Special Precautions when Handling Man-Made Fibre Cordage

Although the rules for handling natural fibre cordage and man-made fibre cordage are generally similar, the properties and characteristics of man-made fibre necessitate greater care in its handling. Many of the advantages of using man-made fibre ropes can become serious liabilities if the seaman is not familiar with certain characteristics of these ropes. When a man-made fibre rope parts, it immediately tends to regain its original length. Nylon when stretched over 40 percent is liable to part suddenly without audible warning. It then whips back along the line of tension and can kill or seriously injure anyone in its path. In the navy, it is referred to as bolt. The following rules must be observed when handling man-made fibre ropes:

a. Men backing up a man-made fibre rope under tension on a capstan drum or any other holding surface must stand well back and out of the line of recoil of the rope.

b. When a man-made fibre rope is turned up on any holding surface and is in tension, a certain amount of heat is generated by friction between the rope and the holding surface. Should this heat approach the melting point of the fibres of the rope, the outer fibre will melt and create a lubricant, whereupon the rope in tension may surge violently. Therefore, it is essential that men backing up a man-made fibre rope in tension on a capstan drum, bollards or any holding surface stand well back. The minimum distance between the first man backing-up the rope in tension and the holding surface should be 2 m. Should the rope surge violently, this distance of 2 m means that the first man backing up will have some warning before he is drawn dangerously close to the holding surface.

c. Ropes that have been subject to stretching, e.g., towing hawsers, should be given time to recover to achieve their natural length if they are to be reeled up. Recovery time may be as long as six hours for a towing hawser that has been under heavy load for long periods.

d. Do not pass man-made fibre and steel wire ropes through the same fairlead. The stretch is incompatible and the resultant chaffing of the man-made fibre will seriously weaken it.

5.4.3 Handling all Cordage

From the precautions listed above for the safe handling of man-made fibre cordage, the following detailed advice should always be practised when handling any ropes or lines:

a. Avoid bad leads and sharp edges. Ensure thimbles or such fittings do not chafe or cut a rope.

b. As a general rule, rope should be veered rather than surged on a capstan or winch drum because surging induces friction and damages the surface of the rope. A rope should never be surged on a capstan or a drum which is rotating in the same direction (turning to veer). This is a dangerous practice and applies to steel wire rope as well as fibre rope.

c. Three turns are usually sufficient when hawsers are being hove in on capstans or drum ends. However, for heavy loading it may be necessary to take an extra one or two turns, giving due regard to the size and strength of the rope and equipment involved.

d. If surging around bollards is necessary, it should be done before the strain on the rope is heavy. Great care must be taken when easing out a rope around bollards if it is heavily loaded.

5.5 Preparing Natural Fibre and Man-Made Fibre Ropes for Use

5.5.1 Coiling and Uncoiling

a. A rope laid out straight will have no tendency to twist or turn either way, whether its lay is left- or right-handed. From this position, it can be stowed on a reel or coiled down.

b. When stowed on a reel or hauled off a reel, a rope will not develop any twists or turns in its length. However, when coiling down a rope, the part of the rope remaining uncoiled will be given one twist or turn as each loop in the coil is formed.

c. When coiling down a rope, the end should be kept free to allow the uncoiled length to rotate and thus keep it free from becoming snarled up with kinks or turns.

d. Similarly, a rope which is run off a coil will acquire a twist or turn for every loop in the coil, but if the end is kept free, the rope will usually free itself of these turns when hauled out straight.

e. One method of avoiding these turns, should the end of the rope not be free, is to turn the coil around while coiling down the rope, thus turning the coil into a reel.

f. Another method, as when coiling direct from a reel, is to allow as long a length as possible between reel and coil; this length will absorb the turns until the end of the rope is free from the reel, and so can be freed of its turns.

g. Similarly, when coiling down a rope which is led through a block, the coil should not be made too near the block; otherwise a slight check may cause a kink to develop in the rope as it is running through and thus choke the luff (Fig 5.5-1).

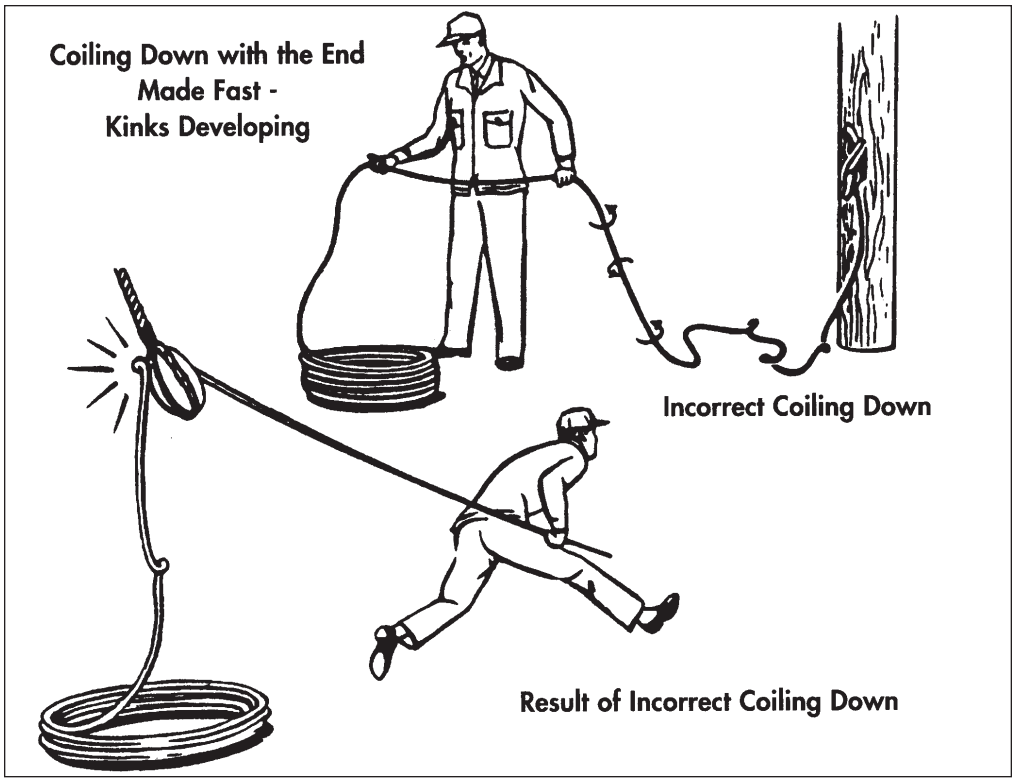

Figure 5.5-1 - Mistakes in Coiling Down

5.5.2 Coiling Down

Cordage is very resilient and will absorb a number of turns in its length without becoming snarled if the length is sufficient and the turns correspond with the lay of the rope; however, if the turns are against the lay, it will quickly become snarled. For this reason, rope of right-hand lay is always coiled down right-handed, and rope of left-hand lay is always coiled down left-handed.

5.5.3 To Coil a Rope for Running

Lay the rope as straight as possible along the deck. Begin coiling it down close to where the standing part is made fast, and lay each loop flat upon the other below it until the bare end is reached. The size of the loops should be as large as stowage space permits. The running part is now underneath the coil, so when the coil is turned over, the rope should then run out freely when required. Remember that the running part or end part should always be on top of any coil.

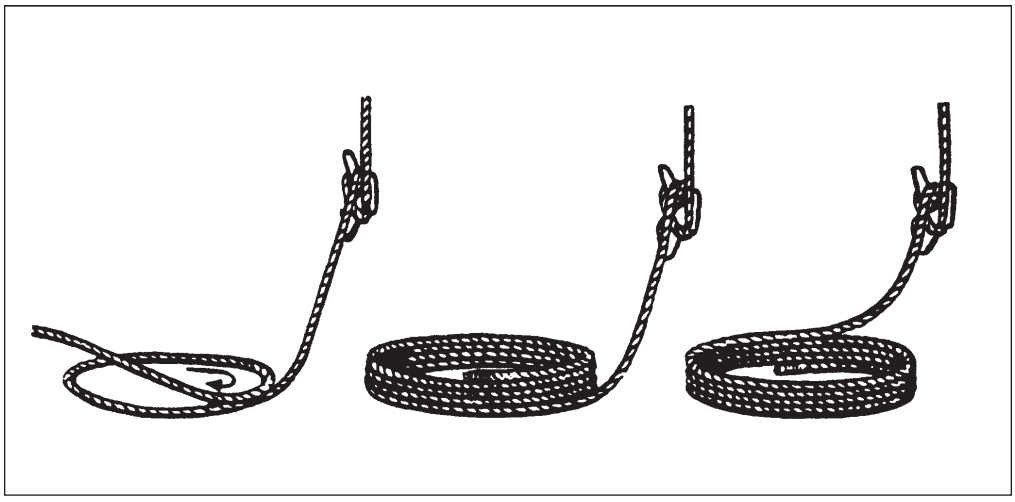

Figure 5.5-2 - To Coil a Rope

5.5.4 To Coil a Small Line in the Right Hand

When coiling in the right hand, the rope should be held with the right thumb pointing towards the end. The coil will then form correctly.

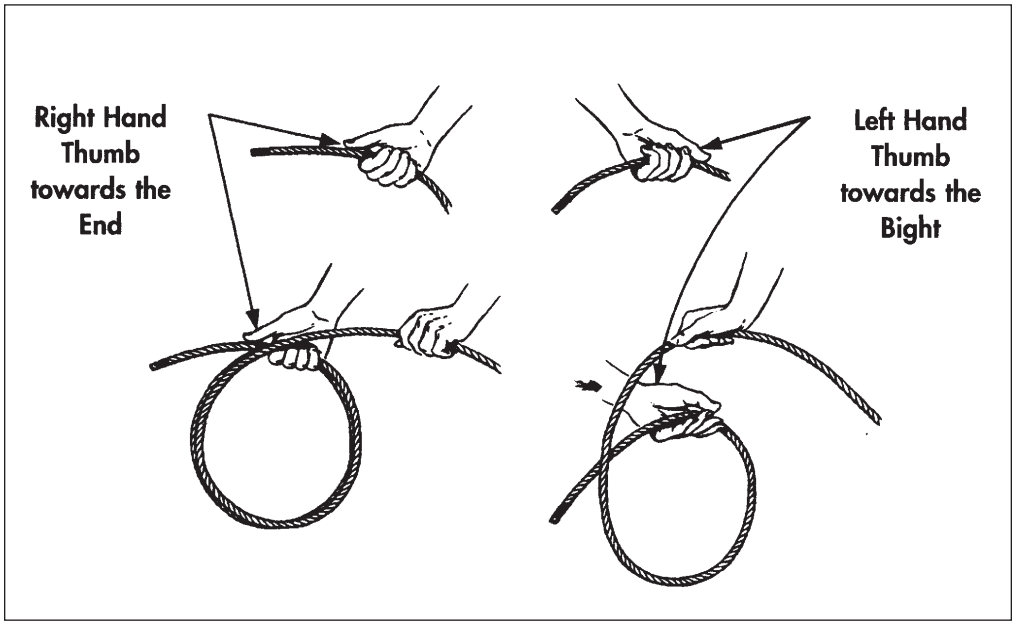

Figure 5.5-3 - Coiling a Line (right hand only)

5.5.5 To Thorough Foot a Rope

This is a method of joining two ropes by their soft eyes (Fig 5.5-4). The eye of Rope A is passed through the eye of Rope B, and the bight of B is then hauled through the eye of A, thus joining the ropes by their eyes. This method is not used for joining two ropes temporarily because it may take some time to unhitch them.

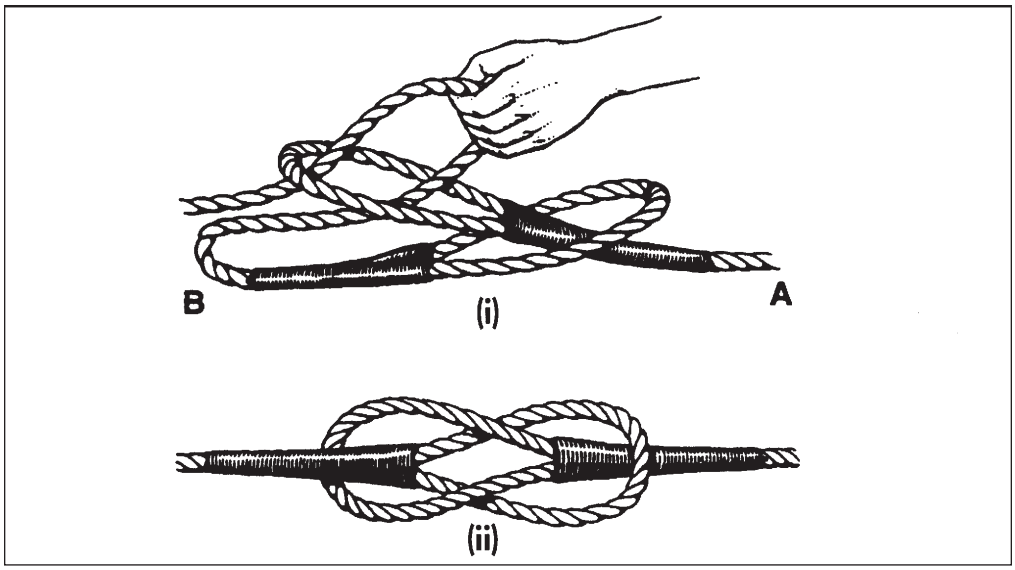

Figure 5.5-4 - Thorough Footing

5.5.6 To Fake Down a Rope

A rope that may have to be payed out quickly should be faked down in as long fakes as space allows. When faked, a rope does not acquire as many turns as when coiled, and it will therefore run out with less chance of becoming snarled. Care should be taken that each bight at the end of a fake is laid under that immediately preceding it to ensure a clear run.

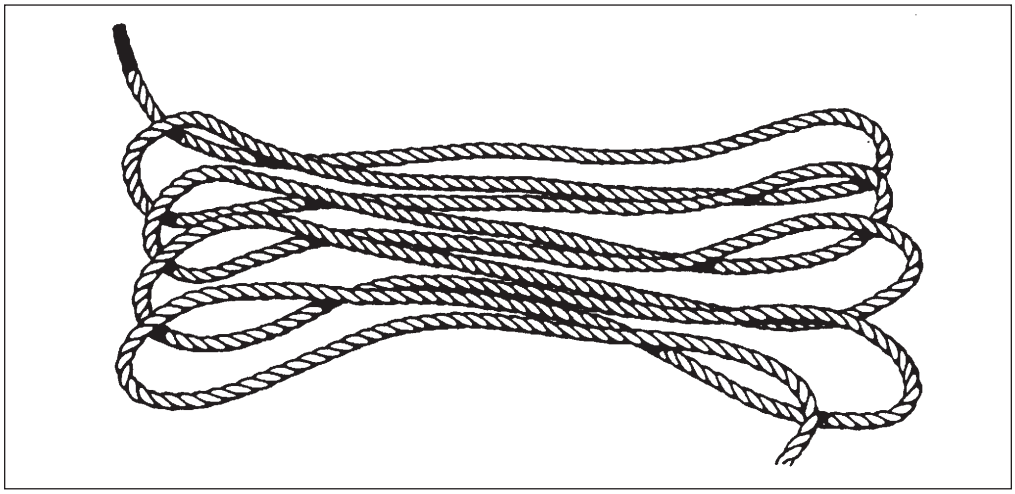

Figure 5.5-5 - Faking Down a Rope

5.5.7 To Cheese Down a Rope

When a neat stow is required for a short end of rope, it may be cheesed down. This method should never be used when the rope will be required to be rove quickly through a block.

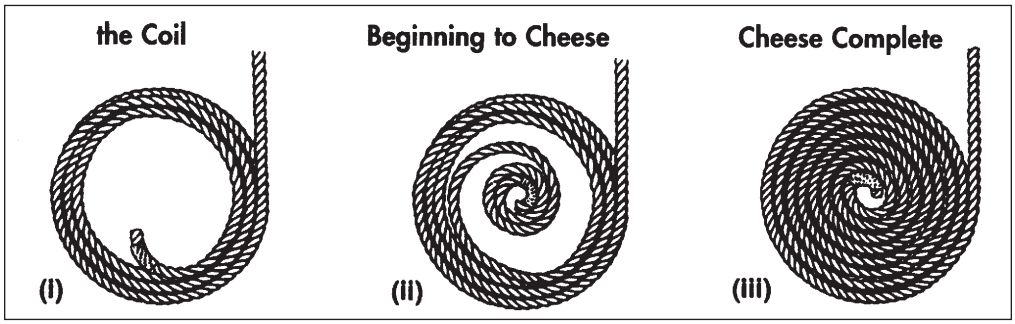

Figure 5.5-6 - Cheesing Down a Rope

5.5.8 To Turn Up a Rope to a Cleat

Take initial turns as shown in Fig 5.5-7. Continue with figure-of-eight turns around the horns of the cleat as many times as required. It will be seen that when the figure-of-eight turns are removed, the rope is ready to be checked under control. A rope turned up to a cleat must be ready for casting off at a moment's notice; therefore, the turns should not be completed with a half hitch because this may jam them. Cleats are not suitable for turning up wire rope.

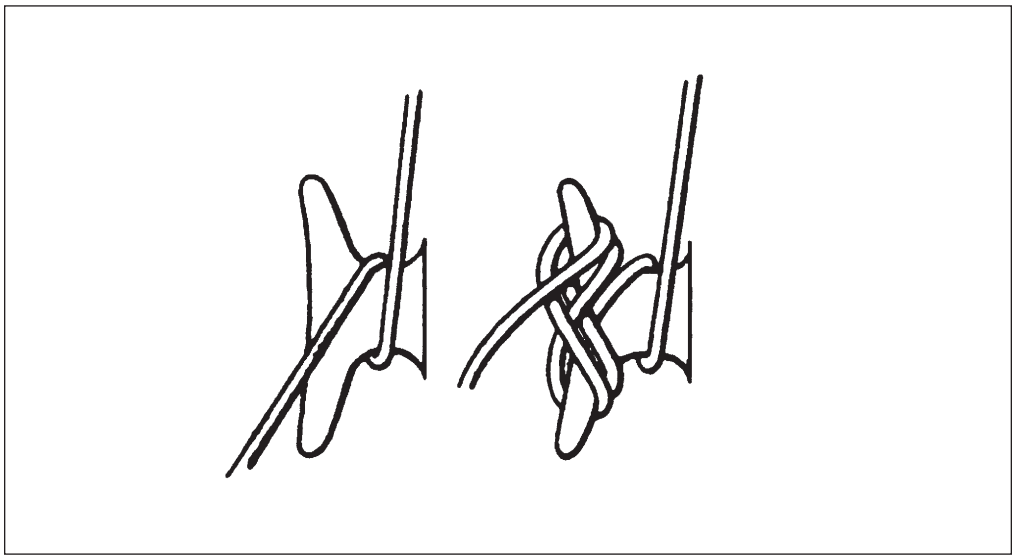

Figure 5.5-7 - Turning Up a Rope to a Cleat

5.5.9 To Hang a Coil on a Cleat

Whenever possible, a coil of rope should be hung up clear of the deck so as to keep the deck clear and the rope dry.

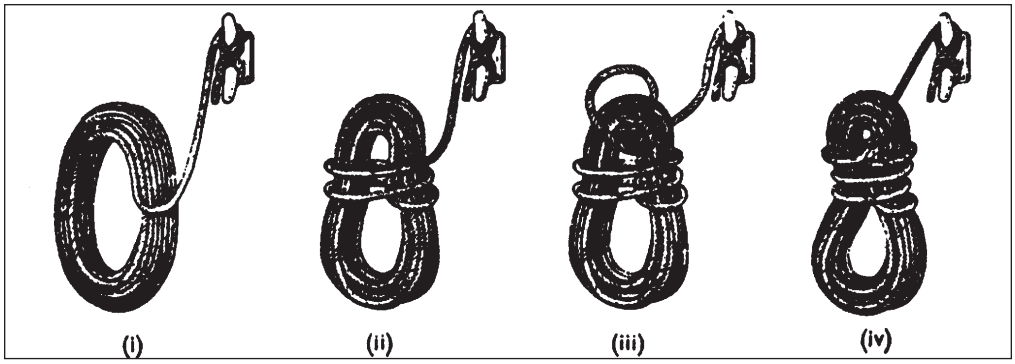

Figure 5.5-8 - Hanging a Large Coil on a Cleat

5.5.10 Handling New Cordage

a. **Opening a New Coil.** A length of rope is supplied to a ship in a compact, machine-wound coil bound with yarns or strands.

(**1**) To open up a new coil of rope of less than 48 mm diameter, roll it over until the outside end of the rope is at the top and pointing directly at you. Then turn the coil over towards the left and lay it flat on its side. The lashings are now cut and the inner end of the rope is pulled out from the centre. The rope will then leave the coil correctly and can be coiled down.

(**2**) With rope of 48 mm diameter or larger, the twisting involved in the preceding method is not acceptable and the coil must be unreeled in the opposite way to that in which it was made up. The coil should be placed on a turntable or slung so that it can be revolved. Cut the lashings and haul the rope off from the outside. If this method is not possible, stand the coil on its end and lap the rope off the top of the coil turn by turn. As each turn is removed, revolve the end of the rope to take out twists.

b. **Cutting off a Length of Rope from a New Coil.** The required amount of rope is hauled from the coil as previously described, then the rope is whipped or taped at each side of the position at which it is to be cut.

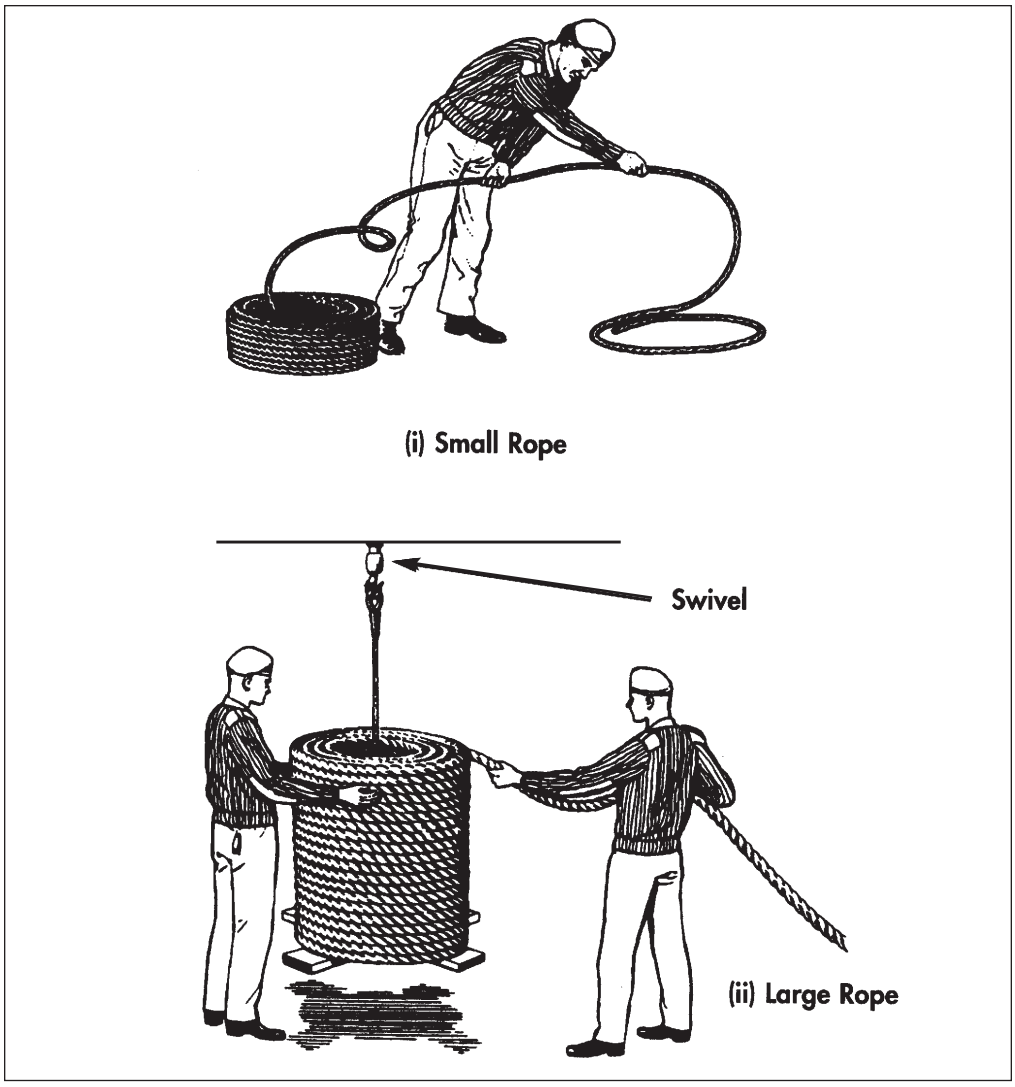

Figure 5.5-9 - Opening a New Coil

5.5.11 Storage of Cordage

Coils of new rope should be stowed clear of the deck, in a cool, well-ventilated, dry place, to allow the air to circulate freely around them. Used rope should be hung in loose coils if this is practical. No cordage should be stowed in contact with bare steelwork. If cordage has to be stowed in the open, it should be protected from sunlight because man-made fibres are susceptible to deterioration caused by the sun's rays.

5.6 Twines, Lines and Spunyarn

The following twines, lines and spunyarn are used in the Canadian Navy:

a. **Sailmakers (whipping twine).** Used primarily for applying whippings to ends of lines. It can be unwaxed or waxed and can also be used for sewing heavy canvas.

b. **Tarred Marlin.** Used primarily for mousing hooks and shackles or as a temporary whipping on wire rope when splicing.

c. **Sash Cord.** Used for making up heaving lines.

d. **Gunline.** Used with line-throwing guns or as a bolo line to establish contact between ships or the jetty over long distances.

5.7 Bends and Hitches

Strictly speaking, a bend is a method of temporarily joining two ropes. A hitch is a method of temporarily joining a rope to a structure or ring. A knot is the intertwining of strands or smaller parts of rope(s) to prevent a rope from unreeling or to provide a handhold, a weight or a stopper on any part of a rope. These definitions have become blurred with time and all three terms are now virtually synonymous. Commonly used bends and hitches are described below.

5.7.1 Strength of Knotted Ropes

All knots, bends and hitches reduce the strength of a rope in that portion where the knot, bend or hitch is made. This reduction varies from 40 to 60 percent and should be kept in mind when putting a load on a knotted rope.

5.7.2 Terms Used

The following terms are used when describing the formation of the various bends and hitches:

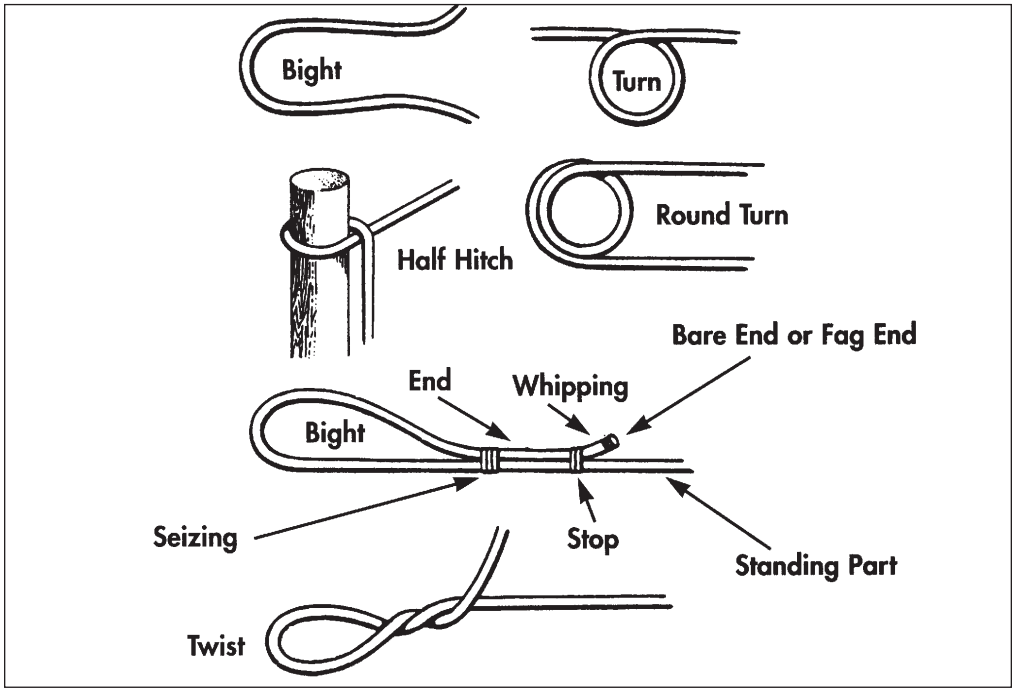

Figure 5.7-1 - Rope Terminology

a. **Bight.** The middle part of a length of rope. This term also refers to a loop of rope. To make a bight is to form a loop.

b. **End.** The short length at the end of a rope which may be formed into an eye, or used for making a bend or a hitch with which to secure it. The end of a rope is also that length of rope left over after making such an eye, bend or hitch. The bitter end is the extreme end of a length of rope.

c. **Standing Part.** The part of the bight of a rope which is nearest the eye, bend or hitch, in contrast to the end.

d. **Stopper.** A light fastening for temporarily holding in place a rope or any other object. It is not meant to bear any strain other than that required to keep the rope or other object in place.

e. **Seizing.** A seizing is used to fasten two ropes or two parts of the same rope securely together in order to prevent them from moving in relation to each other.

f. **Whipping.** The binding around the bitter end of a rope to prevent the strands from unlaying.

5.7.3 Elements of Bends and Hitches

Most bends and hitches consist of a combination of two or more of the elements.

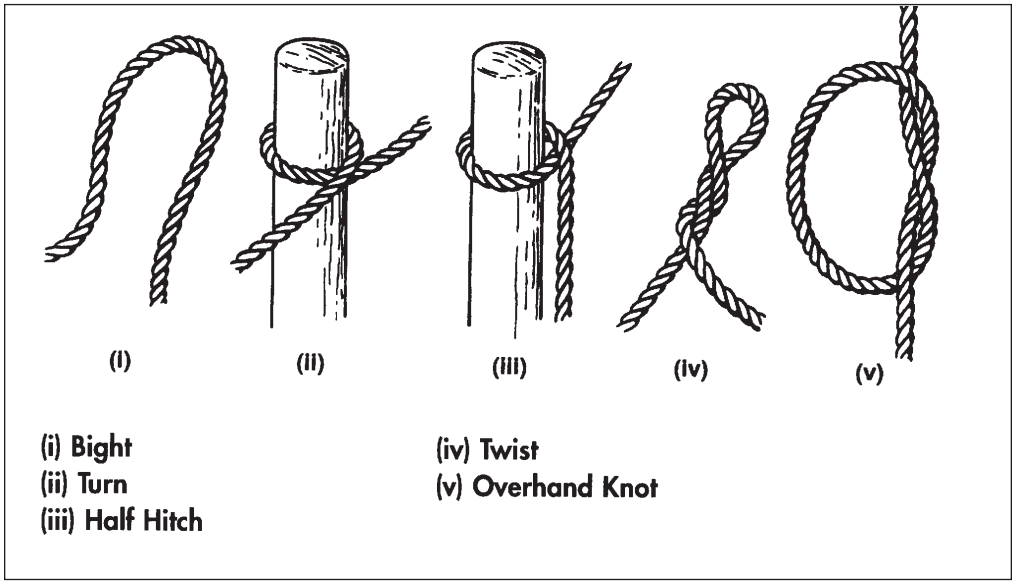

Figure 5.7-2 - Elements of Bends and Hitches

5.7.4 Reef Knot (Square Knot)

The reef knot consists of two overhand knots made consecutively and is used as a common tie for bending together two ropes of approximately equal size. It is not likely to come undone when there is no strain on the knot, but it is not reliable if the ropes are of unequal size or very slippery, unless the ends are seized back to their standing part. To form a reef knot, care must be taken to cross the ends opposite ways each time they are knotted (i.e., right over left, then left over right, or vice versa). Otherwise, the result will be a granny knot which will either slip or jam, depending upon whether it is made with or against the lay of the rope. A granny knot is also very likely to come undone when there is no strain on the knot.

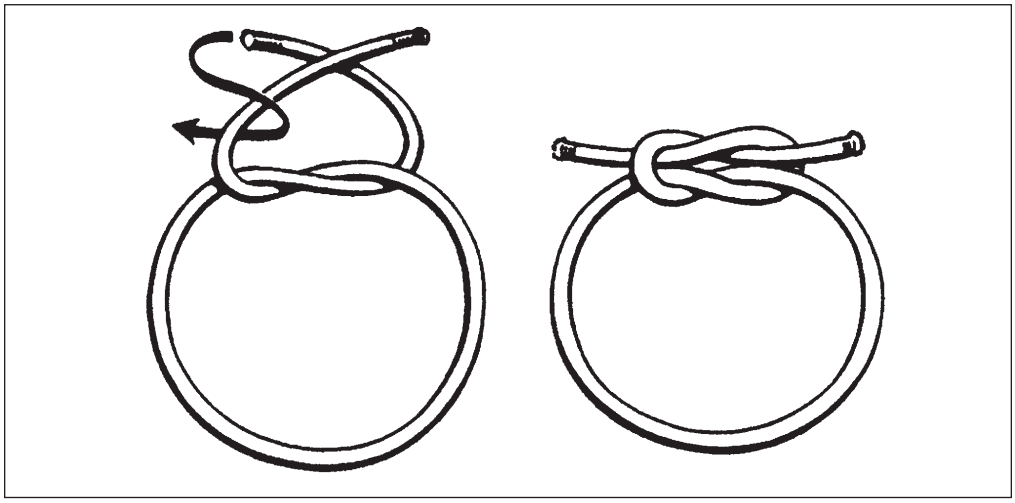

Figure 5.7-3 - Reef Knot

5.7.5 Figure-of-Eight Knot

This knot is used to prevent a rope from unreeving through a block or passing through a small fairlead.

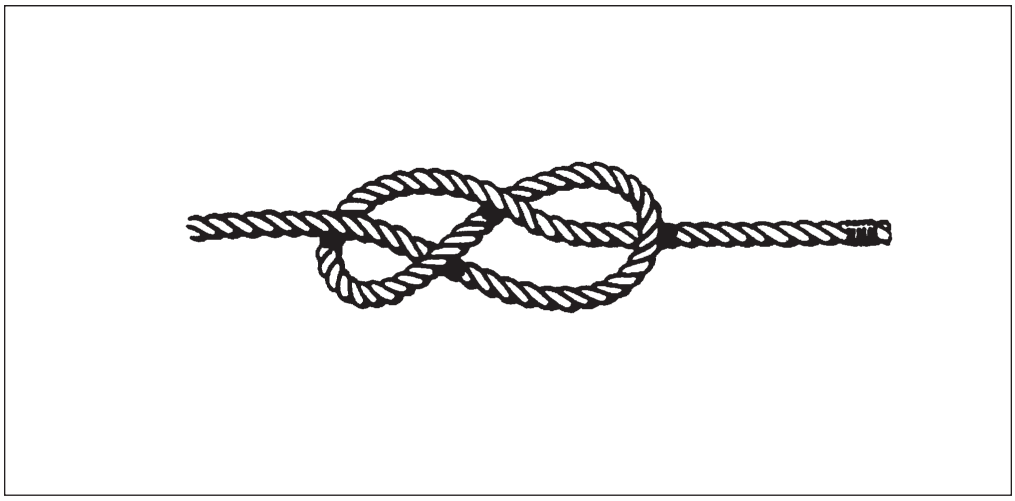

Figure 5.7-4 - Figure-of-Eight Knot

5.7.6 Marling Hitch

This hitch is used for lashing long bundles such as awnings. It will be seen from the illustration that in each hitch, the end is passed down through the bight, thus jamming that part against the bundle and enabling the lashing to be hauled taut. The operation of binding together ropes or yarns by a succession of closely spaced marling hitches is known as marling down. Marling is usually begun with a timber hitch if no eye is spliced into the end of the lashing.

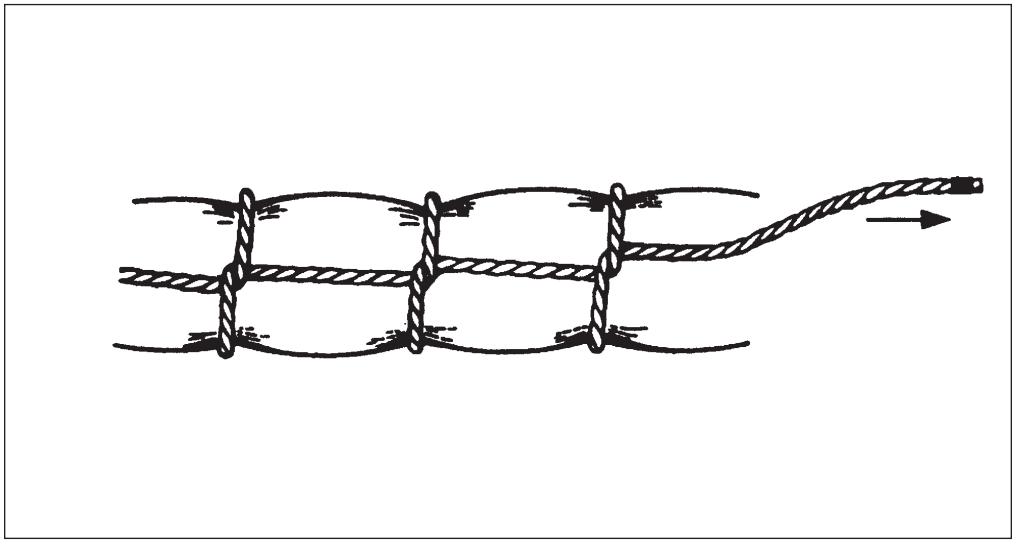

Figure 5.7-5 - Marling Hitch

5.7.7 Timber Hitch and Half Hitch

This hitch is used to tow, hoist or lower a spar. If the spar is tapered, it should be towed or hoisted thick end first, with the timber hitch at the thin end and the half hitch at the thick end.

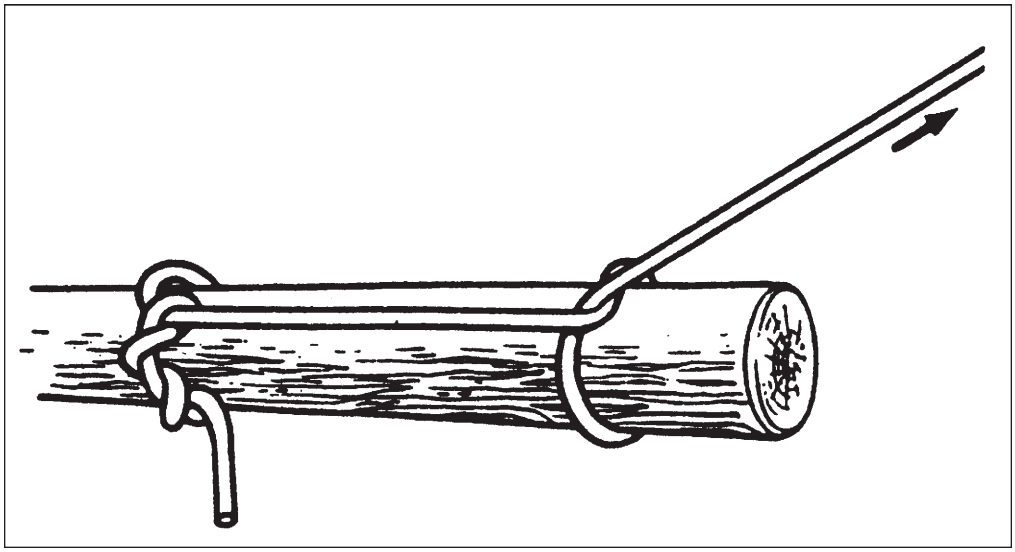

Figure 5.7-6 - Timber Hitch and Half Hitch

5.7.8 Clove Hitch

A Clove Hitch is used to secure a rope to a spar, rail or similar fitting, as well as for many other purposes. It will slip along the spar or rail if subjected to a sideways pull. It can be made with the end or with the bight of a rope, as illustrated in Fig 5.7-7.

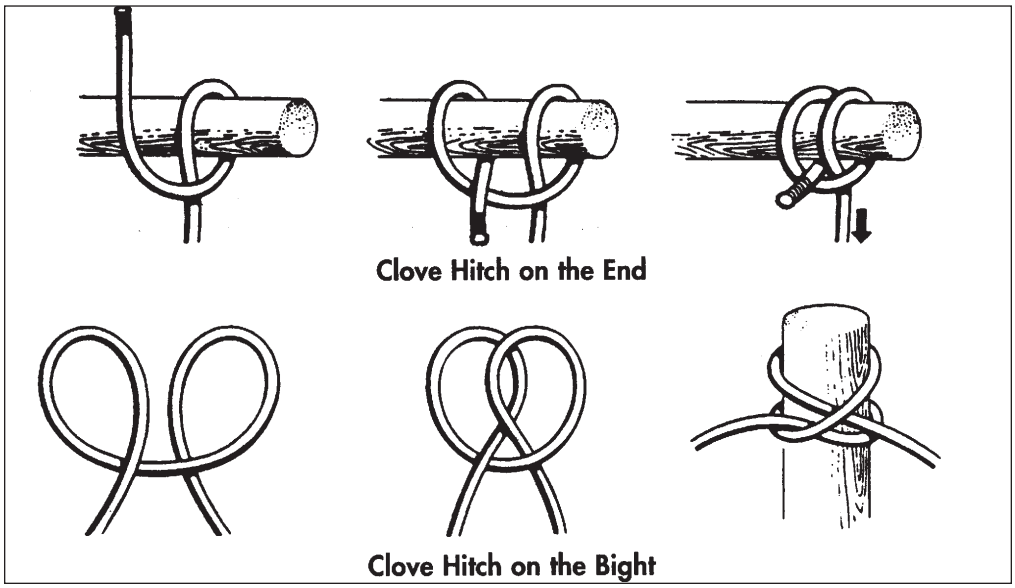

Figure 5.7-7 - Clove Hitch

5.7.9 Rolling Hitch

This hitch is also used for securing a rope to a spar, rail or similar fitting when the pull is expected to be from one side or the other, and to another rope under strain. It is made by passing the end twice around the spar or rope, each turn crossing the standing part. A half hitch on the opposite side completes the hitch. Always pass the two turns on the side from which the pull is expected.

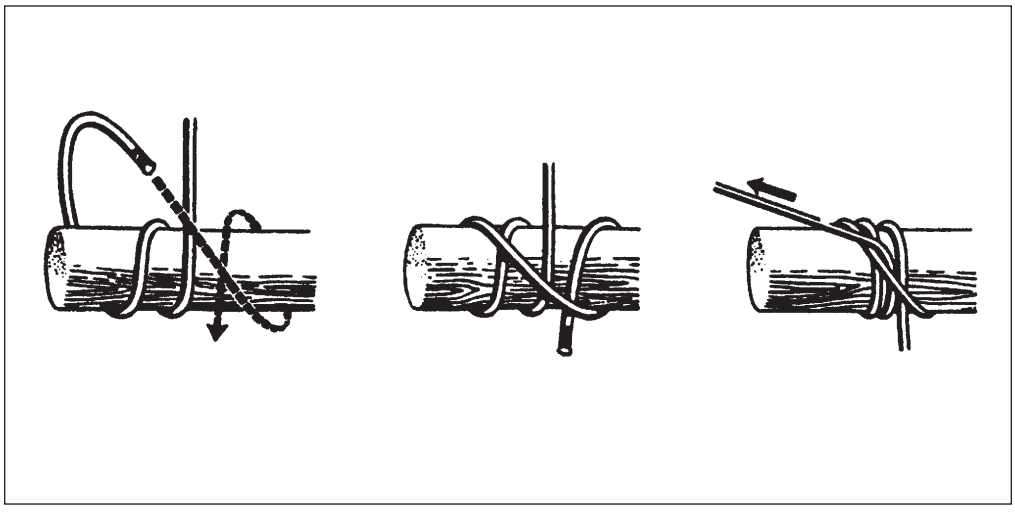

Figure 5.7-8 - Rolling Hitch

5.7.10 Round Turn and Two Half Hitches

This combination is used to secure a line to a spar, ring or shackle. It will never jam and can be cast off quickly. The end should be stopped to the standing part.

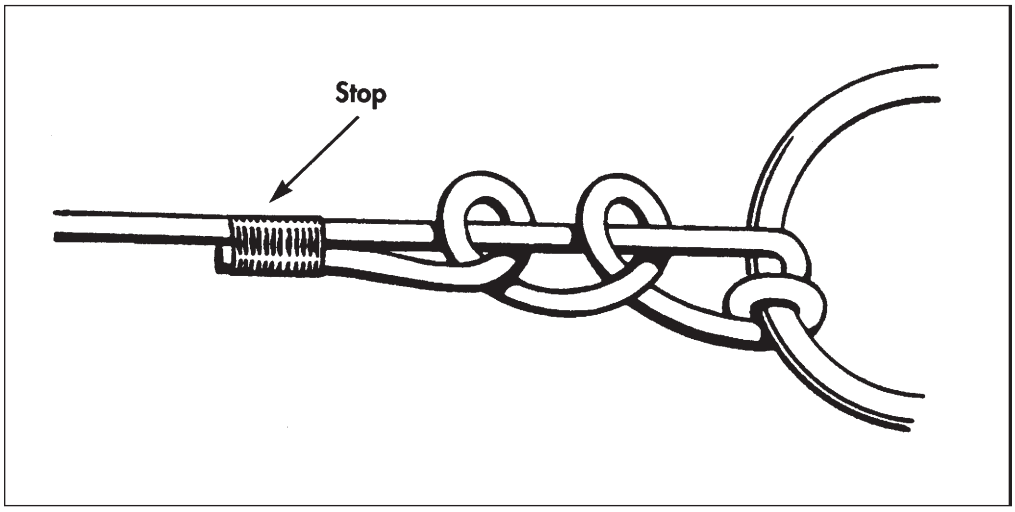

Figure 5.7-9 - Round Turn and Two Half Hitches

5.7.11 Double Sheet Bend

This is a method of securing two ropes of different sizes together, with the smaller line being bent to the eye of the larger line. It is used to secure a boat's painter to the eye of the boat rope when at a boom.

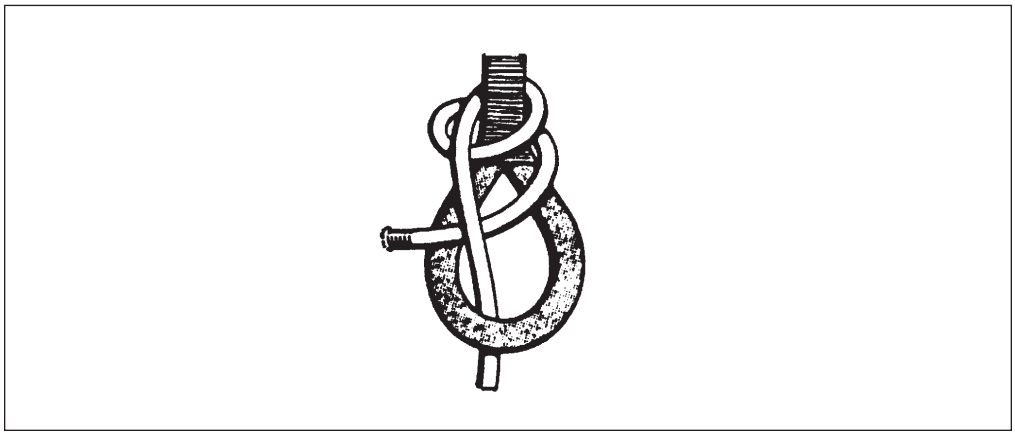

Figure 5.7-10 - Double Sheet Bend

5.7.12 Bowline

This is the most useful knot for making temporary eyes in ropes of all sizes. It can be used as a lifeline around a person's waist and for a great variety of similar purposes. Every member of a ship's company should be able to tie a bowline around his waist with his eyes closed. The bowline is usually made in the following manner which enables it to be formed while there is a strain on the rope.

(**1**) Take the end in the right hand and the standing part in the left.

(**2**) Place the end over the standing part and hold the cross thus formed between the index finger and thumb of the right hand, with the thumb underneath. The loop so formed becomes the bight of the bowline and, if required, it can be formed around the body of the man making the knot. (Step 1 below)

(**3**) Then turn the wrist to the right, away from the body, and bring the end up through the loop so formed. (Step 2)

(**4**) Now hold the cross in the left hand, leaving the right hand free to manipulate the end. (Step 3)

(**5**) Complete the bowline by dipping the end under the standing part, bringing it up again, and passing it down through the hole.

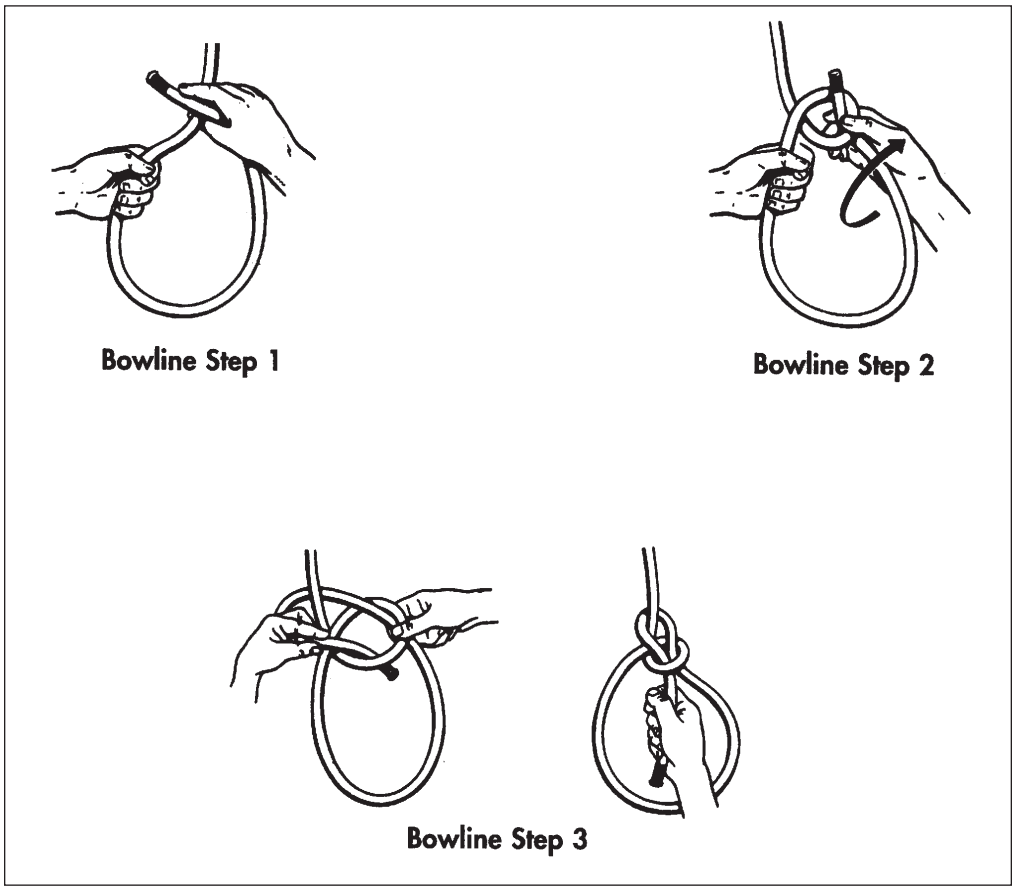

Figure 5.7-11 - Bowline

5.7.13 Running Bowline

This is used to make a running eye in the end of a rope — it must never be placed around a man's body.

