

NAVAL SHIPS' TECHNICAL MANUAL

CHAPTER 573

BOOMS

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CHAPTER 573

BOOMS

SECTION 1.

CRANES

NOTE

Section 1, paragraphs 573-1.1 through 573-1.74, pages 1 through 19, is deleted from **NSTM Chapter 573, Cranes and Booms** .

573-1.1

Section 1 of **NSTM Chapter 573** is superseded by **NSTM Chapter 589, Cranes**.

SECTION 2.

BOOMS

573-2.1 INTRODUCTION

573-2.1.1 GENERAL. Naval ships commonly employ booms rigged in various configurations to handle stores, cargo, ordnance materials, and boats. Usually a pair of booms is used in what is termed the yard and stay system. There are many alternative rigs involving one, two, or four booms as described later in this section. A shore-based boom (stiff-legged derrick) arrangement is sometimes used in stevedoring. Cargo gear designs for a given ship will be found in her Rigging Diagram which corresponds to the Cargo Gear Register found aboard merchant ships.

573-2.1.2 NAVY DESIGN PARAMETERS. Navy design parameters correspond to similar Merchant Marine regulations, as specified by the American Bureau of Shipping, the Department of Labor, the U.S. Coast Guard, the National Cargo Gear Bureau, and the International Cargo Gear Bureau. Merchant ship regulations have been strengthened considerably for naval application, due to the additional gear stresses encountered in naval at-sea operations. Navy design parameters for newer construction are as follows:

- a. **Boom Safety Factor** - 2.5 to 3.0 on the yield point of the structural parts
- b. **Rope Safety Factor** - 5 on the breaking strength of the rope
- c. **Boom Angles (minimum)** - 155 for cargo booms up through 15 tons, and 255 or 305 for heavy lift booms

NOTE

In this section, all tonnages discussed are based on the long ton (2240 pounds), and Safe Working Load (SWL) is defined as being equal to Rated Load. Safety Factor is defined as the multiple of the SWL that is equal to yield or breaking strength, as indicated.

573-2.2 DEFINITIONS AND DESCRIPTIONS

573-2.2.1 **BOOMS.** A boom is a structural member used for lifting, transferring, or supporting heavy weights aboard ship. It is a tubular member and is generally circular in cross section. Usually the greatest cross sectional area of the boom is at the center, with a taper toward both ends. One end of the boom is supported by a bracket or step in the lower part of the mast or kingpost, which allows the boom to pivot while providing a sturdy connection to transmit boom-loading to the ship structure. The bracket carries a vertical pin which, when attached at its eye-shaped head to a clevis on the heel of the boom, allows both horizontal and vertical movement of the boom from that point. This assembly is generally called a gooseneck. The other end of the boom is fitted with a cap and is provided with attachment points for the topping lift, vang, guys, and headblock.

NOTE

On each boom, the SWL, minimum vertical angle for use, the last test date, and the initials of the testing facility will be stenciled or weld-beaded onto the boom near the heel.

573-2.2.2 **HOISTS.** A hoist is an apparatus used for lifting and supporting heavy weights. A hoist wire runs from the winch drum through a heel block at the base of the boom, along the boom through a slack wire fairlead, through a head-block and either directly to the hook assembly, or through a block at that point and up to the becket of the head block. When the hoist wires terminate at the hook assembly they are called whips. When they run through blocks at the hook assembly they are called runners, and the blocks are called runner blocks. The gear in this condition is said to be doubled up and may be used for heavier loads than is possible with whips. Rigging diagrams may show the ratings for both conditions. Multiple purchases may also be used in the hoist wires to further increase gear capacity.

573-2.2.3 **TOPPING LIFTS.** The topping lift is usually a purchase which is reeved between a block at the boom head and a block at the kingpost head, with the hauling part leading down to a winch, cleat, or padeye. To top or lower the boom, the topping lift heaves-in or pays-out rope. When secured, it provides a stay for the boom to hold it in the vertical plane. Newer ships have powered topping lifts which allow topping under load.

573-2.2.4 **VANGS.** The vang (Merchant Marine outboard guy) is the line or purchase which acts to hold the boom against inboard movement. It consists of a guy pendant running from the boom head to a block, and a guy tackle reeved through the block and secured to a deck padeye.

573-2.2.5 **INBOARD GUYS.** An inboard guy is a line similar to a vang except that it acts to hold the boom against outboard movement.

573-2.2.6 **SCHOONER GUYS.** A schooner guy (Merchant Marine midship or lazy guy) replaces two inboard guys by tying the heads of two booms rigged together in the yard and stay fashion. The guy is reeved through a block at each boom head and then led to a cleat on deck.

573-2.2.7 **PREVENTERS.** Preventers are single wires rigged to relieve guys or vangs during unusual stresses and to hold booms in position if the guys part. These are rigged during adverse weather operations, during heavy lifting, and during ammunition handling. The preventer is rigged as nearly parallel to the guy as possible, and the guy is then slacked a small amount to transfer some of the strain to the preventer.

573-2.2.8 BLOCKS. For each ship or class of ship having cargo gear, a block list plan is prepared or is included in the rigging plan. This list plan contains exact descriptions of the blocks and indicates their uses. A similar rope list is provided for the lines and wires used in the ship's rigging. All blocks are marked with their SWL. Advancements in block design have included low friction (roller bearing) sheaves and self-lubricating sheaves. The two major classifications of blocks are fiber rope and wire rope blocks. Fiber rope blocks (synthetic and natural) are covered by specifications GGG-B-490 and MIL-B-24220. Wire rope blocks are covered by specifications MIL-B-16453, MIL-B-23990, and MIL-B-24141.