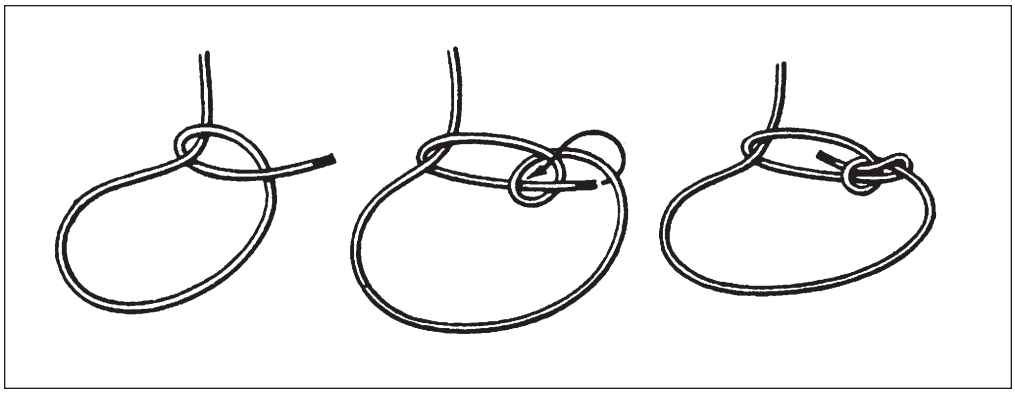

Figure 5.7-12 - Running Bowline

5.7.14 Bowline on the Bight

As its name implies, this type of bowline is made on the bight, the first two operations in its formation being the same as for a simple bowline. It can be used for lowering a man from aloft or over the ship's side, the short bight being placed under his arms and the long one under his buttocks.

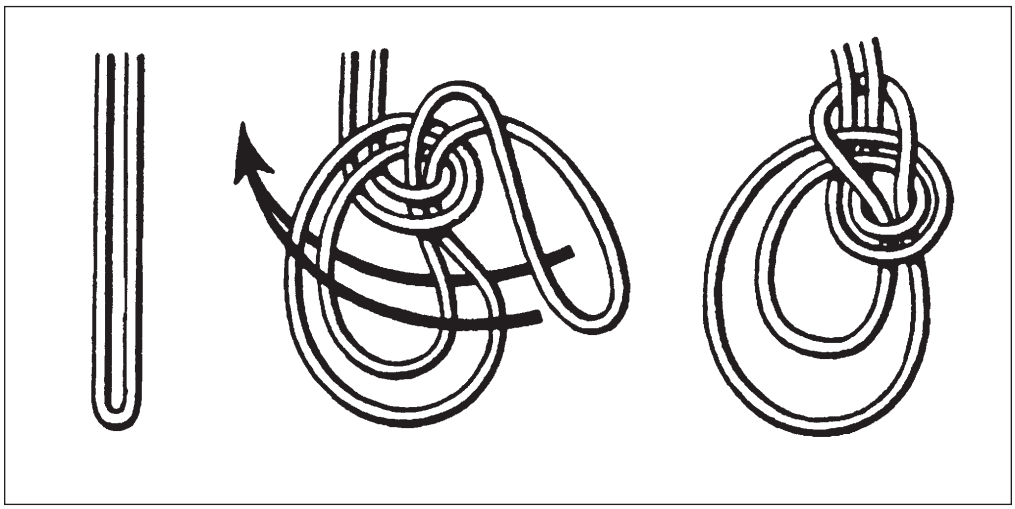

Figure 5.7-13 - Bowline on the Bight

5.7.15 Monkey's Fist

A Monkey's Fist is used to weight the end of a heaving line so that it will carry when thrown against the wind. It is made as follows:

(**1**) Wind three turns around the hand.

(**2**) Pass a second set of three turns across and around the first three.

(**3**) Pass a third set of three turns around and across the second set, but inside the first set and in the direction shown by the arrows. If the knot is correctly made, the end will come out alongside the standing part.

(**4**) To finish the knot, work all parts taut, tie an overhand knot in the end and finish it by seizing the bitter end to the standing part where it comes out of the monkey fist. Tucking the bitter end inside the monkey's fist, then working all parts taut is another method of finishing off the knot.

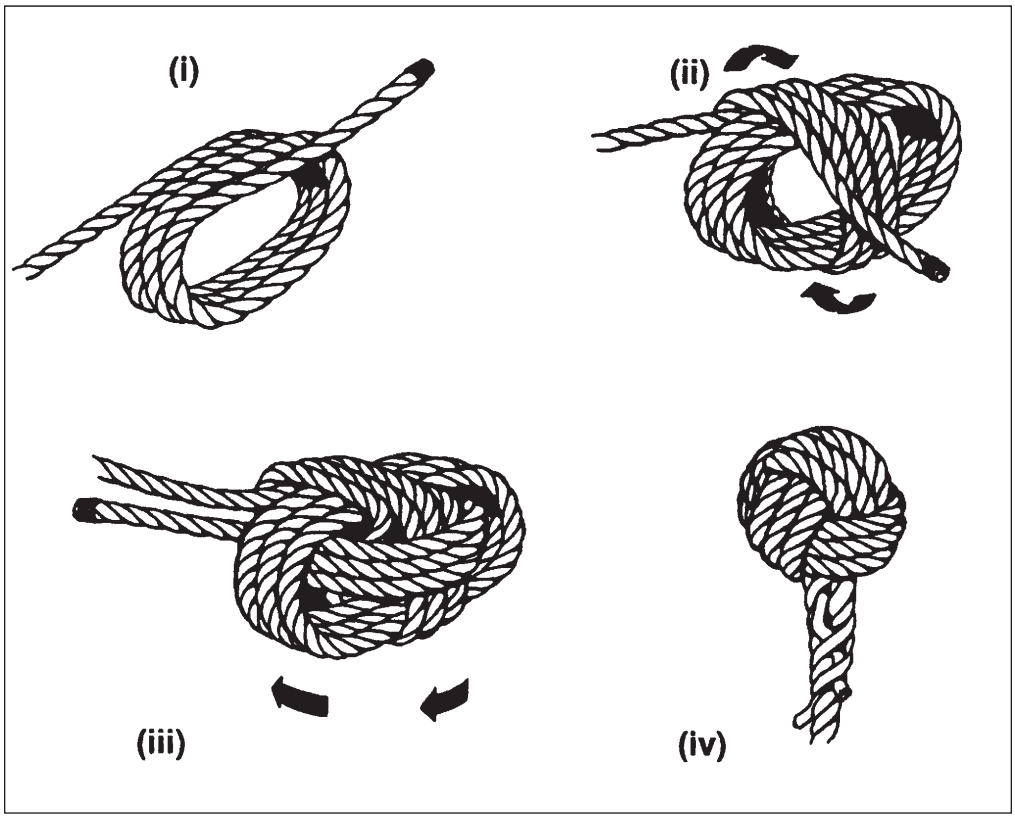

Figure 5.7-14 - Monkey's Fist

5.7.16 Heaving Line Knot

This knot is used as an alternative to the Monkey's Fist and is quickly and easily made as follows:

(**1**) Form a bight about 1.5 m long at the end of the line.

(**2**) Start frapping the end around both parts of the bight at about 20 cm from the actual bend of the bight, and continue until it is all but expended.

(**3**) Then pass the end through the small loop left and haul on the standing part.

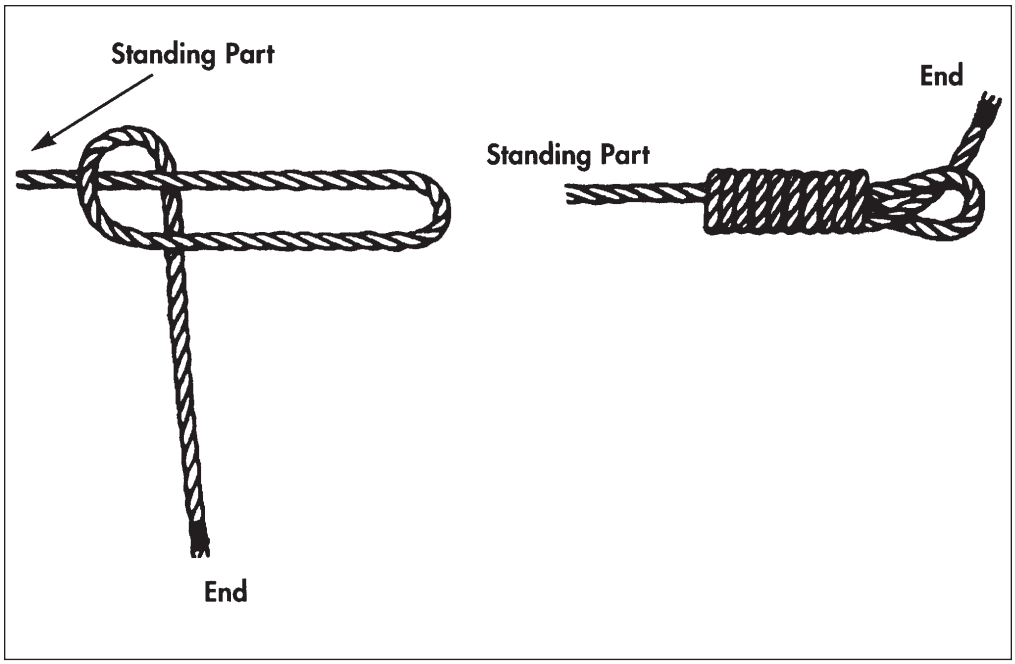

Figure 5.7-15 - Heaving Line Knot

5.7.17 Sheepshank

This is used to shorten the bight of a rope temporarily without cutting it. The strain on the rope will usually prevent the sheepshank from slipping, but if necessary, the loops can be stopped to the standing parts or secured with a toggle.

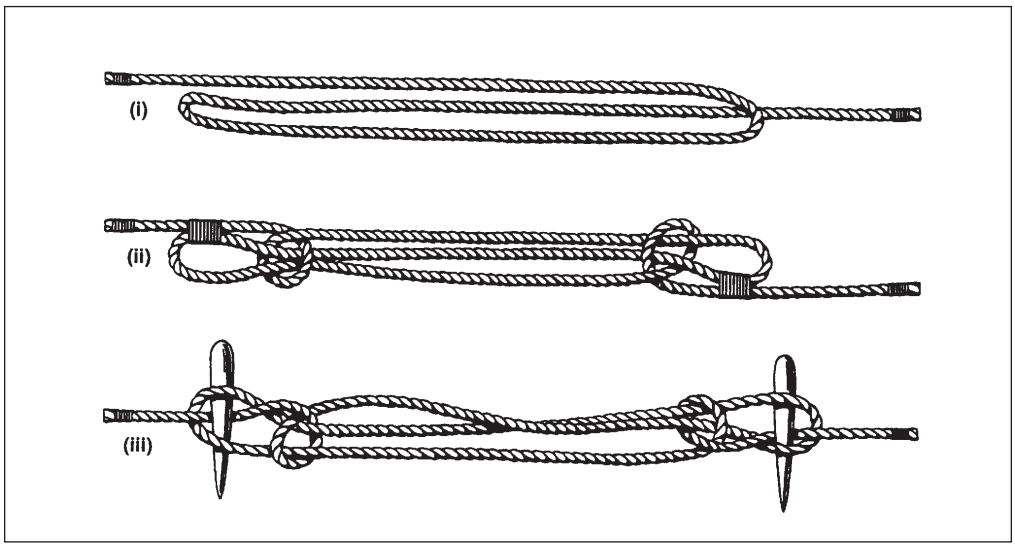

Figure 5.7-16 - Sheepshank

5.7.18 Carrick Bend

A Carrick Bend is used for joining two hawsers together of equal size when the join will have to pass around a capstan or winch. The ends should be stopped to their standing parts.

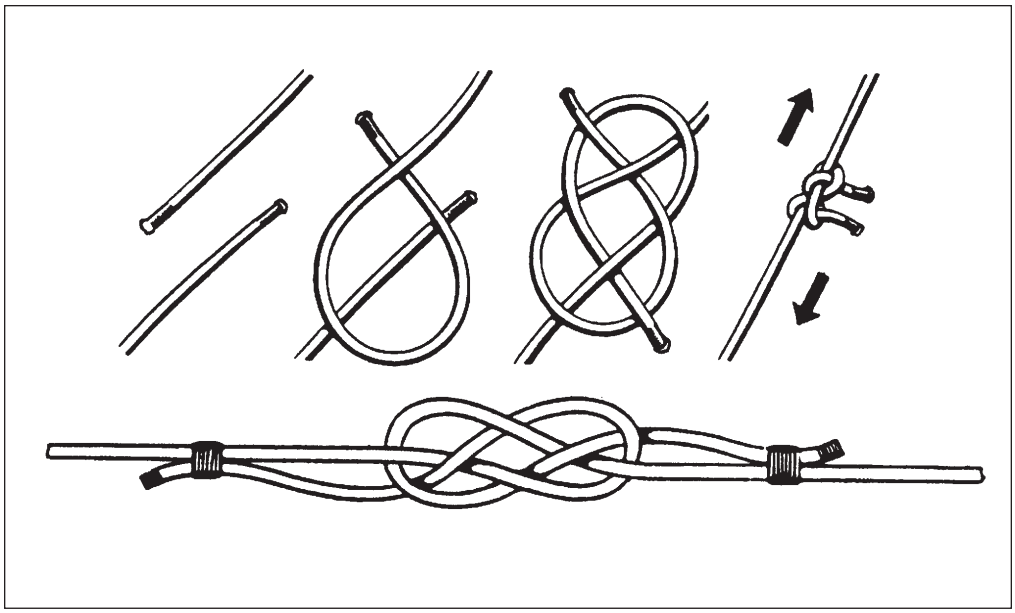

Figure 5.7-17 - Carrick Bend

5.8 Knots

The functions of a knot have been described earlier. Below is a description of how a few commonly used knots are made. To assist in the description, the strands are lettered A, B, C, etc., and their respective bights are lettered a, b, c, etc.

5.8.1 Crown Knot

When finished, the crown knot leaves the three strands pointing back along the rope. It is used to begin a back splice and as a basis for more complicated knots, but is seldom used on its own. To form a crown, do as follows:

(**1**) Whip the rope at a distance from its end equal to 12 times its diameter.
(**2**) Unlay the strands to the whipping, whip their ends, and spread them out in the form of a star with the centre strand farthest away from the body.
(**3**) Bring strand C to the front to form a loop.
(**4**) Place strand A over C and behind B.
(**5**) Thread strand B through the loop of C.
(**6**) Pull all strands taut until knot is tidy and uniform.

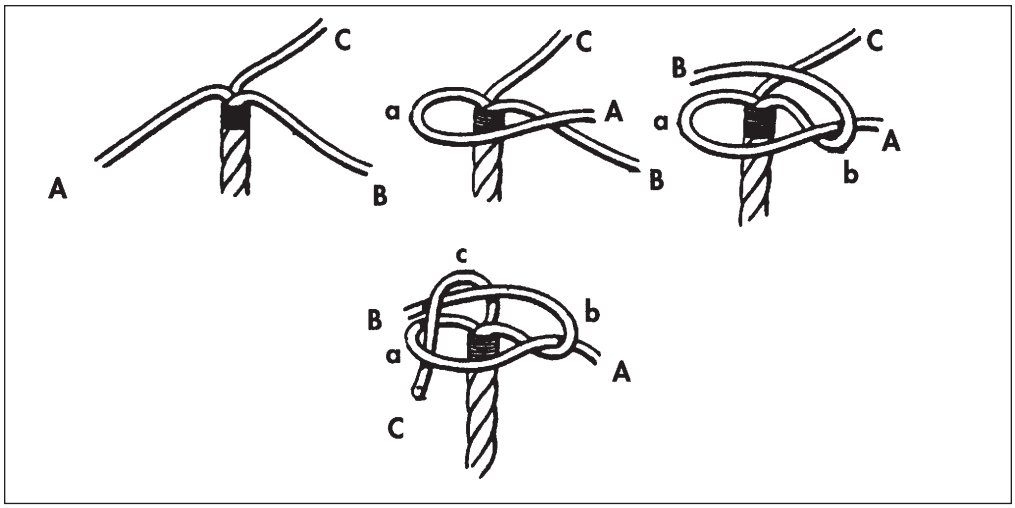

Figure 5.8-1 - Making a Crown Knot

5.8.2 Wall Knot

When finished, the wall knot leaves all three strands pointing in the original direction. It is, in fact, a crown knot turned upside down. To create a wall knot, do the following:

(**1**) Prepare the rope as for a crown.
(**2**) Take strand A and pass it under B.
(**3**) Take strand B around A so as to enclose it, and pass it under C.
(**4**) Take strand C around B so as to enclose it and bring it up through bight a.

If the wall knot is to be used by itself to prevent a rope unreeving, the strands should be whipped together where they emerge from the knot and the ends should then be cut off.

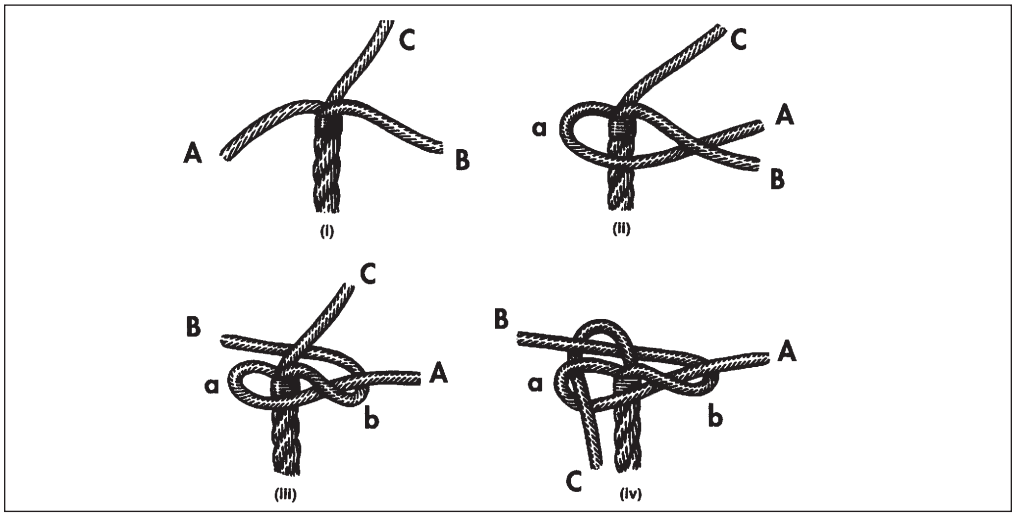

Figure 5.8-2 - Making a Wall Knot

5.8.3 Wall and Crown Knot

This can be used to prevent a rope from unreeving and also to form the foundation for more advanced knots. The whipping is placed at a distance from the end equal to 20 times the diameter of the rope; the wall being formed first and the crown made on top of it.

5.8.4 Crown and Wall Knot

This differs from the wall and crown knot in that the crown is made first and the wall formed under it. It is used for finishing off the end of seizings to prevent them from unreeving. The strands are unlaid right down to the turns of the seizings, against which the crown is formed as close as possible. The wall is then made under it and hauled taut, thus jamming the knot in tightly.

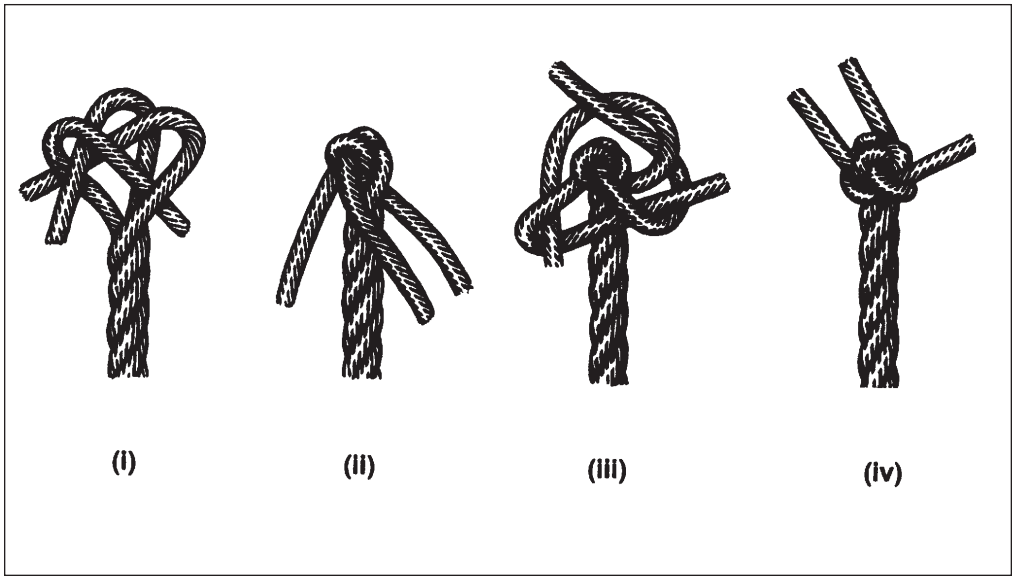

Figure 5.8-3 - Making a Crown and Wall Knot

5.8.5 Manrope Knot

The manrope knot is a decorative knot made at the ends of the gangway or Mediterranean Ladder manropes and lifelines to prevent them unreeving, and to afford a handhold for anyone climbing aboard. To make the knot:

(**1**) Whip the rope at a distance from its end equal to 20 times its diameter, unlay the strands to the whipping, and whip their ends.

(**2**) Make a wall and crown, keeping the knot fairly loose (i).

(**3**) Take strand A and follow it around its own part, thereby doubling up strand A (ii).

(**4**) Work the other two strands similarly, haul all parts taut, and cut off the ends where they protrude from the base of the knot (iii).

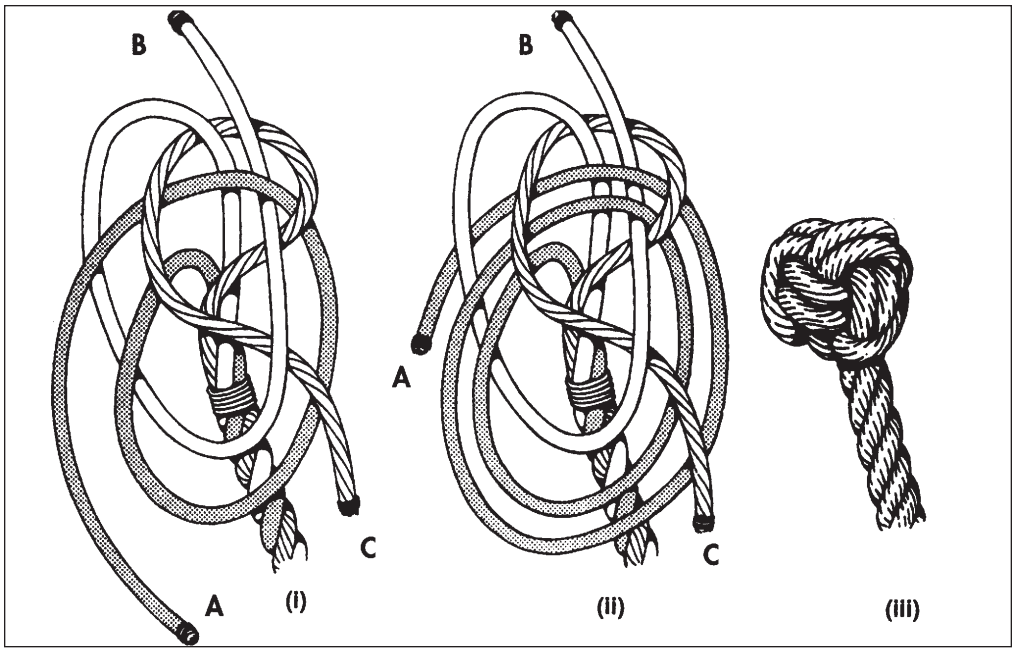

Figure 5.8-4 - Manrope Knot

5.8.6 Turk's Head

The Turk's Head is an ornamental knot which is supposed to resemble the turban once worn in Turkey, and should consist of three or more parts followed around two or more times. It may be made either as a standing or a running knot, according to whether it is to be fixed to an end or a bight, or formed around another part of a rope or a stanchion. Three different forms of this knot are described below.

a. **Standing Turk's Head.** Made at the end of a rope. This is a manrope knot, but the ends are followed around a third or fourth time. However, before starting the knot, the strands must be unlaid for a distance of no less than 25 times the diameter of the rope.

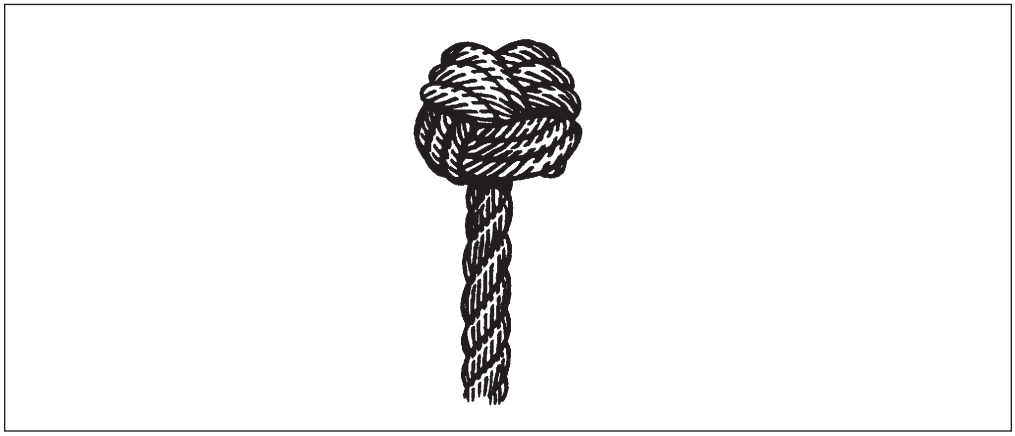

Figure 5.8-5 - Standing Turk's Head

b. **Running Turk's Head.** Made at the end of a rope and around its own bight (as in a running lanyard). This is similar to a standing Turk's Head made at the end of a rope, except that the wall and crown with which it is begun are made around the bight of the rope. The strands are then followed around two or more times, thereby forming a knot which will slide up and down the bight.

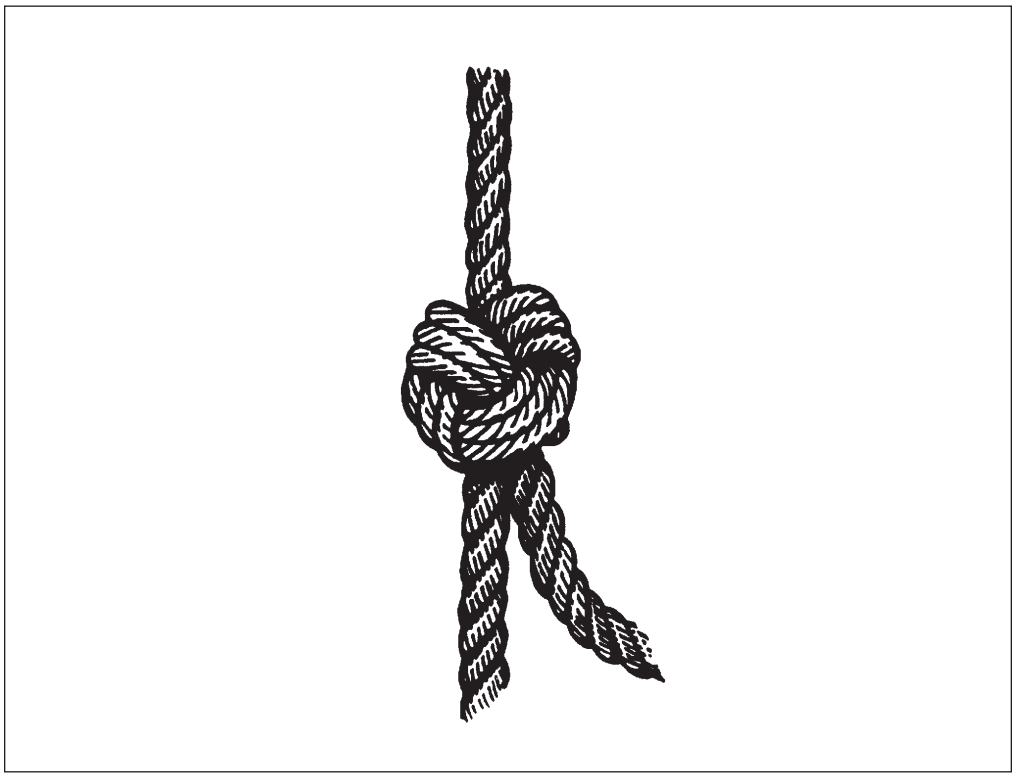

Figure 5.8-6 - Running Turk's Head

c. **Running Turk's Head.** Made around a bight of rope, a stanchion or other fitting. This is formed out of a single length of rope as follows:

(**1**) A half hitch is made around the rope or fitting, and then followed by a round turn;

(**2**) The end is then dipped under the bight of the half hitch (i).

(**3**) The bights around the rope are crossed, the bight which is on the same side as the end of the line being placed underneath.

(**4**) The end is then passed down between the bights (ii) and brought over the other side.

(**5**) The second and third operations are repeated until the rope is encircled (iii).

(**6**) The ends are then followed around as often as may be required.

(**7**) All parts are hauled taut (iv), and the two ends finished off with a crown and wall knot.

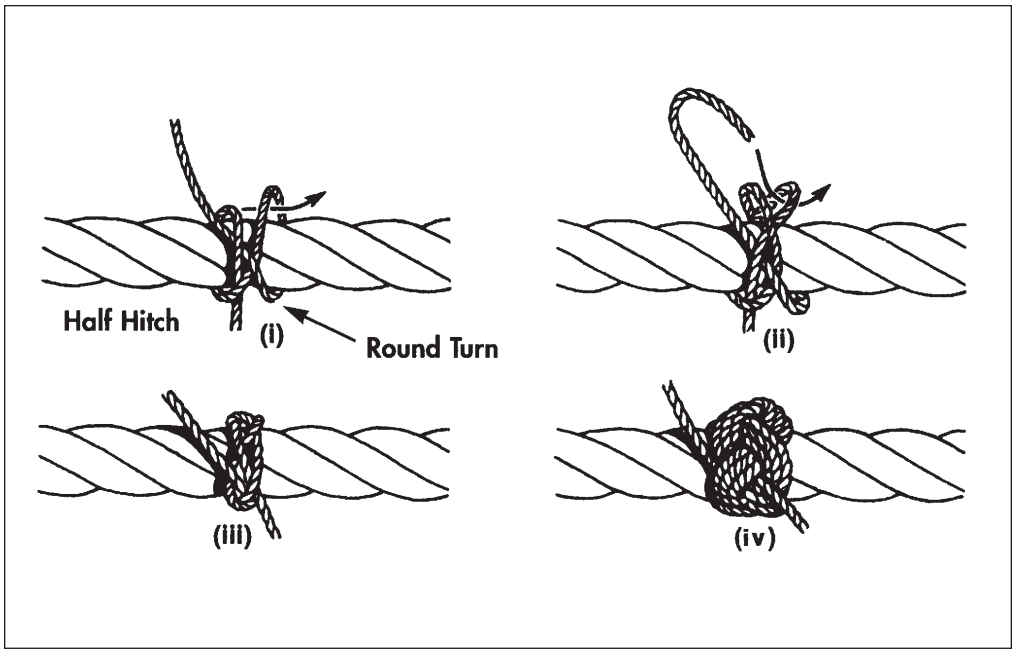

Figure 5.8-7 - Running Turk's Head on a Bight

5.9 Whippings

A whipping is the binding around the bare end of a rope to prevent the strands from unlaying. Three types of whipping are described below.

5.9.1 Common Whipping

A common whipping is created as follows:

(**1**) Place the end of the sailmakers along the rope; pass turns of the sailmakers over the rope against its lay, working towards the end of the rope, and haul each taut.

(**2**) Lay the other end of the sailmakers along the rope, and pass the remaining turns over it, taking the bight of sailmakers over the end of the rope with each turn.

(**3**) When the bight becomes too small to pass over the end of the rope, haul this second end of the sailmakers through the turns which you have passed over until it is taut, thus completing the last turn around the rope.

(**4**) Cut off the end.

An alternative finish, which can be used when the whipping is on the bight of the rope, is to take the last three or four turns loosely over one finger and pass the end back through them. Work the turns taut, and haul the end taut as above.

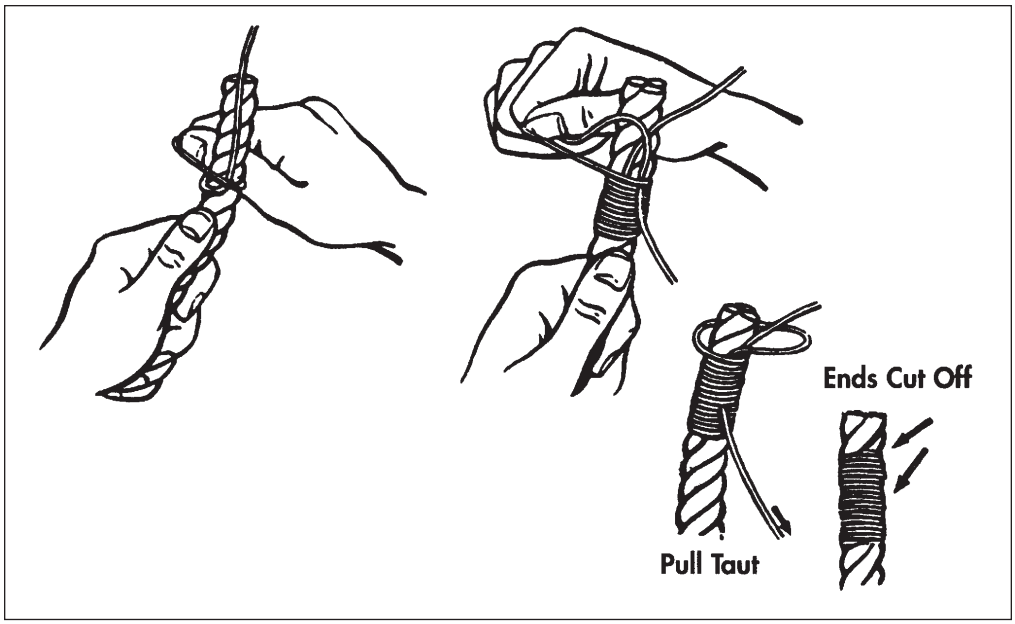

Figure 5.9-1 - Common Whipping

5.9.2 West Country Whipping

A west country whipping is made as follows:

(**1**) Middle the sailmakers on the rope in the position required, pass the two ends round the rope in opposite directions and tie an overhand knot on the other side.

(**2**) Bring the ends up and tie an overhand knot again, and continue in this manner, making an overhand knot every half turn so that the knots lie alternately on opposite sides of the rope.

(**3**) Finish off with a reef knot.

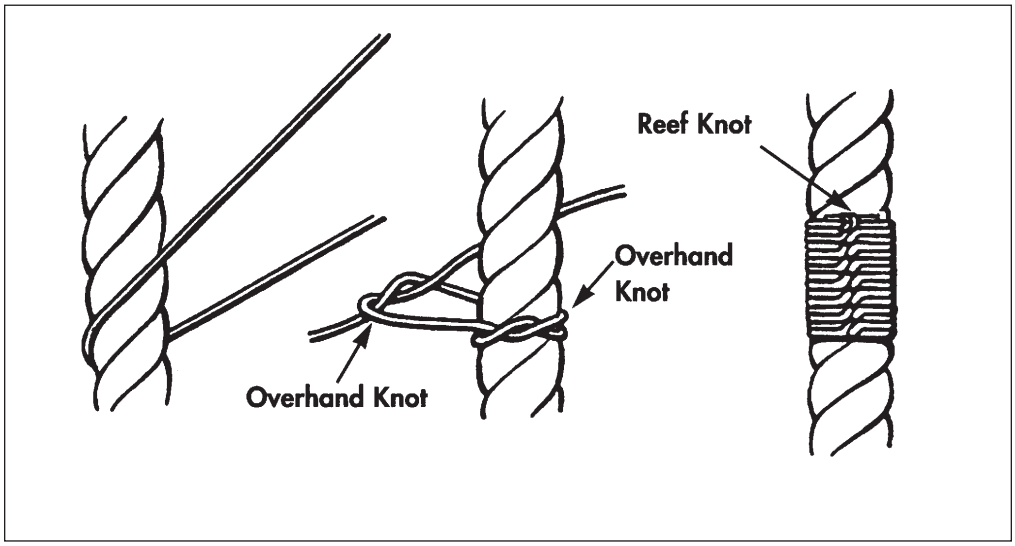

Figure 5.9-2 - West Country Whipping

5.9.3 Sailmakers Whipping

This whipping is the most secure, but of course it can only be used on hawser-laid (three-strand) rope as follows:

(**1**) Unlay the end of the rope for about 50 mm and hold it in the left hand pointing upwards, with the middle strand farthest away.

(**2**) Make a bight in the sailmakers about 20 cm long and pass this bight over the middle strand only with the two ends towards you.

(**3**) With the bight of sailmakers hanging down the back of the rope and the ends pointing down in front, lay up the rope with the right hand.

(**4**) Leave the short end of sailmakers where it is and, with the long end, pass the turns of the whipping, working towards the end of the rope against the lay.

(**5**) When sufficient turns are on, take the bight of the sailmakers, pass it up outside the whipping, following the lay of the strand around where it was originally put, and pass it over that strand, where the latter comes out at the end of the rope.

(**6**) Now haul on the short end so as to tighten the bight.

(**7**) Then bring this end up outside the whipping, again following the lay of the rope, and reef knot the two ends in the middle of the rope and out of sight.

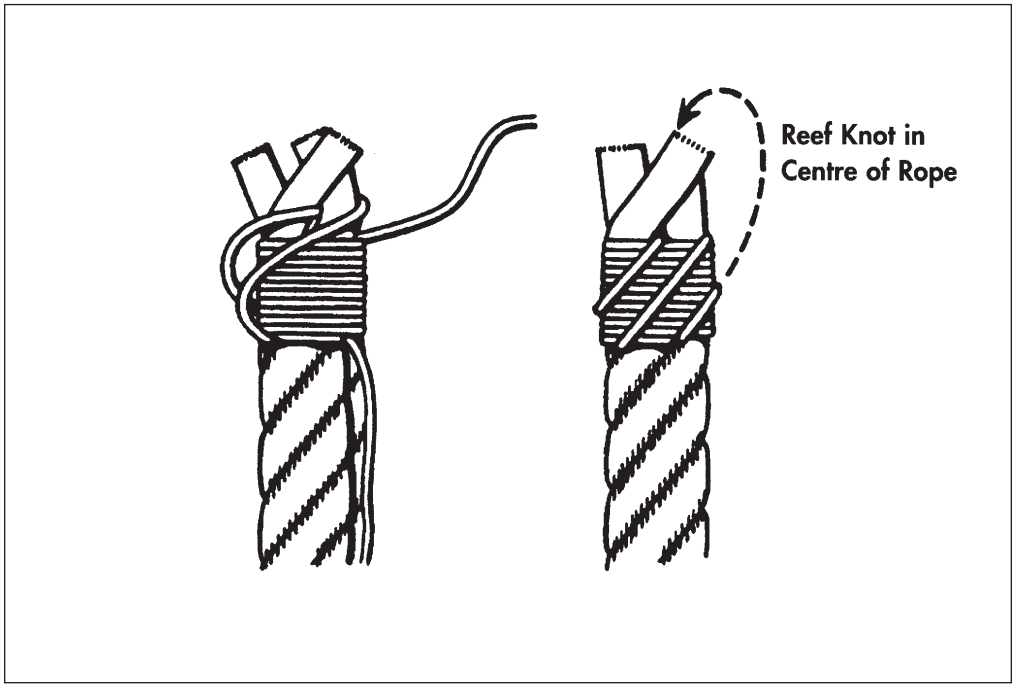

Figure 5.9-3 - Sailmakers Whipping

5.10 Mousing

A mousing is used for keeping the pin of a shackle or slip in position, or to prevent inadvertent unhooking from an open hook. Shackle pins can normally be safely moused with Insulok nylon ties (tie-wraps) (Fig 5.10-1); however, it is advisable to mouse with seizing wire (Fig 5.10-1) if the pin of the shackle is likely to be subjected to considerable movement, for example the pin of the shackle securing the slip of both the light and heavy jackstay rigs. Slip pins must always be moused with seizing wire (Fig 5.10-2). Most hooks now in use in the Canadian Navy incorporate a spring-loaded safety catch; however, should an open hook be encountered, the method of mousing it with seizing wire is shown in Fig 5.10-3.

5.10.1 Strap Tiedown (tie-wrap) Mousings

Mousings are easy to apply (Fig 5.10-1 (i)). First ensure that the shackle pin is fully screwed home, and then lead the end of the tie through the eye of the pin, around the shank of the shackle, and finally through the jamming breech on the end of the tie. Haul taut and cut off the surplus end 5 mm from the jamming breech.

5.10.2 Seizing Wire Mousings

a. To mouse a shackle pin with seizing wire (Fig 5.10-1 (ii)) do the following:

(**1**) Middle a length of the wire through the eye of the pin and twist the two parts together two or three times to attach the wire to the pin.

(**2**) Pass the two ends of the wire in opposite directions three or four times around the shank of the shackle and back through the eye of the pin, making sure that each turn is tight.

(**3**) Finish off by twisting the two parts tightly together two or three times.

(**4**) Cut off any surplus wire from the final twist and bend down the ends.

b. When mousing a slip pin (Fig 5.10-2):

(**1**) Attach one end of a length of seizing wire to the eye of the pin.

(**2**) Then wind the wire tightly in figures-of-eight across the tongue of the slip and around the pin, locking the pin in position.

Three or four turns of wire are normally required, but because of the possibility of an emergency breakaway, mousings on slips used in replenishment rigs and towing are moused with only one full figure-of-eight turn.

c. Mousings on open hooks are applied as shown in Fig 5.10-3.

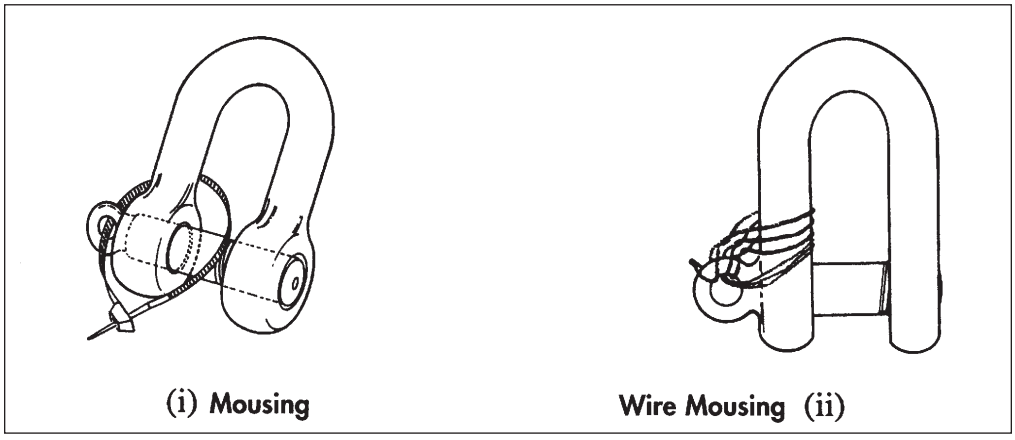

Figure 5.10-1 - Mousing a Shackle

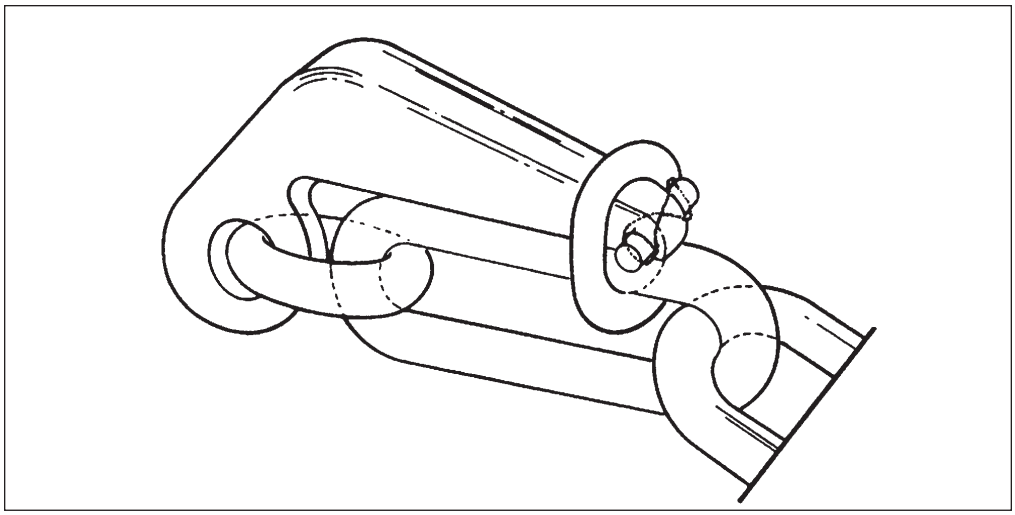

Figure 5.10-2 - Mousing a Slip

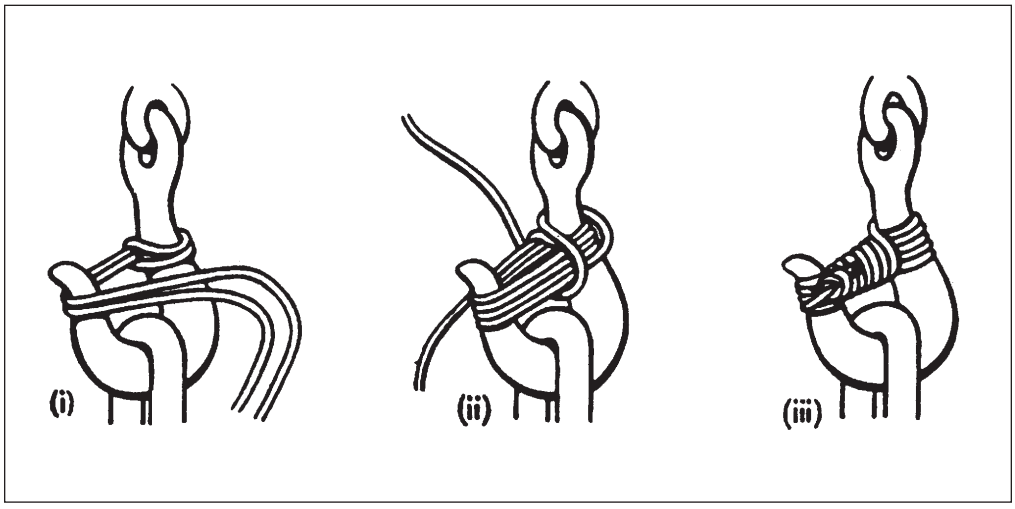

Figure 5.10-3 - Mousing an Open Hook

5.11 Seizings

5.11.1 Types of Seizings

A seizing is a method of fastening together two parts of rope sufficiently strong enough to stand a required strain. Two standard seizings designed to meet certain specific standards are employed in the Canadian Navy.

a. **Flat Seizing.** A light seizing for use when the strain on the two parts of rope is equal. It consists of one layer of approximately 11 round turns.

b. **Racking Seizing.** When the strains on the parts of the rope are unequal or exerted in opposite directions, a racking seizing is used. It is formed by passing one layer of racking turns, and then passing one of the round turns so that they lie between the racking turns. The number of round turns is necessarily one less than the number of racking turns. Sufficient turns are taken for the length of the seizing to be equal to three times the diameter of the rope, e.g., for racking two 24 mm ropes, an overall length of seizing of 72 mm is required.

5.11.2 Strength of Seizings

For seizing cordage, it is normal to use small stuff (tarred marlin or line of appropriate size to the rope being seized). When seizing wire ropes, flexible mild steel wire is used. The number of turns to be used for a seizing depends upon the strength of the seizing line and the strain to which the seizing will be subjected. For cordage, 11 and 21 turns are recommended for flat and round seizings respectively. These seizings are based on a size of the seizing line of about one-seventh of the size of the rope, e.g., 6 mm seizing line would be required for seizing a 40 mm diameter nylon rope.

5.11.3 Making up Seizing Line

Wind the seizing line around one hand in an anti-clockwise fashion with as many riding turns as are required, and finish with a clove hitch on the bight around the middle. Work with the first end which is drawn out through the opposite side of the coil, thus thorough footing the seizing line and making it easier to work by taking the turns out of it. The turns in the coil are held in place by the clove hitch.

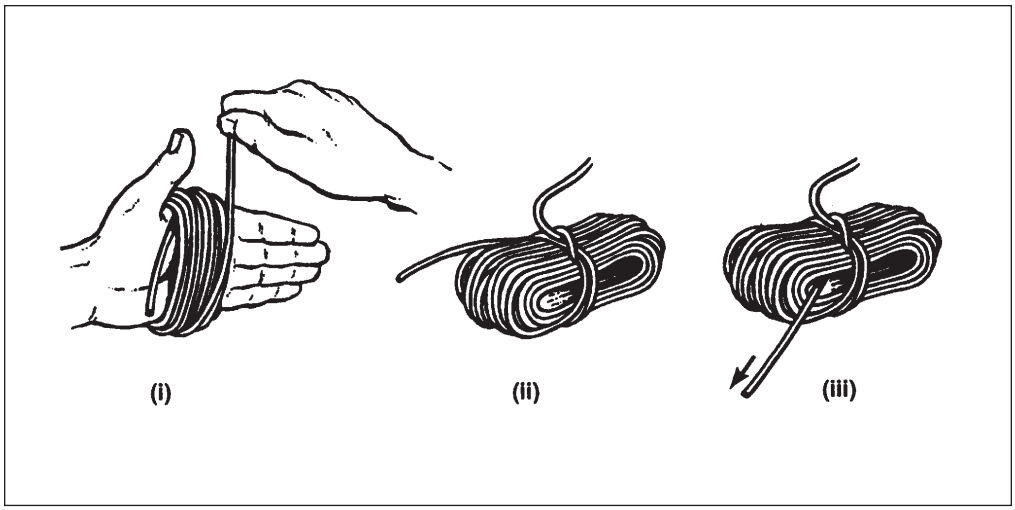

Figure 5.11-1 - Making up Seizing Stuff

5.11.4 Use of a Serving Mallet

When serving heavy rope, the turns must be hauled more than hand-taut, and for this purpose a serving mallet can tighten the lower turns of the serving as follows:

(**1**) Lay the mallet in the bight of the line as shown in Fig 5.11-2 (i) and as close up to the work as possible.

(**2**) Take a turn diagonally round the head of the mallet, bringing the end up the opposite side of the handle (ii).

(**3**) Take half a turn around the handle, and take the end again behind the head (iii).

(**4**) Jam the end between the head and the standing part, and bring it up over the handle, as indicated by the dotted line (iii).

(**5**) Place the head against the rope and heave, using the handle as a lever.

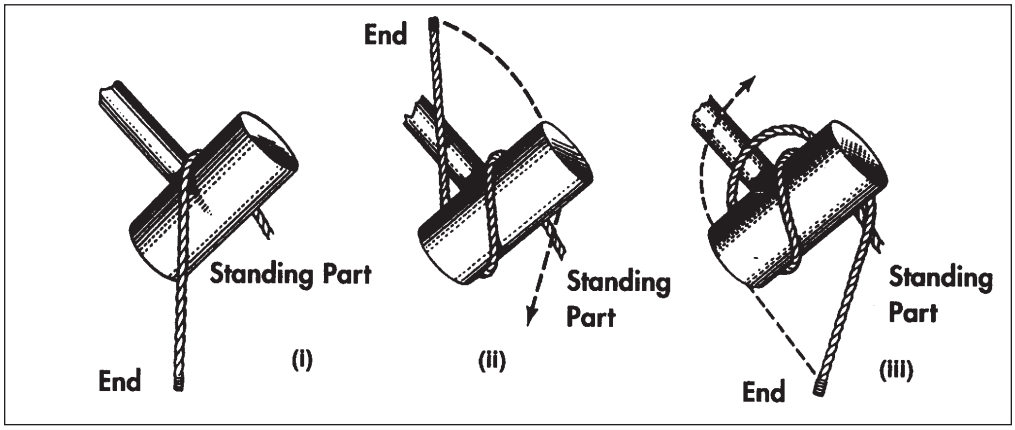

Figure 5.11-2 - How to Use a Serving Mallet

5.11.5 Starting a Seizing

Cordage seizings are begun by making a small eye in the end of the seizing line. Wire seizings are started by taking the end around one of the ropes to be fastened and then half hitching it around its own part. Take care to keep the eye or half hitch in the centre and clear of both parts of the rope.

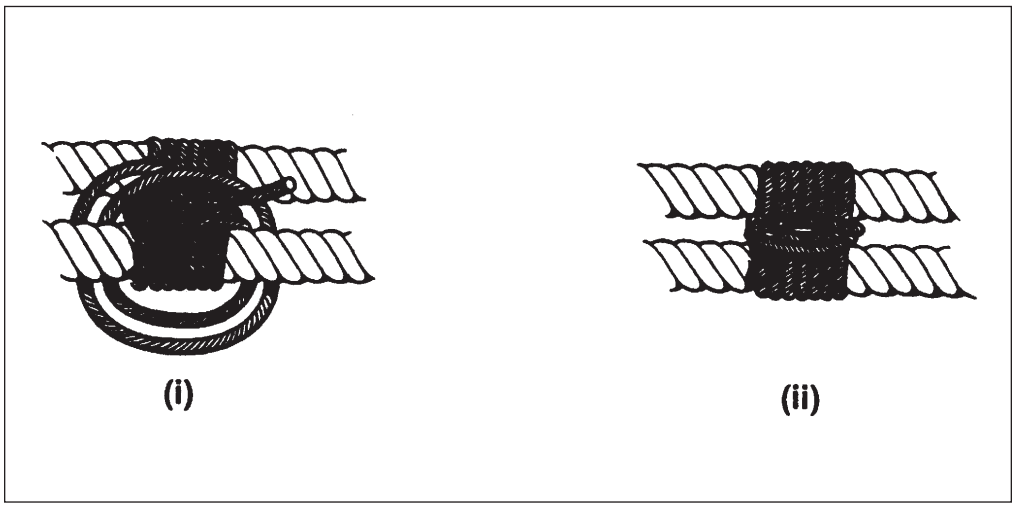

Figure 5.11-3 - Starting a Seizing

5.11.6 Passing a Flat Seizing

Having begun the seizing as described, continue as follows:

(**1**) Take the round turns very loosely around both parts of the rope and then pass the end back, along and between the two parts of the rope, under the turns and through the eye or half hitch of the seizing as in Fig 5.11-4.

(**2**) Heave each turn taut and take a cross turn around the seizing between the two parts of the rope.

(**3**) Haul the seizing taut and secure its end with a clove hitch, one part of the clove hitch being on each side of the round turn.

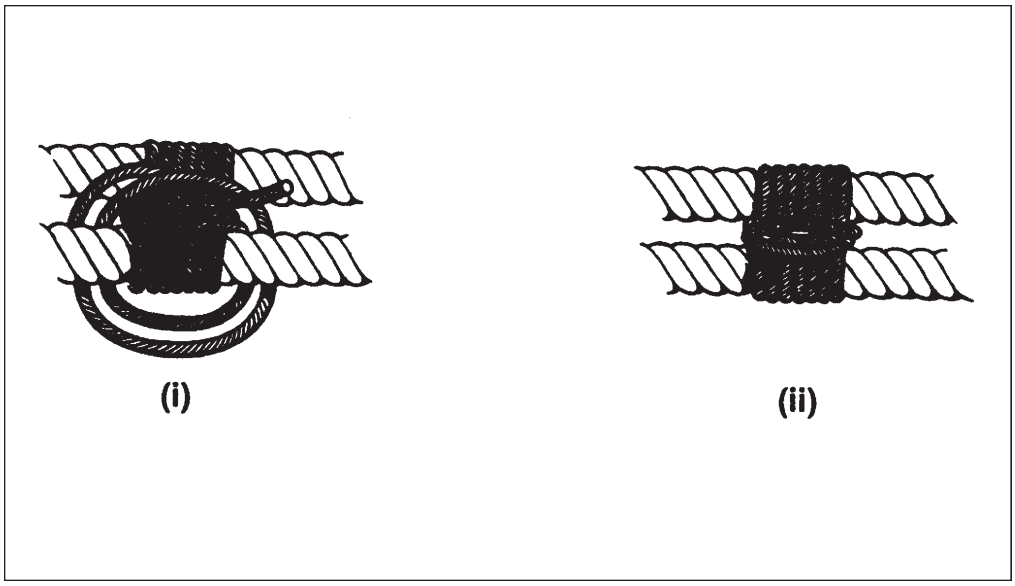

Figure 5.11-4 - Passing a Flat Seizing

5.11.7 Passing a Racking Seizing

Start the seizing as already described and, if the seizing slips when taken around both parts of the rope, do the following:

(**1**) Take the end around one part only and reeve it through the eye.

(**2**) Then dip the end between the two parts of rope and take a number of figure-of-eight turns around each part alternately, taking care to have the same number round each part and to leave room between each racking turn for the around turn which will come later (i).

(**3**) When the racking turns have been hove taut, dip the end under the last turn and pass the round turns back towards the eye, filling the spaces between the racking turns (ii).

(**4**) When the last round turn has been passed (see that there is one less than the racking turns), complete the seizing by taking one round turn around the whole seizing and forming a clove hitch between the two parts of the rope.

(**5**) Finish off as for a flat seizing.

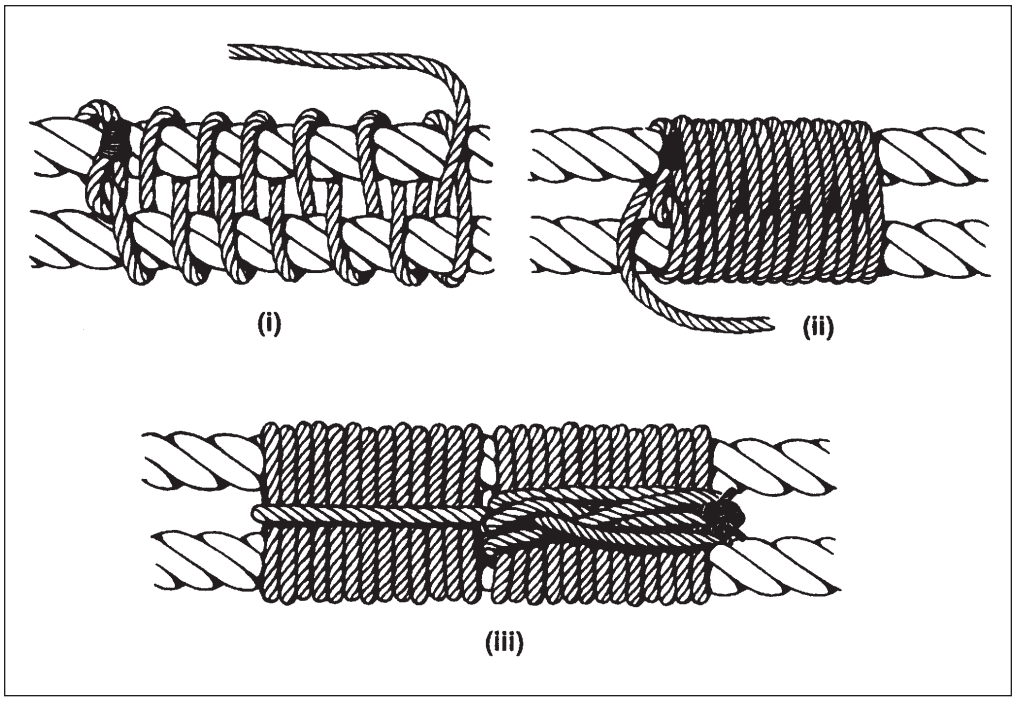

Figure 5.11-5 - Passing a Racking Seizing

5.12 Worming, Parcelling and Serving

A rope or part of a rope is wormed, parcelled and served (Fig 5.12-1) to protect its outer surface against wear from chaffing, to make its outer surface smoother so as to prevent other ropes from chaffing when led over it, and, in the case of a steel wire rope, to protect the hands of those using it from the sharp ends of wire projecting from any splice in it. Worming, parcelling and serving are not necessarily damp-proof and there is a danger that a rope may rot underneath its covering. Ropes so treated should therefore be inspected frequently for deterioration.

5.12.1 Worming

This consists of filling in the spaces between the strands with lengths of small stuff laid along the lay of the rope. The object is to make the rope smooth and round.

5.12.2 Parcelling

This consists of binding the rope with strips of rot-proofed canvas or similar material. The strips should be from 50 to 75 mm wide. It is customary to bind them on in the direction of lay of the rope, working towards the eye. Each turn should overlap that preceding it by half the width of the strip, and the rope, if not man-made fibre, should first be well tallowed. When parcelling and serving a stay throughout its whole length, the parcelling should be worked upwards from the eye of the lower splice to the eye of the upper splice as this affords the maximum obstruction to the entry of water.

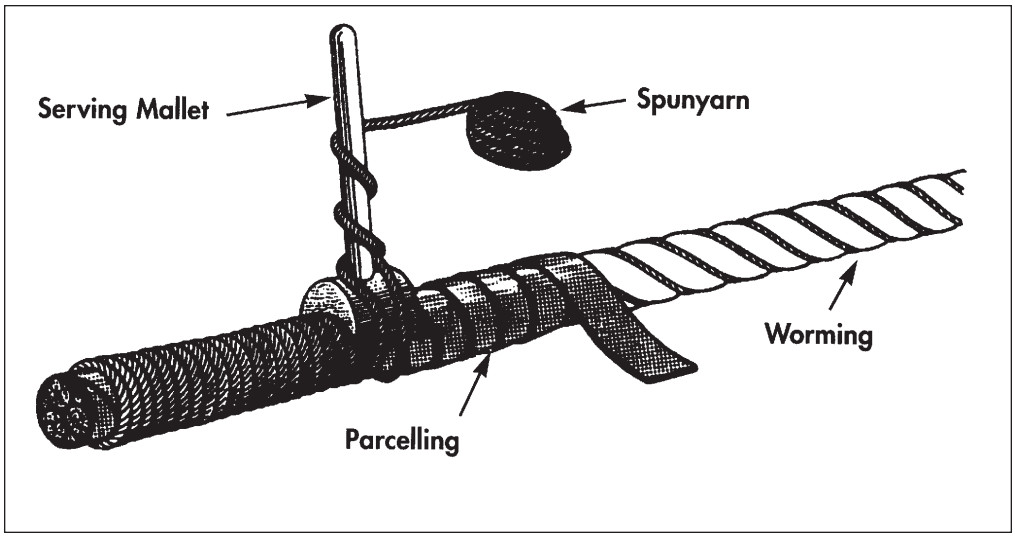

Figure 5.12-1 - Worming, Parcelling and Serving

5.12.3 Serving

a. This consists of binding a splice or a length of rope with close turns of small stuff or tarred marlin. (Flexible mild steel wire rope can be used to serve steel wire rope.) Each turn is hove taut with a special serving mallet which has a score in its head to fit the rope, and a wooden handle about 40 cm long. A service is always bound on in the direction opposite to that of the parcelling in order to avoid bunching up the latter. It is, therefore, put on against the lay of the rope, a rule which can be memorized thus: worm and parcel with the lay, turn and serve the other way. A serving is begun as for a common whipping, although when serving with the larger sizes of flexible mild steel wire it may be necessary to stop the first end down to the rope until sufficient turns have been applied to hold it firmly. The first few turns are put on by hand and hauled taut with a spike or heaving mallet. The serving mallet is then placed on the rope and the turns of the service are passed as follows:

(**1**) Take a half-turn around the handle and then one turn around the fore end of the head of the mallet and the rope.

(**2**) Dog the serving around the handle of the mallet.

(**3**) To put on a serving, stand with the rope on your left side while facing in the direction in which the turns are advancing.

(**4**) Pass the ball of serving line around and around in step with the serving.

(**5**) Having completed the required length, finish off the service by passing the end back under the last four turns, hauling all parts taut and making a crown and wall knot or, if finishing a wire seizing, breaking off the wire close to the hitch and tucking away the ends so no harm will result when the rope is handled.

(**6**) Finish the serving of a wire serving on an eye splice in a customary and similar manner to that of a seizing; a cross turn is therefore taken round the last few turns of the serving, inside the neck of the eye, and is followed by a clove hitch, the ends of the wires being then broken off and tucked away.

b. If serving over a restricted length of rope (up to an eye splice for example) which does not allow the mallet to advance ahead of the last turns, the serving line should be brought to the mallet as follows:

(**1**) up over the cut in the fore end of the head;
(**2**) one-quarter turn around the handle;
(**3**) one turn around the rope and rear end of the head (taken in the direction of the service, i.e., against the lay of the rope); and
(**4**) dogged around the handle.

5.13 Rope Splicing

Splicing is a method of joining the ends of two ropes together, making an eye in the end of a rope, or finishing off the end of a rope instead of applying a whipping. A splice will reduce the strength of a rope by about one-eighth. The tools required for splicing hawser-laid rope are:

(**1**) A fid, which is a pointed wooden spike made of hardwood.
(**2**) A mallet for pounding tucks into place (on larger line).
(**3**) A sharp knife and whipping of some type to prevent the ends of the strands or the line from unraveling.

When reference is made in the text on splicing to the left or right of a rope, imagine yourself to be looking along the rope towards the end which you are handling.

5.13.1 Special Considerations when Splicing Man-Made Fibre Cordage

Special care is needed when splicing MMFC because an unsatisfactory splice may be dangerous. When unlaying strands make sure that the yarns are disturbed as little as possible. Each strand should be marled or taped every 50 mm along its length to maintain its form. Firm whippings of twine or tape must be used and the ends of the strands must be heat fused. When making an eye splice, a throat seizing is recommended. Serving an MMFC splice is not recommended because it tends to loosen when the rope's diameter decreases under load; if such a rope has to be served, it must be very tight. When splicing man-made fibre hawser-laid rope, five full tucks should be made if the ends of strands are to be dogged. To complete the splice, the ends of strands should be fused. Four full tucks reduced

to two-thirds and one-third should be made if the splice is tapered. If the splice is then served, the first three tucks should be left uncovered. When splicing MMFC, take care that:

(**1**) Strands lifted for tucking are not kinked. To avoid strand distortion, use a small fid of oval cross section; then follow this with larger fids until it is just possible to pass the strand without distorting it.

(**2**) Strands are pulled back as far as possible.

(**3**) The rope is kept level the whole time and strands are lifted only high enough for the tuck to take place.

(**4**) The rope itself is not allowed to kink.

5.13.2 Types of Splice

a. **Back Splice.** For finishing the end of a rope which is not required to be rove through a block; it prevents it from unlaying.

b. **Eye Splice.** For making a permanent eye in the end of a rope.

(**1**) A soft eye is a small eye spliced in the end of a rope, and a thimble eye is formed by fitting and splicing the end of the rope around a thimble, the splice holding the thimble in place. It is fitted in the ends of cordage and wire ropes which are intended to be used in conjunction with a joining shackle or other rigging fittings. The hawser eye is an alternative to the thimble eye and is just as efficient.

(**2**) The eye is first spliced larger than the thimble, then the thimble is fitted into the eye and secured in place by a strong seizing just below it. This enables the thimble to be easily removed and replaced, merely by cutting the seizing and then renewing it. A bollard eye is a long soft eye, 1.5 m long from crown to splice, which is fitted in the ends of berthing hawsers so it can be placed over bollards.

c. **Short Splice.** For joining two ropes not required to pass through a block.

d. **Long Splice.** For joining two ropes which are required to pass through a block. A well-made long splice does not increase the diameter of the rope and should not reduce its strength.

e. **Cut Splice.** For making a permanent eye in the bight of a rope.

5.13.3 Back Splice in Hawser-Laid Rope

a. This method of finishing the end of a rope must not be used if the rope is to pass through a block, eye plate or similar fitting. Follow these steps:

(**1**) Whip the rope at a distance from its end equal to 20 times the diameter of the rope.

(**2**) Unlay the strands to the whipping and whip the end of each strand.

(**3**) Make a crown knot (i).

(**4**) Cut the whipping and then tuck each strand over one strand and under the next, to the left and against the lay of the rope, as shown in (ii).

(**5**) After each strand is tucked, pull the strands taut and tidy up this first tuck until each strand is uniform.

(**6**) Repeat this tucking twice more (iii), four times more if splicing MMFC. Always tuck to the left, using the next strand to the left.

b. If the splice is to be served, taper it down after the third tuck (or fourth if splicing MMFC) as follows:

(**1**) Take one-third of the yarn out of each strand and tuck the remaining two-thirds once, as already described. Though discarded, the thirds should not be cut off until the splice is completed.

(**2**) Halve the reduced strands, then tuck one-half of each and leave the other.

(**3**) Haul all parts taut, including the discarded ends which should now be cut off.

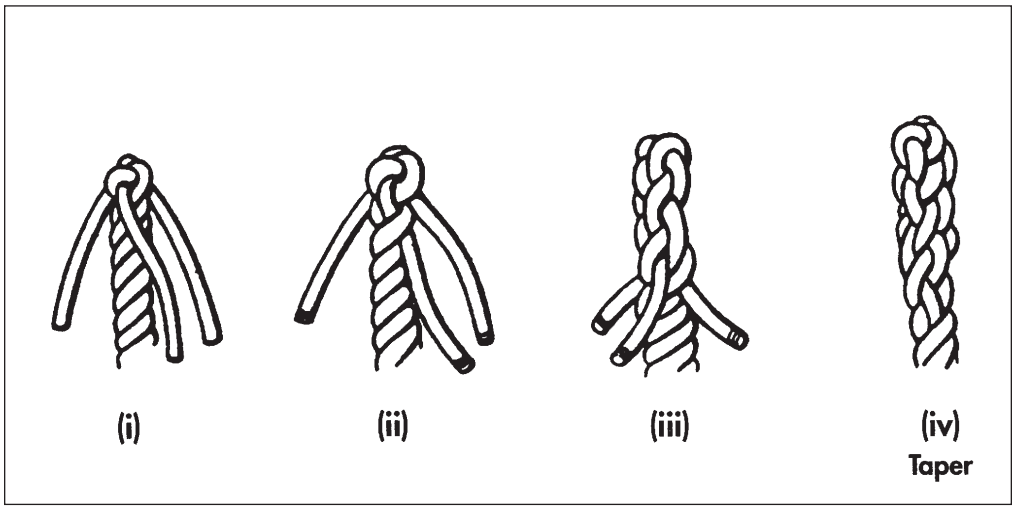

Figure 5.13-1 - Making a Back Splice

5.13.4 Soft Eye Splice in Hawser-Laid Cordage

a. Whip the rope at a distance from its end equal to 20 times the diameter of the rope, then unlay it to the whipping and whip the end of each strand. Mark the place intended for the crown of the eye, and bend the rope back from there so as to bring the unlaid strands alongside the place where the splice is to be made, with the left and middle strands lying on the top of the rope. The set of the splice will depend on selecting this middle strand correctly.

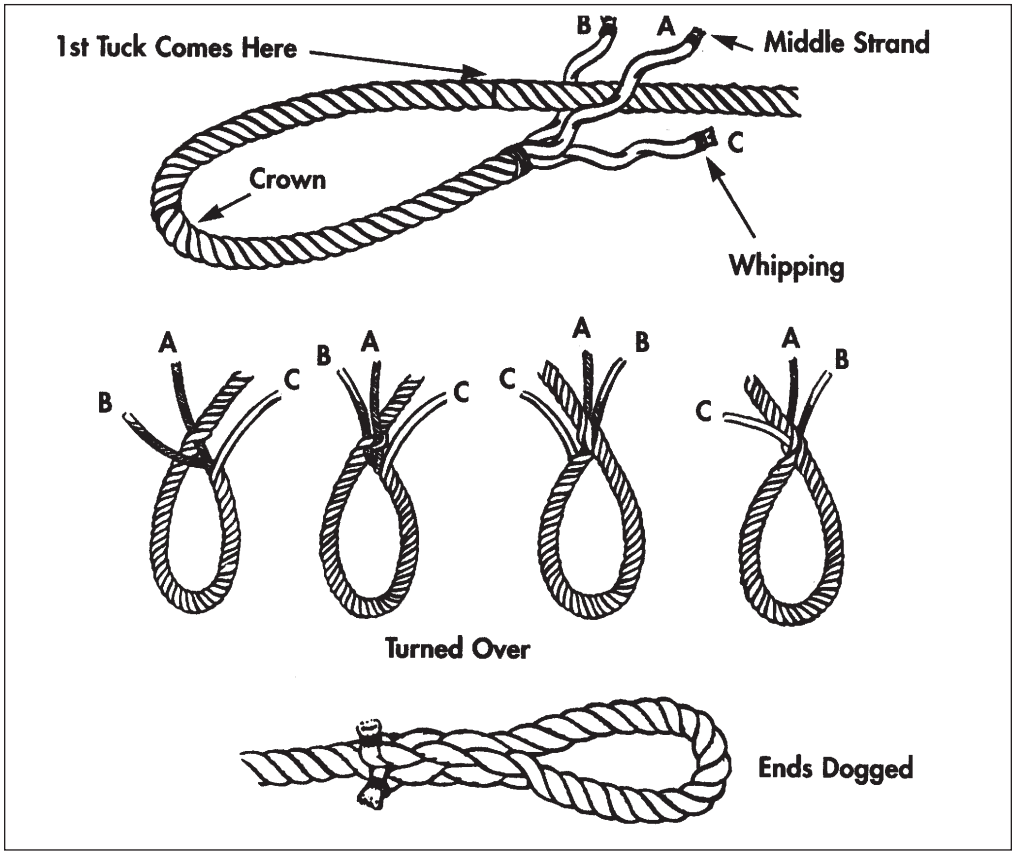

Figure 5.13-2 - Making an Eye Splice

b. Now refer to Fig 5.13-2 in which the middle strand is marked A, the left-hand strand marked B and the right-hand strand marked C, and make the splice as follows:

(**1**) Tuck A, from right to left, under the nearest strand of the standing part.

(**2**) Tuck B, from right to left, under the next strand of the standing part.

(**3**) Now turn the rope right over so as to bring the remaining strand C on the top, and then tuck C from right to left under the unoccupied strand of the standing part. Care must be taken to retain the lay of the rope in the last strand tucked, as this enables it to lie closer.

(**4**) Now, beginning with C, heave each strand taut with a heaving mallet. Then tuck all three strands a second and third time (fourth and fifth time if splicing MMFC).

(**5**) Finish off by tapering the splice as described for the back splice or, if the appearance of the splice is of secondary importance and maximum strength is required, dogging the ends by halving each of the three strands and whipping each half to its neighbor over the adjacent strand.

5.13.5 Short Splice in Hawser-Laid Rope

The strands of each rope are tucked between the strands of the other rope against the lay, each strand being taken over the strand on its left, then under the next strand and emerging between this and the subsequent strand. In Fig 5.13-3 the ends of the rope are lettered A and B, and their unlaid strands C, D, E, F, G and H respectively. Certain whippings and stops have been omitted to show the tucking of the strands more clearly. Follow these steps for a short splice in hawser-laid rope:

(**1**) Whip each rope at a distance from its end equal to 20 times the diameter of the rope (this whipping has been omitted from rope A in the illustration).

(**2**) Unlay the strands to the whipping and whip their ends (these whippings have also been omitted).

(**3**) Marry the two ropes so that one strand of each lies between two strands of the other (i).

(**4**) Having ensured a close marry, whip the strands strongly round the joint to prevent them slipping, and stop ends C, D and E to rope B with a strong stop (whipping and stops have been omitted).

(**5**) Cut the whipping on A.

(**6**) Take F over C, under E, and bring it out between D and E (ii).

(**7**) Take G over E, under D, and bring it out between D and C (ii and iii).

(**8**) Take H over D, under C, and bring it out between C and E (iii).

(**9**) Stop G, F and H to A, cut the stop and whipping on B, and tuck C, D and E in a similar manner.

(**10**) Heave all six strands equally taut with a heaving mallet.

(**11**) Again tuck each strand over the strand on its left and under the next one, and then repeat this operation a third time (fourth and fifth time if splicing MMFC).

(**12**) Finish off as described for an eye splice.

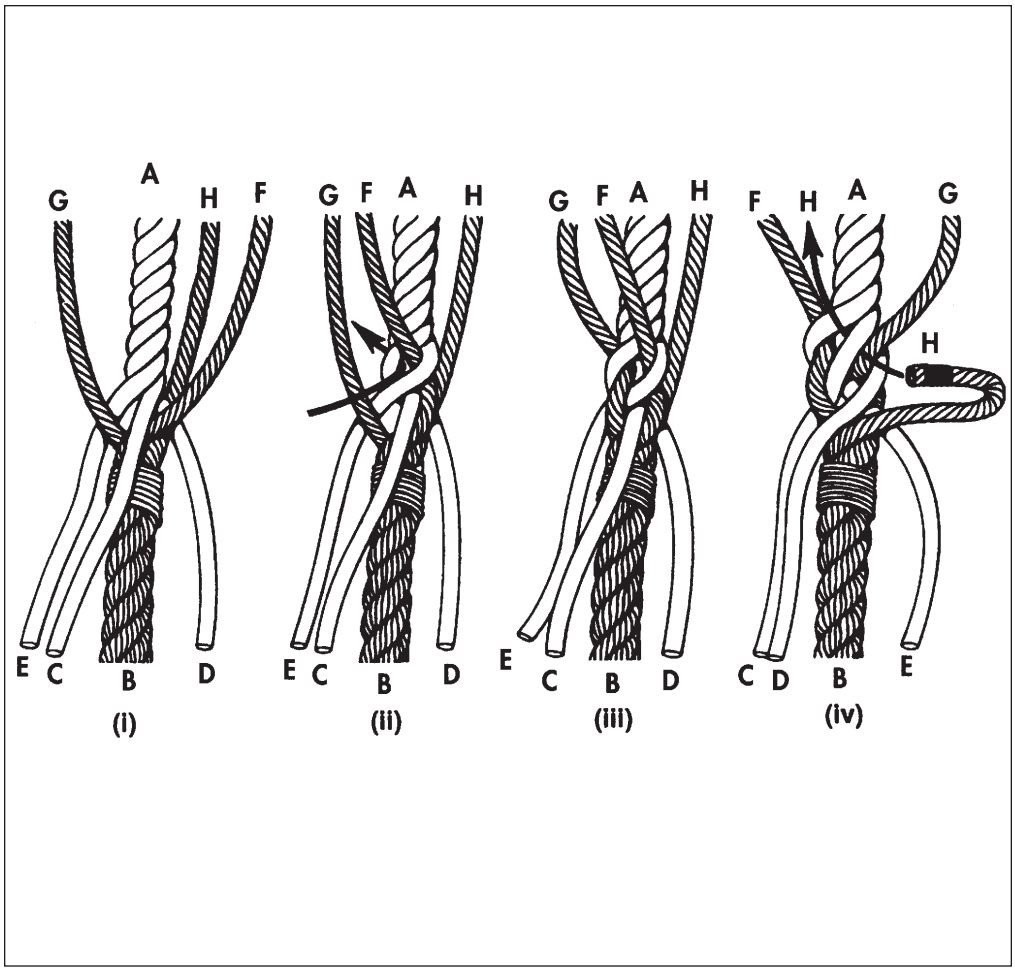

Figure 5.13-3 - Making a Short Splice

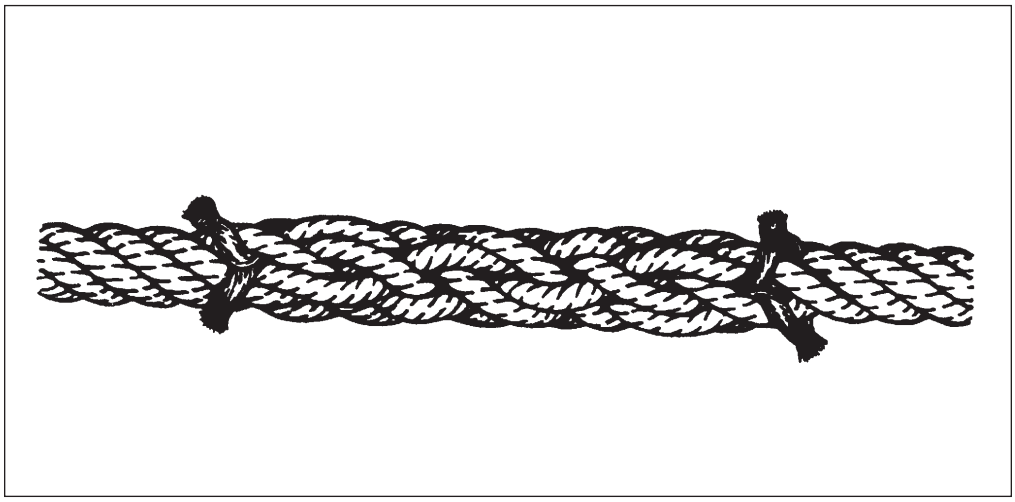

Figure 5.13-4 - Finishing a Short Splice by Dogging

5.13.6 Cut Splice in Hawser-Laid Cordage

This splice is used when it is required to make a permanent eye in the bight of a rope as follows:

(**1**) Whip each rope at a distance from its end equal to 20 times the diameter of the rope.

(**2**) Unlay it to the whipping and whip the end of each strand (i).

(**3**) Place the ends of the two ropes alongside and overlapping each other, and stop them together.

(**4**) Tuck the unlaid strands of both ropes as for an eye splice.

(**5**) Finish off as for an eye splice.

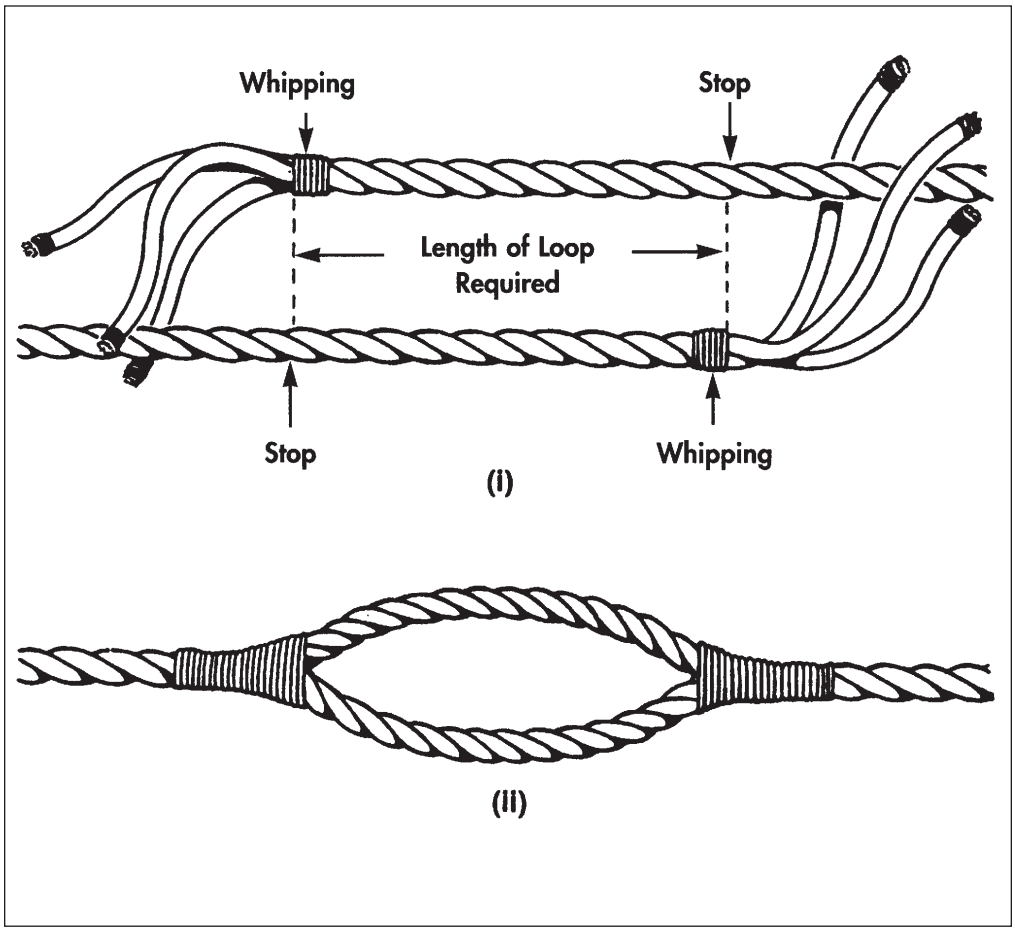

Figure 5.13-5 - Making a Cut Splice

5.13.7 Long Splice in Hawser-Laid Cordage (natural fibre cordage only)

This splice is used to join two ropes which are required to pass through a block. Provided the splice is well made, it will not increase the diameter or weaken the rope. It is possible to make a long splice in MMFC, but results are usually unsatisfactory. The principle of the long splice (Fig 5.13-6) differs radically from that of the short splice as follows:

(**1**) One strand from each rope is unlaid, and the corresponding strand of the other rope is given a twist and laid up in its place.

(**2**) The remaining strand from each rope remains at the marry, resulting in three pairs of strands spaced equidistantly along the married ropes.

(**3**) One third of the yarn is now taken out of all strands (not shown in (iv) and, though discarded, these yarns should not be cut off until the splice is completed).

(**4**) Each pair of strands is then tied in an overhand knot (left over right for a right-hand laid rope).

(**5**) Each strand is tucked over one strand and under the next, as for a short splice.

(**6**) Half of the yarns in each strand are now taken out and the remaining yarns tucked once more, to give a gradual taper (v).

(**7**) The splice is finished off by stretching it, hauling all ends taut (including the discarded yarns) and then cutting them off.

(**8**) To make a long splice, whip each rope at a distance from its end equal to 40 times the circumference of the rope.

(**9**) Then unlay the strands to the whipping and whip their ends.

(**10**) Marry the two ropes together, as in a short splice.

(**11**) Each strand unlaid as described above is followed up by the strand from the other rope which lies on its right in the marriage, so that H is unlaid and followed up by E, D is unlaid and followed up by F, and C and G remain at the marry. Each strand is unlaid until the length of the end of the strand following it up is reduced to 12 times the diameter of the rope.

(**12**) The splice is now finished off as described above.

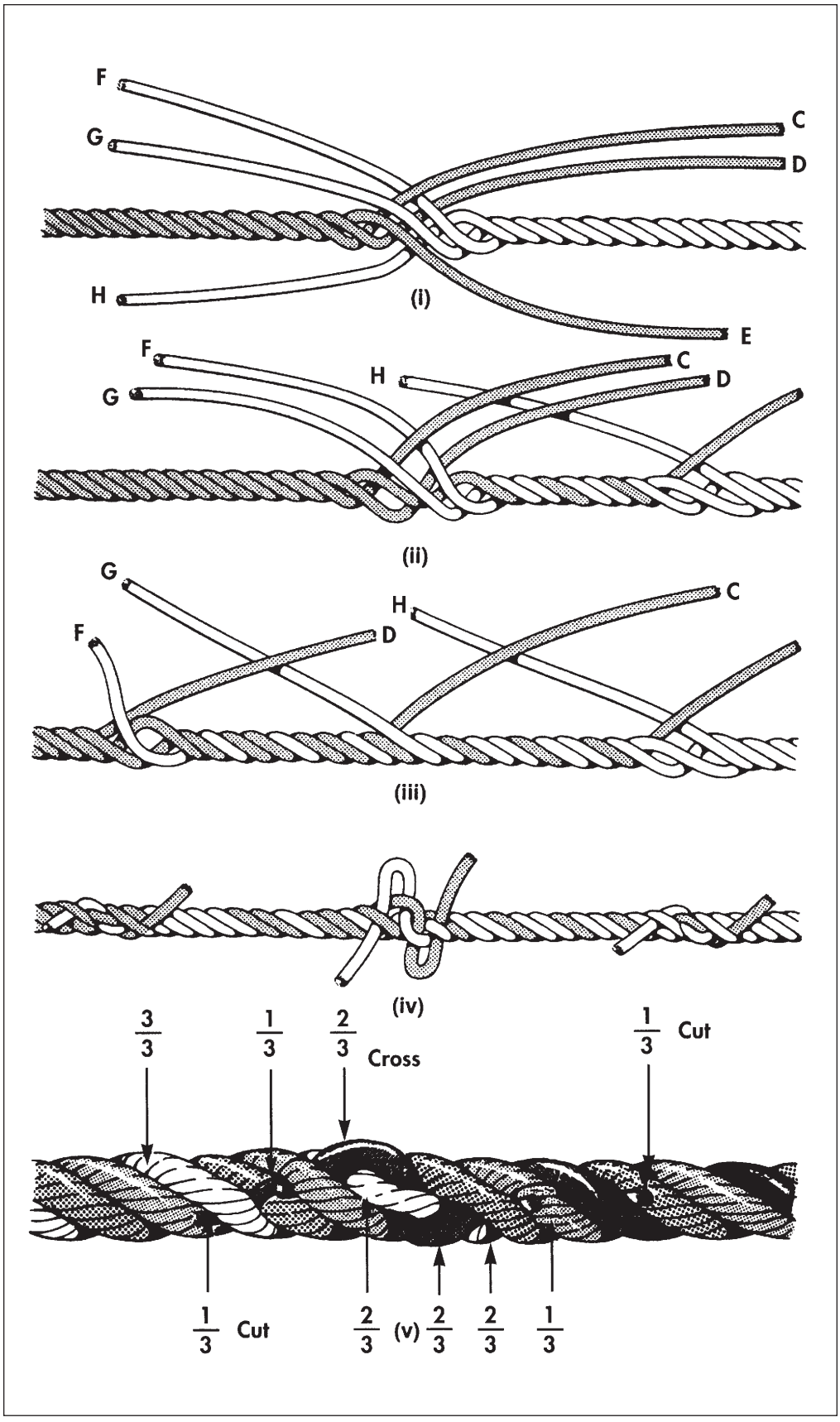

Figure 5.13-6 - Making a Long Splice

5.14 Construction, Characteristics and Details of Supply of Steel Wire Rope (SWR)

Improvements in the design and characteristics of MMFC and slings, and the need in ships to reduce top weight, limit noise and minimize interference to radar equipment has resulted in a reduction in recent years in the use of SWR throughout the fleet. However, SWR still has many applications aboard warships and this requirement is likely to remain in the foreseeable future.

5.14.1 Construction

a. A wire rope is constructed of a number of small wires which extend continuously throughout the entire length. These wires are laid up into strands, and the strands themselves are laid up to form the rope. With the exception of certain special types described later, all wire rope used at sea is preformed, has a galvanized finish, and consists of six strands. The wires forming a strand are laid up left-handed around a fibre or wire core and the strands forming the rope are laid up right-handed around a fibre main core.

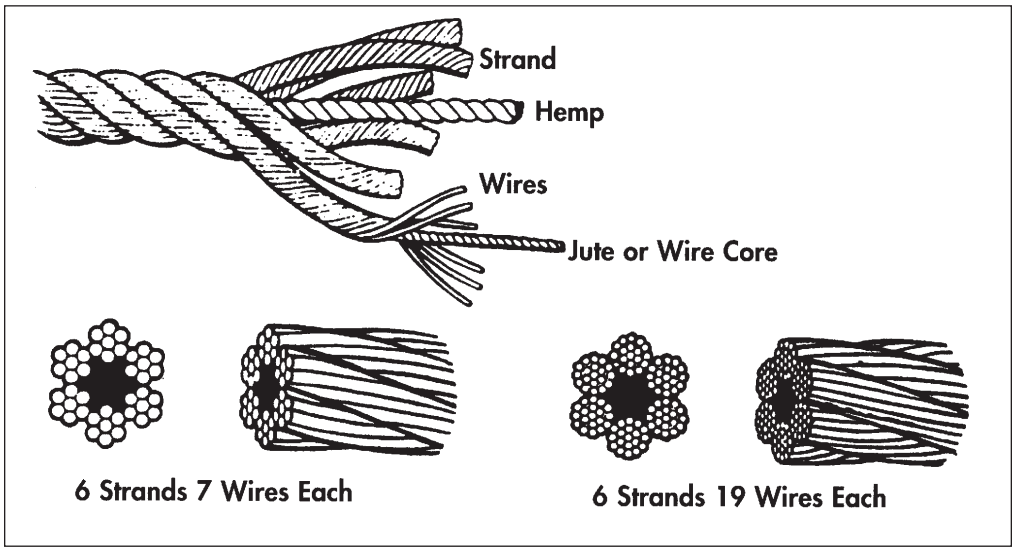

Figure 5.14-1 - Construction of a Wire Rope

b. During manufacture, the individual strands are preformed to give the exact spiral they take up in the completed rope. Therefore, the wires and strands lie in their true positions free from internal stress and will not spring out of place should the rope break or be cut. The main fibre core of a wire rope has two main functions:

(**1**) It acts as a cushion into which the strands bed, allowing them to take up their natural positions as the rope is bent or subjected to strain.

(**2**) It absorbs the lubricant with which the rope should be periodically dressed, so that as the rope is stretched or flexed the lubricant is squeezed between the wires, thus lubricating them and reducing the friction between them.

c. A wire rope can be made flexible in one of two ways:

(**1**) By replacing the centre wires of each strand with a large fibre core, in which case strength is sacrificed for flexibility.

(**2**) By making up each strand with a large number of small-gauge wires around a wire core in which case the full strength is retained.

5.14.2 Description

The full description of SWR states the diameter and construction of the rope followed by the construction of each strand in brackets, e.g., 24 mm 6 x 26 (15/9/Fibre) fibre-core SWR. This indicates a diameter of 24 mm, a construction of 6 strands around a central fibre main core, each strand constructed from 26 wires, 15 of which are laid up around 9 which in turn are laid up around a fibre (hemp/jute) core. In practice, a SWR is identified simply by quoting the size and rope construction only and omitting the strand construction, e.g., 24 mm 6 x 26 SWR. Wire used by the Canadian Navy is manufactured on the foregoing principles and falls into the following groups: 6 x 19, 6 x 25, and 6 x 37. The degree of flexibility improves as the number of wires in the strands increases.

5.14.3 Uses

a. **SWR (6 x 19, 6 x 25 and 6 x 37 construction).** This range of ropes has greater strength and flexibility and is used for standing and running rigging, and slinging and towing pendants. The strands are constructed of a number of small gauge wires made up around a fibre core.

b. **Non-Rotating Wire.** This type of wire rope (Fig 5.14-2) has its strands laid up in the same direction as that in which their constituent wires are twisted. All the wires and strands are small, and the inner strands are arranged so that the tendency of the rope to rotate under load is reduced to a minimum. It is very flexible and is particularly suitable as a whip for cranes and single point davits, where strength and non-unlaying action are essential. The wire requires very careful handling before and during installation. It has no tendency to twist either way but it is so pliable that turns either way can be imparted. When making fast the plain end to the side of the drum or crane structure, ensure that the entire cross section of the rope is firmly secured. At present, non-rotating wire rope whips are supplied as made-up items, details of which can be found in the manuals dealing with the maintenance and operating instructions for davits and cranes.

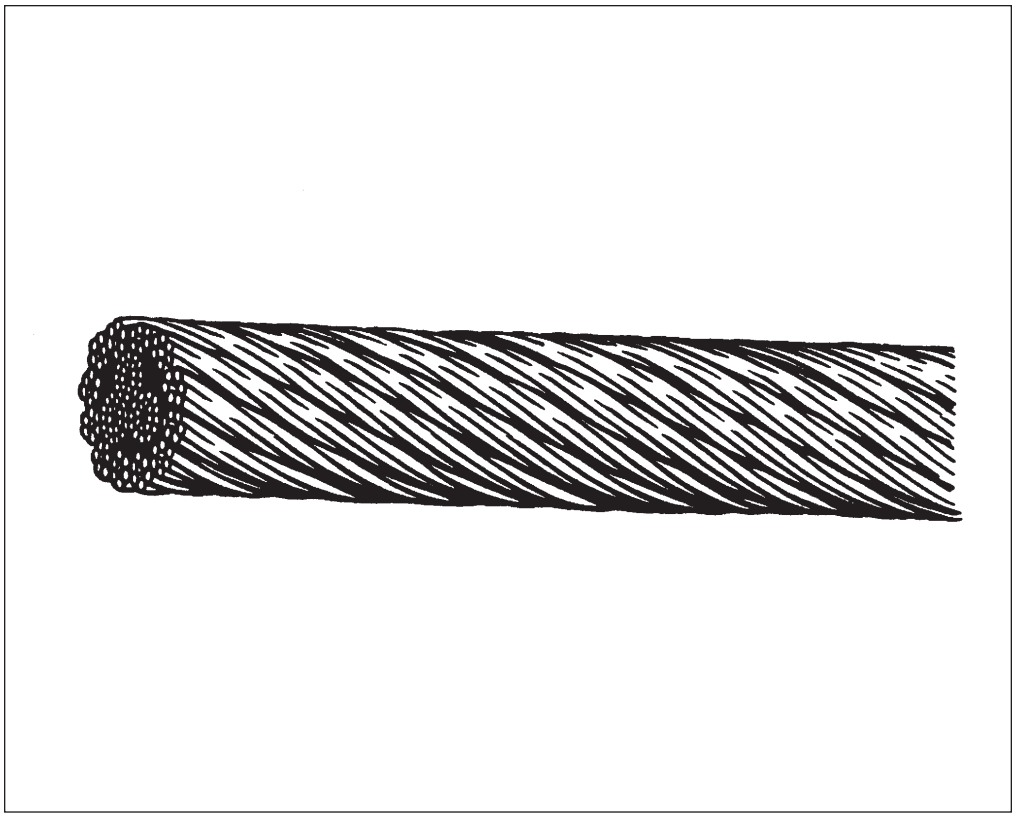

Figure 5.14-2 - Non-Rotating Wire Rope

5.14.4 Strength

The rule of thumb method of calculating the breaking strain of conventional SWR is to divide the square of the diameter by a known factor. Table 2 gives the approximate strength of new SWR according to its construction and its diameter (d) in mm. However, the test certificate supplied with the rope is the most accurate guide to the breaking strength.

Table 2 Formula for Calculating Approximate Breaking Strength of Conventional SWR

Construction	Range of Sizes	Breaking Load of Rope
6 x 19	3-8 mm	$d^2/17$ tonnes
6 x 25	10-12 mm	$d^2/17$ tonnes
6 x 37	14-28 mm	$d^2/17$ tonnes

5.15 Handling Of Wire Rope

Wire rope is much less resilient and, therefore, much less tractable than cordage. It resists being bent, does not absorb turns readily, is much more liable to kinking and snarling, and tends to spring out of a coil, or off a drum or bollard. However, if handled correctly, it can be used for most of the purposes to which cordage is put, but bends and hitches should not be made in it.

5.15.1 Kinking and Crippling

Because of its construction and comparative lack of flexibility, wire rope requires more care in handling than cordage; if carelessly handled, it may suffer serious damage through kinking and crippling.

a. **Kinking.** Any loop or turn in a wire rope can all too easily be pulled into a kink which permanently damages it. If a kink is seen to be about to develop, it should be removed as indicated in Fig 5.15-1, and no attempt should be made to pull it out in the manner shown in Fig 5.15-2.

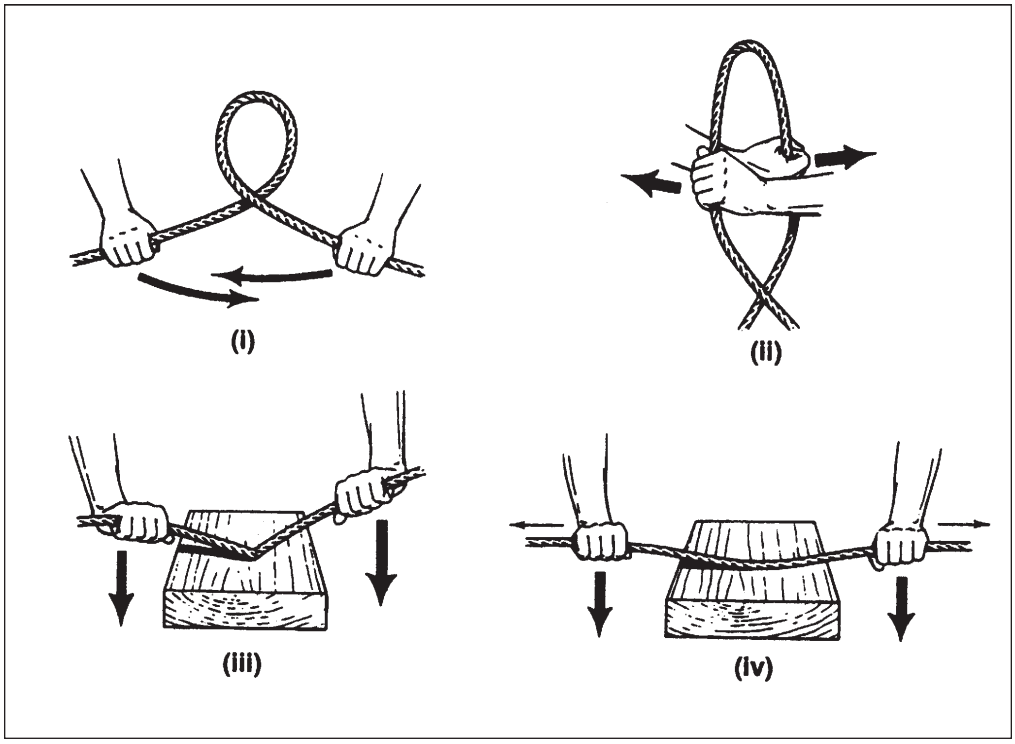

Figure 5.15-1 - Right Way to Remove a Kink in Wire Rope

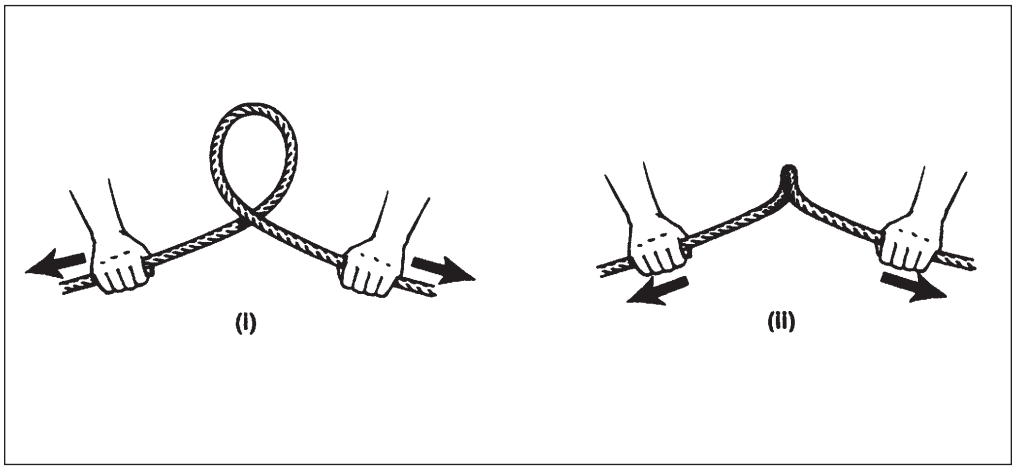

Figure 5.15-2 - Wrong Way to Remove a Kink in Wire Rope

b. **Crippling (bad nips).** If a wire rope is bent at too acute an angle or led over a sharp edge, it will be seriously damaged by distortion of its strands which may result in a permanent kink or even in the rope parting. A rope so led is said to form a bad nip and this results in it being crippled. To freshen the nip is to veer or heave in a short length of rope that is under strain so as to bring a fresh portion of the rope to take the chafe where it passes through fairleads or around bollards. To prevent crippling, a wire rope which will come under strain should never be led through a shackle or eye plate to alter the direction of its lead. In addition, it should not be around a bollard or drum of a diameter less than 13 times the diameter of the rope. If it has to run through a block, the diameter of the sheaves should be at least 20 times the diameter of the rope.

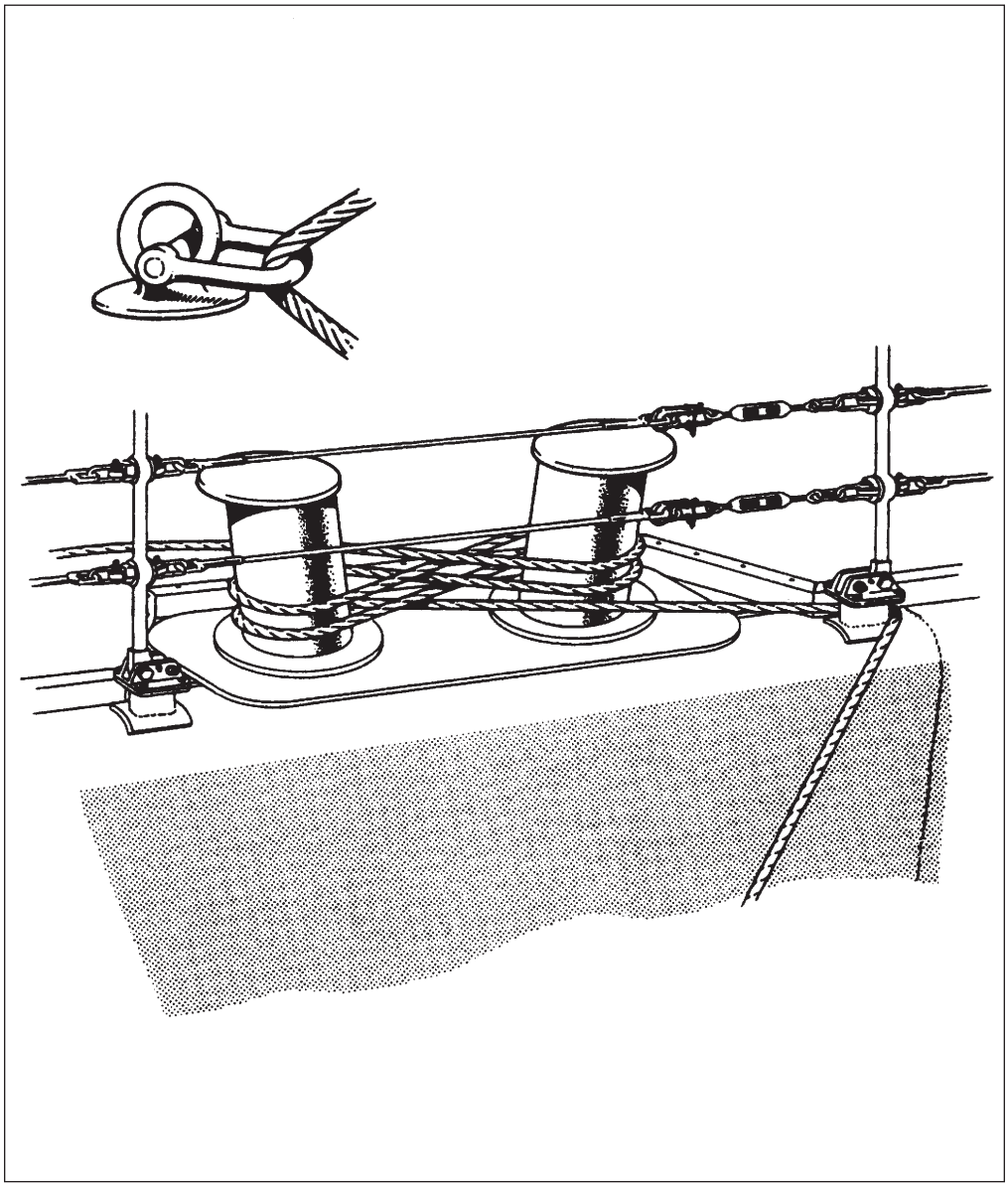

Figure 5.15-3 - Examples of Bad Nips (Leads)

5.15.2 Coiling and Uncoiling

Wire rope, especially long lengths of it, should be stowed on reels, but where this is not practical, it must be coiled down. Wire rope is less able to absorb turns than fibre rope. When coiling down, it is therefore all the more necessary to have the uncoiled length free to revolve. Where this is impossible, an alternative is to use left-handed loops, called Frenchmen, in the coil (Fig 5.15-4). These Frenchmen serve to counteract the twists put in by coiling down right-handed. Frenchmen are also necessary when coiling down a wire rope of which some portions have contracted a left-hand set (as will occur when a rope belayed left-handed round a bollard has been subjected to strain). Such portions will resist being coiled right-handed and each loop must be allowed to become a Frenchman. It is wise to stand clear when rope is being hauled off a coil containing Frenchmen as such turns are very likely to jump off. A coil of wire rope should always be well stopped to prevent the coils from springing out of place.

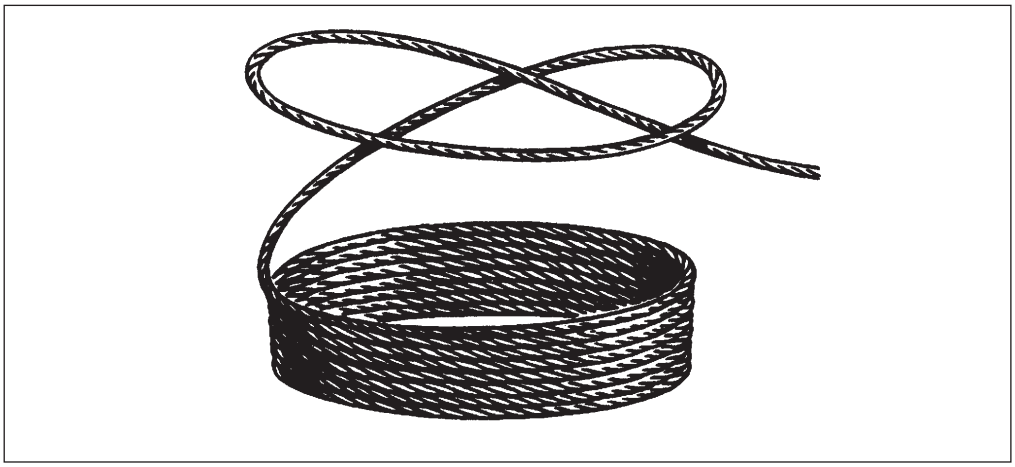

Figure 5.15-4 - A 'Frenchman'

The best way to run out a coiled down wire is shown in Fig 5.15-5.

Figure 5.15-5 - Running Out a Coiled Down Wire

5.15.3 Handling New SWR

a. **To unreel or uncoil a new rope:**

(**1**) New wire ropes are supplied either in machine-wound coils or on cable drums (reels). They must be taken off the coils or drums in the correct manner or kinks will quickly develop. A small coil can be rolled along the deck, but if space does not permit, or the rope is heavy, place the coil on a turntable and lash down two strong battens crosswise on the top of the coil (Fig 5.15-6). This will prevent the rope from springing up over the top of the coil and kinking. Then cut the stops, and haul the rope off the coil as it rotates on the turntable.

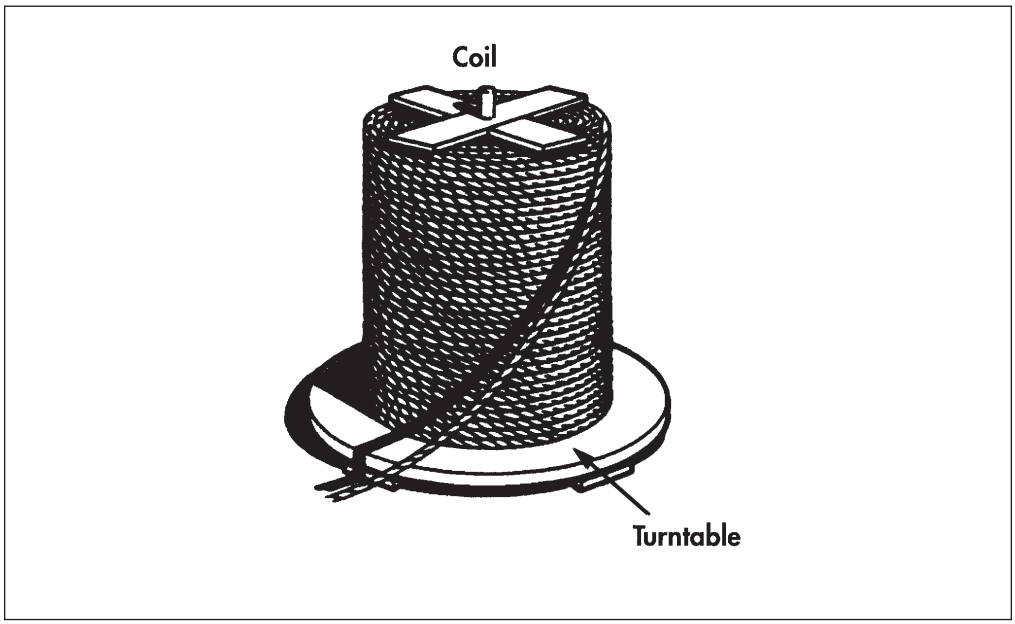

Figure 5.15-6 - Uncoiling a New Wire Rope

(**2**) To unreel the rope from a drum, pass a shaft through the drum and support the shaft at either end, thus allowing the drum to revolve. Then cut the outer stops and unreel the rope off the drum (Fig 5.15-7). To coil down a small rope from a drum, up-end the drum as shown in Fig 5.15-8 and lap the rope off the top of the drum, lapping off each turn anti-clockwise. The twist put in the rope as each turn is lapped off is cancelled automatically by coiling the rope down clockwise.

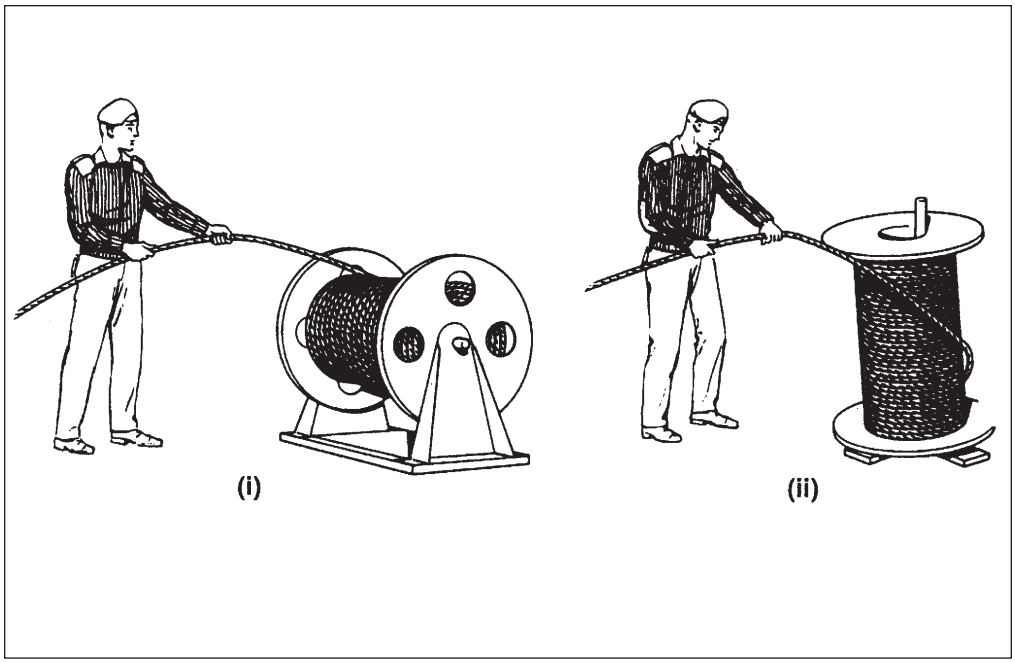

Figure 5.15-7 - Unreeling a New Wire Rope

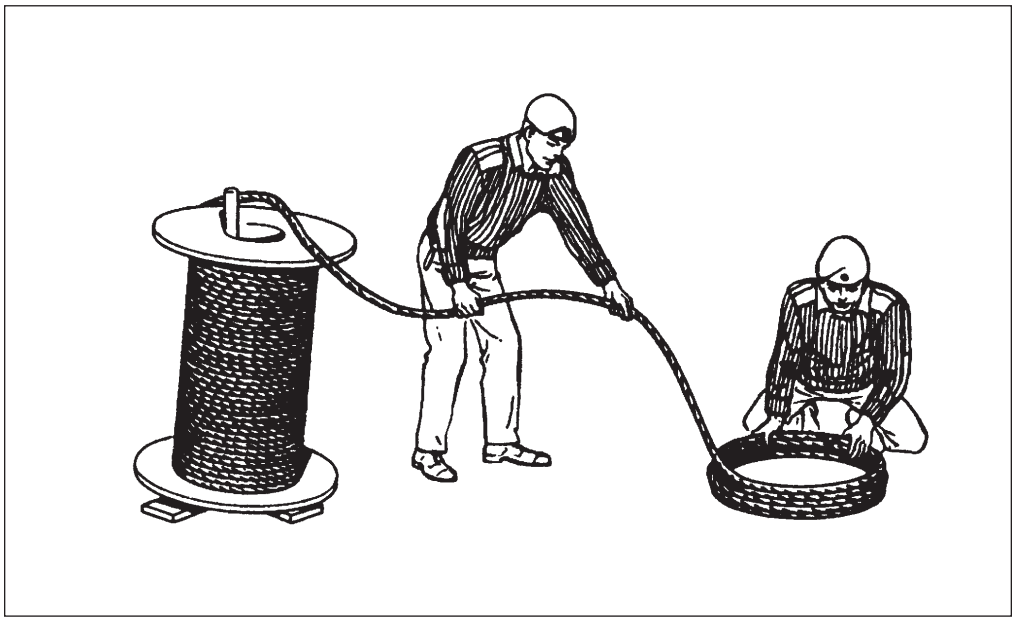

Figure 5.15-8 - Lapping Off and Coiling Down a Small Wire Rope

b. **To cut off a length of wire rope.** The rope should be very firmly whipped about 25 mm on each side of the position at which it is to be cut, and then placed on the top of a bollard or similar hard surface. The strands should then be cut with a hammer and cold chisel or with a wire-cutter. Whenever a length of rope is cut off a coil or a drum, the coil or drum should be clearly marked, indicating either the length cut off or the length remaining.

5.15.4 Care and Maintenance of SWR

a. Wire ropes have a lubricant incorporated during manufacture. This serves a dual purpose; it provides corrosion protection and also minimizes internal friction. The protection provided by this manufacturing lubricant is normally adequate in preventing deterioration due to corrosion during the early part of a rope's life. However, the lubricant applied during manufacture must be supplemented by lubrication in service. This service lubricant is called dressing. The kind of dressing used and the frequency of application varies with the type of rope and its usage. Details of the maintenance of SWR carried by, or fitted in, HMC ships is laid down in the Ship's Maintenance Management Information System (SMMIS).

b. Wire hawsers should be stowed on reels under a fitted cover whenever possible. When being reeled in or otherwise stowed, the surface of a wire hawser should be washed with fresh water to free it from salt, then dried with cloths and lightly smeared with the appropriate lubricant.

5.15.5 Inspecting SWR

SWR carried or fitted in HMC ships must be inspected periodically in accordance with the NAMMS system. When inspecting, the indications described below should be sought:

a. **Distortion of Strands.** This is the result of damage by kinking, crushing, serious crippling round a bad nip, or other mistreatment. If likely to cause the strands to bear unequal stresses, they must be considered as reducing the strength of the rope by 30 percent. Should they be sufficiently serious to cause the heart to protrude, the rope must be discarded. A crushed rope may be restored to some extent by the careful use of a mallet.

b. **Flattening of Some of the Outer Wires by Abrasion.** These flats are easily seen because the abrasion gives the flattened wires a bright and polished appearance. However, they do not affect the strength of the rope unless they are very pronounced. Flats which extend to three-quarters of the diameter of the wires will reduce their cross sections and, therefore, reduce their individual strengths by 10 percent. As only a limited number of wires will be affected, the loss in strength of the whole rope will be very small. (These flats must not be confused with flattening of the whole rope which indicates distortion of the strands and is, therefore, much more serious.)

c. **Broken Wires.** These are usually the result of fatigue and wear, and mostly occur in crane wires. It is generally accepted that a wire rope is coming to the end of its useful life when one wire of any strand breaks. To deal with a broken wire, grip the broken end with a pair of pliers and bend the wire backwards

and forwards until the wire breaks inside the rope between the strands where it can do no harm. A rope should be discarded if more than 5 percent of its wires are broken in a length equal to 10 times the diameter of the rope. For example, a 24 mm diameter, 6 x 24 wire rope should be discarded if seven broken wires are found in a length of 240 mm. Because of the danger to handlers, berthing wires should be discarded if any broken wires are discovered.

d. **Corrosion.** Wire rope can be corroded by:

(**1**) The action of dampness on the wires from which the galvanizing has worn off. If this happens to the inner wires first, it causes rust to fall out of the rope and is therefore easily detected.

(**2**) The action of fumes and funnel gases, which attack the outside wires. The effect then becomes visible on inspection.

(**3**) Contact with acid, which soaks into the heart and attacks the inside wires. This is not necessarily noticeable on the outside of the rope and can be the cause of parting without warning.

(**4**) Lack of lubrication. This is a frequent cause of corrosion. When a wire rope is under tension it stretches and becomes thinner, and during this process the individual wires are compressed and friction is set up. The fibre heart and cores are also compressed, releasing oil to overcome the friction. A wire rope of outwardly good appearance but with a dry powdery heart or core has not been properly maintained and should be treated with caution.

e. **Effect of Extreme Cold.** When subjected to extreme cold, a wire rope may become brittle and lose its flexibility, and an apparently sound rope may part without warning. The brittleness is not permanent and the rope will regain its resilience in a normal temperature, but the potential danger should be remembered when working wires in very cold climates.

5.15.6 Testing of SWR

The wire from which the rope is to be made is tested before manufacture of the rope to ensure it complies with the relevant standards and specifications with regard to tensile strength, torsion and galvanizing properties. After manufacture of each production length of rope, test samples are cut from the finished rope and strand. These samples are used for a tensile test to destruction, tests of rope performance, and tests on a mixture of the individual wires with regard to diameter, tensile strength, torsion and quality of galvanizing. Each coil of wire is accompanied by a certificate of conformity and a test certificate showing the guaranteed minimum breaking strength of the wire when new.

5.16 General Remarks about SWR

5.16.1 How to Measure the Size of a Rope

The size of a wire rope is the diameter in mm of a true circle which will just enclose all the strands (Fig 5.16-1). Measure at each of three places at least 2 m apart. The average of these measurements is to be taken as the diameter of the rope.

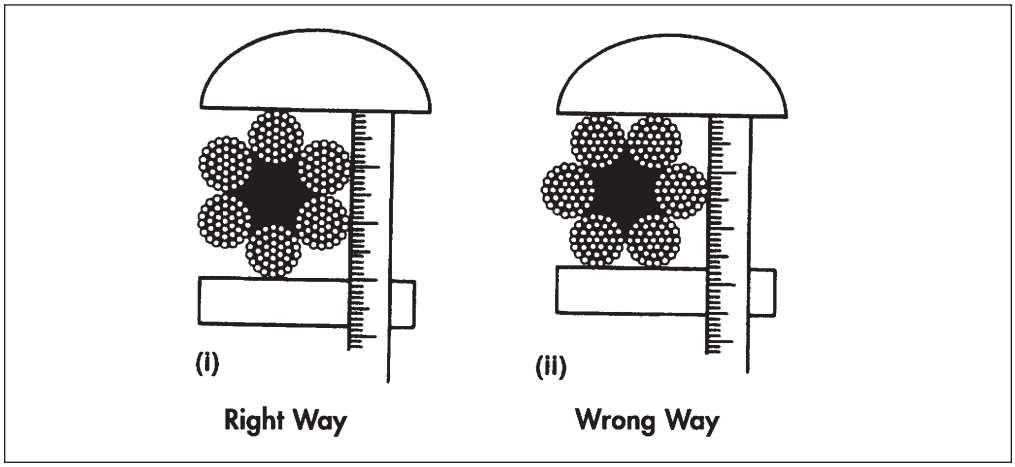

Figure 5.16-1 - How to Measure the Diameter of a Rope

5.16.2 Sheaves for Wire Rope

a. **Size of Sheave Required for a Wire Rope Hoist.** The diameter of sheave required for each type of six-strand wire rope supplied to the Canadian Navy should be at least twenty times the diameter of the wire. The diameter of a sheave used for any wire rope will considerably affect the life of that rope. As the rope bends around a sheave, the strands and wires farthest from the centre of curvature move apart and those nearest the centre of curvature move closer together. This results in the generation of considerable friction between these wires and strands, and the smaller the sheave the greater will be the friction. Friction also increases rapidly with the speed at which the rope is moving. While the rope is bent around a sheave, the outer wires are also subjected to a marked additional stress, and the smaller the diameter of the sheave, the greater will be the stress. For these reasons the minimum diameters of sheaves recommended from practical experience for various types of ropes at speeds not exceeding 60 m per minute are 20 times the diameters of the ropes. For each increase in speed of 30 m per minute, 5 percent must be added to these figures. This will give a rope a reasonable life, but it is emphasized that its life will be greatly increased if still larger sheaves are used. Similarly, if a smaller sheave than that recommended has to be accepted, it will shorten the life of the rope. On no account should a sheave be used that is more than 20 percent smaller than that determined by reference to the above criteria.

b. **Use of Correct Sheave.** The life of a rope used for hoisting can also be considerably shortened by using the wrong type of sheave. The groove in the sheave must fit and support the rope as it travels around the sheave. Otherwise, there will be increased internal friction and external wear. Fig 5.16-2 (i) shows a sheave with too wide a groove, resulting in a flattening of the rope and considerable distortion and internal friction. Fig 5.16-2 (ii) shows a sheave with too narrow a groove, resulting in the rope not being supported, the wires of the strands being subjected to considerable wear, and friction being set up between the rope and the sides of the groove. The groove of the correct sheave should be shaped in cross section to the true arc of a circle for a distance equal to one-third of the circumference of the rope. The radius of the groove should be between 5 to 10 percent greater than the specified radius of the rope (Fig 5.16-3).

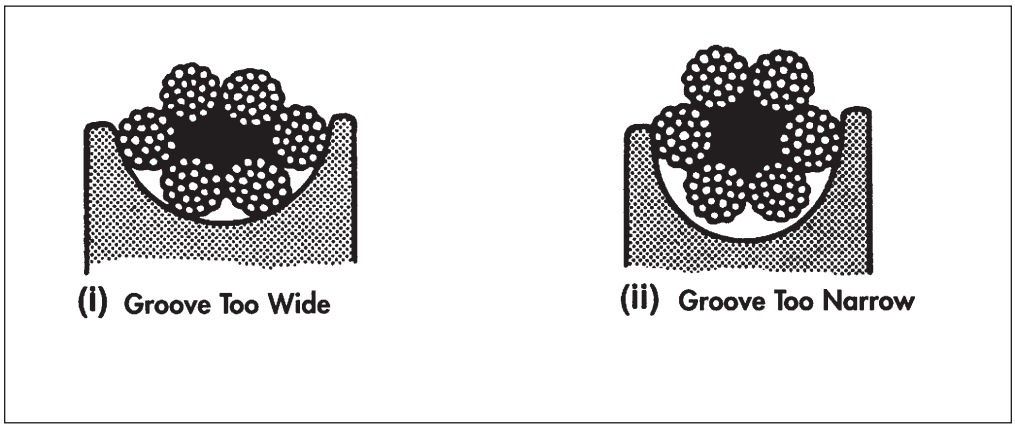

Figure 5.16-2 - Incorrect Sheaves

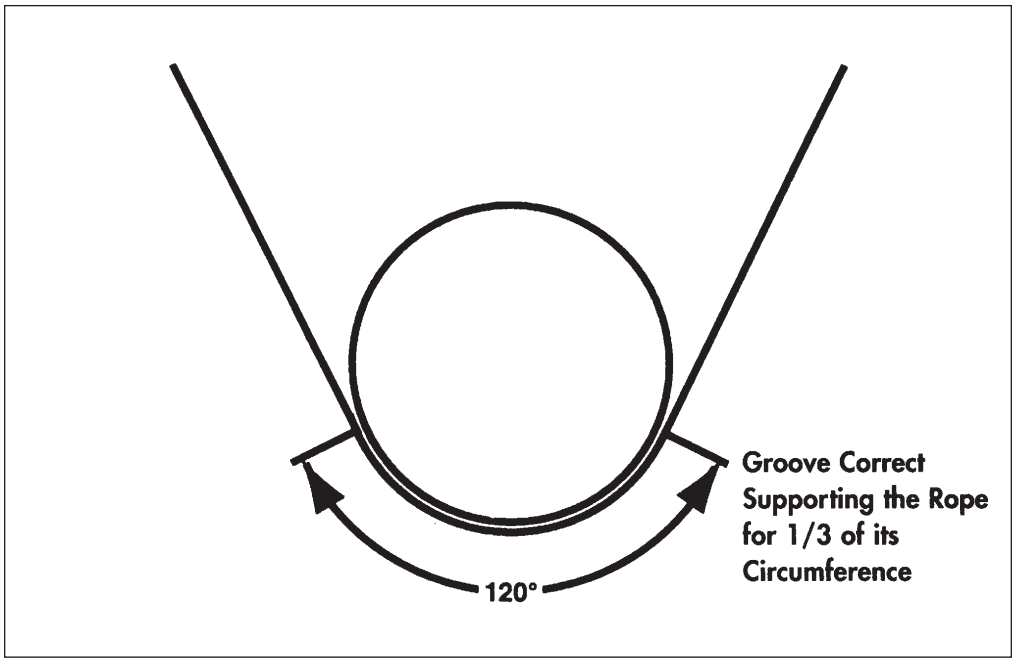

Figure 5.16-3 - Correct Sheave

5.17 Splicing Wire Rope

a. The dockyard splice is the only splice accepted for use in the Canadian Navy at the present time. To prepare the wire and first tuck, proceed as follows:

(**1**) Put a whipping on the wire at a distance equal to 4 cm from the end of the wire for every mm of diameter of the wire. For example, a 28 mm diameter wire would require a whipping 1.1 m from the bitter end. The whipping length should be equal to the diameter of the wire and should be applied to the wire with a serving mallet.

(**2**) Unlay the wire from the end to the whipping, wiping off the strands and taping the ends of each strand.

(**3**) Form the eye to the desired size and secure the eye in a vise. Cut the heart out from between the strands at the seizing if it is a wire heart, or tuck the heart when tucking the No. 2 strand and cut it off.

(**4**) Insert the spike from the back of the wire, picking up two strands, and emerging to the left of centre inside the wire. Tuck No. 1 against the lay.

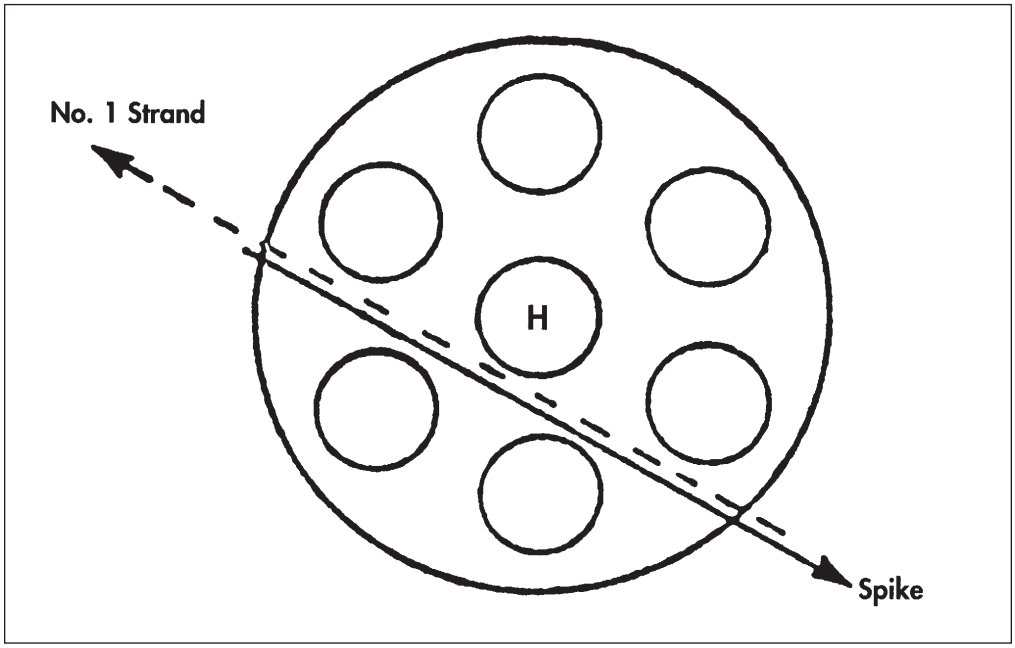

Figure 5.17-1 - Dockyard (DKYD) Splice

(**5**) Move to the right one strand and pick up three strands, tucking No. 2 wire with the lay. Ensure that the core is to the right.

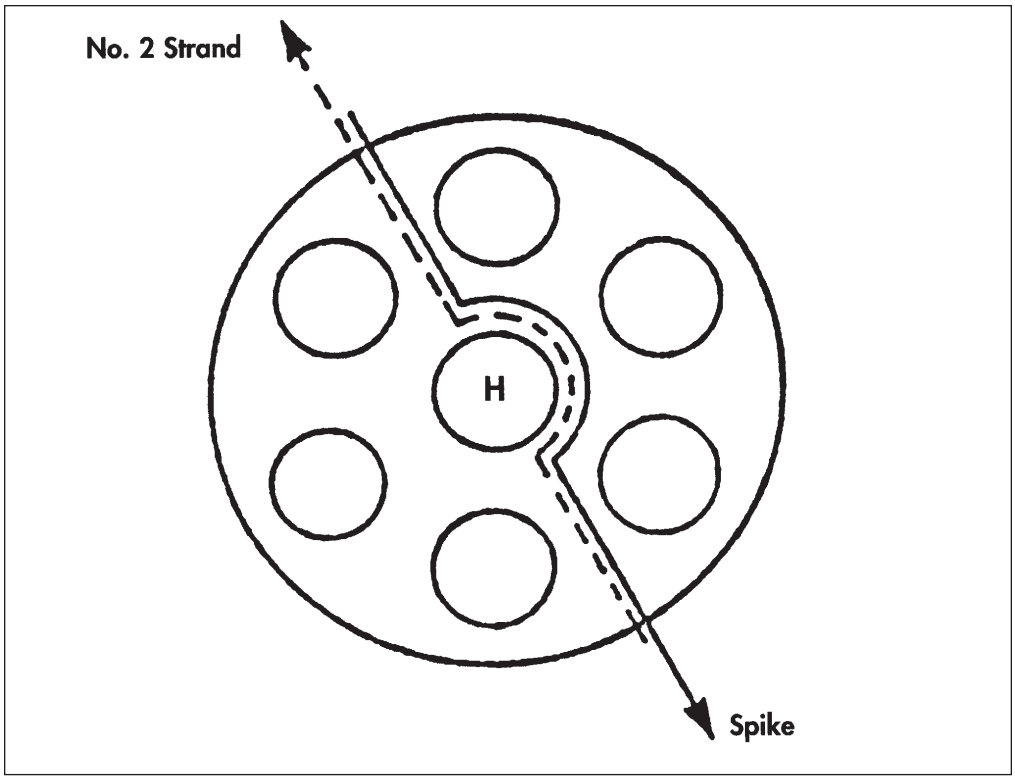

Figure 5.17-2 - DKYD Splice

(**6**) Continue to move the spike in a clockwise direction, pick up two strands and tuck No. 3 wire.

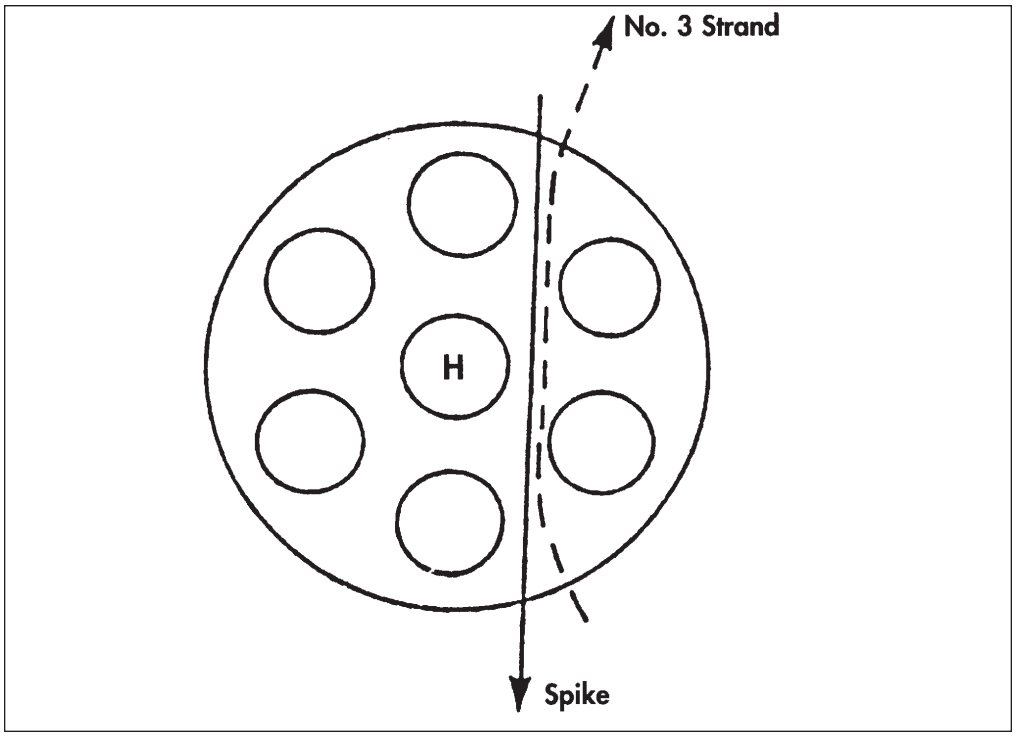

Figure 5.17-3 - DKYD Splice

(**7**) Continue clockwise, pick up one strand and tuck wire No. 4.

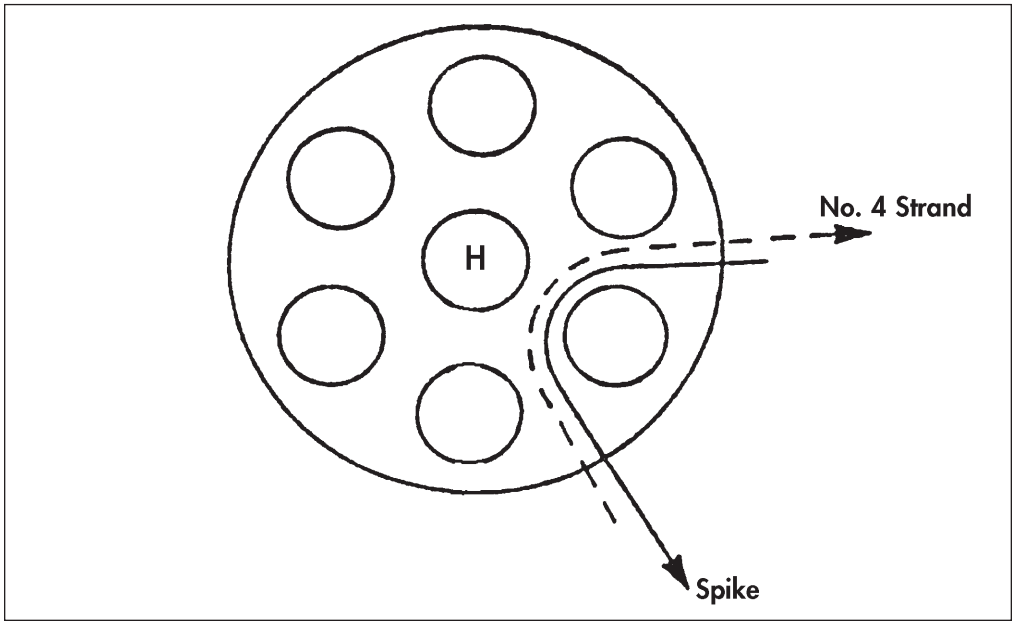

Figure 5.17-4 - DKYD Splice

(**8**) Move clockwise again and place the spike under the next wire so that No. 5 will enter to the left of the strand and will come out where 1, 2, 3 and 4 enter.

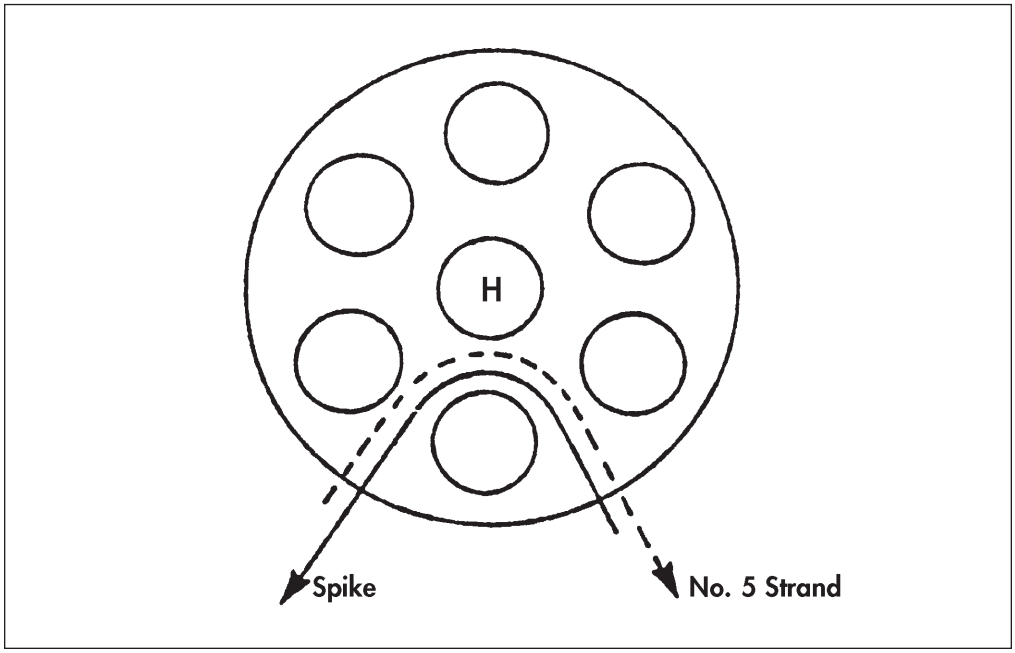

Figure 5.17-5 - DKYD Splice

(**9**) Move clockwise again and pick up one strand so No. 6 enters the wire on the left and comes out where No. 5 goes in.

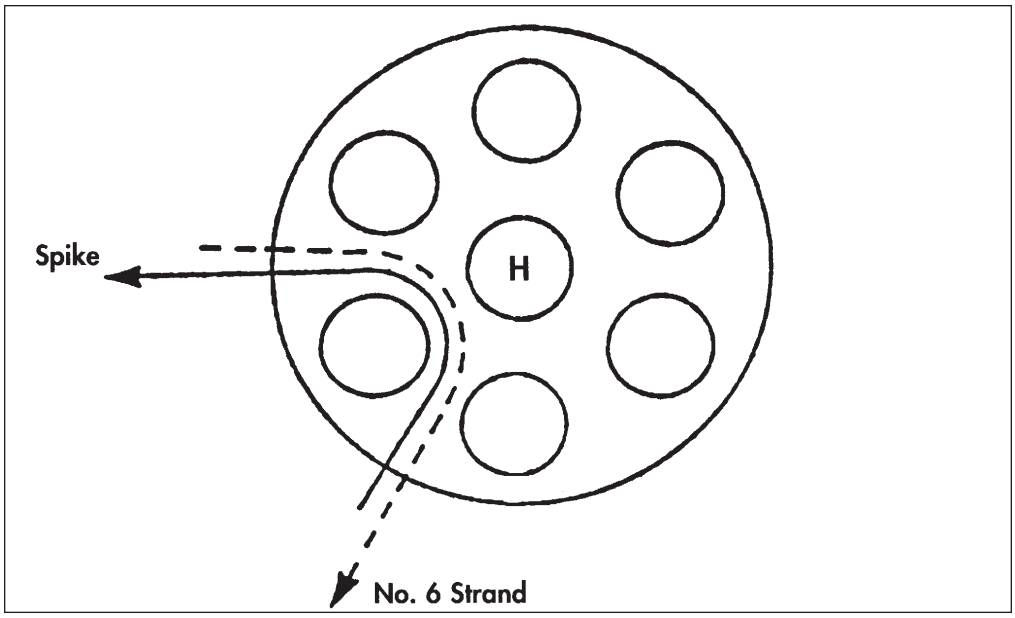

Figure 5.17-6 - DKYD Splice

(**10**) Now enter the hole as you did for wire No. 6 and pick up two strands tucking No. 1 wire with No. 6 wire.

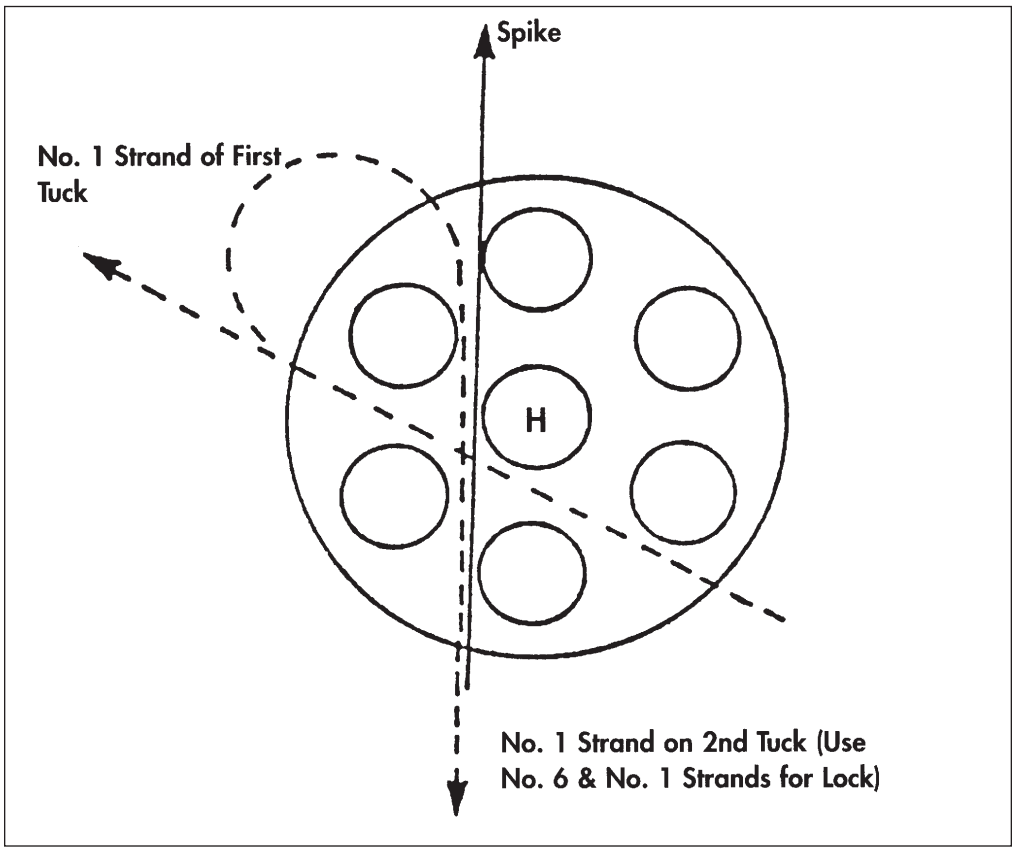

Figure 5.17-7 - DKYD Splice

(**11**) Pick up two more strands and tuck No. 2 wire.
(**12**) Repeat the above steps with wires No. 3, 4 and 5.
(**13**) Pick up two wires and cross wire No. 6 and wire No. 1, tucking the bottom wire (No. 6) around and over.
(**14**) Pick up two more strands and tuck No. 2 wire.
(**15**) Repeat Steps 12 through 14 two more times.
(**16**) Taper by tucking wires No. 1, 3 and 5, picking up two strands (one on either side of the wire).
(**17**) The splice is now complete.
(**18**) Round the splice in a vise, cut off the excess strands and serve.

b. To form the wire around a thimble, complete the following steps:

(**1**) Find the point of the wire that will lie at the crown of the thimble.
(**2**) Seize the wire firmly at the crown to secure the thimble.
(**3**) Pull the rope to form a "U" as close around the thimble as possible.
(**4**) Cross the parts of the wire until they close the throat of the thimble.
(**5**) Seize the wires at the cross over point.
(**6**) Uncross the parts of wire and lay them side by side.
(**7**) Put two shoulder seizings on either side of the throat of the thimble, ensuring that the thimble fits snugly.
(**8**) Prepare and splice the wire as for a soft eye splice.

Note:

Wire splicing carried out in HMC ships is to be done when emergency repairs are necessary. When the ship has returned to home port, a work order will have to be raised to replace the splice with a tested mechanical splice.

5.18 Mechanical Splicing

Mechanical splicing carried out under various trade names is carried out by dockyard rigging shops and commercially under contract. The splice gives comparable strength to a hand splice and has the following advantages: it uses less wire, requires no worming, parcelling and serving, and is completed in less time. In the Canadian Navy, it has superseded the hand splice. The mechanical splice must be tested and marked with the safe working load prior to use.

5.19 Shackles

Shackles come in a variety of shapes and sizes. Shackles are used in standing and running rigging for securing the end of a wire or rope. They are also used for connecting lengths of anchor cable together. The size of a shackle is measured in inches or mm, using the diameter of the metal at the crown. Because of their

shape, a straight shackle is stronger than a bow shackle of equal size. The Safe Working Load (SWL) is stamped on all shackles. Screw shackles should be moused to keep the bolt from turning out.

5.19.1 Parts of a Shackle

The ends of a shackle are called the lugs, the space between them is called the jaw, and the part opposite the jaw is the crown. The inside width or length of a shackle is called the clear. The jaw is closed by a removable bolt which passes through a hole in each lug. Shackles are usually named by reference to the manner in which their bolts are secured in place.

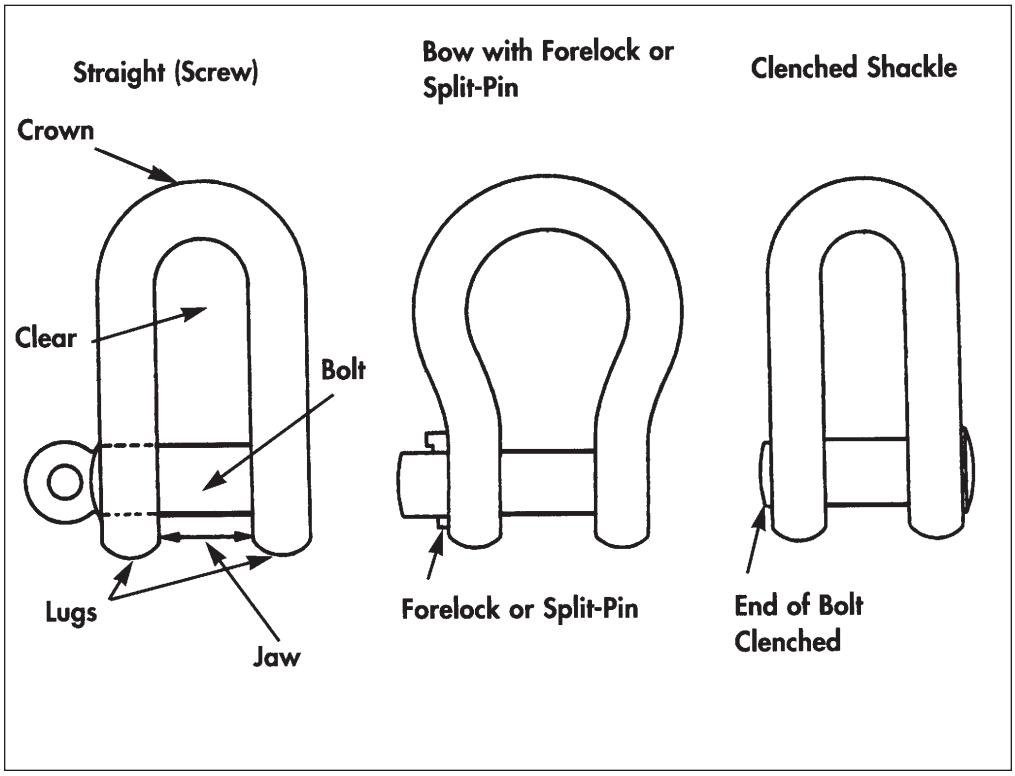

Figure 5.19-1 - Types and Parts of Shackles

5.19.2 Types of Shackles

a. **Screw Shackle.** May be a bow or straight shackle. The end of the bolt is screwed into one of the lugs, and the bolt is fitted with a flange at its head. This type of bolt should be moused.

b. **Forelock Shackle and Split-Pin Shackle.** These shackles may be bow or straight shackles. The end of the bolt projects beyond one of the lugs and has a flat tapered split-pin (forelock) or cotter pin passed through the hole in the end of the bolt. The split pin or cotter pin may by attached to the shackle by a keep chain.

c. **Pin and Pellet Shackle.** A tapered hole is drilled through one of the lugs and the end of the bolt. The bolt is secured in place by a tapered pin being driven into the hole, and held in place by a lead pellet hammered into the mouth of the hole over the head of the pin. This very secure method of locking the shackle bolt is a common arrangement on shackles that are part of the anchor and cable arrangement.

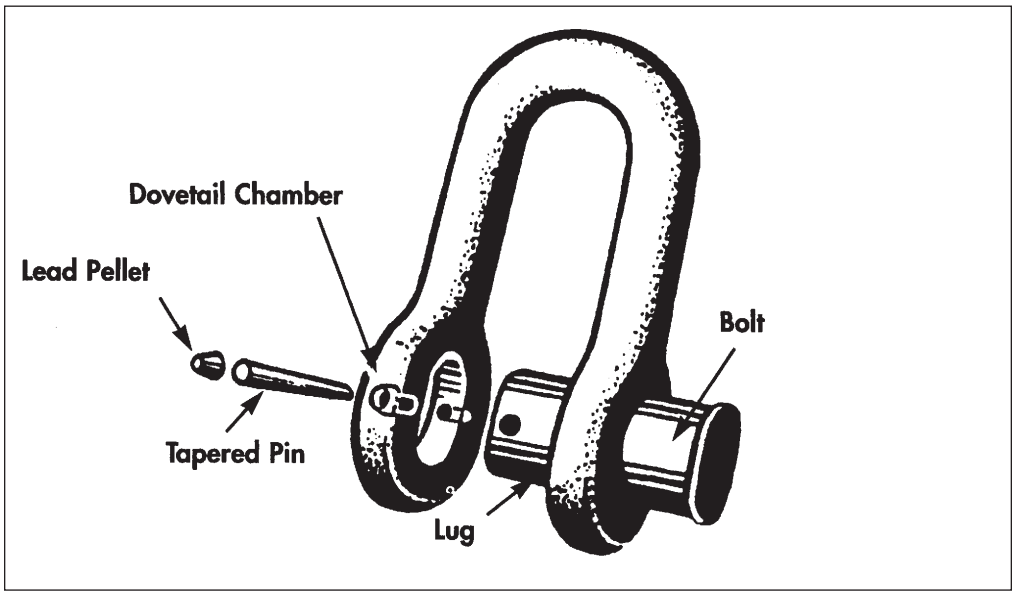

Figure 5.19-2 - Pin and Pellet Shackle

d. **Safety Shackle.** These shackles have a threaded bolt. A nut is fastened on the end of the bolt after it is passed through the lugs. A hole is drilled through the bolt or through the bolt and nut and secured in place with a cotter pin.

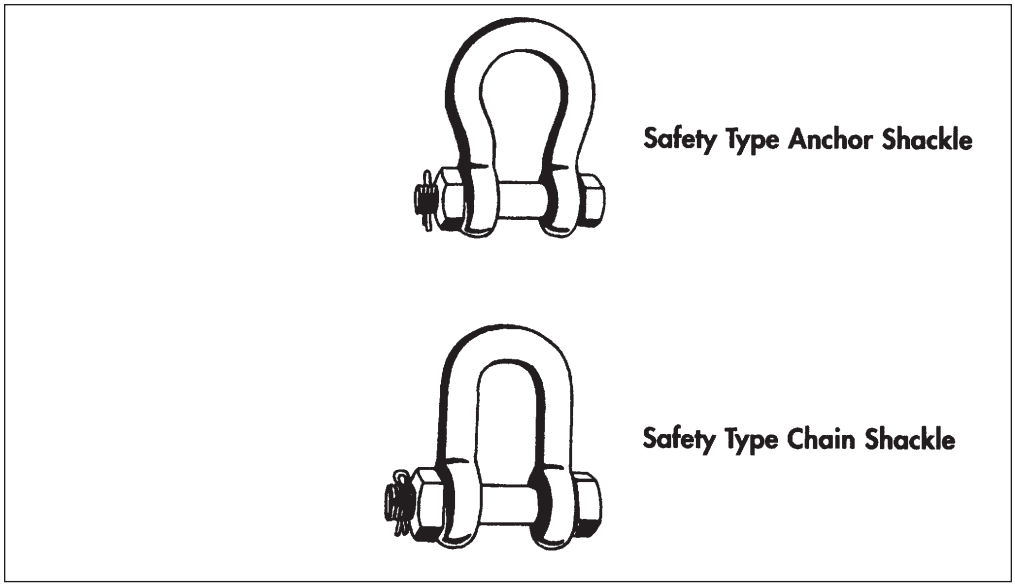

Figure 5.19-3 - Safety Shackle

e. **Roller Shackle.** These shackles are used when rigging awnings. They are placed over the hook on the awning stanchion and a wire is shackled to the awning, passed through the roller shackle and hooked onto a block and tackle.

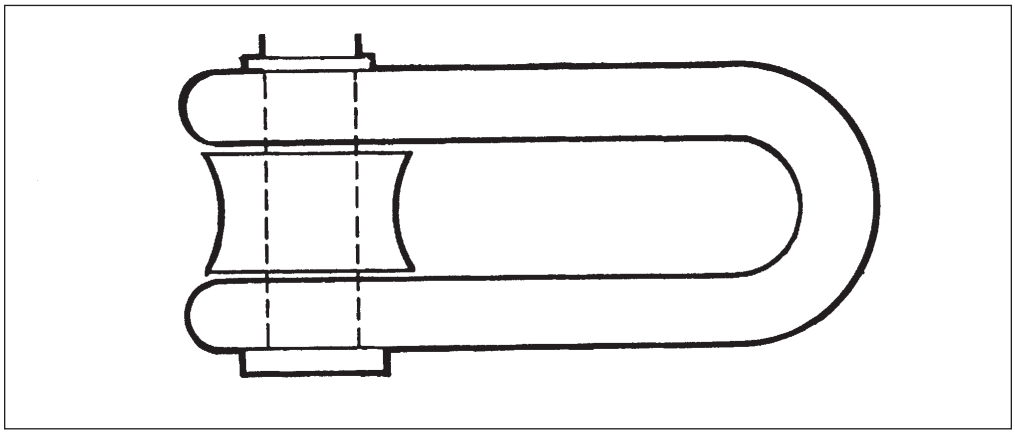

Figure 5.19-4 - Roller Shackle

5.20 Thimbles

Thimbles are classified according to the diameter of the rope for which they are intended and their shape. When an eye splice is formed in the end of wire or rope, a thimble is inserted to take the chafe of a shackle or shackle bolt and also to support the eye formed in the rope. The support given by the thimble prevents a bad nip in the rope when under tension

5.20.1 Types of Thimbles

a. **Heart-Shaped Thimbles.** These are the most commonly used thimbles for forming a hard eye or hawser eye in the end of a rope or wire.

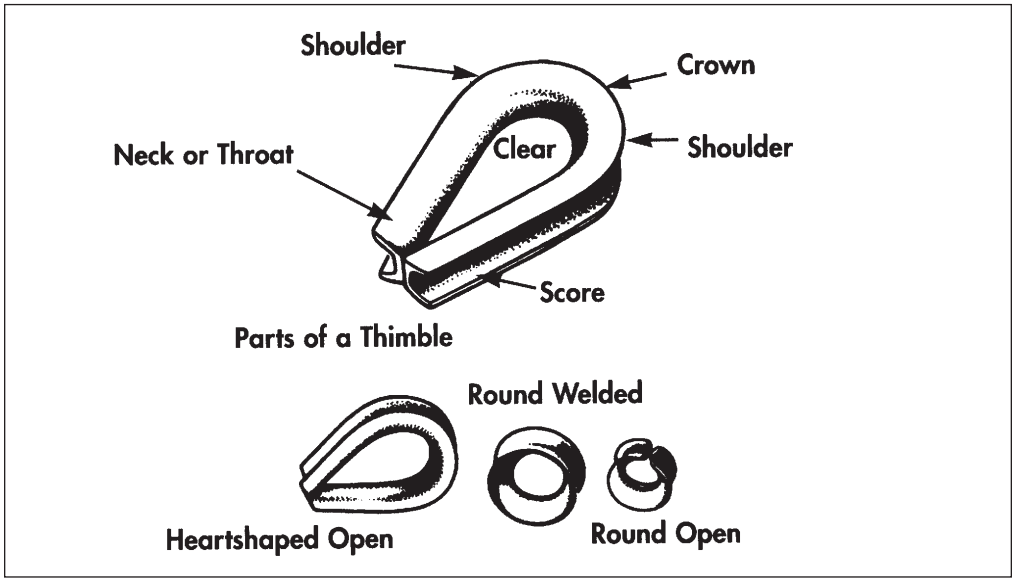

Figure 5.20-1 - Types and Parts of Thimbles

b. **Round Thimble.** These are used when it is necessary to insert something in the eye; for example, the wire grommet at the end of the jackstay, the eye at the tail of a block or the ends of manropes on lifelines.

c. **NEWCO Thimble.** These thimbles are used when splicing braided line. They are most commonly used in the ends of towing hawsers.

Figure 5.20-2 - NEWCO Thimble

5.21 Common Rings

Common rings are available in various shapes and sizes. The most common are round, oval and pear-shaped rings.

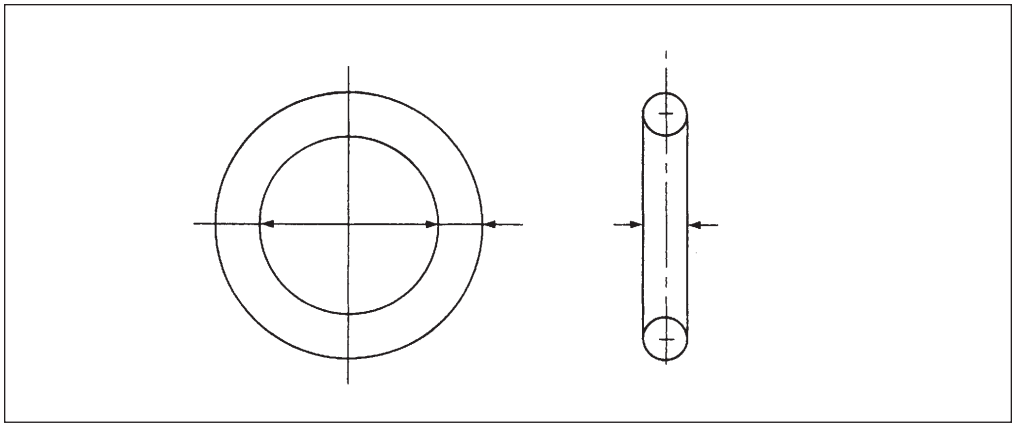

Figure 5.21-1 - Round Ring

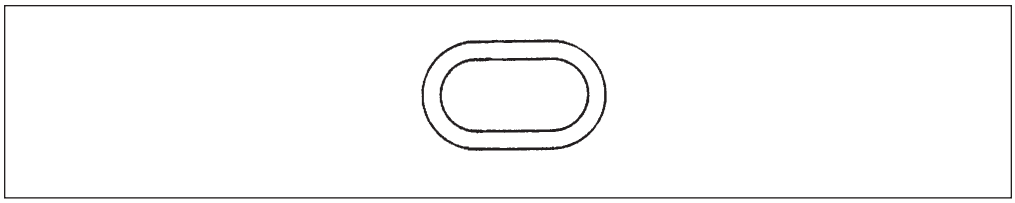

Figure 5.21-2 - Oval Ring

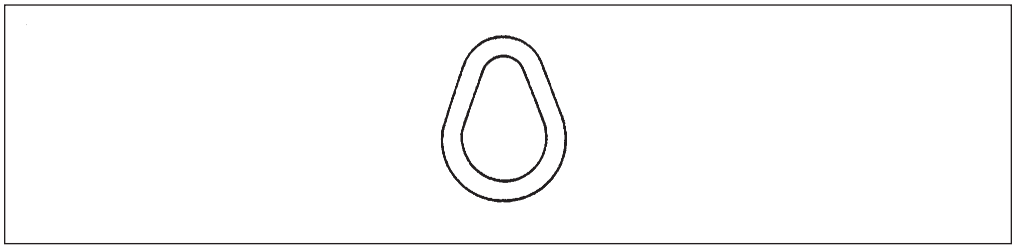

Figure 5.21-3 - Pear-Shaped Ring

5.22 Hooks

There are two basic types of hooks in use today in the Canadian Navy: the tackle hook and the spring hook. The spring hook is becoming the most accepted hook as it requires no mousing. The parts of the hook are the eye which is shackled or secured with a splice to a wire or rope, the back, the crown which is at the bottom, the bill which is the point opposite the back, and the clear which is the opening between the back and the bill. The spring hook has the base of the spring near the eye and the other end is in the clear up against the inside of the bill. Tackle hooks should be moused when in use to prevent the chance of the load being tripped from the hook.

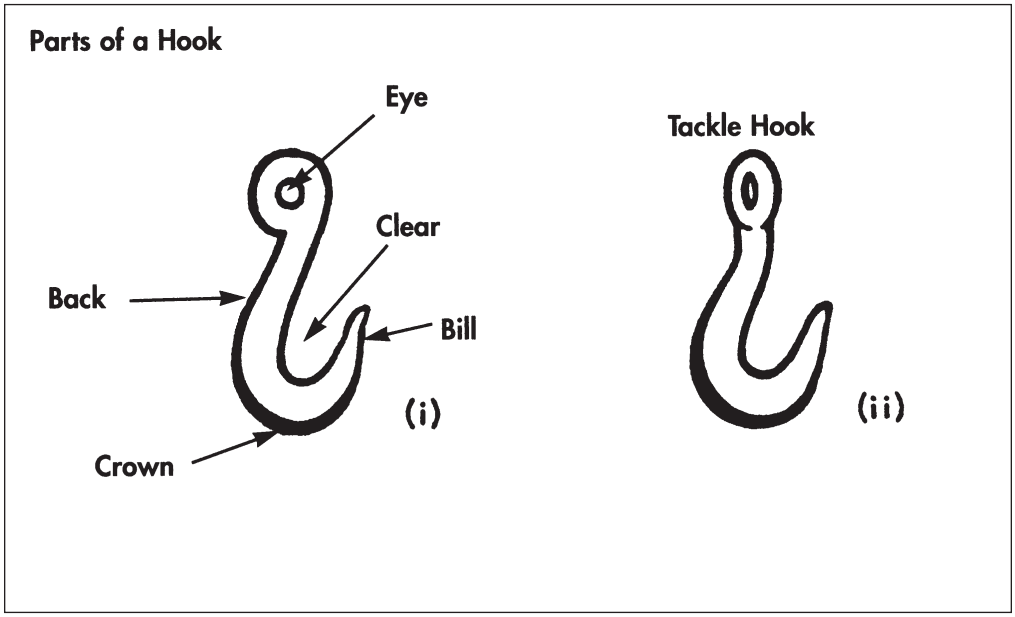

Figure 5.22-1 - Tackle Hook

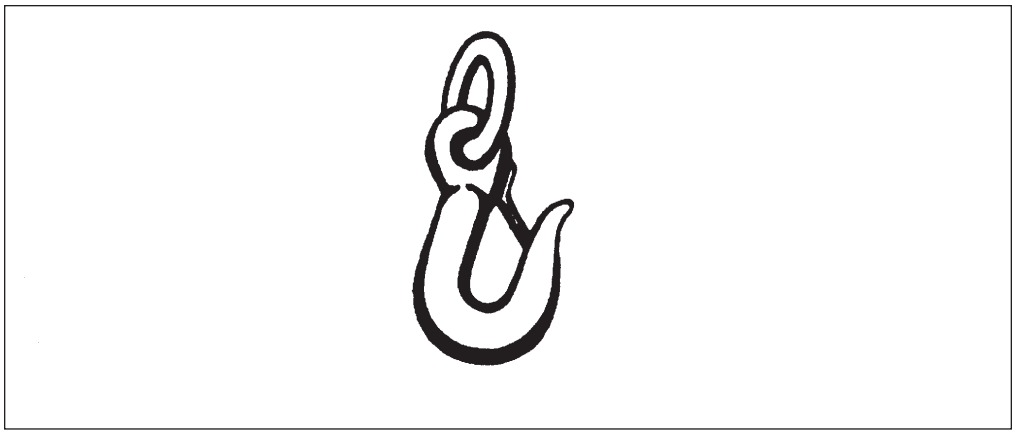

Figure 5.22-2 - Spring Hook

5.23 Eyepads

There are two types of eyepads in use: fixed eyepads and reversible eyepads. AORs and HALIFAX Class ships have reversible eyepads while the remainder of the ships have fixed eyepads, including the AOR Class. Table 3 identifies the fixed and reversible eyepads on the HALIFAX Class and Table 4 identifies the eyepads fixed to the superstructure in HALIFAX Class ships. Fixed eyepads are welded permanently in place and are tested for the specific purpose they are used for. The two types of reversible eyepads have either a well (HALIFAX Class) or through deck fitting (AOR Class). On the HALIFAX Class, the wells for the eyepads are filled with oil to ensure they remain lubricated between maintenance routines. The reversible eyepads on HALIFAX Class ships are used for replenishment operations, with the exception of two eyepads on the starboard side which are used for securing the Inflatable Rubber Boat (IRB). In the AOR Class, the through deck fittings must be lubricated by hand between maintenance routines. The reversible eyepads on the AORs are used primarily for securing deck cargo.

Table 3 Fixed and Reversible Deck Eyepads in HALIFAX Class Ships	
Eyepad Number	**Function** (f) indicates a fixed eyepad; (r) indicates a reversible eyepad
1(f)	Towing/mooring blake slip clench
2(f)	Ranging block eyepad
3(r)	For stbd anchor platform strongback
4(r)	For port anchor platform strongback
5(f)	For stbd anchor platform
6(f)	For port anchor platform
7(r)	For stbd anchor platform strongback
8(r)	For port anchor platform strongback
9(f)	Blake slip deck clench
10(f)	Bottle screw deck clench
11(r)	For hose-hanging pendant for astern fueling
12(r)	For hose-hanging pendant for astern fueling
13(r)	Kingpost backstay eyepad
14(r)	Kingpost backstay eyepad
15(r)	Messenger eyepad/12” jackstay block
16(r)	Messenger eyepad/12” jackstay block
17(r)	To be determined (obsolete)
18(r)	To be determined (obsolete)
19(r)	To be determined (obsolete)
20(r)	To be determined (obsolete)
21(r)	Kingpost back stay eyepad
22(r)	Kingpost back stay eyepad
23(r)	Messenger eyepad (liquids) (to be relocated during configuration changes)
24(r)	Messenger eyepad (liquids) (to be relocated during configuration changes)
25(r)	Messenger eyepad (solids) (to be added during configuration changes)
26(r)	Messenger eyepad (liquids) (to be added during configuration changes) (jackstay 6” block and new messenger block liquids)
27(r)	Stbd IRB securing eyepad
28(r)	Messenger eyepad messenger
28a(r)	Light jackstay 12” block
29(r)	Stbd IRB securing eyepad
30(f)	For 6” snatch block DRP
31(r)	Stbd IRB securing eyepad
32(f)	Port IRB securing eyepad
33(f)	Stbd IRB securing eyepad
34(f)	Port IRB securing eyepad
35(f)	For 6” snatch block DRP
36(f)	Port IRB securing eyepad
37(f)	Securing eyepad for RIB
38(f)	Port IRB securing eyepad
39(f)	RIB securing eyepad
40	Port jumping ladder eyepad
41	RIB securing eyepad
42	Port boat boom fwd guy eyepad
43	Stbd jumping ladder eyepad

Table 3 Fixed and Reversible Deck Eyepads in HALIFAX Class Ships (cont)	
Eyepad Number	**Function** (f) indicates a fixed eyepad; (r) indicates a reversible eyepad
44	Towing cleat
45	Stbd boat boom fwd guy

Table 4 List of Superstructure Eyepads in HALIFAX Class Ships	
Eyepad Number	**Function** (p) indicates port; (s) indicates stbd
1(s)	Eyepad for lifeline
2(p)	Eyepad for lifeline
3(s)	In/outhaul eyepad (configuration change will move in/outhaul to choker plate on bollard aft of kingpost)
4(p)	In/outhaul eyepad (configuration change will move in/outhaul to choker plate on bollard aft of kingpost)
5(s)	Upper block for light line (new)
6(p)	Upper block for light line (new)
7(s)	Lower block for light line (new)
8(p)	Lower block for light line (new)
9(s)	Fairlead block stowage staple (jigger tackle)
10(p)	Fairlead block stowage staple (jigger tackle)
11(s)	Riding line fairlead (jigger tackle)
12(p)	Riding line fairlead (jigger tackle)
13(s)	Fairlead block stowage staple (jigger tackle)
14(p)	Fairlead block stowage staple (jigger tackle)
15(s)	Riding line fairlead (jigger tackle)
16(p)	Riding line fairlead (jigger tackle)
17(s)	Staple for jackstay pendant
18(p)	Staple for jackstay pendant
19(s)	Eye for hose-hanging pendant
20(p)	Eye for hose-hanging pendant
21(s)	Jigger tackle eyepad
22(p)	Jigger tackle eyepad
23(s)	Jigger tackle securing staple
24(p)	Jigger tackle securing staple

Note.

Configuration changes are anticipated that will see the removal of all jigger tackle arrangements.

5.24 Turnbuckles and Bottle Screws

Turnbuckles can be supplied with eye end fittings, jaw end fittings, hook end fittings and a combination eye, jaw and hook on one end and a slip on the other. Their rated load depends upon the outside diameter of the threaded portion of the end fitting. Turnbuckles are fabricated from alloy steel, and on HALIFAX Class ships, the turnbuckle assemblies for guardrails are fabricated from aluminum alloy. If the turnbuckle is to be used in an area where vibration is present, it is important to lock the frame to the end fittings using the nuts on the threaded piece or with wire moused through the body and the end of the turnbuckle (jaw, hook or jaw). Care must be taken to ensure that the nut is not tightened too severely. This could weaken the turnbuckle or distort the threads. Bottle screws are basically the same as turnbuckles, the difference being that bottle screw fittings are open while turnbuckles are covered.

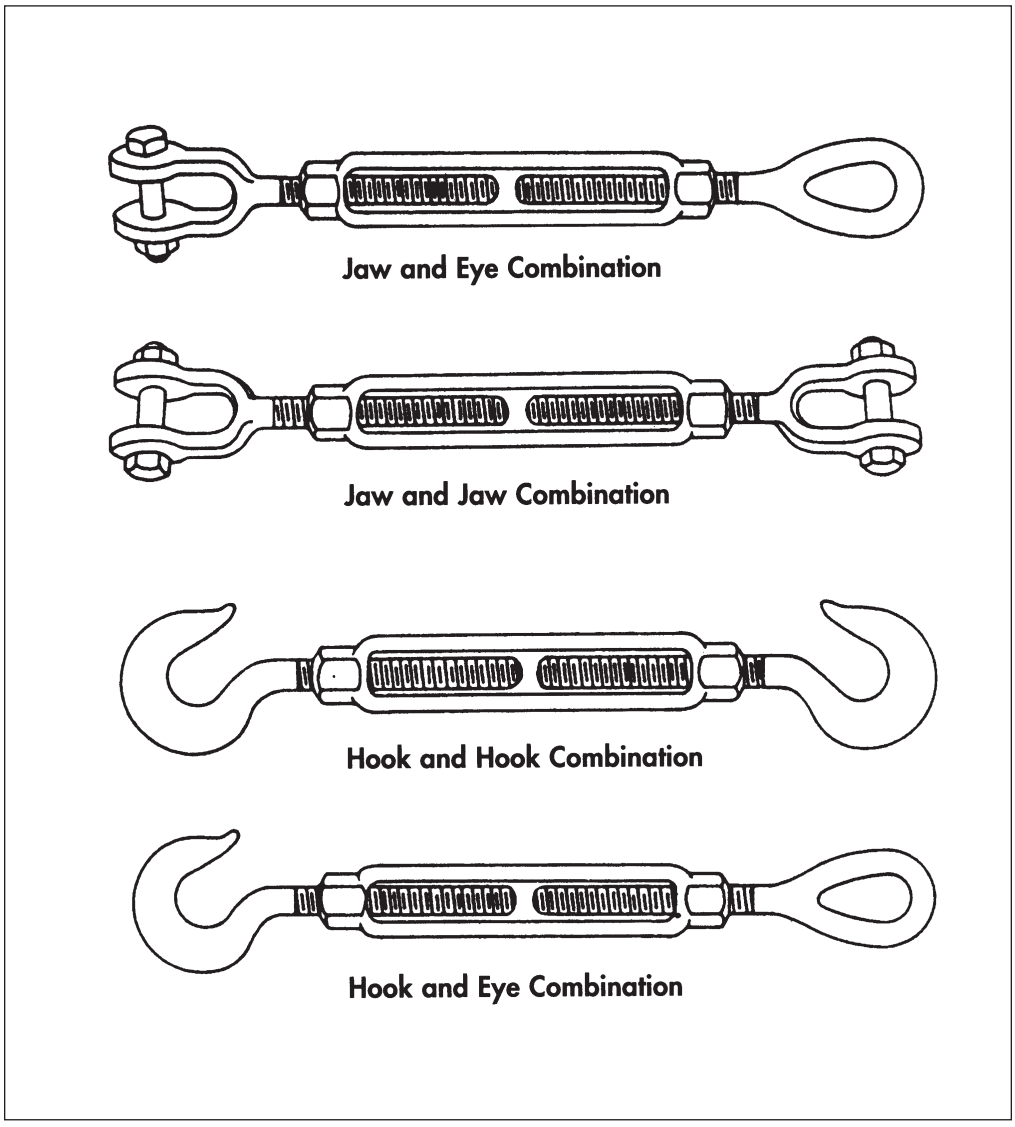

Figure 5.24-1 - Turnbuckles and Bottle Screws

5.25 Guardrail Assemblies

HALIFAX Class guardrails are made up out of Kevlar (Black Max™) cover with a PVC coating and aluminum end fittings. They are secured to the guardrails with sister hooks. They are made up by shore authorities and are ordered to the desired length. All other classes of ships have PVC-coated aluminum guardrails with aluminum end fittings. They are secured to the guardrail stanchions with galvanized bottle screws which are shackled to the guardrail stanchion at one end, and secured to the guardrail with a jaw fitting at the other end.

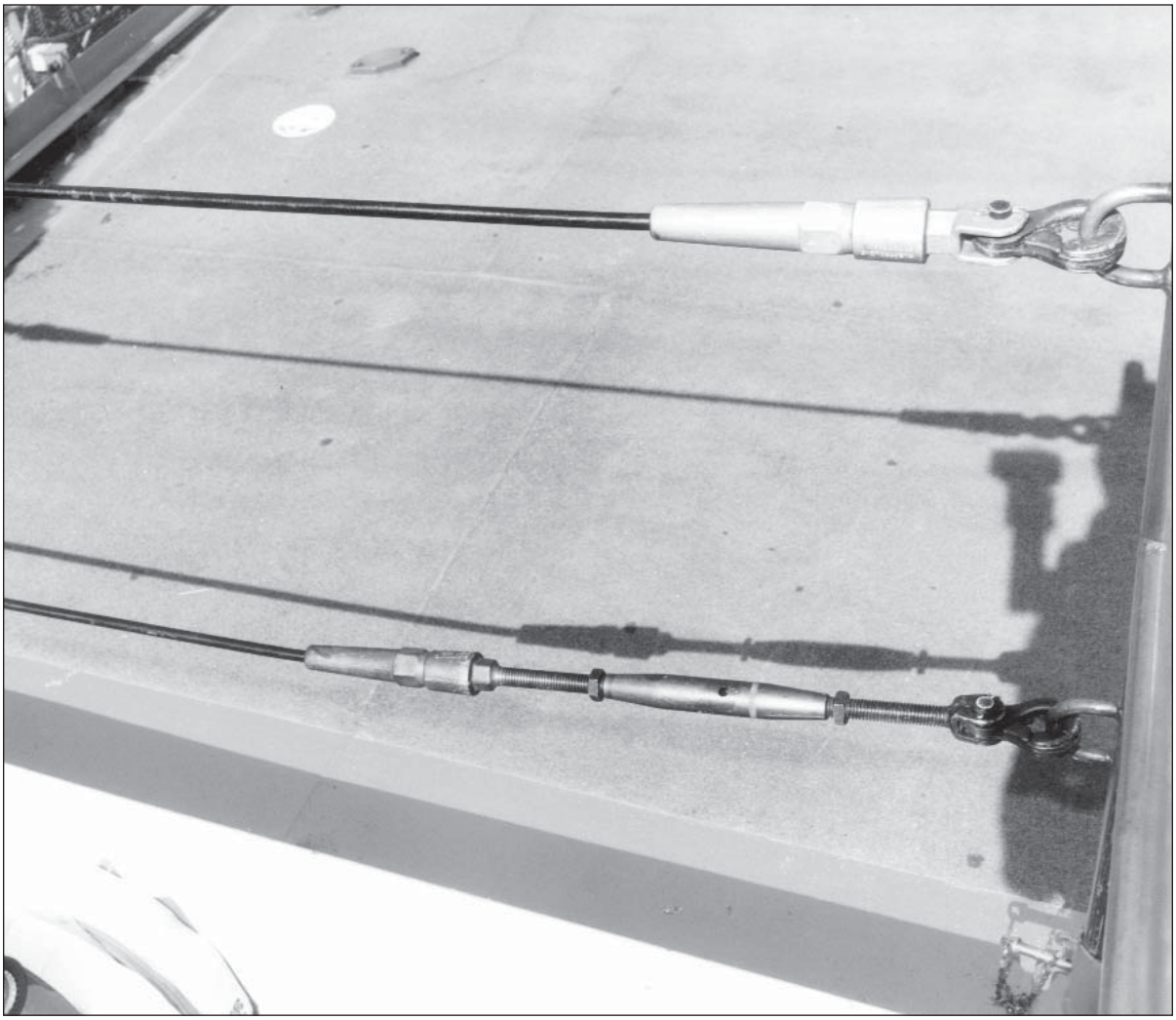

Figure 5.25-1 - HALIFAX Class Guardrail End Fittings

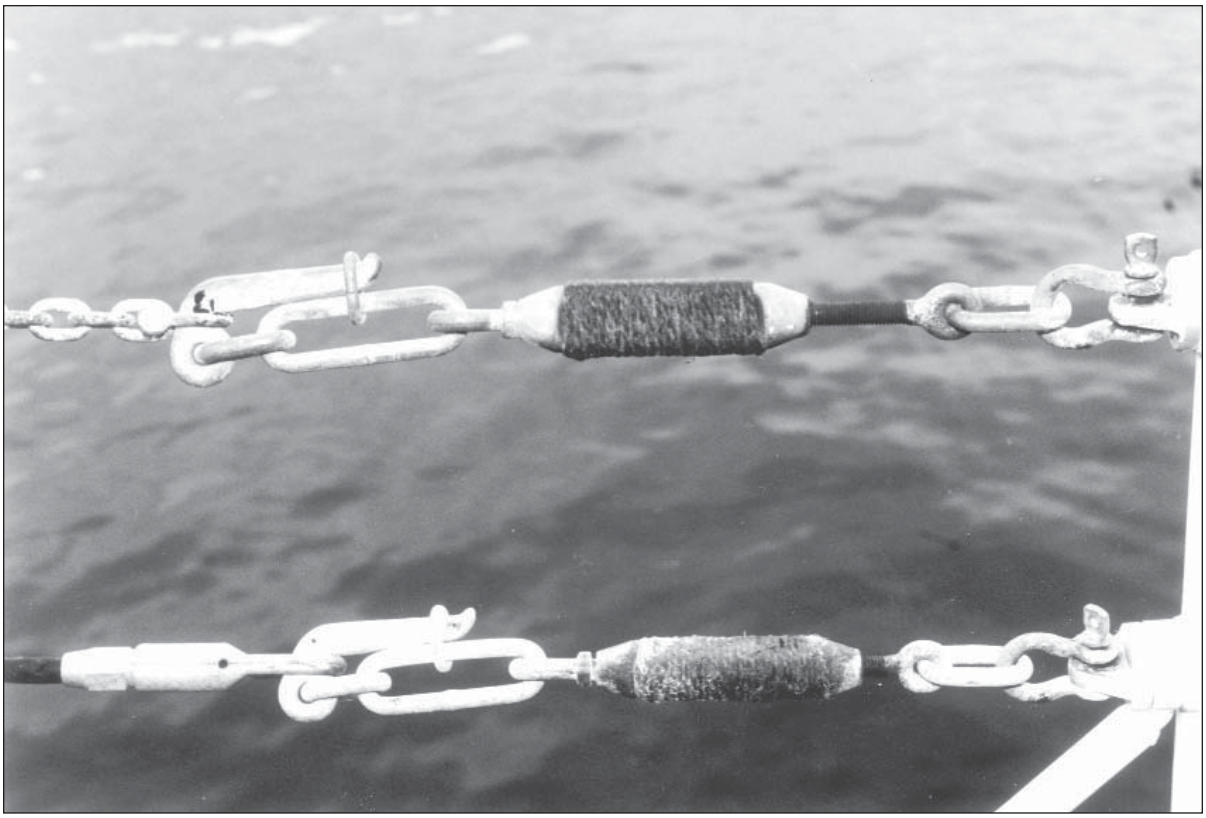

Figure 5.25-2 - Galvanized Bottle Screw Slip and Aluminum End Fittings for all other Classes of Ships

5.26 Union Plates

Union Plates have limited use in the Canadian Navy. They are primarily used in the fueling rigs on the AOR Classes and in the backbone assembly of the awning for the HALIFAX Class. They are used when three securing points are required in a rigged system.

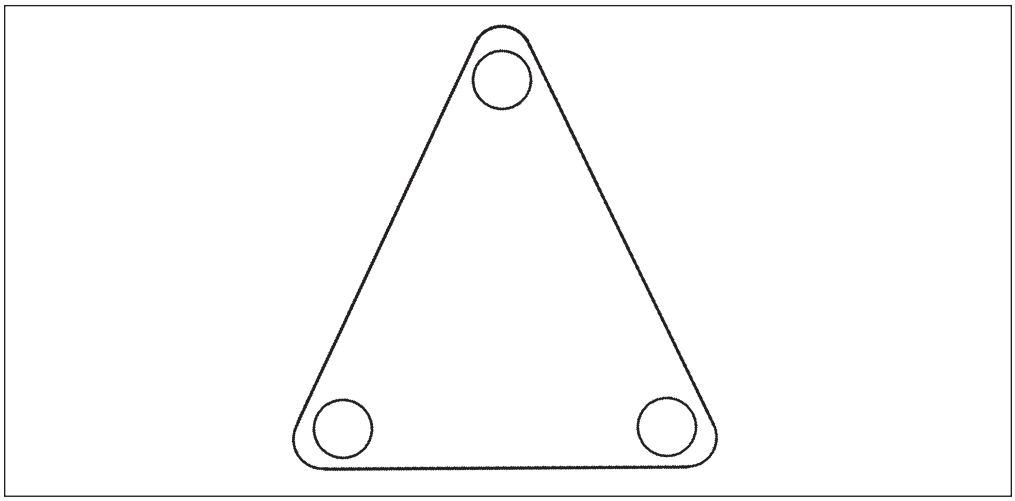

Figure 5.26-1 - Union Plate (Flounder Plate)

5.27 Slips

A slip is a quick release link used for joining the end of rope, wire or chain to a fitting when the end may have to be released quickly or frequently. All these slips are called senhouse slips. Slips are used in replenishment operations, towing evolutions, cable securing arrangements and on the end of guardrail fittings on all ships except those of the HALIFAX Class.

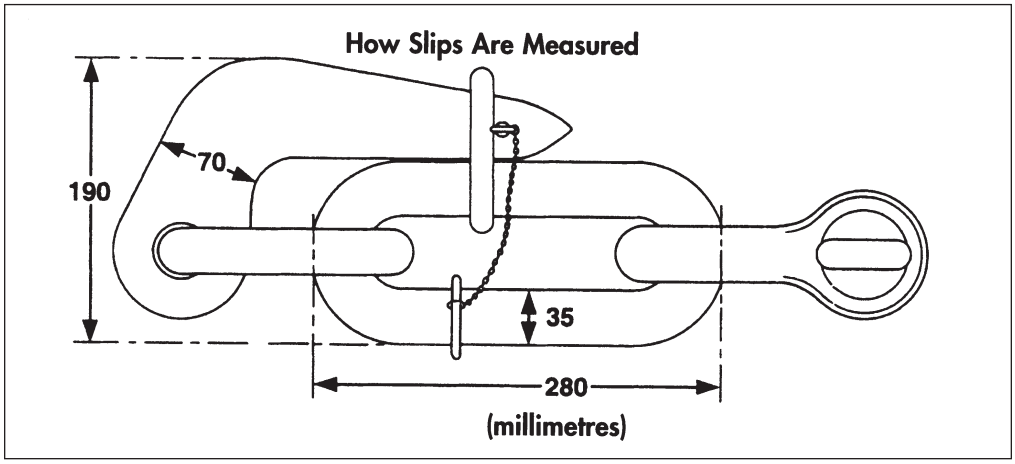

Figure 5.27-1 - Slips for General Use

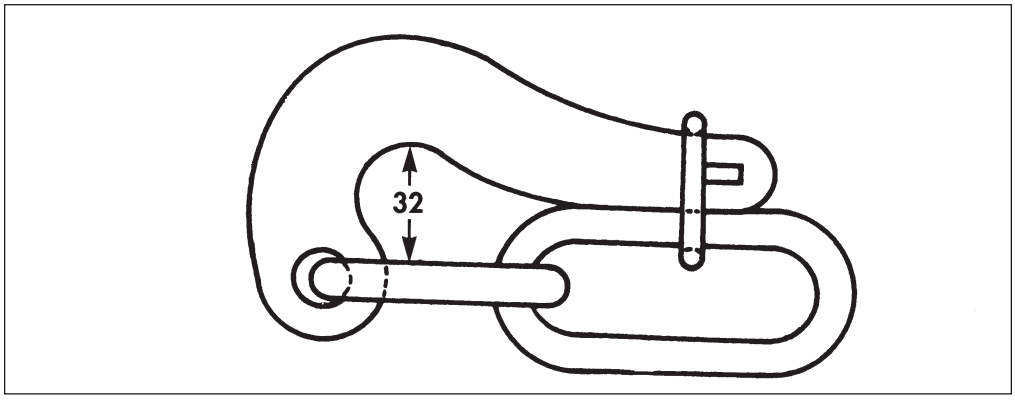

Figure 5.27-2 - Details of Slip for Rigging

5.28 Care and Maintenance of Associated Rigging Fittings

Associated fittings such as shackles, snap hooks, slips and guardrail fittings are to be inspected frequently and cleaned of all rust, corrosion and dirt.

a. Shackles worn in the crown or pin (see Fig. 5.28-1) by more than 10 percent of the original diameter should be destroyed.

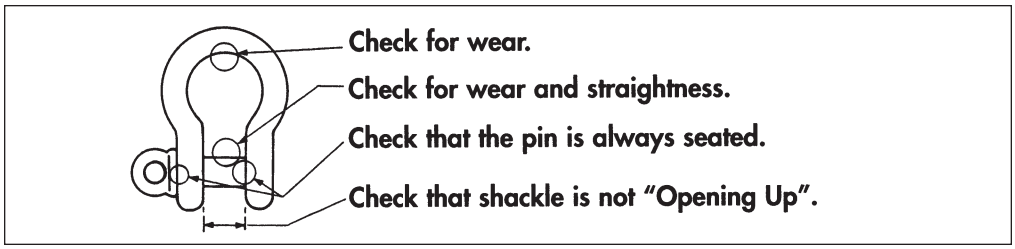

Figure 5.28-1 - Shackle Inspection Areas

b. On snap hooks, look for wear in association with Fig. 5.28-2 in the jaw of the hook, cracks, severe corrosion and twisting of the shank. Be especially careful to measure the bill opening. If there is evidence of opening or distortion, destroy the hook.

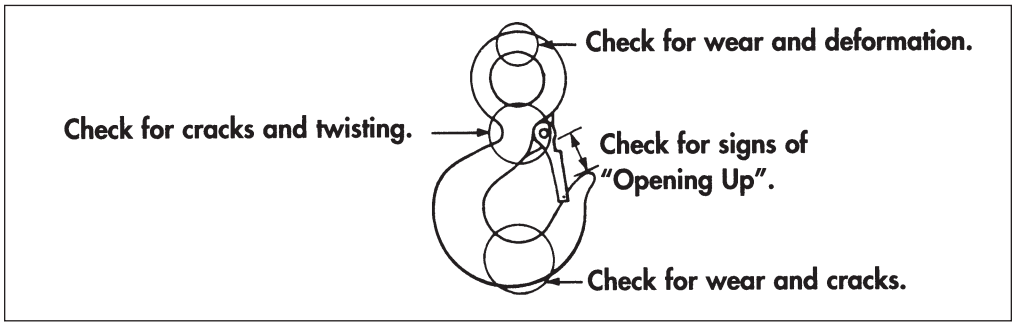

Figure 5.28-2 - Hook Inspection Areas

c. Bottle screws should be checked for cracks in end fittings, deformed end fittings and bent rods in association with Fig. 5.28-3.

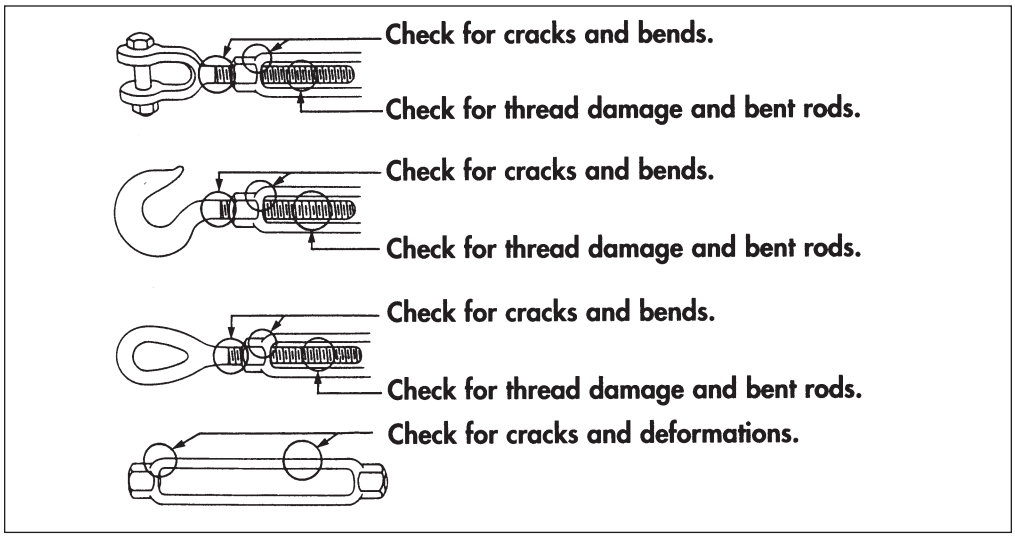

Figure 5.28-3 - Bottle Screw Inspection Areas

d. Slips should be checked for distortion of bill, wear on coupling line and joining links/shackle. If worn more than 10 percent, replace.

5.29 Blocks, Tackles and Portable Lifting Appliances

a. **Blocks.** A block is a pulley made of wood, metal and/or synthetic-resin bonded fibre and, in some cases, a combination of wood and metal. The use of blocks is the principal way mechanical advantage is obtained in ships. The sheave is the roller which turns on an axle called a pin. A rope goes in the opening called the swallow, and it rides on the sheave. The sheave is contained in a shell of which the cheek, crown and tail are parts. An eye or hook may be fastened on the top. Blocks are classified by their size, measured around the shell from crown to tail. An ordinary block takes a line 1/3 its size, so a 9 inch block takes a rope 3 inches in circumference. The one exception is the clump block which takes a line half its size. Clump blocks are used for boat ropes on boat booms and accommodation ladders.

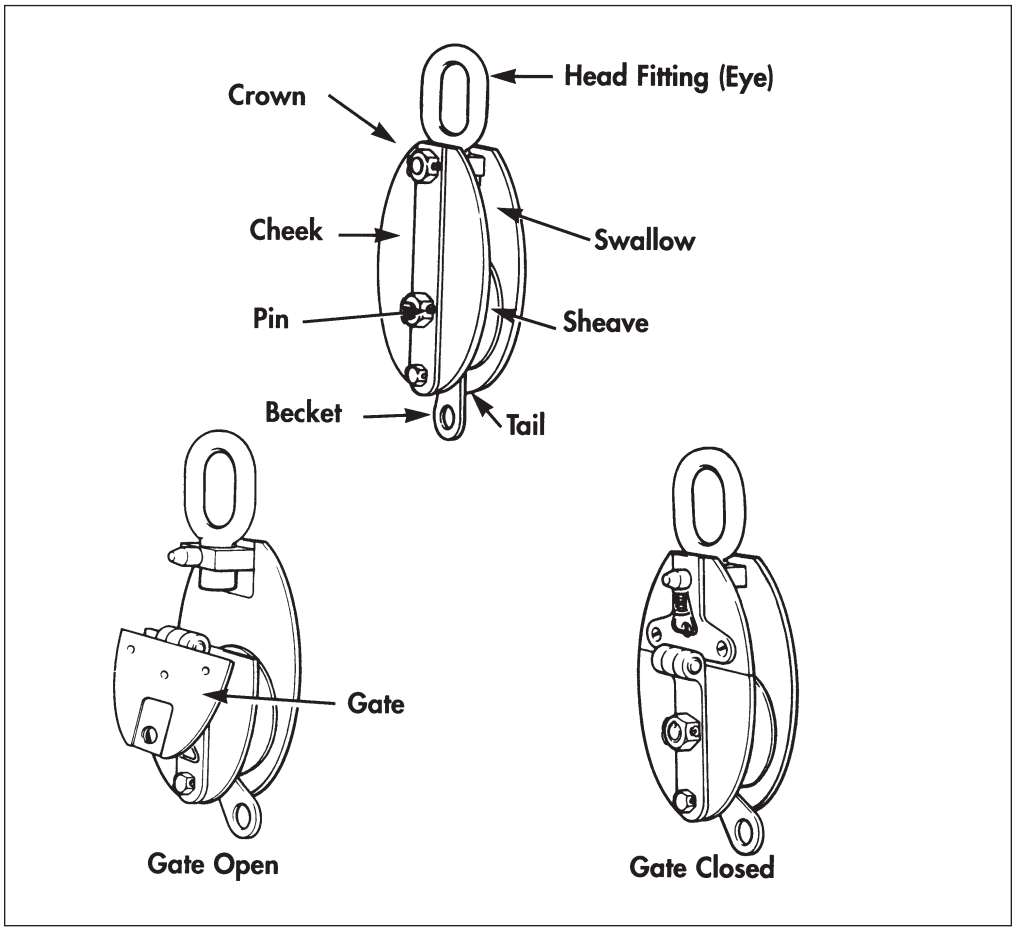

Figure 5.29-1 - Parts of a Block

b. **Tackles.** A tackle is made up of two or more blocks and lines to produce mechanical advantage. There are three types commonly used in the Canadian Navy: the luff made up of a single sheave block and double sheave block; a two-fold purchase made up of two double sheave blocks; and a three-fold purchase made up of two triple sheave blocks.

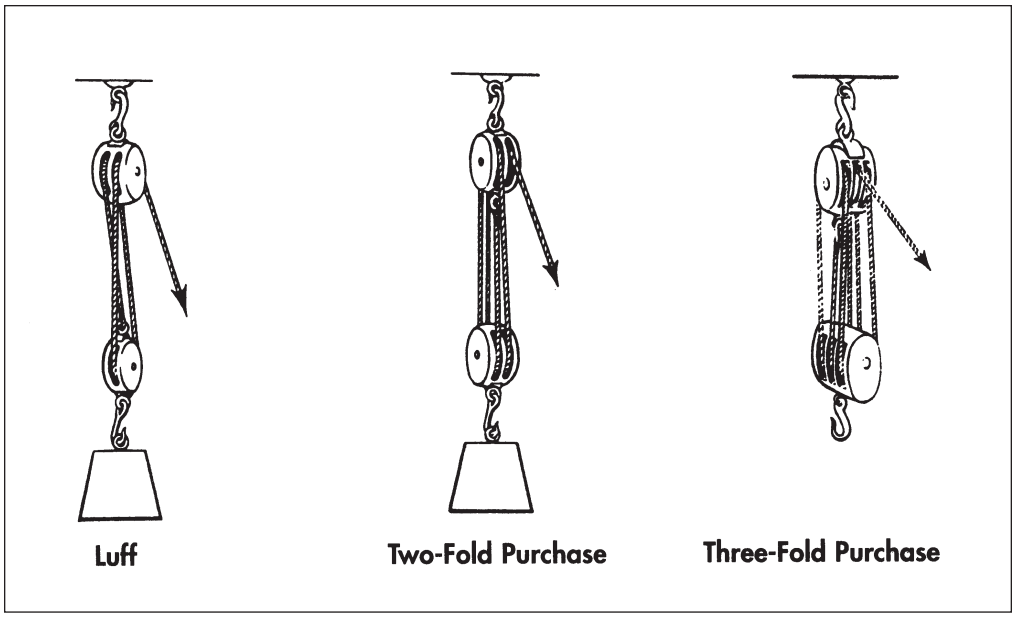

Figure 5.29-2 - Tackles

c. **Parts of a Tackle.** The names of the parts of a tackle are shown in Fig. 5.29-3. The standing part does not move. The running part pulls the running block along the standing part. The standing part can be secured to the standing block or the running block depending on the number of parts that make up the tackle.

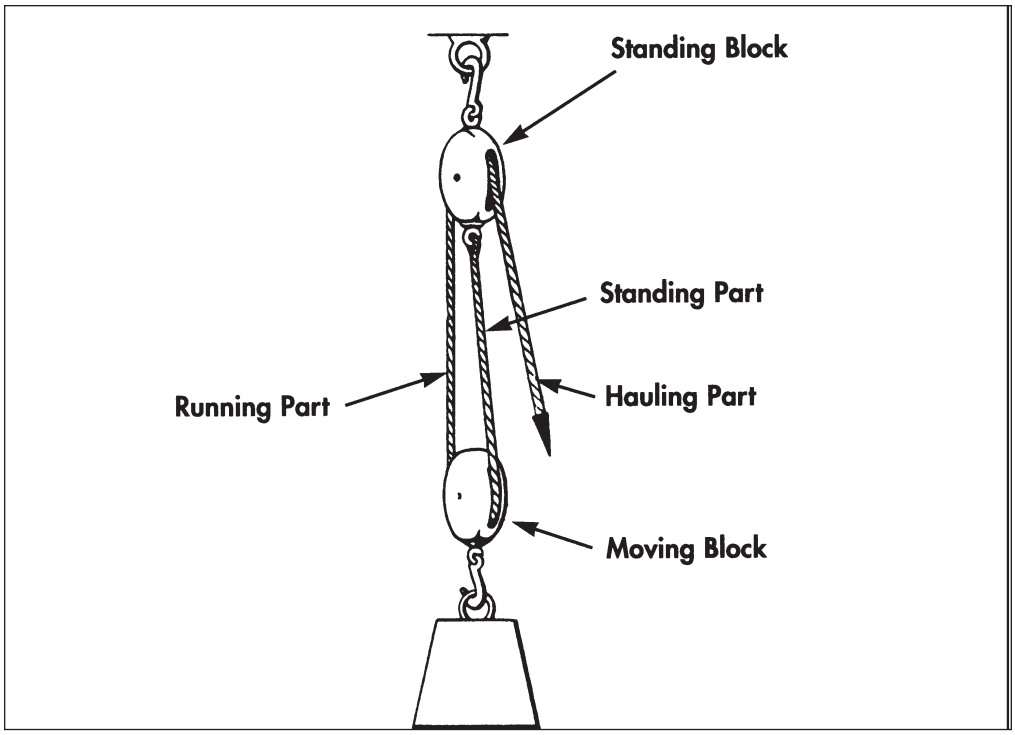

Figure 5.29-3 - Parts of a Tackle

d. **Advantage and Disadvantage.** Tackles are rigged either to advantage or to disadvantage. The simplest way to remember the difference is if the hauling part comes from the moving block, the system is rigged to advantage, and if the hauling part comes from the standing block it is rigged to disadvantage. To determine the amount of force required to move an object (if the weight is known), the number of moving parts is divided into the weight of the object. For example, a luff is rigged to advantage, and the number of moving parts equals three. If the load weighs 100 kg, the amount of force required to move the load is 100 ÷ 3 = 33 1/3 kg. If the luff is rigged to disadvantage, the amount of force is 100 ÷ 2 = 50 kg. This does not take into account the friction that is involved within each system.

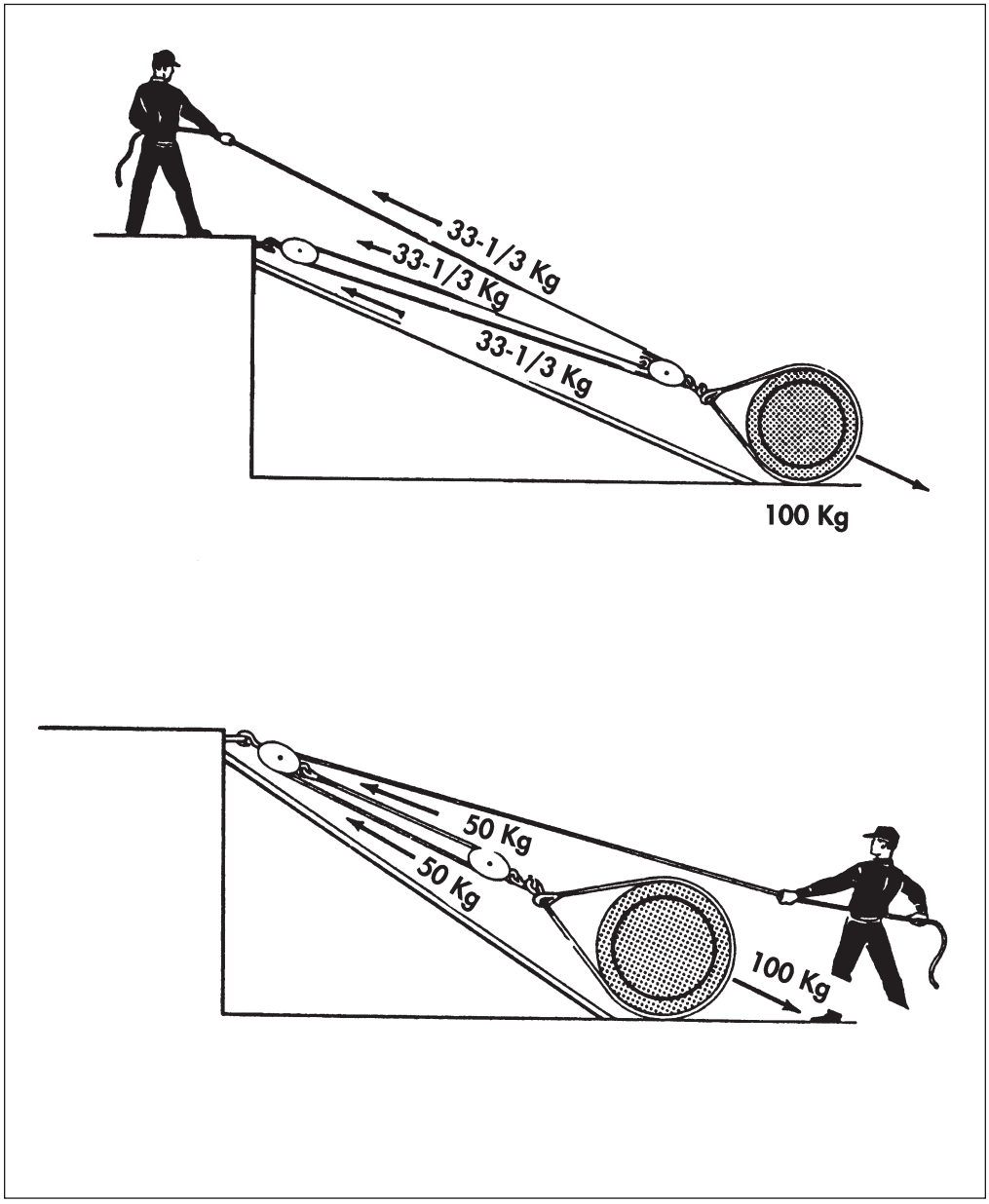

Figure 5.29-4 - Advantage and Disadvantage

e. **Chain Hoists.** There are three basic types of chain hoists in use today. They are chain blocks (suspended), built-in (electric or manual) and "Handy Billy's" (ratchet and lever). They have an advantage over conventional blocks as they consist of a sprocket worked by an endless chain which operates the sprocket through gearing. The load sprocket carries the chain load to which the hoisting hook is attached.

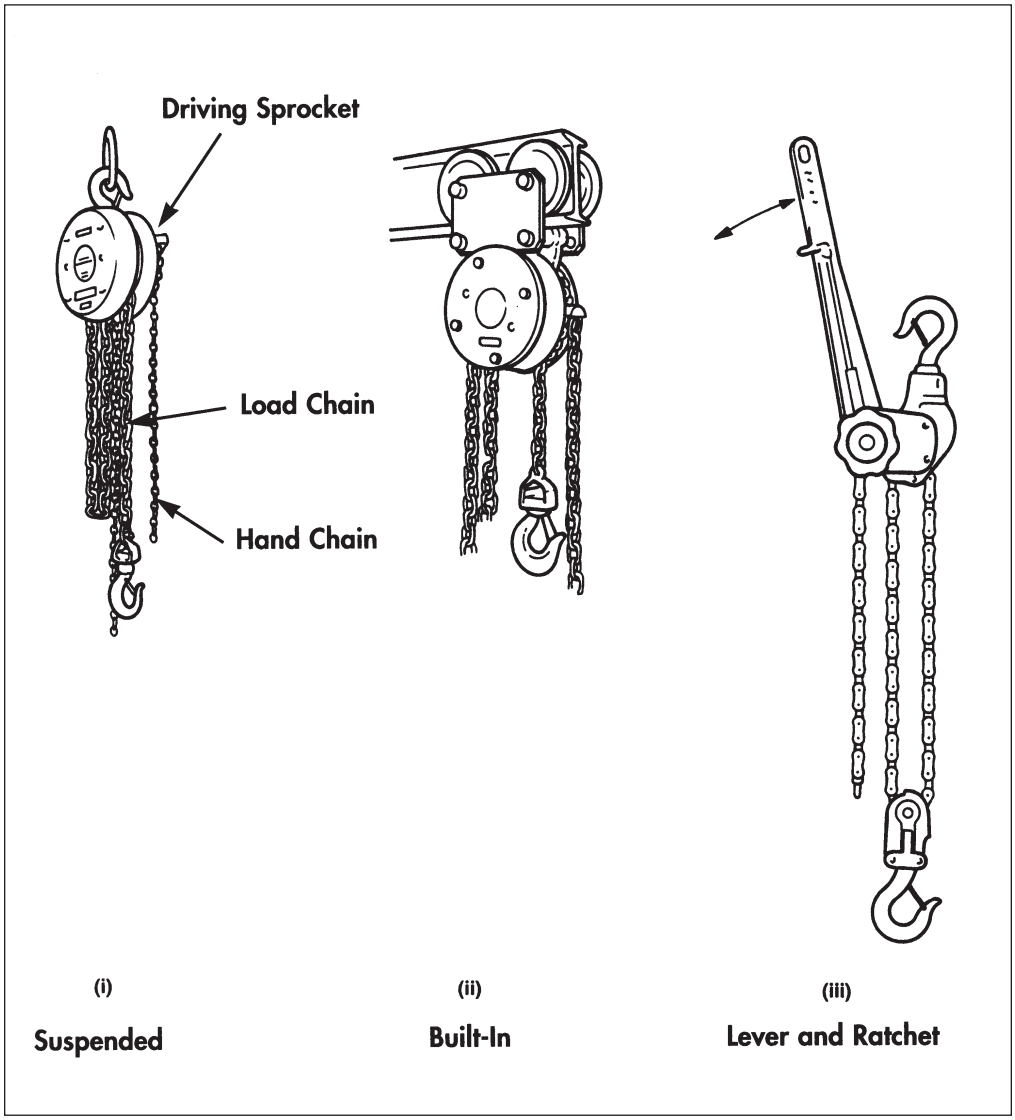

Figure 5.29-6 - Chain Hoists

f. **Tirfor Pulling and Lifting Appliance.** The Tirfor is a hand-operated pulling and lifting machine similar in operation to the ratchet and lever chain block. Instead of chain, wire is used as the fall. Maxiflex wire is supplied with each unit and must never be replaced with any other type of wire. An operator's handbook is supplied with each unit. Tirfor machines are used as a safety back-up system while raising or lowering the kingpost on IROQUOIS Class ships.

5.29.1 Care and Maintenance of Blocks

The proper care and maintenance of blocks is essential to their operations. Blocks that are used on the upper decks require monthly maintenance. All blocks should be checked periodically for the following:

(**1**) Check the blocks for excessive wear on the brackets, end connections, sheave bearings and centre pins.

(**2**) Ensure that the sheave grooves are smooth. If a wire rope sheave shows the imprint of the rope, excessive rope wear will occur.

(**3**) Look for signs of overloading, elongated links, shackles bent or stretched, enlarged throats and bent pins. If such conditions are found, the blocks should be replaced.

(**4**) Check the sheave(s) for proper rotation.

(**5**) Check the clearance between sheave(s) and cheek. It should be small enough that there is no danger of the rope slipping between them.

(**6**) Check the tally plate to see when the last test was conducted. Blocks used directly for life saving of personnel must be tested yearly. All other rigging blocks are tested every other year.

Note:

If no tally plate is found, have the blocks tested before using.

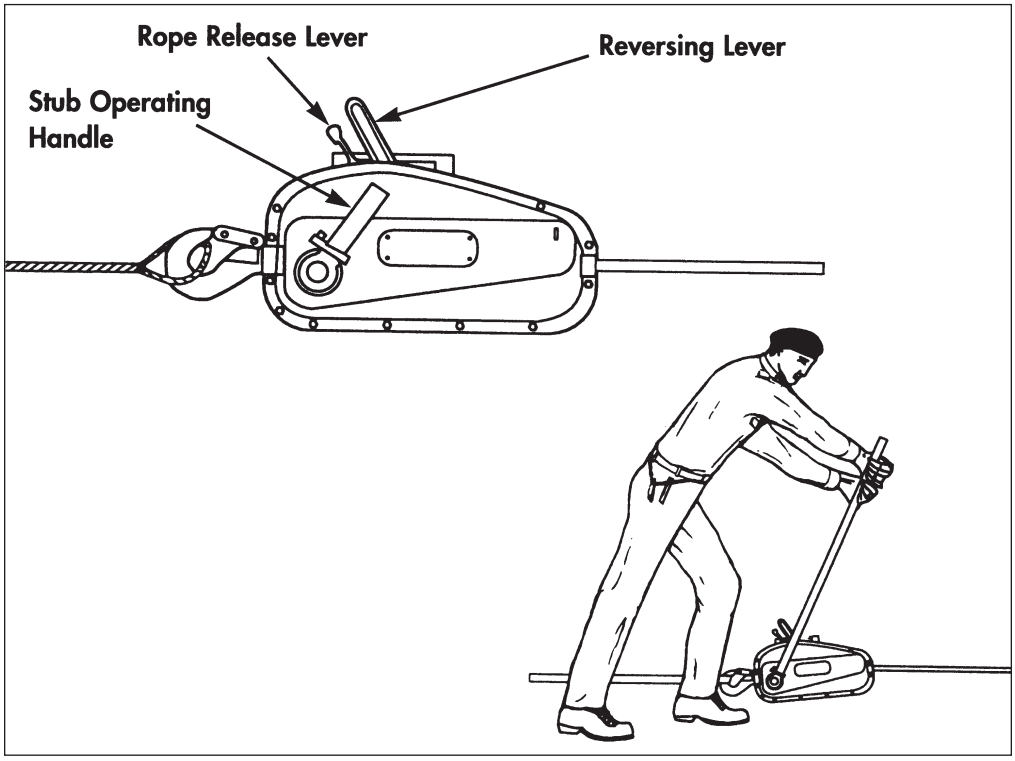

Figure 5.29-7 - Tirfor Machine

5.30 Cranes

The following figures are the types of cranes operated by the Bosn 181 tradesman in the performance of his duties.

Figure 5.30-1 - AOR Class 15 Ton Crane

Figure 5.30-2 - AOR Class Mobile Cranes

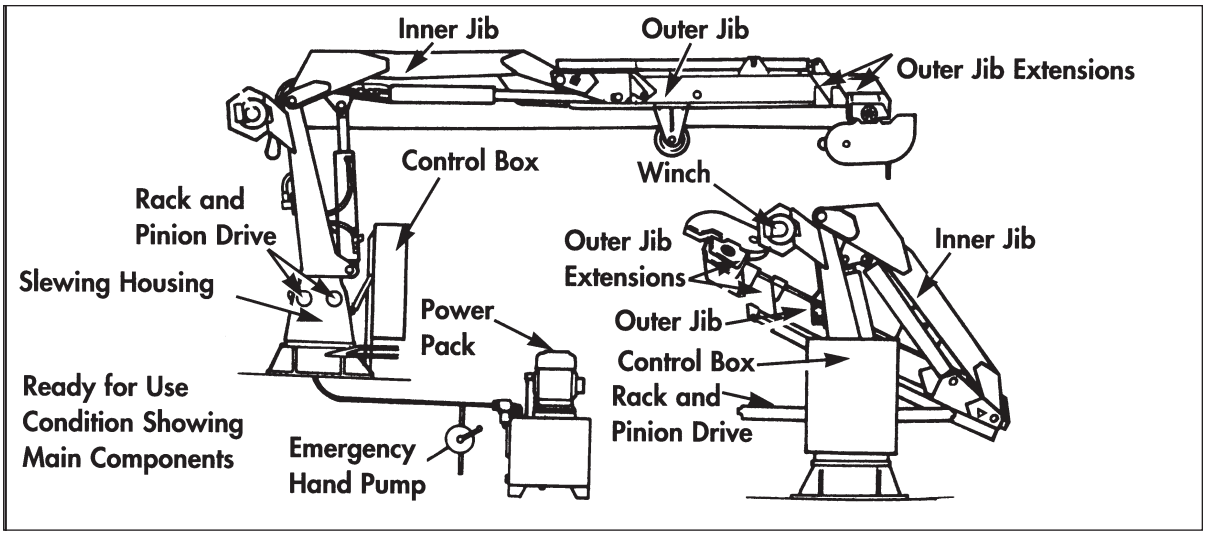

Figure 5.30-3 - IROQUOIS Class Cranes

Figure 5.30-4 - HALIFAX Class Cranes

Figure 5.30-5 - KINGSTON Class Cranes

5.30.1 Care and Maintenance of Cranes

Care and maintenance is to be carried out in association with the applicable manual.

5.31 Improvised Lifting Devices

There will be times when an improvised rigging device will be required in order to move an object in the ship or from the ship. The two basic types employed are the gyn and the baulk.

a. **Gyn.** To rig a gyn, first mark all three spars that are to be used for the legs. Place the two outside legs (cheeks) pointing one way and the centre leg (prypole) facing the other, so the ends overlay approximately 0.5 m. Starting with a timber hitch on one of the cheeks, pass a line over the prypole, under the other cheek, under the prypole and over the starting cheek to form a figure-of-eight pattern. Continue until six to eight figure-of-eight turns have been made and finish off the lashing with a clove hitch on the cheek without the timber hitch. The lashing must not be tight. Raise the poles at the lashing, splaying out the legs to form a tripod. Be sure to place a strop and the lifting tackle over the lashings before raising the gyn to its full height. Tackles are rigged between each leg to prevent the legs from splaying when they come under a load.

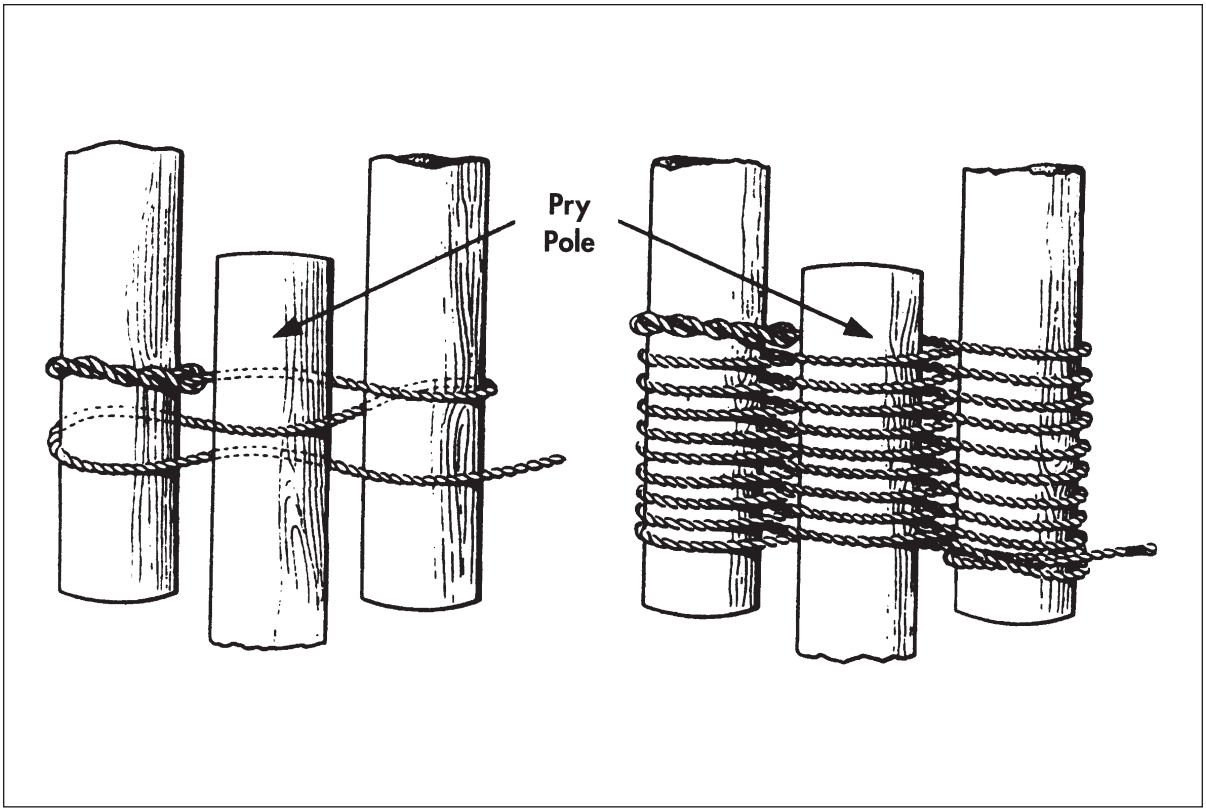

Figure 5.31-1 - Head Lashing for a Gyn

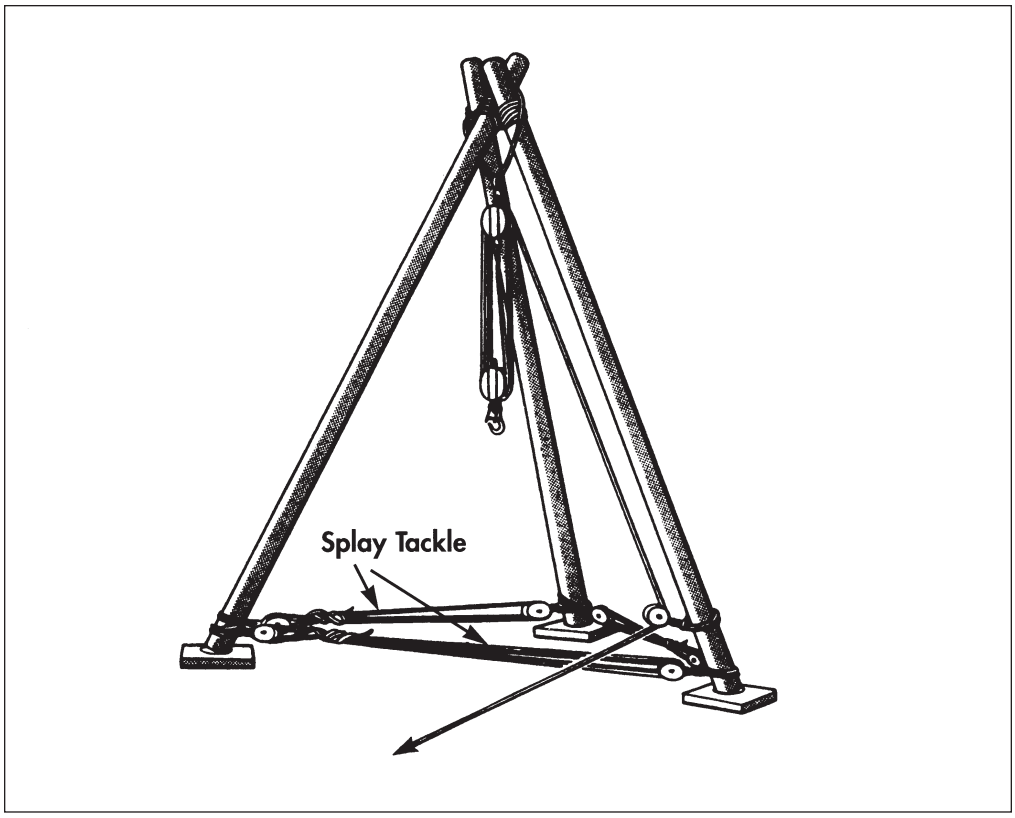

Figure 5.31-2 - Rigged Gyn

b. **Baulk.** A baulk is made from timber or metal which is placed across an opening such as a hatch or door to provide a strong point from which to rig tackle when no eyepads are available.

5.32 Estimating Weights

a. The most important step in any rigging operation is the determination of the weight of the load to be hoisted. If this information cannot be obtained from shipping papers, tally plates or data from any other source, it may be necessary to calculate the weight.

b. To estimate weights, you must know how to find the area or volume of the articles that are going to be lifted. Symbols used in these calculations and their meanings are as follows:

A = Area
B = Base
C = Circumference
D = Diameter
H = Height
L = Length
R = Radius

W = Width
V = Volume
π = pi (which is approximately 3.14)

c. To find the area of a given object you will need two of the above in order to be able to make the calculation.

d. To find the area of a square or rectangle, multiply the length times the width.

Area = Length x Width (A = L x W)

e. To find the area of a triangle, multiply half the base by the height.

Area = 1/2 Base x Height (A = 1/2 B x H)

f. To find the area of a circle, the formula is π times the radius squared.

Area = πr^2 (R x R x π)

g. To find the area of a cylinder, multiply the circumference by the height. To find the circumference, multiply the diameter by π.

Area = π x D x H (A= π x D x H)

h. To find the volume of a square or rectangular object, you need to know the height, length and width.

Volume = H x L x W

By applying the above formulas with the weights per cubic foot of various materials from the table below, you can determine the weight of the objects you may be required to lift and the safe working load required of the lifting appliance.

Table 5 Approximate Weights	
Material	**Approximate Weights**
Aluminum	165 lbs per cubic foot (165 lbs/ ft^3)
Brass	535 lbs per cubic foot
Bronze	500 lbs per cubic foot
Iron	480 lbs per cubic foot
Lead	710 lbs per cubic foot
Steel	490 lbs per cubic foot (A steel plate 1 ft x 1 ft x 1 inch thick = 40 lbs)
Ice	56 lbs per cubic foot
Paper	60 lbs per cubic foot
Gasoline	42 lbs per cubic foot
Oil	58 lbs per cubic foot
Fresh Water	62 lbs per cubic foot
Salt Water	64 lbs per cubic foot
Plywood	1 ft x 1 ft x 1 inch = 3 lbs

5.33 Nets

There are three types of nets used today in the navy: safety nets, cargo nets and scramble nets.

a. **Safety Nets.** Most commonly used under gangways. They can be made of cordage or nylon webbing. When rigged they must extend four feet on either side of the gangway.

b. **Cargo Nets.** Made from nylon webbing and are used to transfer stores at sea during replenishment operations.

c. **Scramble Nets.** Made from polypropylene and metal aluminum tubes. They are fixed on the upper decks close to the ship's side and are used to embark and disembark personnel from boats or the water.

Figure 5.33-1 - Safety Nets

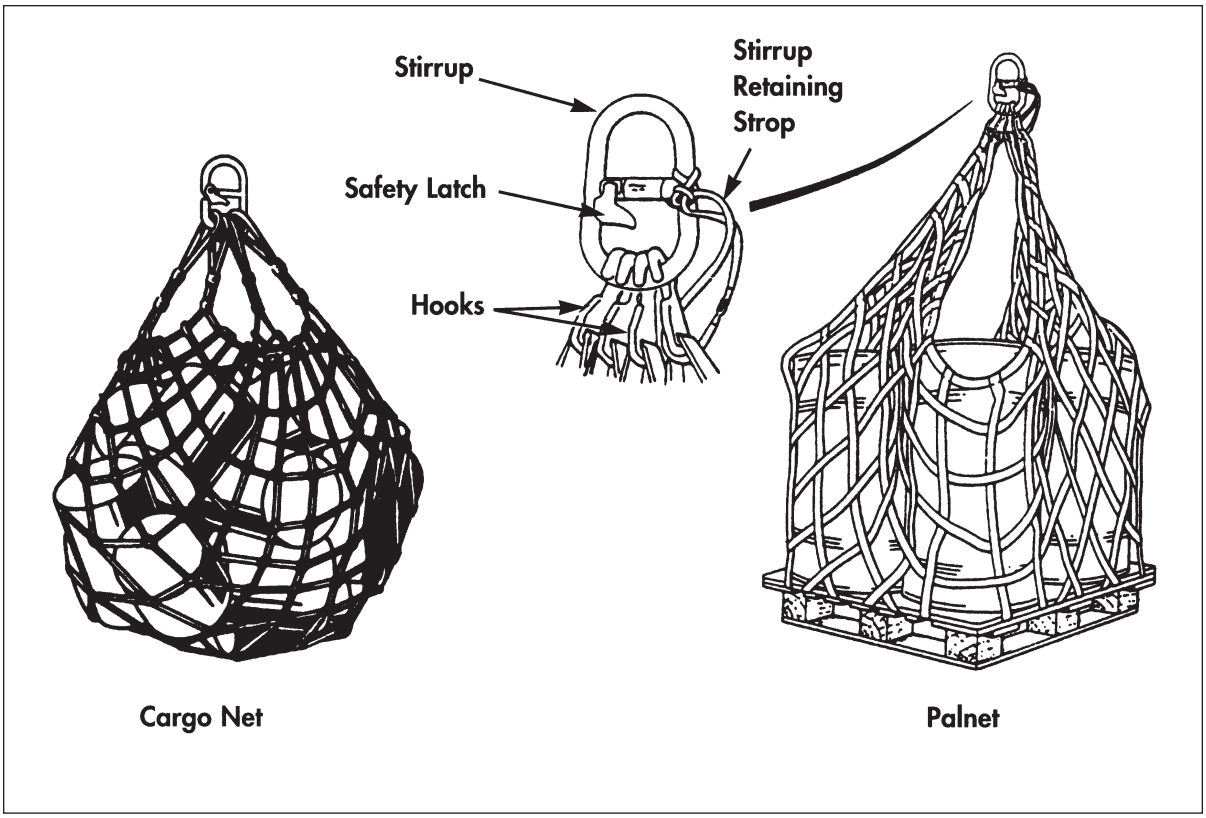

Figure 5.33-2 - Cargo Nets

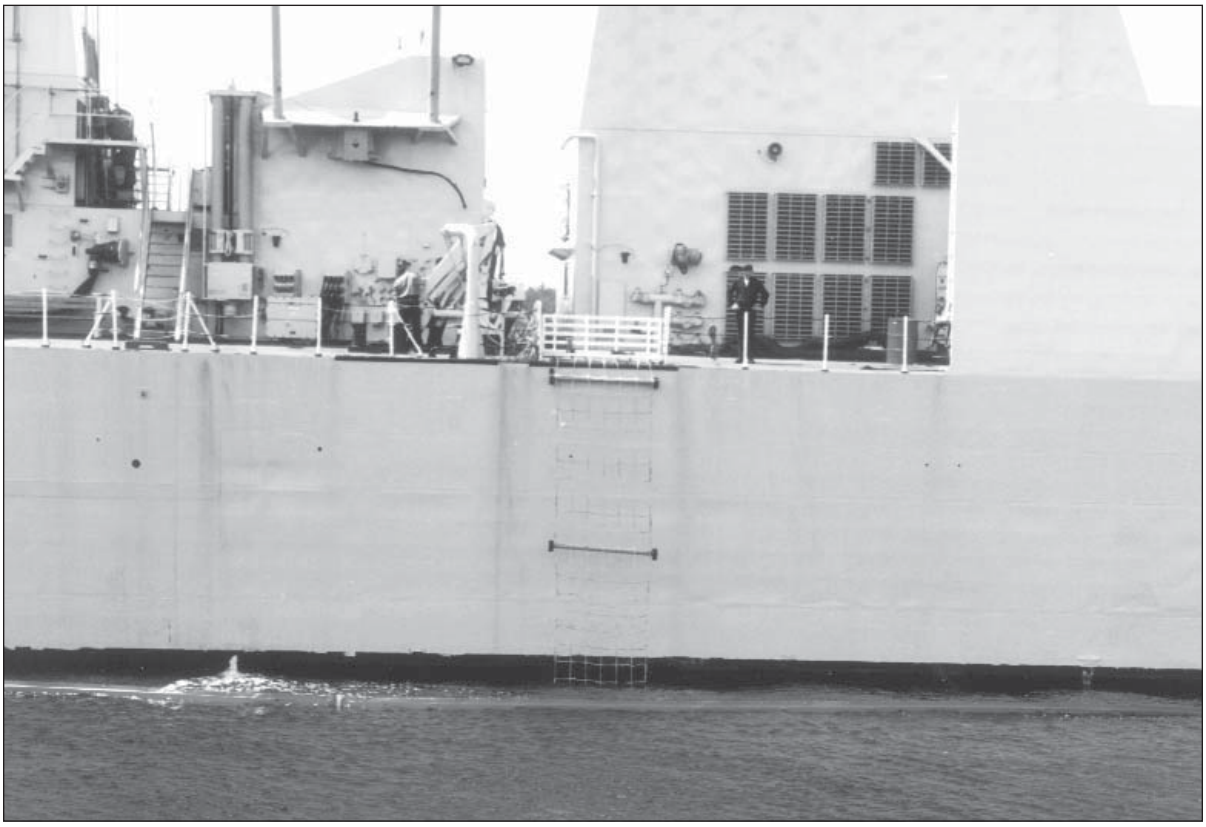

Figure 5.33-3 - Scramble Nets

5.33.1 Care and Maintenance of Nets and Slings

Polyester style nets and slings require little maintenance other than occasional cleaning with water and a mild detergent. They are fully resistant to corrosion and have a high resistance to hydrocarbons. However, ammonia, alkalis and certain acids can cause damage. Slings are to be inspected before use. If the outer core is damaged to the point where the inner yarns are visible, the sling should be cut up and discarded.

5.34 Hand Lead and Line

a. The hand lead and line is rarely used in today's navy. It is used when entering and leaving a harbour, or where water depth is uncharted or in doubt, in order to ensure that there is enough water under the ship. The hand lead and line is made up of the following:

(**1**) The lead is a bar weighing approximately 5 -7 kgs.
(**2**) The line is 50 m of special line.
(**3**) The line is secured to the lead by a rawhide becket.
(**4**) Markings as shown in Fig 5.34-1.

b. The lead on the bottom end is hollow. This hole is filled with tallow. When lowered to the bottom, the type of bottom is indicated by whatever sticks to the tallow. This practice is known as arming the lead. The Leadsman mans the chains or a boat and, with the assistance of the Lazy Leadsman, takes soundings. Soundings are reported to the bridge in a clear voice. When the sounding agrees with one of the marks, it is reported "By the Mark 2, 3, 5", etc. If the bottom is not reached, the report is made "No Bottom at _____".

c. As soon as the sounding is taken, the Lazy Leadsman recovers the line and the Leadsman prepares for the next sounding.

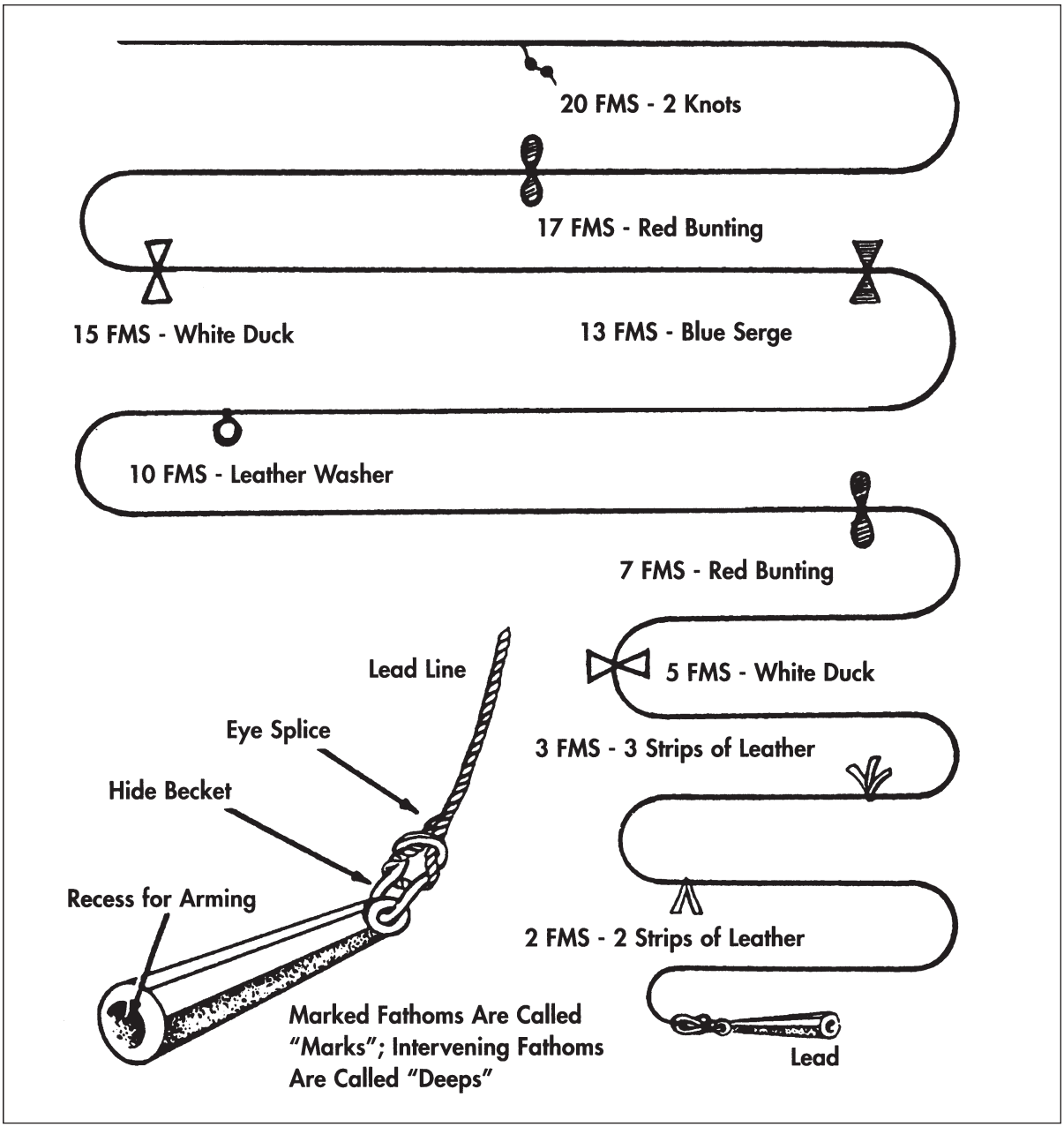

Figure 5.34-1 - Hand Lead and Line

5.35 Boat's Lead and Line

This line is similar to the hand lead and line but the lead is lighter, weighing 3 kgs. It is 30 m of line with markings as shown in Fig 5.35-1 and is used in small boats for soundings.

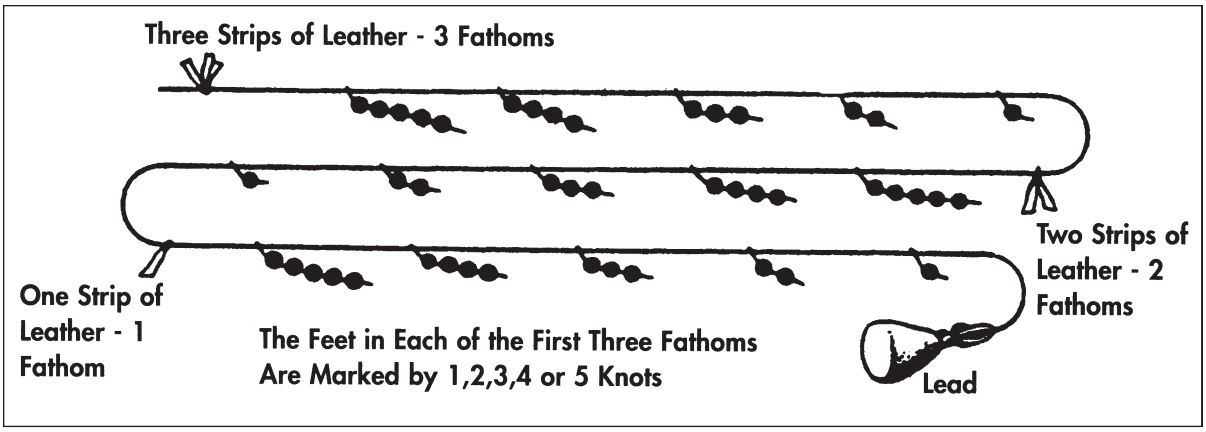

Figure 5.35-1 - Boat's Lead and Line

5.36 Rough Weather Lifelines

Lifelines are fitted on all ships for use in rough weather. They are rigged across all exposed decks approximately 1 m above the deck to provide a handhold for personnel. They have short lines with a manrope knot in the lower end and a round thimble on the upper end. The thimble is fitted around a wire which is secured to strong points on the ship. Hangar top lifelines are left rigged at all times for personnel working in these areas.

5.37 Awnings

a. Awnings are fitted over certain exposed decks to give protection from the sun. Side curtains are provided to shelter and protect the areas below large awnings. Most HMC Ships are fitted with a flight deck awning. Minor war vessels are fitted with a quarter deck or focsle awning. The awnings are made of Dacron and are supported in the middle by a wire backbone. The awning is supported on the sides by awning stanchions. Cringles are sewn along the edges of the awning to receive an earring. Earrings are short pieces of wire with a hard eye in each end. The earring passes through a roller shackle. The roller shackle is placed on the hook at the top of the awning stanchion. The earring is shackled to the cringle of the awning, passes through the roller shackle and is secured on the other end with a small two-fold purchase commonly known as awning tackle. The awning tackle is secured to the bottom of the awning stanchion. The purpose of this arrangement is to secure the outboard of the awning, keeping it tight. The forward end of the awning is normally secured to the superstructure. The after end is secured to a stanchion which is located on the centreline of the ship. When strong winds are expected, the awning should be struck down and when this is not practical, the awning must be frapped. To frap an awning, line is passed over the top of the awning in a crisscross fashion, forward to aft then forward again. When it is raining, the awning must be sloped. This is done by lowering the roller shackle on every other stanchion to the lower hook provided and then hauling taught. This creates valleys for the water to run off.

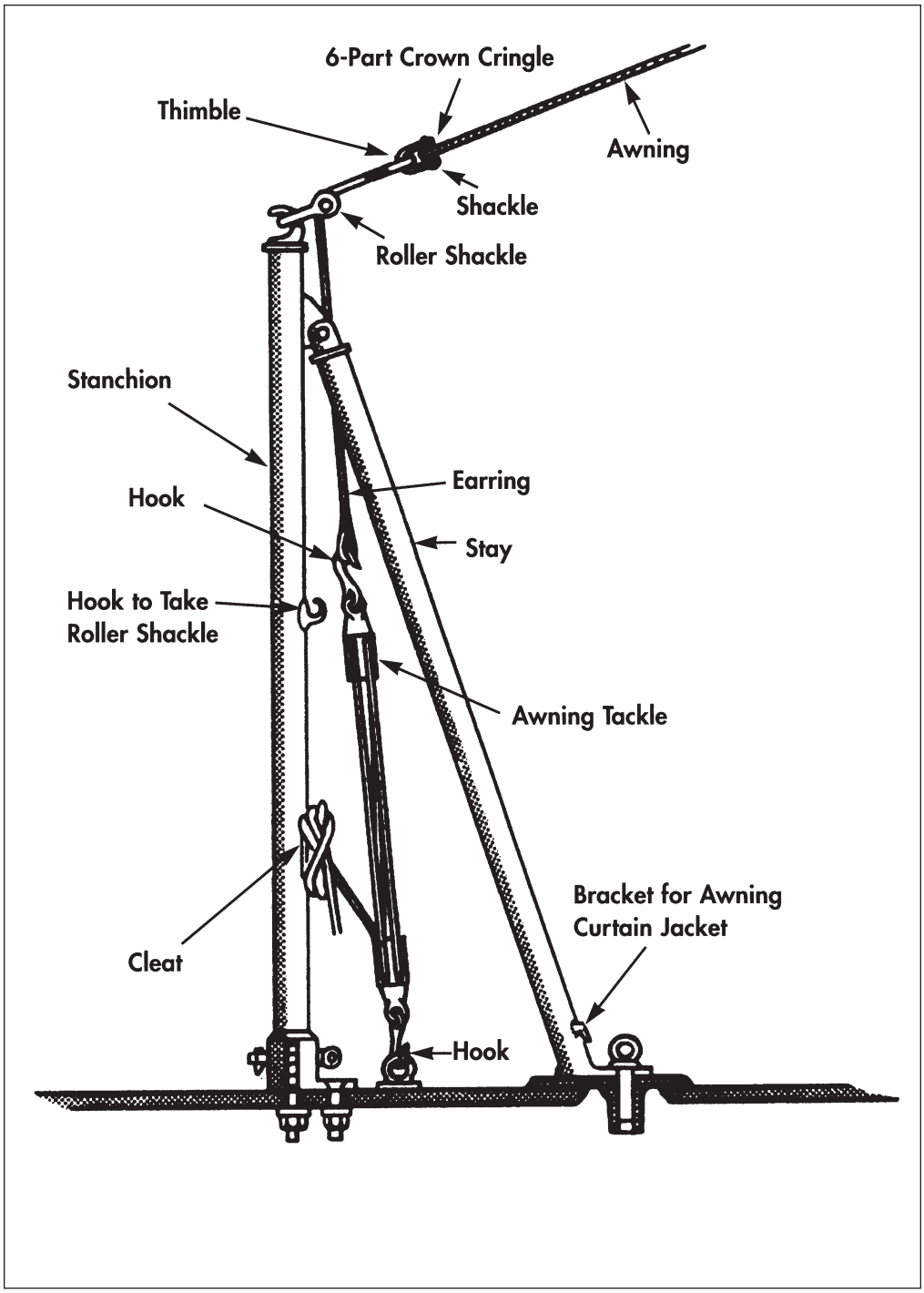

Figure 5.37-1 - Awning Stanchion

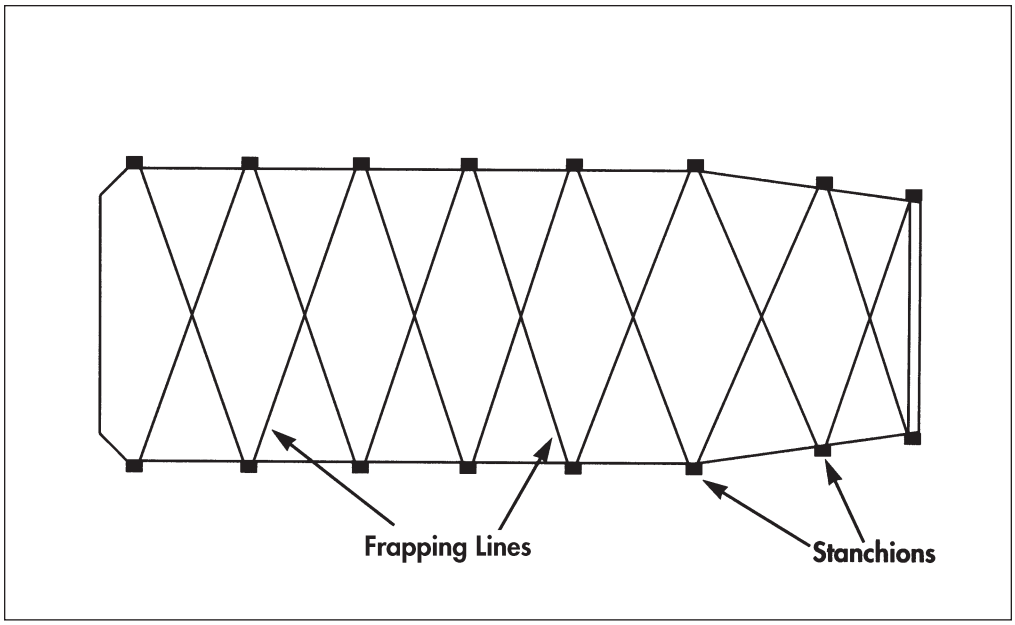

Figure 5.37-2 - Frapping an Awning

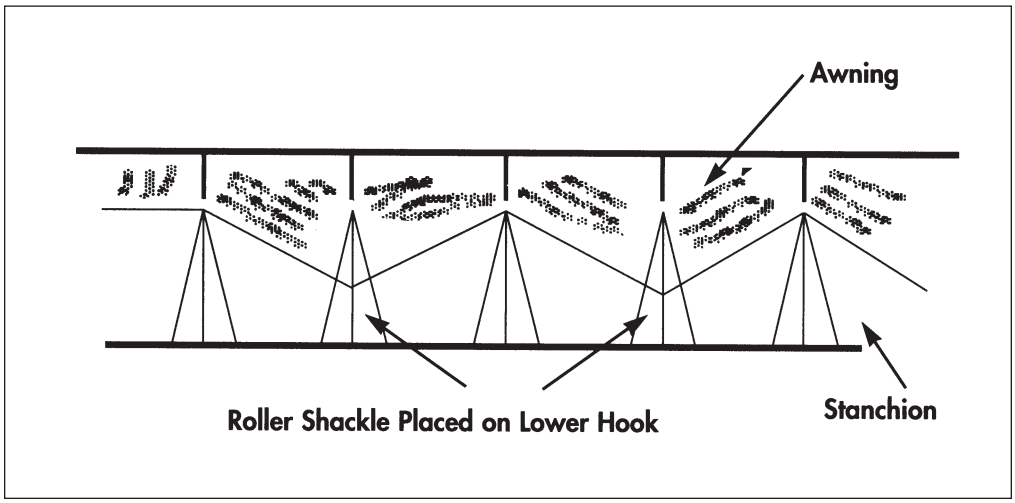

Figure 5.37-3 - Sloping an Awning

b. To rig the awning, it is first laid out on deck and checked that it is serviceable. The awning should always be laid out on the leeward side of the ship. It is passed over the backbone from leeward to windward. Before passing the awning, the leeward cringles are made fast to the earrings and awning tackle. Lines are passed over the backbone to pull the awning over. Care must be taken when passing over the backbone as some stanchions located on the centreline have spikes on their ends to receive the stainless steel grommets sewn into the centreline of the awning. Once the awning is over the backbone, the forward end of the awning is secured to the superstructure. It is then pulled aft and secured at the stern. The awning tackle is hauled taut on both sides together in order to keep the awning centred.

c. All awnings are fitted with side curtains. Side curtains offer protection from sun, wind and rain to activities taking place under the awning. Side curtains will have openings sewn in at locations where the brow will be placed. The side curtains are fastened at the top end to a wire which runs the length of the awning on both sides. The bottom of the awning is secured to the bases of the awning stanchions.

d. When striking down an awning, the windward side is released first. The awning tackle is eased out and the leeward side is pulled, allowing the awning to slide over the backbone and onto the deck. Once on deck, all awning tackles are removed and the awning is folded and secured.

e. Ships with hangars will have a tent-like structure for spreading in the hangar. The roof and sides are normally separate and are made of nylon. The peak of the awning is secured to the deckhead of the hangar. The sides have a wire running the length and width of the hangar and are either laced or secured to the wire with snap hooks.

f. Care must be taken whenever handling awnings as they are easy to tear or soil. Awnings must never be stowed wet. When stowing a Dacron or nylon awning, it must be folded versus rolled to avoid unnecessary wrinkles.

5.37.1 Care and Maintenance of Awnings and Canvas

An awning, or for that matter any canvas gear, should never by stowed below in a wet condition as this will cause rot and mildew. Canvas stored wet also possesses the risk of spontaneous combustion. Awnings/canvas should never be dragged across the deck. Not only can this cause undue wear and damage, but it will cause unnecessary soiling. Decks where awning or canvas is to be laid out should be free of oil and swept clean. When laid out, it is not to be walked on. If small tears occur, repair immediately to prevent further damage.

Upperdeck Eyepad Arrangement HALIFAX Class
The eyepads are numbered forward to aft.
Superstructure eyepads are numbered 1-26 and have either a Starboard (S) or Port (P) after the number.
Deck eyepads are numbered 1-45 and have either a Fixed (F) or Reversible (R) after the number.
This schematic is to be used in conjunction with Tables 5-2 and 5-3 of CFCD 105.

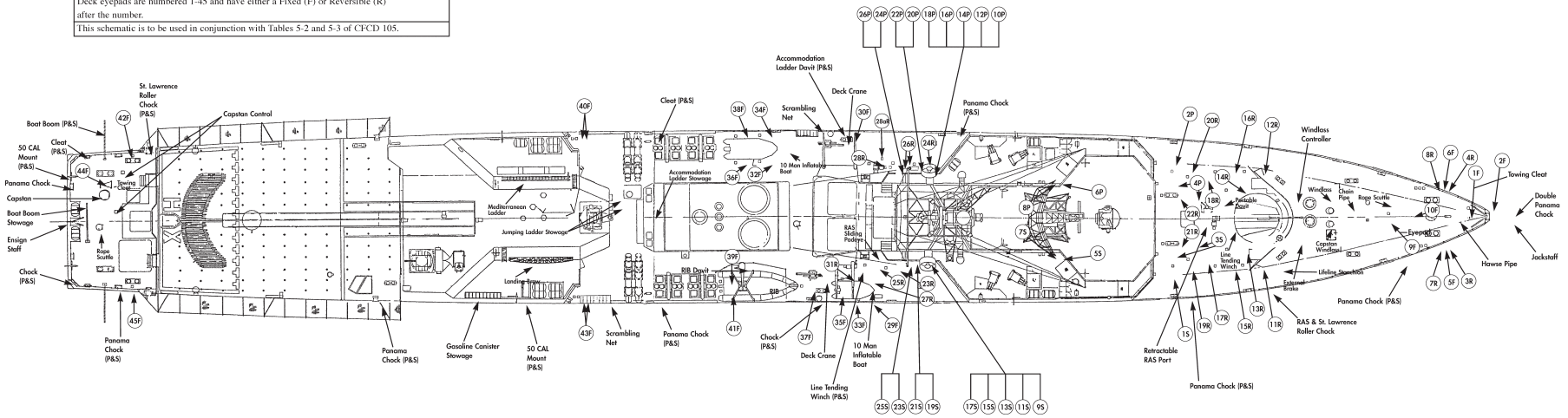

Figure 5.23-1 - Configuration of Eyepads

CHAPTER 6
Berthing and Slipping

contents

list of figures & tables

list of figures & tables(cont)

CHAPTER 6
Berthing and Slipping

6.1 Introduction

a. One vital and constantly practiced aspect of seamanship is that of berthing and slipping[1]. Under benign circumstances when the weather is calm and sea room is ample, a ship's arrival or departure can appear fairly routine. However, circumstances can and often will change very rapidly, requiring Part Ship I/Cs and their subordinates to react smartly and safely.

b. A ship is said to berth (moor) when it comes alongside a pier or jetty. It is held fast to the pier or jetty by several berthing hawsers, commonly referred to as berthing lines. Each of these hawsers has a name and purpose, which will be described later in the chapter. Slipping is essentially the reverse of berthing and involves the taking in of the berthing hawsers and departure from the berth.

c. The guiding principle of berthing and slipping, as in any seamanship evolution, must be safety. It is simply poor seamanship and bad shiphandling if any damage is done to the ship, jetty or – most importantly – to personnel when berthing or slipping (emergencies aside). Communication plays a vital part when berthing or leaving a berth. Each part ship must be in direct communication with Command.

d. **Berthing**. At the Command pre-arrival briefing, the ship and line handling intentions will be promulgated. Under normal circumstances a ship will approach a jetty – bow first – at an angle of approximately 15 degrees. The fore spring is normally the first line ashore, as it is used to check the ship's headway and assist in twisting the stern in towards the jetty. Great care must be exercised on the focsle as excessive headway could lead to the fore spring parting. The head rope is the second line ashore, and is normally taken to the capstan in order to control the ship's head. Aft, the first line ashore is normally the stern rope, which is taken to the capstan and heaved in to bring the stern onto the jetty. The after spring is the second line ashore aft, and is used to check any sternway that develops while manoeuvering alongside. The breast lines (normally two) are taken ashore in no particular order (depending on jetty bollard location) and are down-slacked by hand as the head and stern ropes (and engines) are worked to bring the ship alongside.

e. **Slipping**. At the Command pre-departure briefing, the ship and line handling intentions will be promulgated. Under normal circumstances, a ship will depart a jetty in reverse order from the arrival. The breast lines, after spring, and stern rope are simultaneously taken in to allow the stern to move freely off the

[1] Much of the material in this chapter is taken from BR67.

jetty. The fore spring is held while the head rope is heaved in on the capstan, and engines are used, resulting in the ship's head being cast in toward the lie of the jetty. Again, great care must be exercised on the focsle as excessive headway may develop, leading to hazardous working conditions with the fore spring. The head rope and fore spring are then taken in, and the ship makes a sternboard departure.

f. There are unlimited sets of circumstances that will result in Command modifying the plans. For instance, a ship may back into a berth with or without tug assistance, and then make a forward departure. An anchor may be used to help control the movement of the bow in high winds. In any event, a sound plan that is made clear to all safety officers, I/Cs and part ship hands is key to the safe conduct of the evolution.

6.2 Terminology

Double Up To pass a second line through the same fairlead to the same bollard and middle the weight.

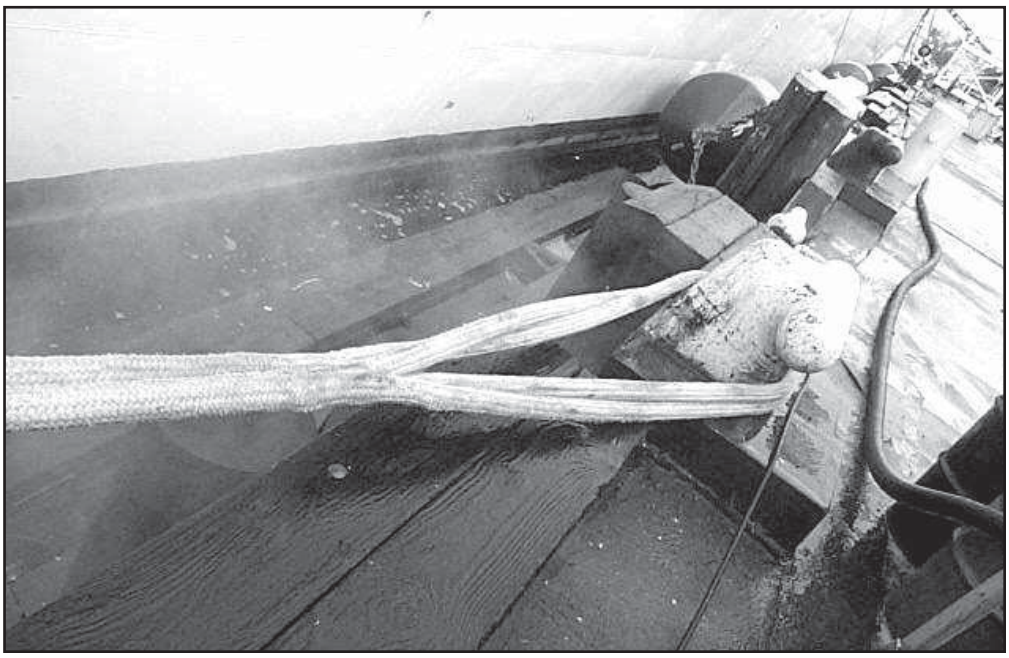

Figure 6.2-1 - Double Up with Second Eye Dipped

Dipping the Eye When more than one eye is required to be passed to the same bollard, the eye of the second hawser is passed up through the eye of the first hawser then onto the bollard. This will allow either eye to be slipped from the bollard first.

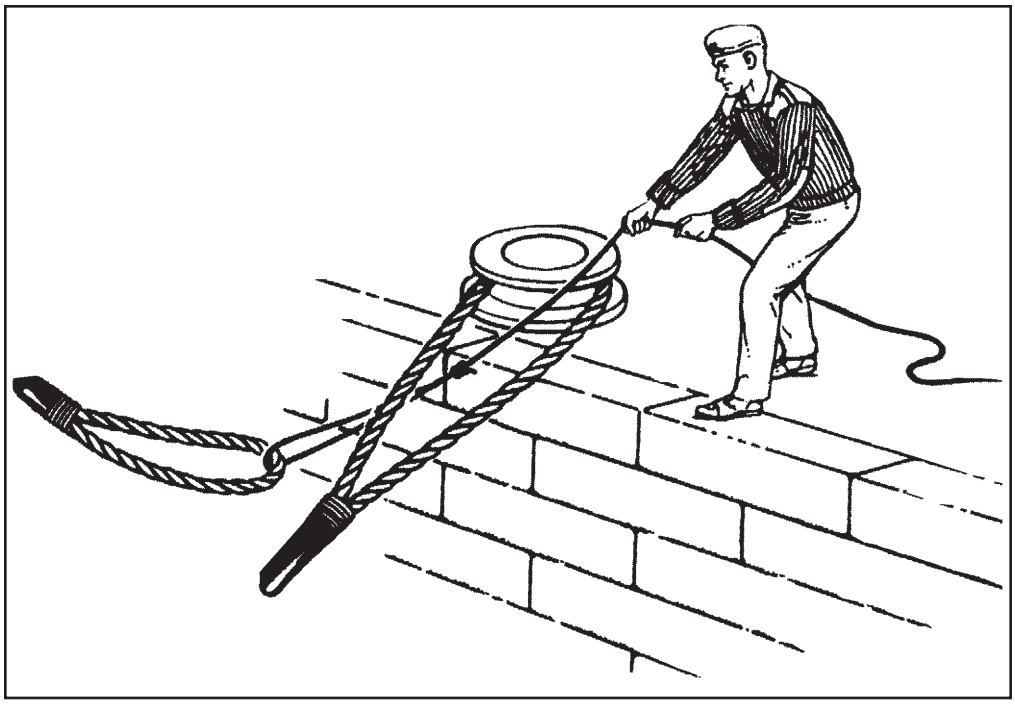

Figure 6.2-2 - Dipping the Eye

Check To ease a line out under control either from a bollard, capstan or winch.

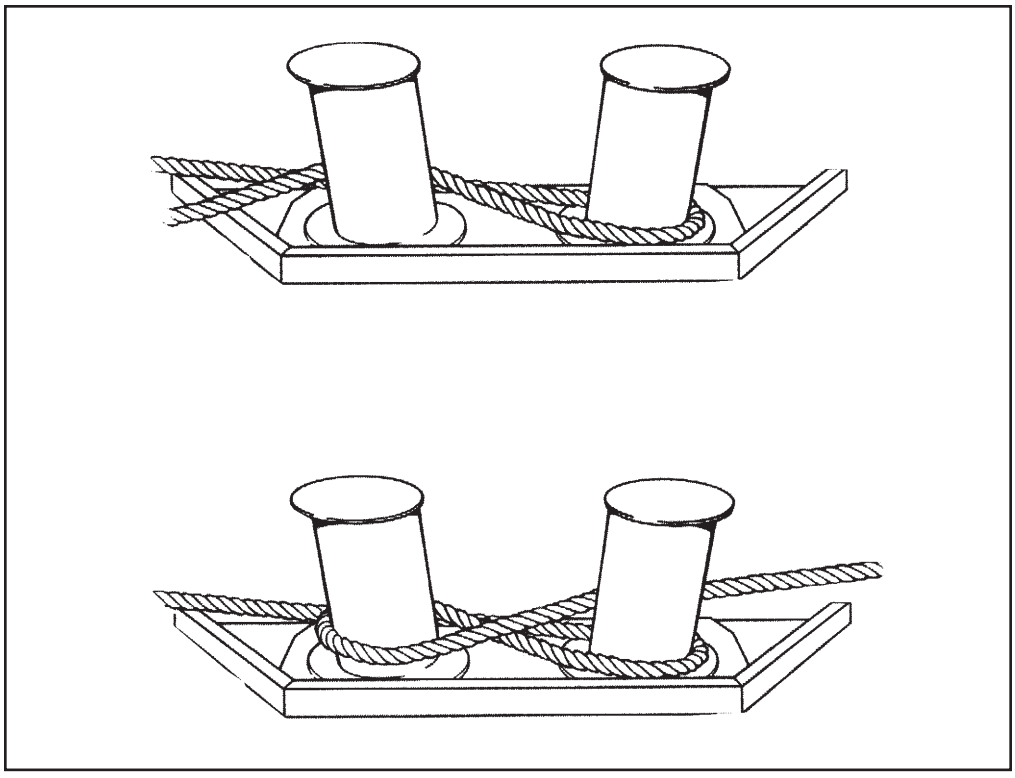

Figure 6.2-3 - Checking a Line

Surge To surge a line is to ease the tension on the line so as to allow the winch to turn without heaving in on the line.

Greasy Fid A large tapered wooden pin with a securing line attached at one end that is used to secure an eye of a hawser back onto itself.

To Fake Down To place a line or wire on deck in large fakes or bights so that it is free for running.

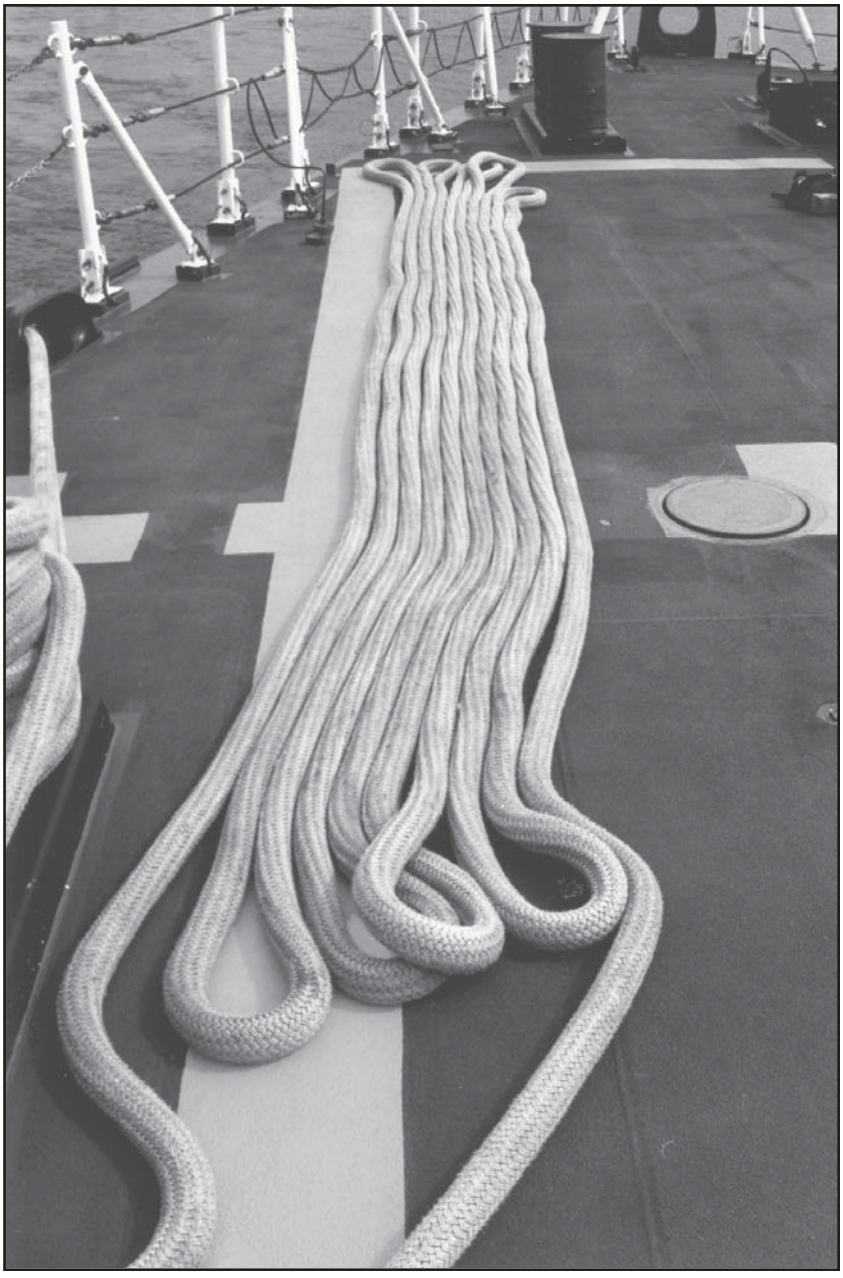

Figure 6.2-4 - To Fake Down

To Cheese Down A method of coiling a rope or line neatly and flat on the deck for stowage commencing with the standing end working inward.

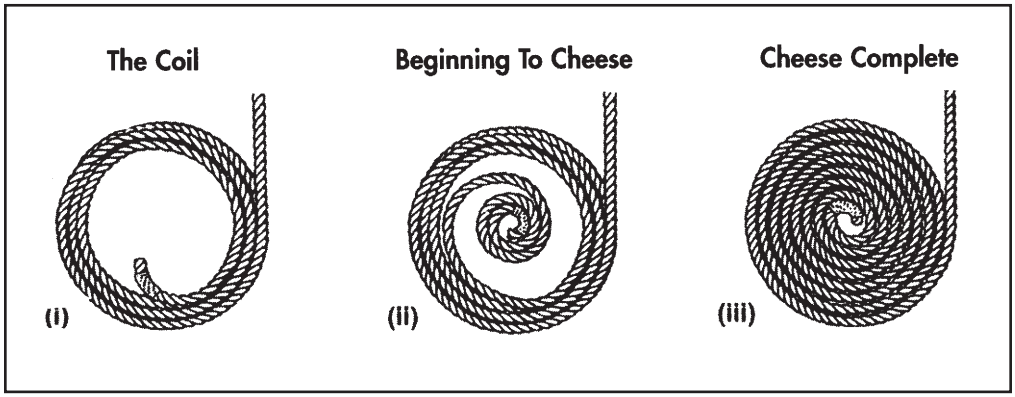

Figure 6.2-5 - To Cheese Down

Snap Back Caused when a hawser is stretched beyond its limit and suddenly breaks. It then contracts and whips back to regain its original size (much like a stretched elastic). When this happens it is capable of severely damaging or injuring anything and anyone in its path.

Racking a Hawser If a wire hawser is to remain on a twin bollard for any length of time, the two upper turns are lashed together. This is called racking.

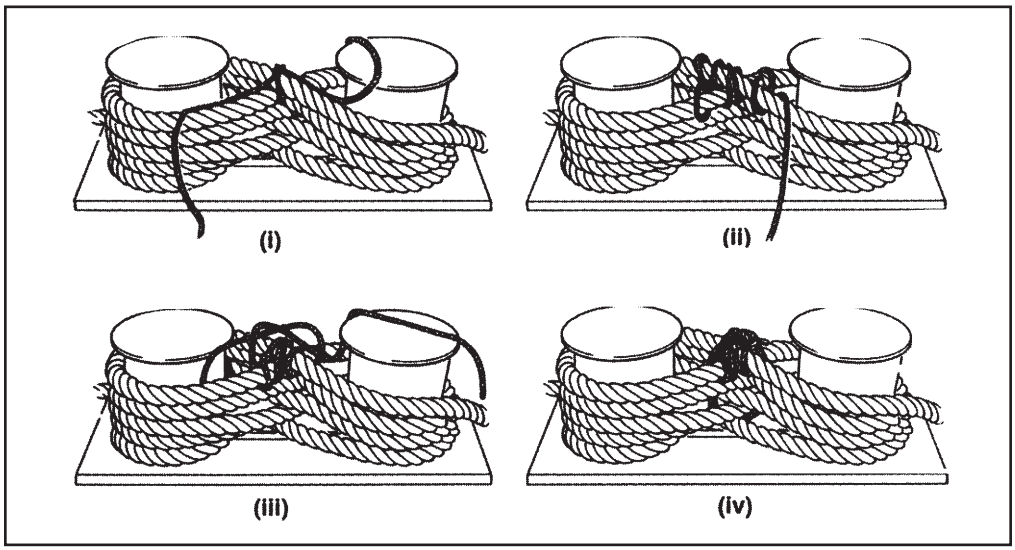

Figure 6.2-6 - Racking a Hawser

Back Up — Hold pressure on the hauling part of a hawser under tension to prevent it from surging forward on a winch or bollard.

Hurricane Hawser — Specially constructed wire or rope hawsers used mainly if high winds are present or forecast. They are led to the jetty, one from the focsle and one from the after end of the ship.

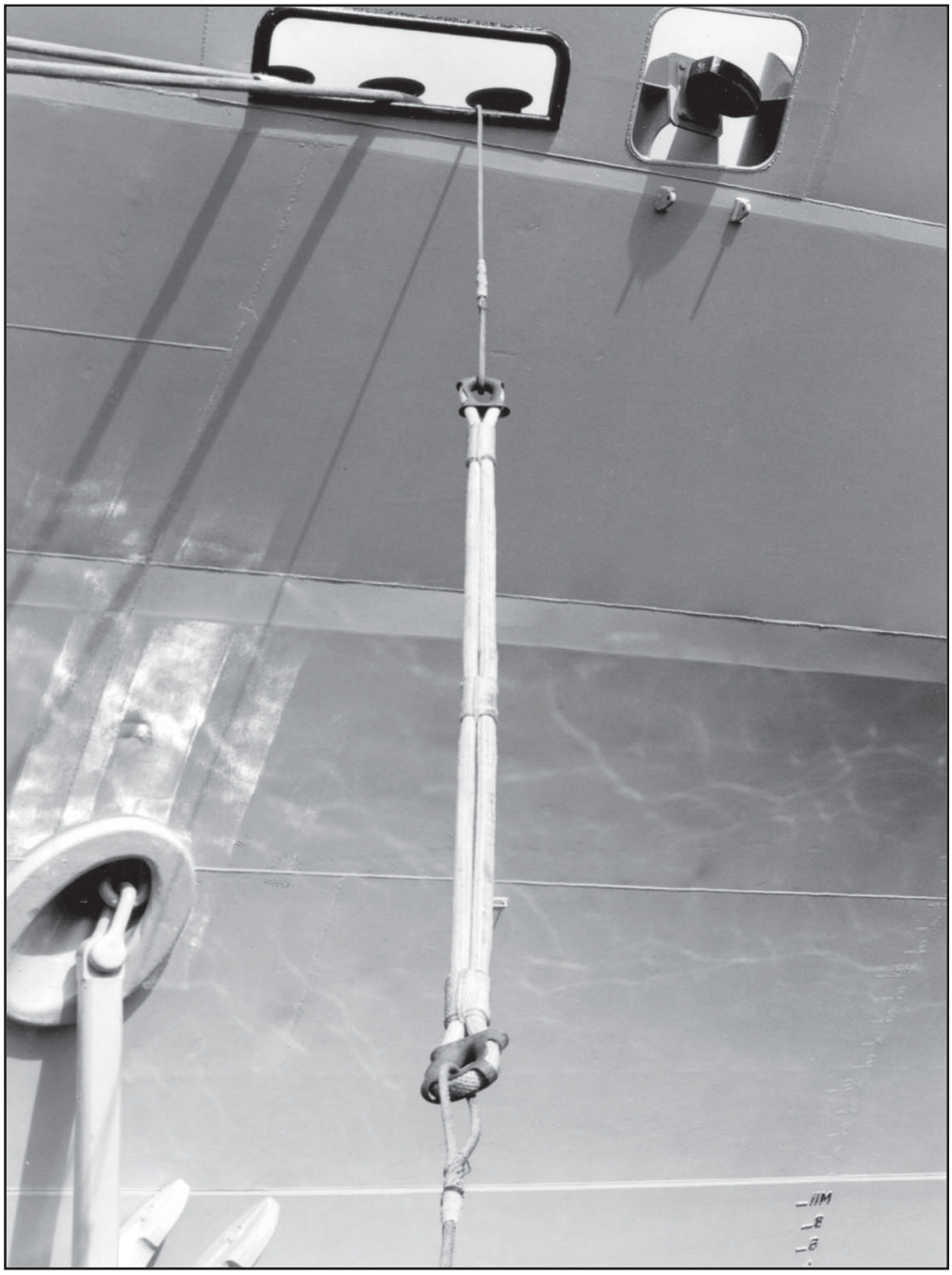

Figure 6.2-7 - Hurricane Hawser

6.3 Common Orders

The common orders and terms used when handling hawsers or lines are listed below.

Table 1 Terms/Definitions

Orders or Term	Definition
Heave in	The order to heave in on a capstan, winch or by hand.
Hand over hand	To haul a rope, keeping a steady pull.
Haul taut	An order to take down the slack and take the strain.
Avast	Order to stop hauling or lowering.
Hold	An order to hold a rope under strain so as to keep it from moving.
Hoist away	To lift.
High enough	The order to stop hoisting.
Marry	The order to bring two ropes together side by side and handle them as one. Also a term used in splicing, meaning to butt two ropes' ends together with their respective strands interlocking.
Lower away	The order to lower.
Handsomely	Slowly, with care (e.g., 'heave in handsomely').
Roundly	Smartly, rapidly.
Walk back	An order to ease a rope out while keeping it in hand and taking a step moving towards the pull.
Light to	An order to let go of the line and let it run freely.
To veer	To pay out under power.
Check away	The order to ease a rope steadily by hand while keeping a strain on it.
To surge	To allow a hawser to ease out by its own weight or by the strain on the outboard end. A hawser slipping around the drum of a capstan or winch is said to surge whether the drum is stopped or turning to heave in. **Surging when the drum is veering is dangerous.**
To back up	To take a line in hand on the disengaged or after side of a capstan or bollard on which turns have been passed.

6.4 Personnel Requirements

a. Special Sea Dutymen, Cable Party, Part Ship hands and Submarine Casing Party, as promulgated in the ship's Watch and Station Bill and Special Parties Boards, will be required for all berthing and slipping evolutions. The Boats Crew and lowers may be required as well to hoist or lower the boat in the event that the ship must provide her own berthing or slipping party.

b. The optimum number of Part Ship hands to work each hawser is shown below:

Table 2 Personnel Requirements

Class	Calm Weather	Wind Warning Issued
AOR	6	10
IROQUOIS/HALIFAX	4	8
KINGSTON	3	3

6.5 Equipment Required for Berthing/Slipping

6.5.1 Common Associated Equipment

Table 3 Equipment for Berthing/Slipping

Rope Stopper	Line-throwing Gun (FX/AX)
Fire Axe	Bolos
4" x 4" Wood Block	Berthing Hawsers
Heaving Lines	Fenders
Brow (if req'd)	Tug Towline (if req'd)
Bollard Strops	Casing Jewellery
Safety Net	Rat Guard

6.5.2 Hawsers

a. A ship's hawser berthing arrangement varies according to the size and characteristics of the vessel. Each of the hawsers in a berthing arrangement has a special name and purpose. Berthing hawsers can be one of the following types: head rope and stern rope, breast rope or spring rope.

b. The head rope and stern rope are used to adjust the ship's position alongside a jetty. They also assist in checking fore and aft, and lateral movement alongside.

c. Springs lead obliquely, but nearly parallel to the keel and control the fore and aft position of the ship with respect to her berth. Any spring that leads aft and prevents the ship from moving forward is known as a head or fore spring and any spring that leads forward and prevents the ship from moving aft is known as a back or after spring.

d. Breasts lead nearly perpendicular to the keel of the ship and control lateral movement or the distance that the ship lies from the jetty.

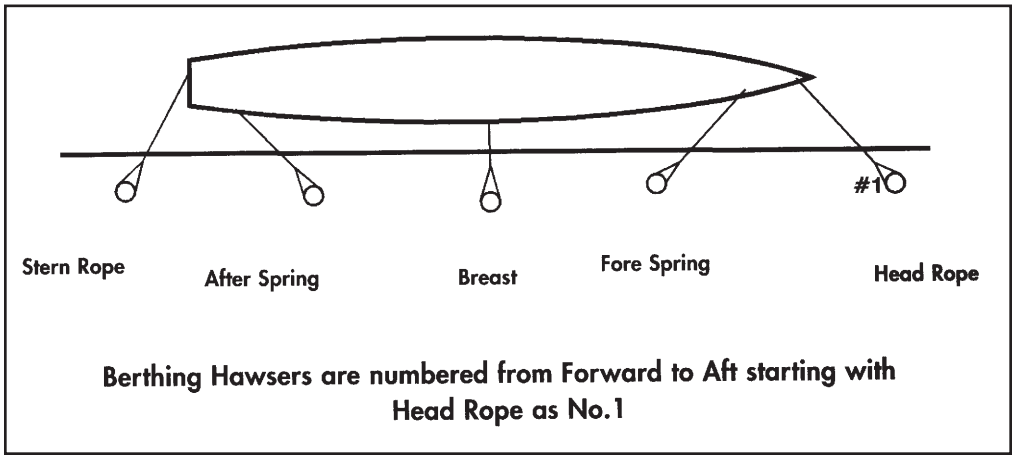

Figure 6.5-1 - A Ship Secured Alongside

e. Berthing hawsers are delivered to the Dockyard Riggers on reels measuring 370 m (1200') in length. It is the responsibility of ships' Chief Bosn's Mates to submit work orders whenever required for lines to be cut to specific lengths with eyes spliced on either end. The following are the required size and length ranges of the berthing lines used in the Canadian Navy:

(**1**) IROQUOIS and HALIFAX Classes:

Diameter: 48 mm double-braided nylon (52.2 tonnes breaking strength).
Length Range: 110 - 150 metres.
Number of Hawsers: 6

(**2**) AOR 509/510 Classes:

a. Diameter: 56 mm double-braided nylon (68.1 tonnes breaking strength).
Length Range: 110 - 150 metres.
Number of Hawsers: 4

b. Diameter: 48 mm double-braided nylon.
Length Range: 110 - 150 metres.
Number of Hawsers: 2

(**3**) KINGSTON/UPHOLDER Classes:

Diameter: 40 mm double-braided nylon (37.2 tonnes breaking strength).
Length Range: 100 metres.
Number of Hawsers: 5

6.5.3 Bolos, Gunline and Heaving Lines

a. In order to pass a hawser or similar type line ashore, a lighter line that can be worked quickly must first be passed to "make contact", and then be used to haul the hawser over. Under normal circumstances, heaving lines are thrown the short distance from the ship to the berthing party waiting on the jetty. When the distance ashore is greater, for instance when a strong off-jetty wind is blowing, a bolo or gunline will be used.

b. **Heaving Lines** . Most heaving lines are made of 10 mm circumference sash cord to lengths of approximately 50 metres. One end of the heaving line is made into a weighted monkey's fist, which leads the line ashore.

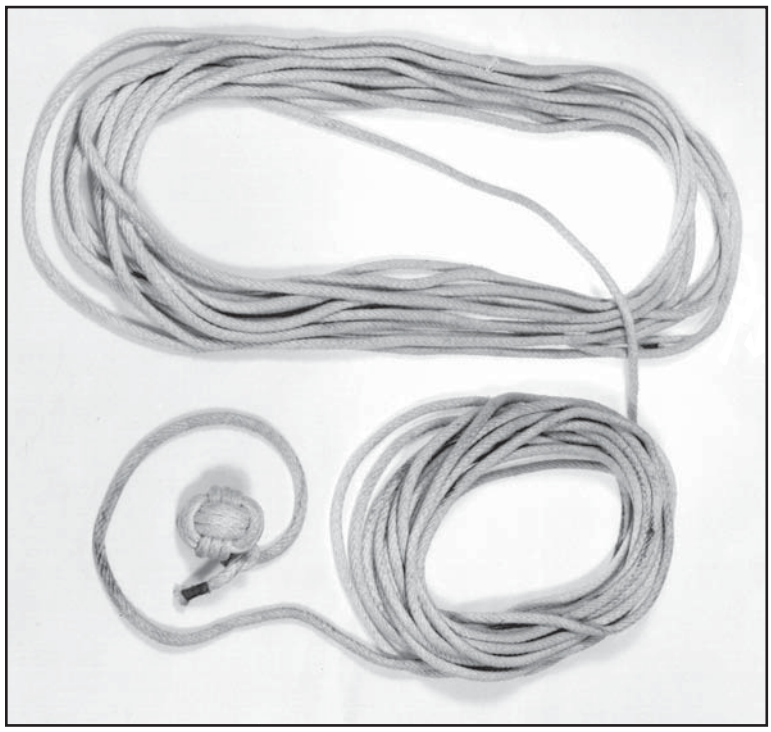

Figure 6.5-2 - Heaving Line

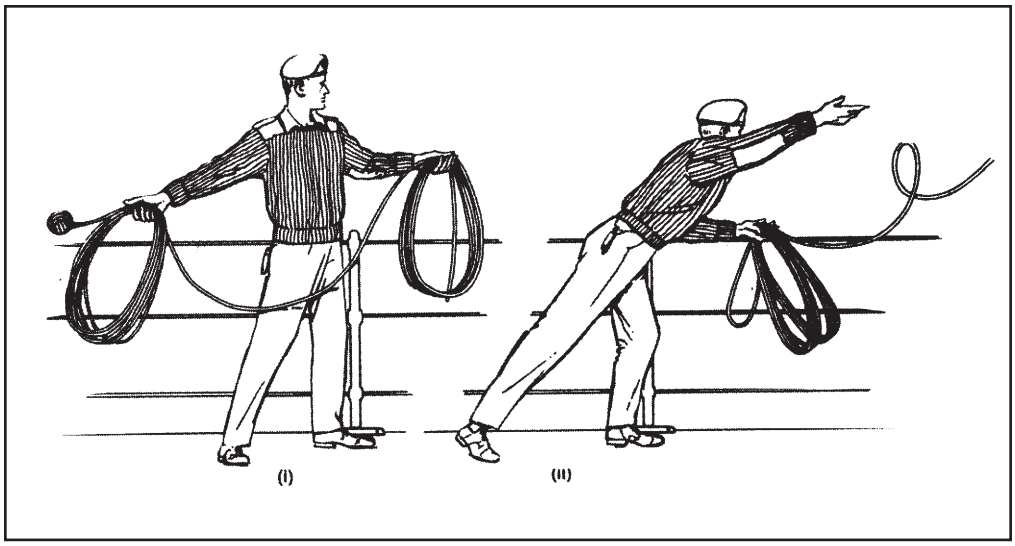

Figure 6.5-3 - Throwing a Heaving Line

c. **Bolos.** Bolos are made using orange buoyant line of 1 mm circumference. A small canvas bag weighted with small lead pellets is attached to one end, which leads the line ashore. It can be thrown greater distances then a heaving line.

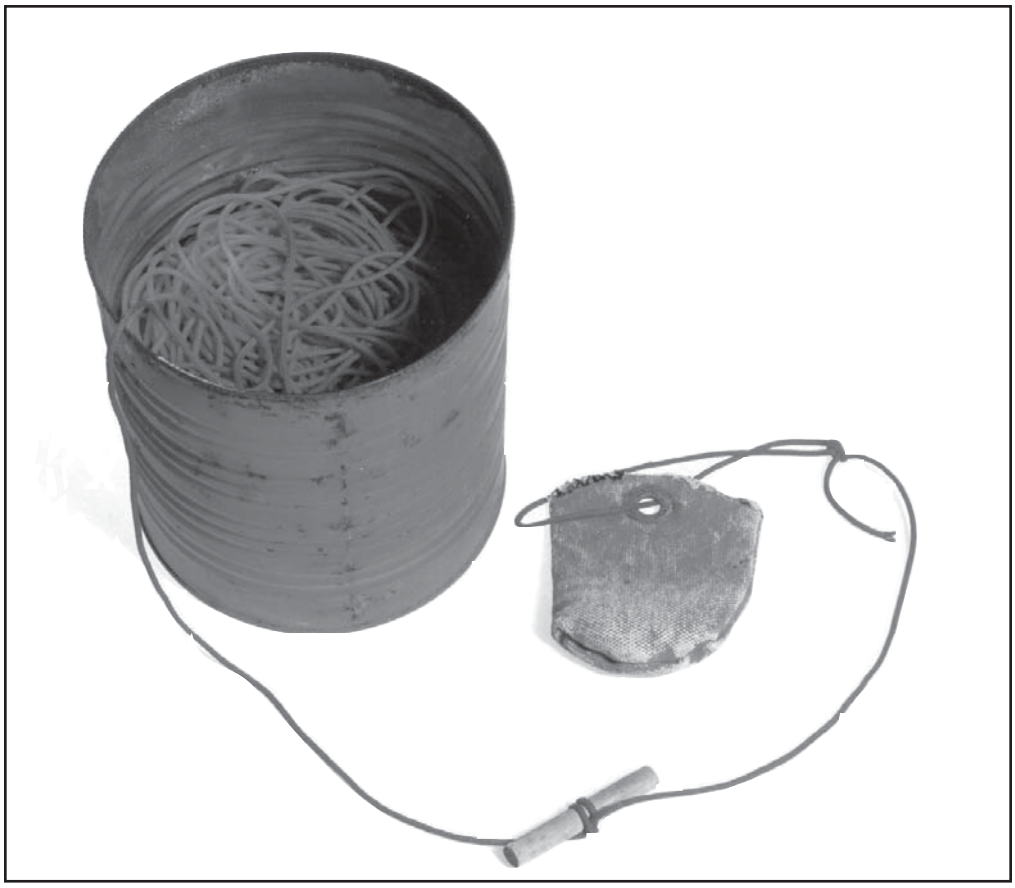

Figure 6.5-4 - Bolo

d. **Gunline**. Gunlines are made using the same buoyant line as bolos. One end of the line is attached to a plastic projectile which is fired from a line-throwing gun. A .44 calibre line-throwing cartridge provides the projectile with considerable momentum, throwing it greater distances than the bolo. It is most commonly used to make contact during RAS and towing evolutions; however, it can prove invaluable during difficult berthing sequences.

Figure 6.5-5 - Gunline in Containers c/w Projectile

6.5.4 Rope Stoppers

To transfer a hawser under strain from the capstan to a bollard or vice versa, the strain must first be taken temporarily by passing a stopper. A stopper consists of a length of line of the same material as the hawser but normally smaller diameter, middled to form two tails and made fast to an eyeplate or other fixture. The stopper is half hitched and laid alongside the hawser with its tails pointing towards the source of the strain. The tails are passed by crossing them under and over the hawser in the direction of the source of the strain. The ends are kept in hand or stopped to the hawser.

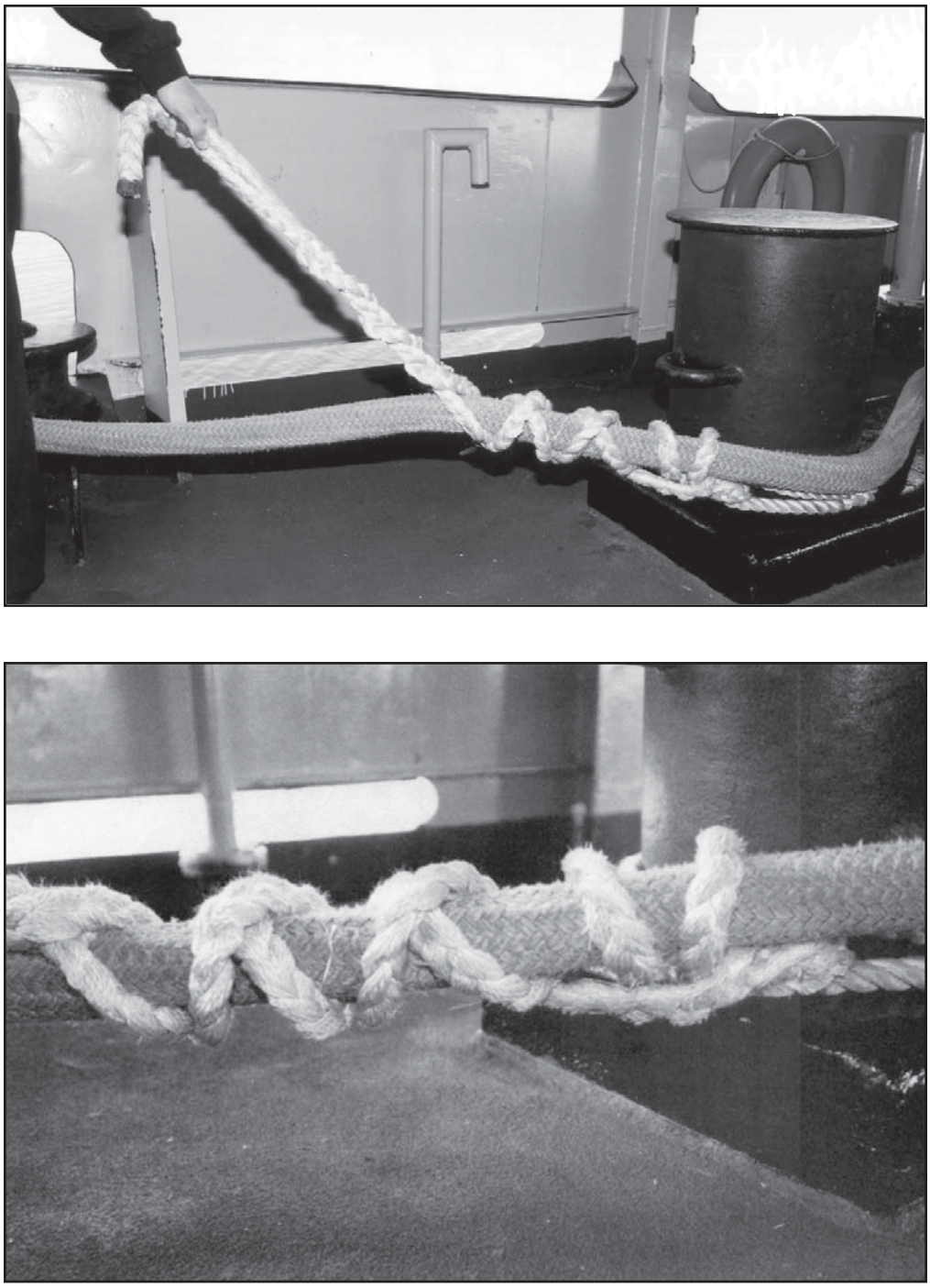

Figure 6.5-6 - Rope Stoppers

6.5.5 Rat Guards

Rat guards are used to prevent rats, mice or any other rodents from climbing up the hawsers from the jetty and infesting the ship. They are used on all lines that lead to the jetty, including shore connections such as power cables. They are placed approximately 1.5 m from the jetty end of a hawser.

Figure 6.5-7 - Rat Guard

6.5.6 Fenders

When berthing and slipping, resilient fenders are necessary to absorb any impact. Impact does not necessarily imply mishap. For instance, during a departure when casting the ship's head into the lie of the jetty, the bow often rests on the jetty to facilitate the twist. There are several types of fenders: those that are fixed to jetties such as large pneumatic and log fenders, and portable fenders that are carried in ships. In all cases, they must be sufficiently robust to withstand the crushing weight of the ship, and large enough to spread and absorb the shock over a large area of comparatively weak hull plating.

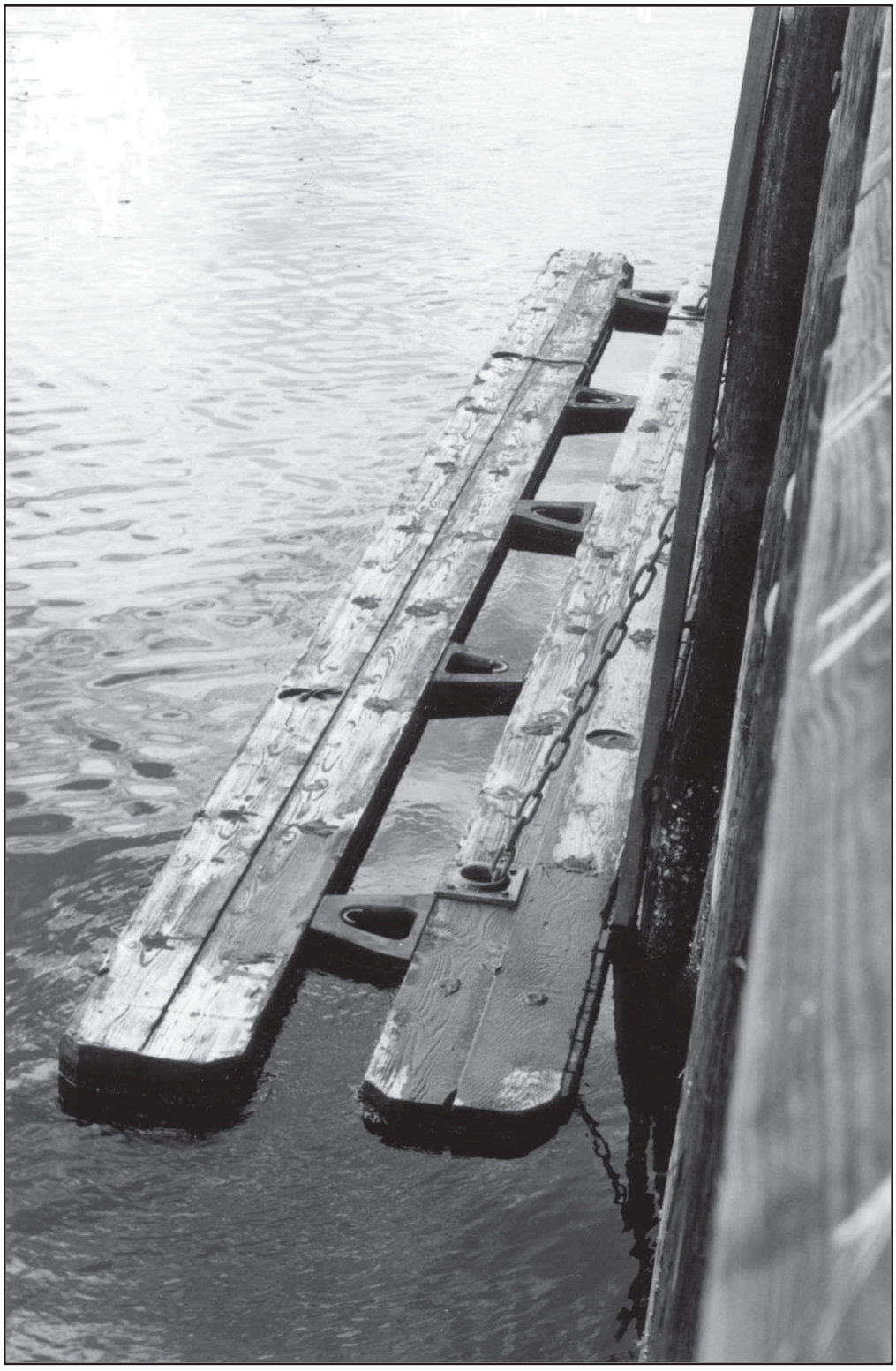

Figure 6.5-8 - Compression Catamaran

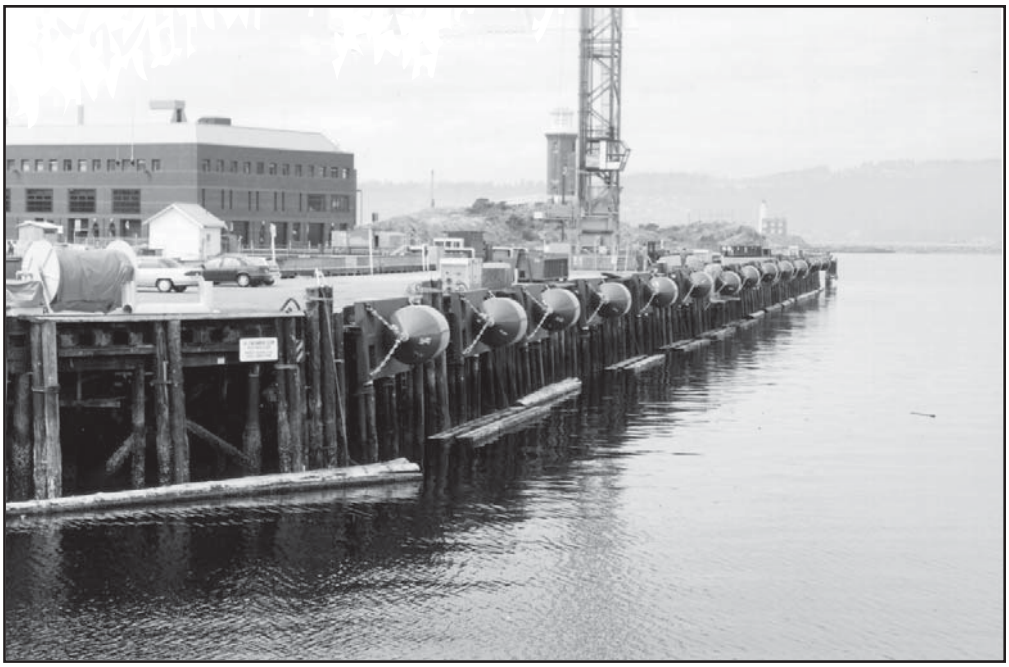

Figure 6.5-9 - Small Pneumatic Fenders

Figure 6.5-10 - Log Fender

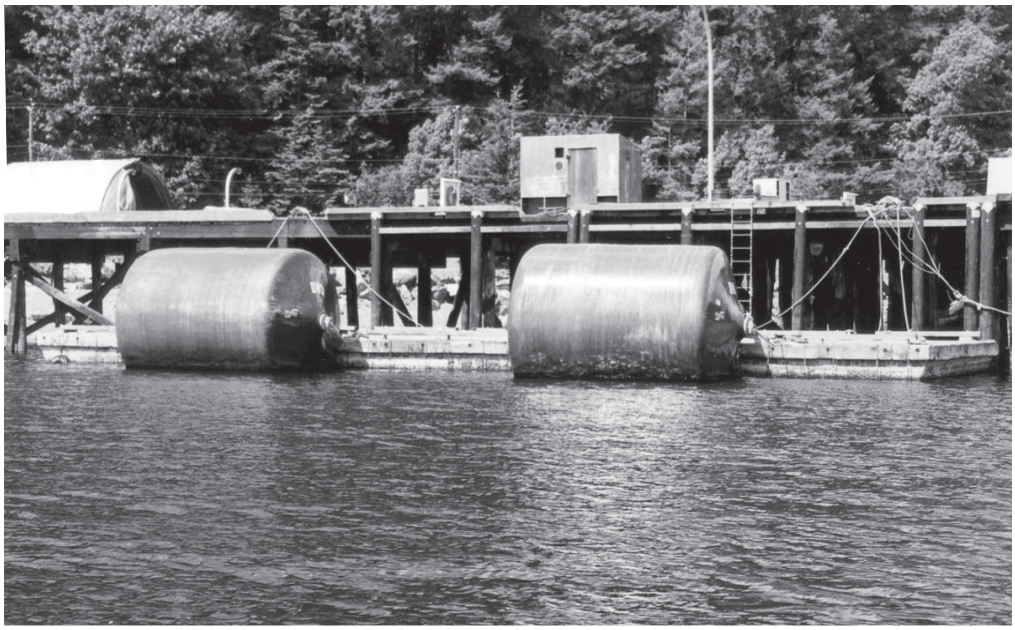

Figure 6.5-11 - Large Pneumatic Fenders (Yokohama)

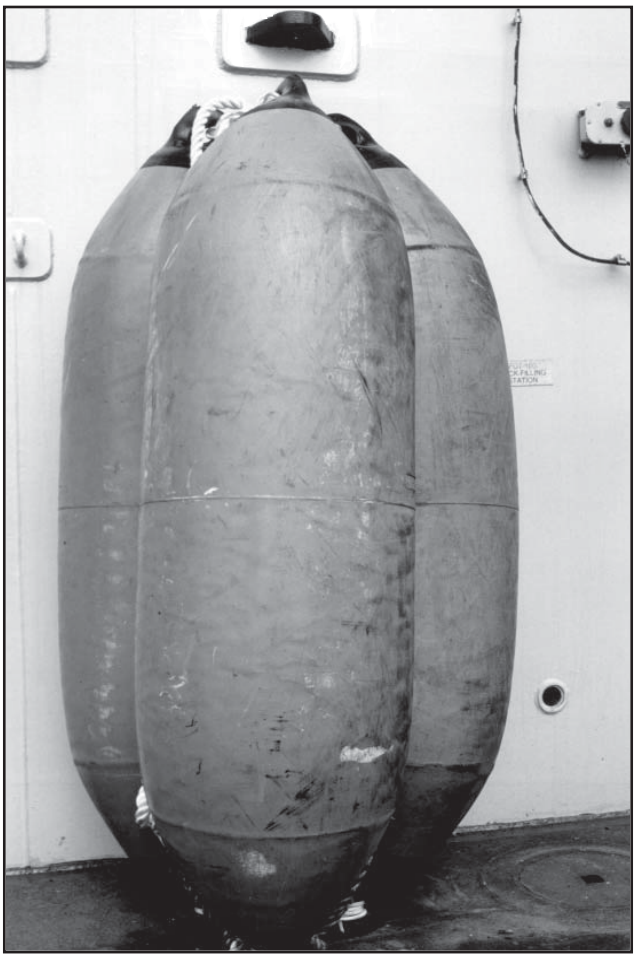

Figure 6.5-12 - Portable Fenders

6.5.7 Safety Equipment

Sledgehammers are required at each part ship in the event that lines are fouled on fittings and require freeing. In addition, axes and 4 x 4 wooden blocks are to be available in case there is a requirement to cut lines under strain in an emergency.

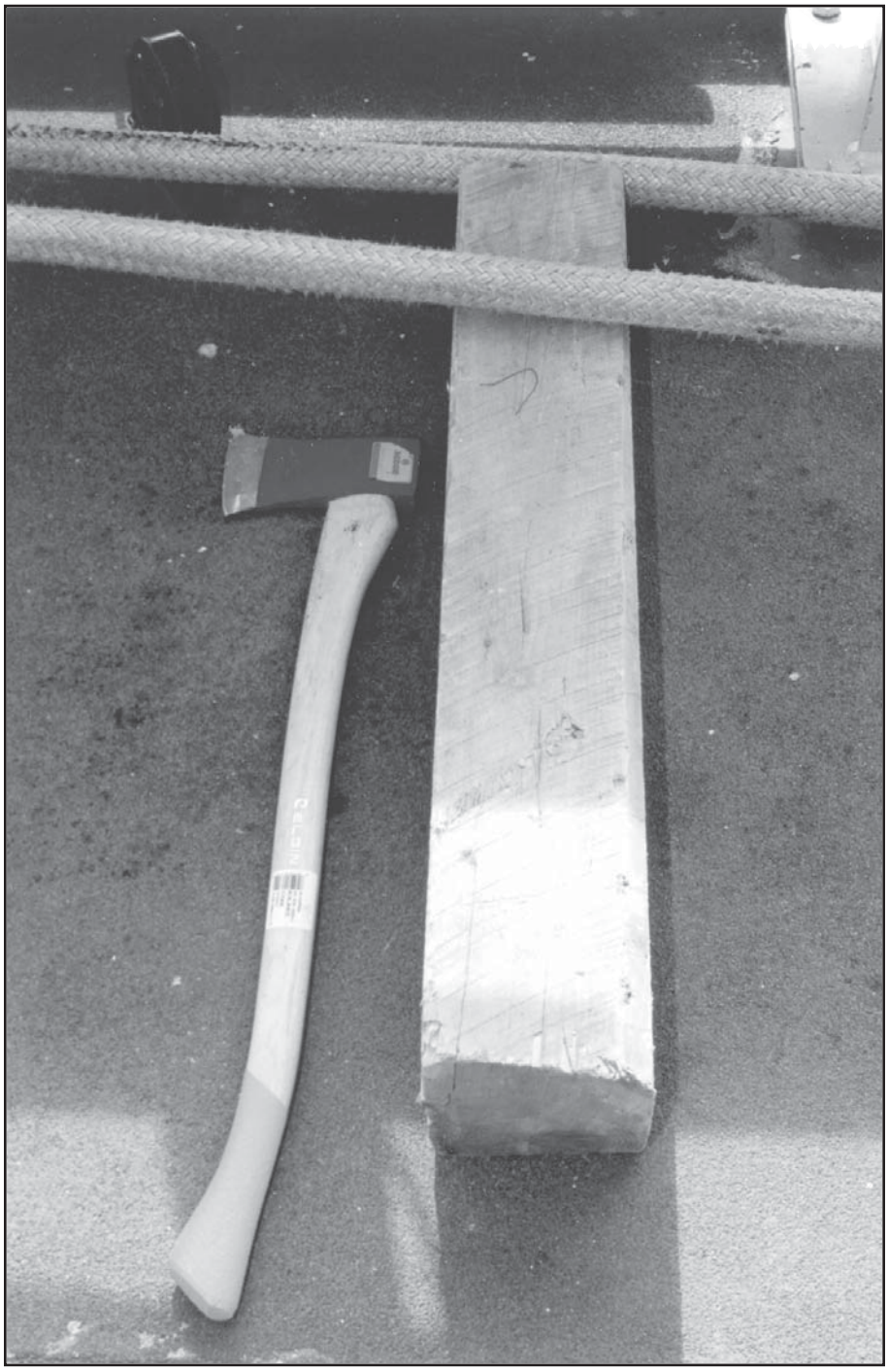

Figure 6.5-13 - Safety Equipment

6.5.8 Deck Fittings

Berthing hawsers leading from a ship to a jetty pass through fairleads near the ship's side. Fairleads are fittings with round surfaces through which a hawser may be led so as to change its direction without excessive friction. A Panama fairlead is an older type of fairlead which is fitted on top with a fixed or removable plate. It was designed to facilitate the use of the four "mule" lines that are used to safely middle ships at various heights in the locks of the Panama Canal. A roller fairlead is one fitted with rollers designed to facilitate the streaming and recovery of hoses, during an astern fuelling. A Bullring is a fairlead located on the focsle immediately above the stem. A bollard is a single or double bitt used to work or secure hawsers. Cleats are normally used to secure smaller lines, but on occasion can be used for tug lines or hawsers if no bollards are available.

Figure 6.5-14 - Fairlead

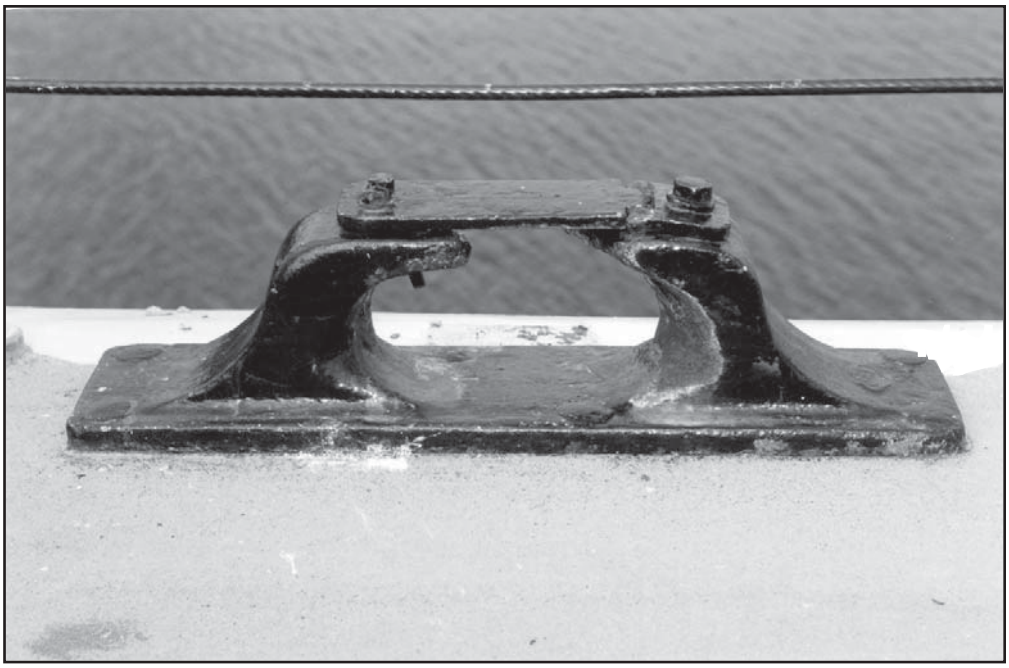

Figure 6.5-15 - Panama Fairlead

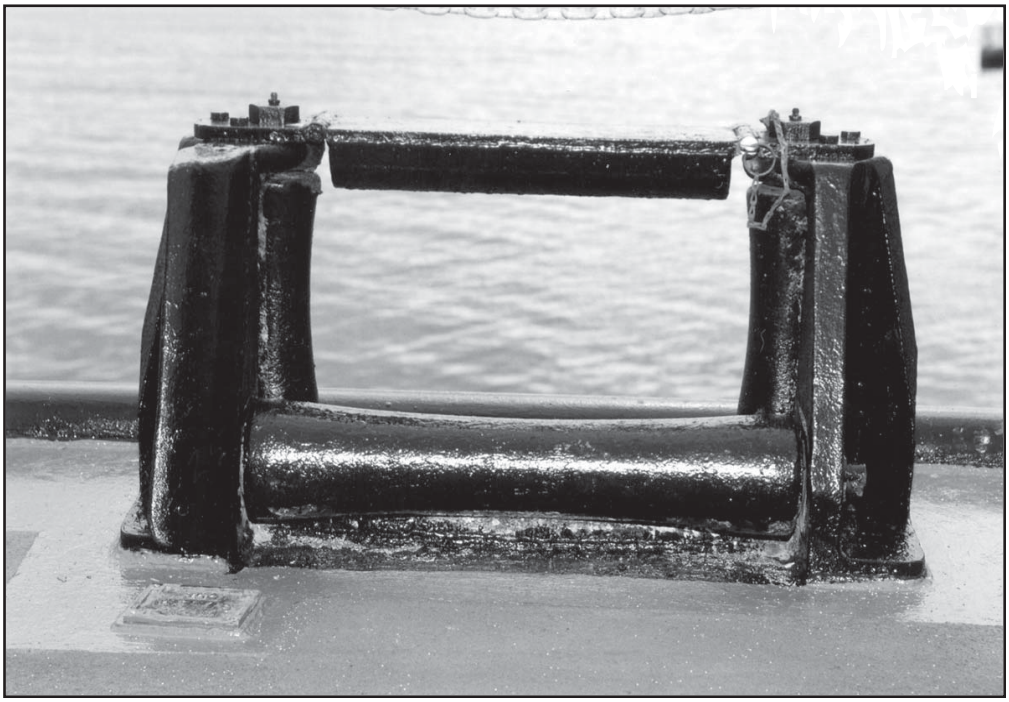

Figure 6.5-16 - Roller Fairlead

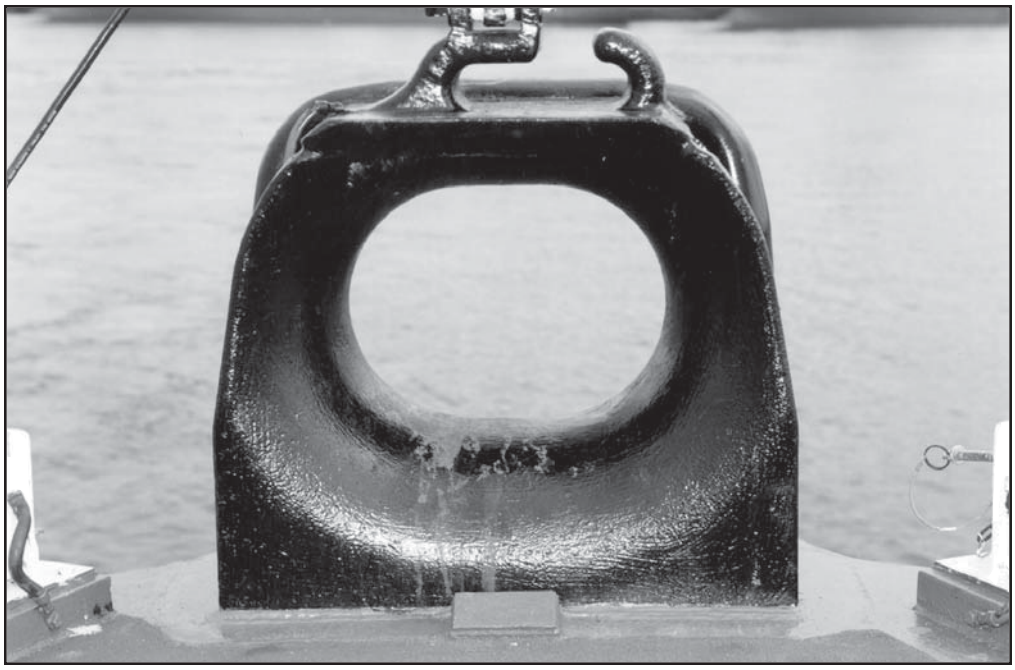

Figure 6.5-17 - Bullring with Angle Fairlead

Figure 6.5-18 - Bollard

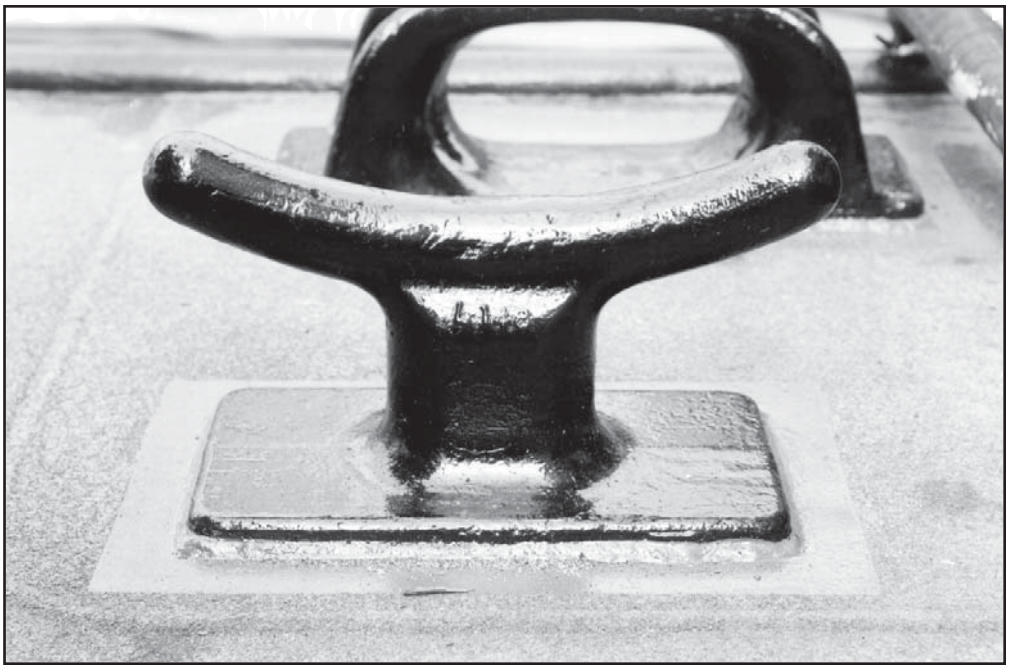

Figure 6.5-19 - Cleat

6.5.9 Brow Ceremonial Equipment

The following table and photos show ceremonial equipment that is set up at the brow whenever a ship is alongside. It is set up immediately prior to berthing, and secured for sea immediately prior to departure.

Table 4 Equipment - Brow Ceremonial	
Ship's Bell	Ship's Name Plates
Battle Honours Board	Ship's Kisby Ring
Brow Skirts	Ship's Crest
Pegboards	Quartermaster's Desk

Figure 6.5-20 - Ship's Badge and Bell

Figure 6.5-21 - Name Plate

Figure 6.5-22 - Battle Honours

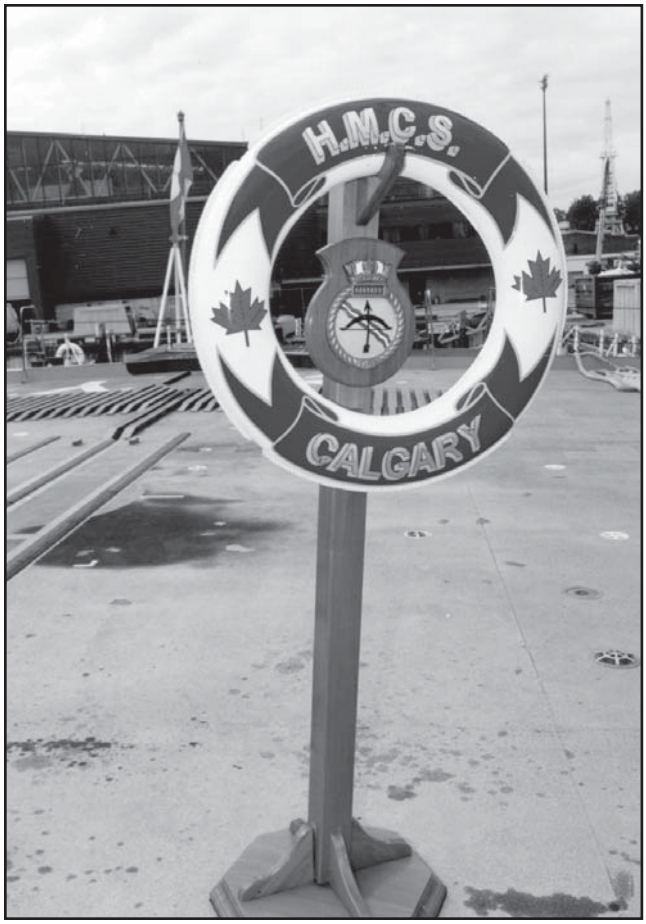

Figure 6.5-23 - Ship's Kisby Ring

Figure 6.5-24 - Pegboards

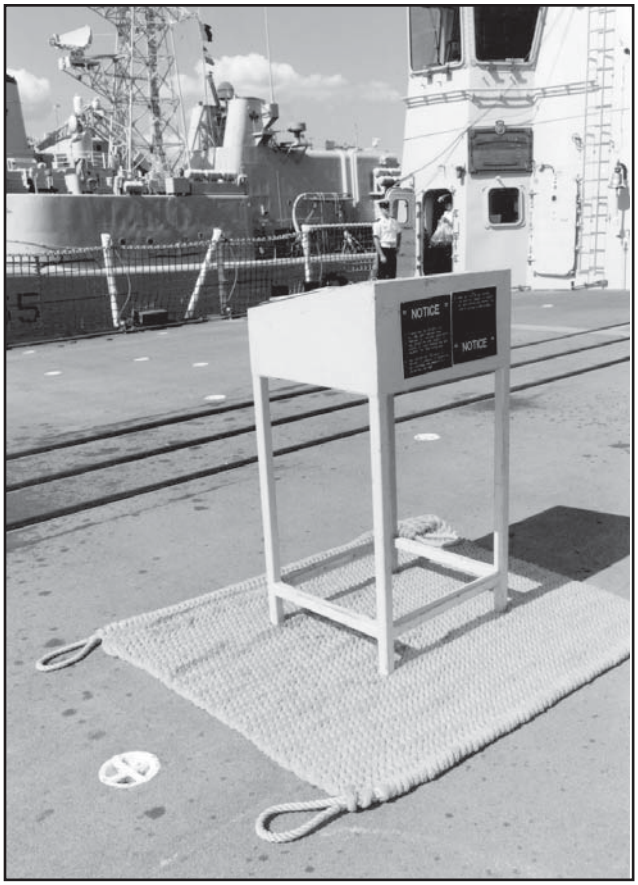

Figure 6.5-25 - Quartermaster's Desk

6.5.10 Brow Lifesaving and Emergency Equipment

When secured alongside a jetty or another ship, safety equipment shall be put in place in order to minimize the risk of persons falling overboard, and to provide immediate assistance should a mishap occur. The following is required:

a. A safety net of sufficient size to extend four feet forward and five feet aft of the brow shall be suspended beneath the brow.

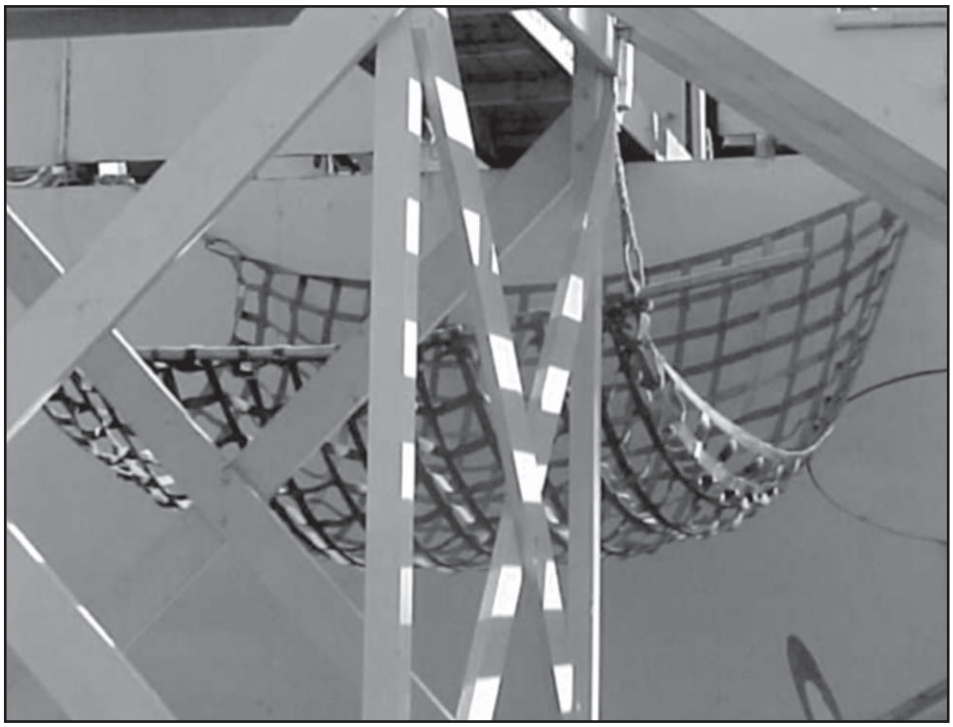

Figure 6.5-26 - Safety Net

b. A jumping ladder shall be rigged forward or aft of the safety net (that side which, considering all features of the brow and approaches, offers the greater chance of someone falling into the water – normally aft).

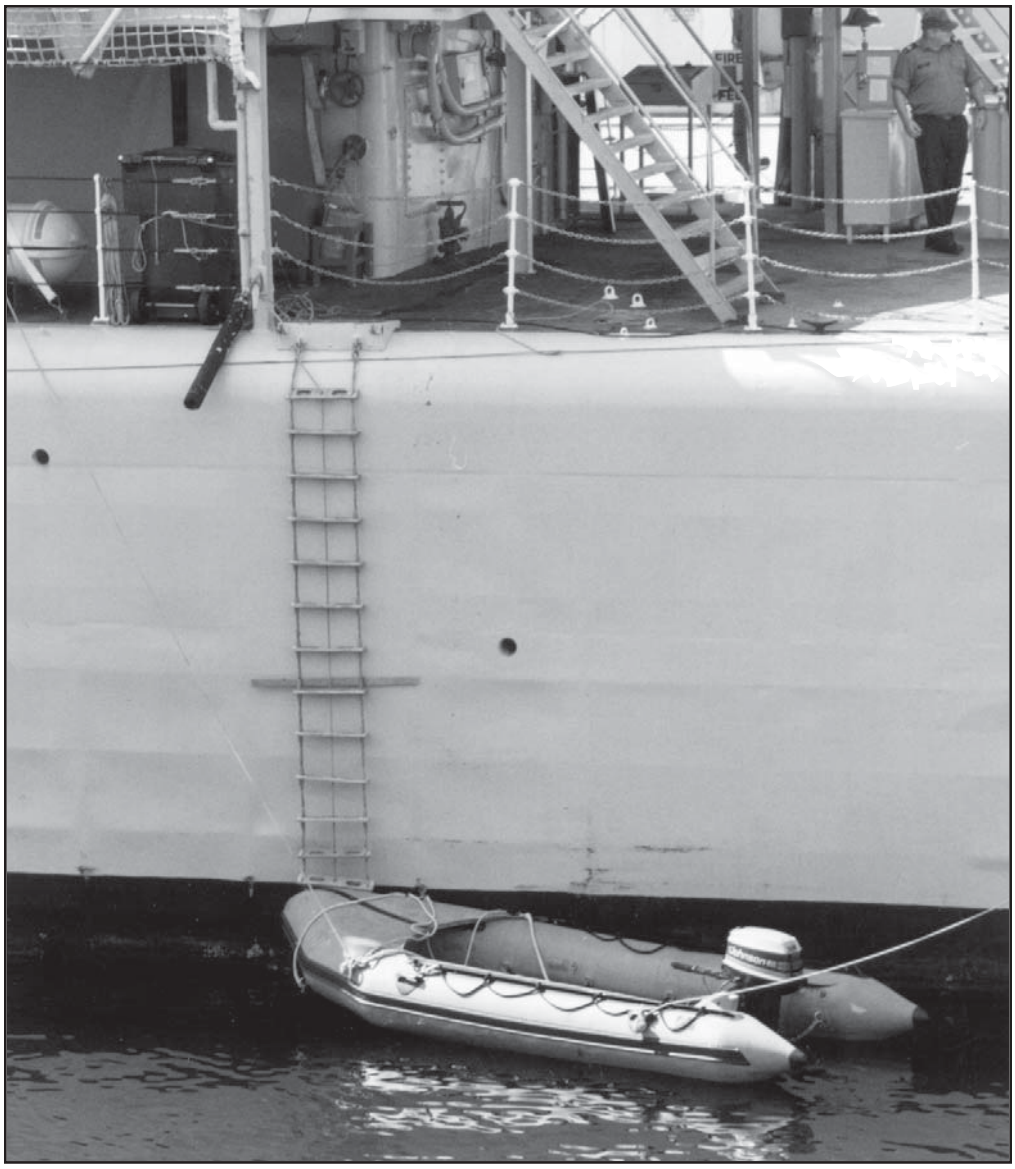

Figure 6.5-27 - Jumping Ladder

c. If adequate lighting has not been provided by the shore authority, temporary jetty lighting is to be rigged.

d. Hand lanterns or extension lights of sufficient quantity and brilliance to illuminate the surface of the water between the ship and the jetty shall be available.

e. Kisby ring with 30 m line attached.

f. Steadfast.

g. At least two long handled boat hooks.

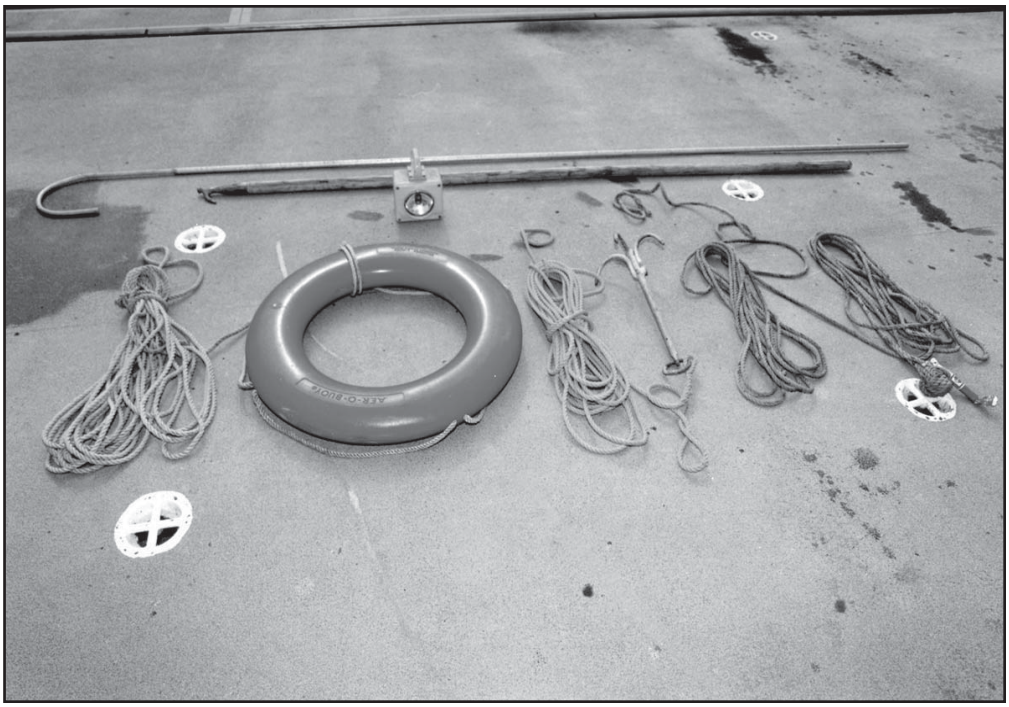

Figure 6.5-28 - Brow Emergency Equipment

h. The DRP, line and rescue sling and grappling Hook are left rigged in their normal sea positions.

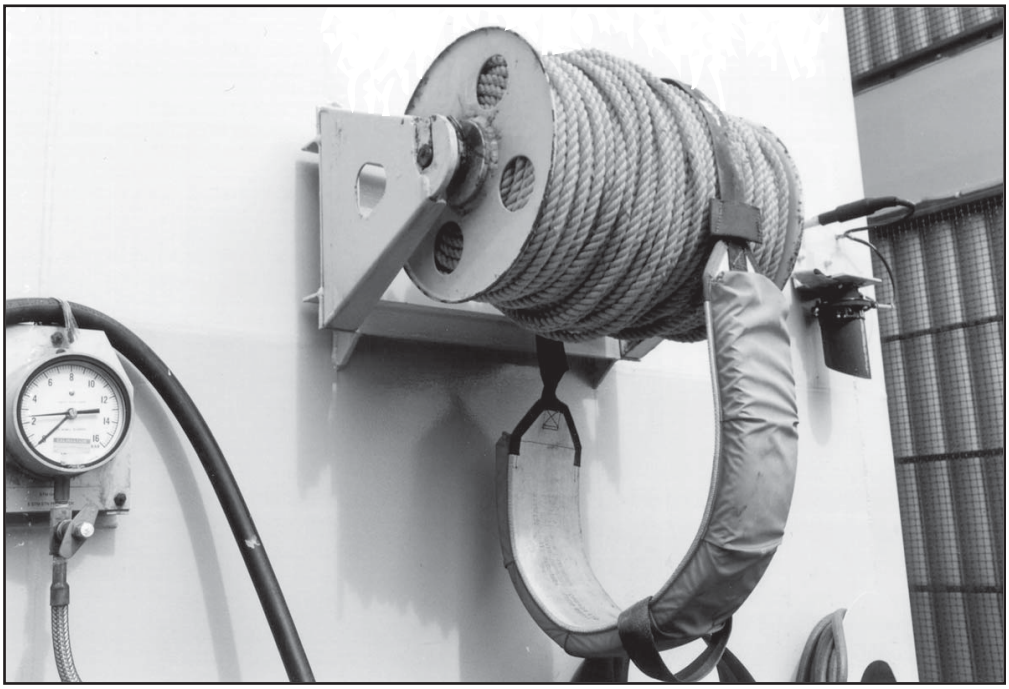

Figure 6.5-29 - Ship's Fitted DRP, Reel, Line and Harness

i. A fire pull alarm box (if available).

Figure 6.5-30 - Pull Alarm Box

6.5.11 Ensign and Jack Staffs

Both staffs must be rigged and in place before entering harbour. The Jack is hoisted when the first hawser is secured to the jetty.

Figure 6.5-31 - Naval Jack

Figure 6.5-32 - Naval Ensign

6.5.12 Fire Lines

Fire Lines are required in certain ports to assist the fire tugs in removing an HMC ship from her berth in an emergency**.** They are made up of wire rope with a soft eye in either end or of braided nylon with a soft eye in either end. They are secured on the Focsle and Quarterdeck, suspended over the ship's side just above the waterline, and secured to a bollard inboard.

6.6 Tug Assistance when Berthing/Slipping

6.6.1 Introduction

a. The use of tugs is often an essential component of berthing and slipping evolutions. Whenever conditions such as high wind or limited sea room prevail, the use of tugs will be required. For larger ships, such as AORs, tugs are almost always used, regardless of prevailing conditions.

b. Tugs are used either with or without making lines fast to the ship, and either with or without embarking a harbour pilot to control the tugs. If there is only a requirement to push a ship onto a jetty, then tug lines may not be passed. In more complicated manoeuvres requiring the swinging of the ship, lines will be passed. When pilots are embarked, which is often deemed mandatory by harbour regulations, they will work directly with Command and retain control of the tugs. When they are not embarked, Command passes orders directly to the tug masters.

c. As Canadian warships most commonly work with the highly manoeuvrable GLEN and VILLE Class tugs in Halifax and Esquimalt, these will be described in some detail below. However, it is also important to note that in foreign ports, tugs come in a variety of sizes, use a variety of tow ropes, and display varying levels of competence. Safety assumes an even greater importance in these situations, with extreme caution being required in the vicinity of tow ropes under strain.

6.6.2 GLEN Class Tugs

a. These vessels are sometimes referred to as "water tractors" or "tractor tugs" and are fitted with two Voith Schneider cycloidal propulsion units located forward, one on each side of the centre line. These units are vertical axis, controllable pitch propellers which permit thrust to be directed through 360 degrees. They allow the vessel to turn and stop within its own length, navigate stern first with full control, and "crab" sideways with a limited capability. Water tractor/tractor tugs manoeuvre more readily than conventional tugs when on a towline. They are fitted with a remote hydraulic tow hook release and have 60 m of 162 mm double-braid nylon towline.

Figure 6.6-1 GLEN Class Tugs

b. There are three GLEN tugs in Halifax and two in Esquimalt. Their principal characteristics are as follows:

Length:	92’6”/28.2 m
Beam:	28’0”/8.5 m
Draft:	15’3”/4.6 m
Bollard Pull:	18.3 tonnes ahead, 15 tonnes astern, 12 tonnes sideways
Horse Power:	1750 bhp
Maximum Speed:	10.5 knots

c. Because of the position of the propellers directly beneath the bridge front (about one third of a ship’s length from the bow), GLEN tugs perform better in the astern configuration in some circumstances. Better results are achieved, for example, by making up alongside an IROQUOIS/HALIFAX Class ship’s quarter, bow to stern, because the wash from the propellers is directed beneath the cut-away when pulling off. Similarly, slightly better performance is achieved by “squaring off” in the stern to position, because the propellers are that much further from the side of the assisted ship. On the GLEN tug, note that the bottom of the nozzle plate which protects the propellers draws nearly sixteen feet. Because of the possibility of fouling the tug’s superstructure under the flare, GLEN tugs have difficulty in securing with short stern lines. Consequently, they may require time to make fast and may not be able to attain an ideal position to push or pull. These tugs have sufficient power to part any line that is improperly led. Towlines should not be led through the bullring of IROQUOIS/HALIFAX Class ships if the tug is expected to work broad on the bow at high power settings.

6.6.3 VILLE Class Tugs

a. These vessels are single-screw and fitted with steerable "Kort" nozzles. The thrust of the propeller can be directed over the arc of normal rudder operation, hence the turning effect is considerable and the vessel can be steered well while proceeding astern. They are fitted with a remote, manual tow hook release and have 60 m of 110 mm double-braided nylon towline.

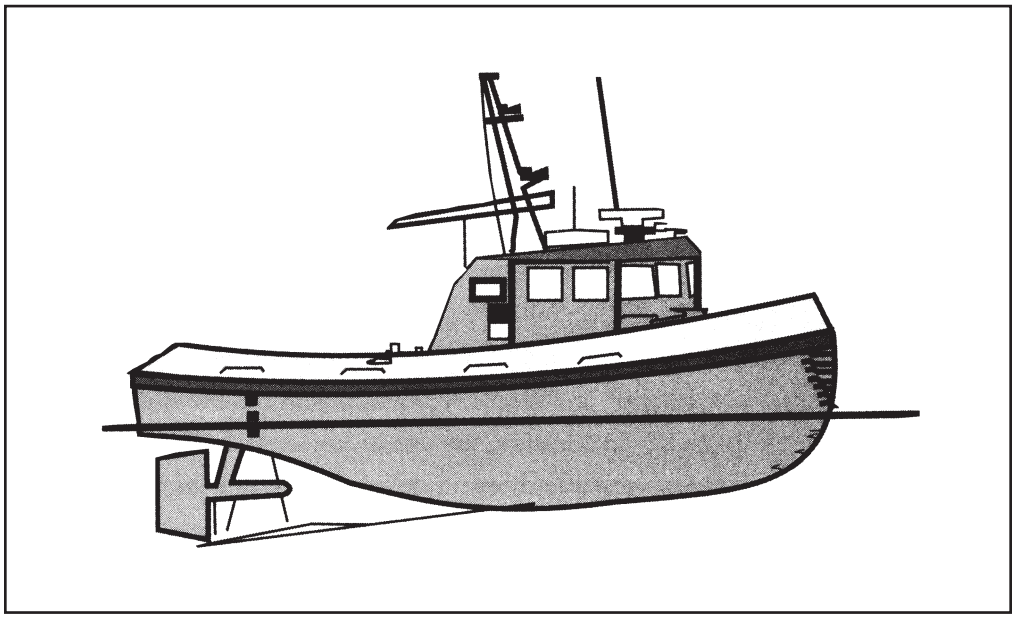

Figure 6.6-2 - VILLE Class Tugs

b. There are three VILLE tugs in Halifax and two in Esquimalt. Their principal characteristics are as follows:

Length:	45'4"/14.14 m
Beam:	14'6"/4.49 m
Draft F:	4'8"/1.15 m, A: 7'7.5"/1.93 m
Bollard Pull:	7.5 tonnes maximum ahead, 4.0 tonnes maximum astern
Horse Power:	365 bhp
Maximum Speed:	0.0 knots

c. The bow flair may restrict the use of a VILLE tug on a head line to a position abaft the bridge. In this position, the pull-off capability is reduced and will be further curtailed by headway, sternway, or strong winds. If a simple pull off a berth is all that is required, it is recommended that a tow line to the VILLE tow hook be used from either the bullring or forward fairlead. However, in this mode it is easy to overpower the tug with ahead or sternway. In this case, the use of the tow hook abort may have to be used to prevent dragging or girding the tug.

Note.

Tugs prefer to have the towline on their tow hook, but ships should always have an axe and block ready to cut the towline. If the eye of the towing hawser is passed to the ship, it is invariably to be placed over both bollards.

6.7 Safety

6.7.1 Seamanship Briefing

a. Prior to entering/departing harbour, a Command briefing will be conducted by the Deck Officer. This briefing to the Captain will normally take place in the Wardroom or Operations Room, or any other compartment deemed appropriate by Command. The seamanship briefing will normally follow the Navigating Officer's general briefing of the weather and navigation plan. Note that the navigation briefing will include direction on the amount of cable to be let go in an emergency anchorage, and recovery intentions in the event of a man overboard within the harbour. In addition, the use of tugs may be discussed, as well as boat launch and/or recovery intentions in the event that the ship must provide her own berthing or slipping party. In some cases, the briefing may take place several hours or even the previous evening before the evolution, so that everyone has time to make the necessary preparations. The following personnel as a minimum will be in attendance: Executive Officer, Deck Officer, Navigating Officer, Part Ship Officers, Chief Bosn's Mate, Senior Naval Communicator, Part Ship I/Cs, Senior Met Tech, Cable Party I/C, and the Special Sea Duty Lookouts and Echo Sounder Operator.

b. Following is a briefing format to be followed. In this example, the ship is slipping and proceeding to sea:

(**1**) Captain Sir, ladies and gentlemen, (OWN SHIP) will be departing (HARBOUR - BERTH) and proceeding to sea at (TIME).

(**2**) (PORT/STARBOARD) watch Special Sea Dutymen, Cable Party and Part Ship hands will be required to close up at (TIME). Upon closing up, each Part Ship I/C will prepare their part ship for departure and give a detailed safety briefing.

(**3**) The Cable I/C will make the anchor ready for letting go, riding on the blake and brake. Lines are to be singled up at all parts of ship on closing up. All shore connections are to be landed without further order except for telephones, which will be landed ten minutes prior to slipping once Command permission has been received. A slipping party is being provided by (SHIP) and is expected 15 minutes prior to departure. A mobile crane is

expected to assist in landing the brow, which will occur when ordered by Command immediately prior to slipping.

(**4**) The intention for slipping will be to let go all lines aft, hold No. 2, heave in on No. 1, and use engines to assist in casting the ship's head into the lie of the jetty 15 degrees. On Command order, the forward lines will be let go, and (OWN SHIP) will make a sternboard departure.

(**5**) On departure, hands will fall in and face to (PORT/STARBOARD) until abeam (LOCATION), when Command will order them to fall out and secure the parts of ship for sea. The ensign is to be shifted to the sea position at that time, and the ensign and jack staffs struck down and stowed below.

(**6**) The dress for entering/departing harbour, as discussed with the Executive Officer will be (DRESS).

(**7**) The Part Ship Officers and I/Cs for the evolution will be (NAMES).

(**8**) Effective communications are essential. Primary shall be (PRIMARY NET), with secondary being (PRC Channel ___).

(**9**) Sir, this completes the briefing. The Chief Bosn's Mate will now brief on the safety-related aspects of the evolution.

6.7.2 Safety Briefing

It is imperative that the Chief Bosn's Mate and the I/Cs give a thorough briefing to all personnel involved in entering/departing harbour. As well as the general shipboard safety items listed in Chapter 4, the following safety points must be covered:

a. Ensure all personnel know the tasks which they are to perform.

b. Safety equipment must be worn by the Cable Party if required to let go the anchor.

c. Never stand directly behind the cable if required to let the anchor go.

d. Never straddle lines.

e. Never stand in bights of lines.

f. Ensure personnel never stand behind a line under tension.

g. The snap back zone safety criteria shall be followed. Personnel must stand clear of the snap back danger zone, and at least 2 m away from bollards and capstans, whenever possible.

h. Proper safety equipment is to be present, including an axe and a 4 x 4 block in the event of emergency.

i. Proper turns on the capstans/winches is four turns with nylon lines and six turns with Kevlar.

j. The naval jack is not to be hoisted/hauled down at the jackstaff until all work on the cable has been completed.

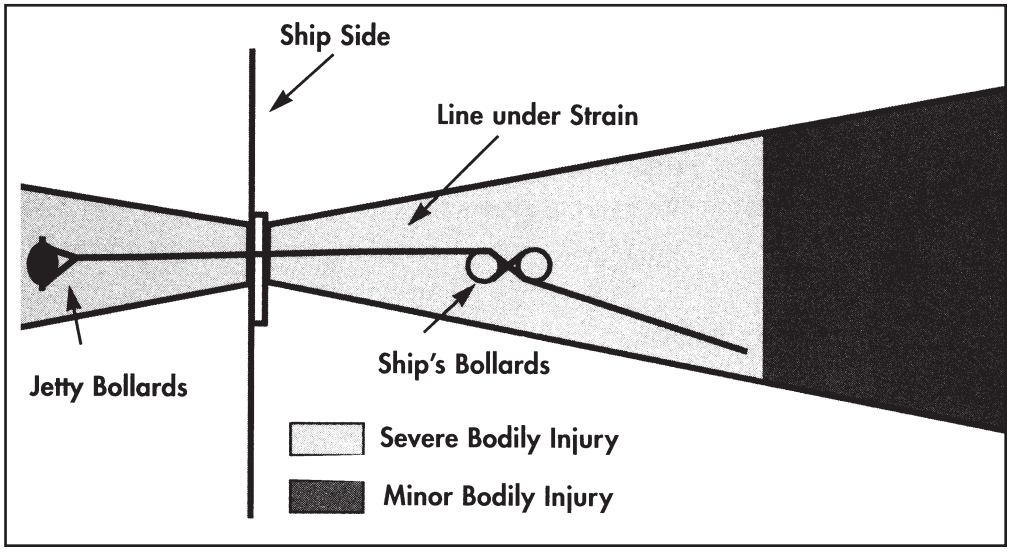

Figure 6.6-3 - Snap Back Danger Zone