573-2.2.8.1 Fiber Rope Blocks. Fiber rope blocks are made of either wood or metal and are sized by shell length. Shell length equals three times the circumference of the rope for which it is used, and sheave diameter equals approximately two times the circumference.

573-2.2.8.2 Wire Rope Blocks. Wire rope blocks of both Navy and commercial design are used in the Fleet. The Navy blocks are sized by the diameter of the wire and are heavier and stronger than their commercial counterparts.

573-2.2.8.3 Ordering Information. When ordering blocks, the following information must be given:

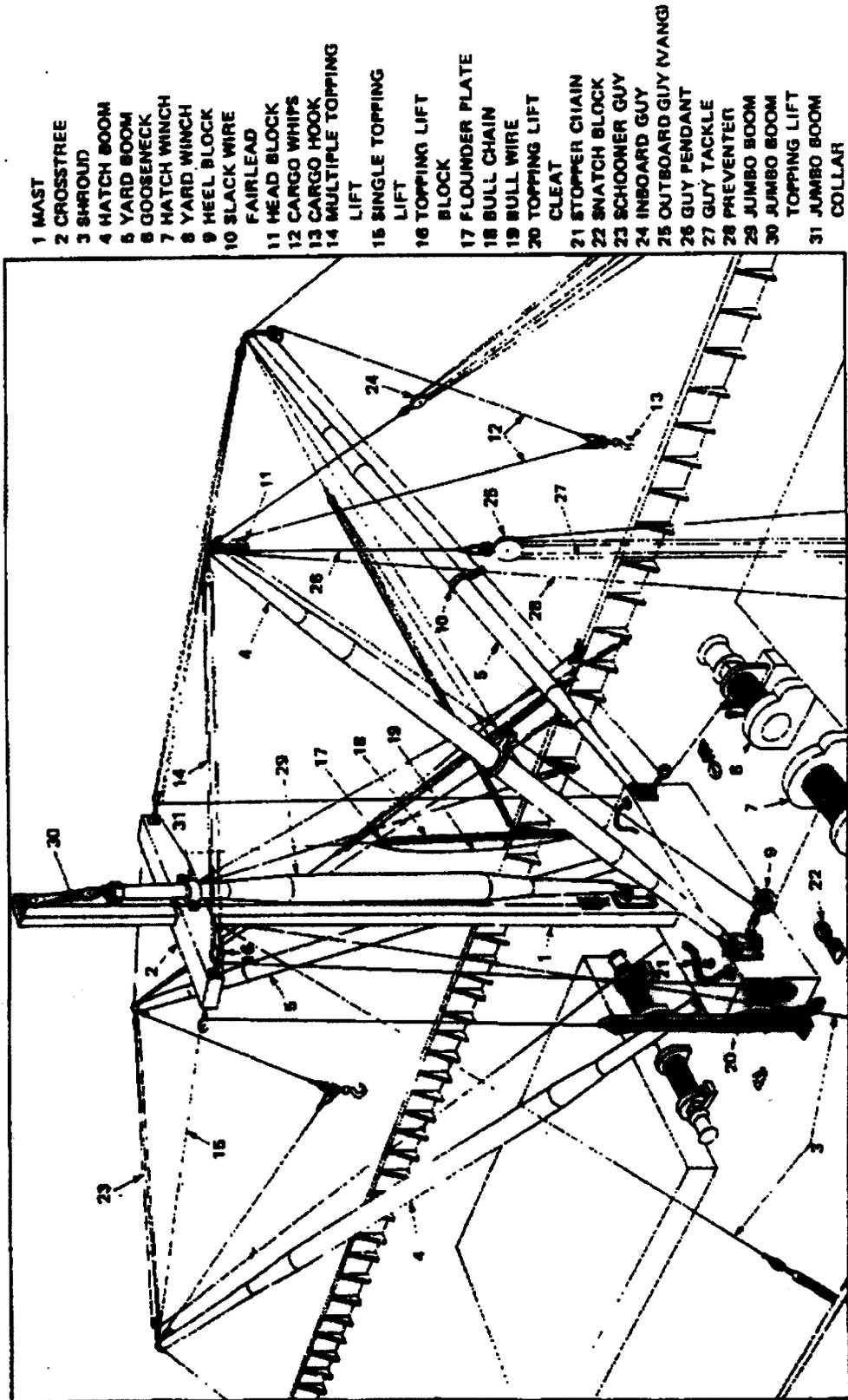
- a. **Type and size of rope** (manila, nylon, wire as required)
- b. **Block shell material** (wood, metal)
- c. **Block size** (sheave tread diameter)
- d. **Number of sheaves** (single, double, triple, or as required)
- e. **Block shape** (oval, diamond, snatch, or as required)
- f. **Type of bearings** (journal, roller, self-lubricating, or as required)
- g. **Rig number** or special fittings (as required)

NOTE

Bracket parts should be requisitioned only when a becketed block is required.

573-2.2.9 RIGS. Rigs (or rigging) as defined herein refers to their relationship and usage with cranes and booms. Therefore the individual descriptions will be as indicated in the following paragraphs.

573-2.2.9.1 Yard and Stay Rig. The yard and stay rig ([Figure 573-2-1](#)), also called the Married Fall, Union, or the Merchant Marine Burton rig, is the most common rig to be found for general loading/ discharging use. In this rig, each boom is held in position by a topping lift, a vang, and either a schooner guy or an inboard guy. In the yard and stay rig, one boom (the yard boom) is spotted over the landing/loading position while the other (the hatch boom) is spotted over the hatch. Each boom hoist is married to a common hook. Material/equipment is transferred by heaving-in and paying-out on the two hoist winches in order to lift a draft of cargo, transfer it horizontally between the booms and land it in its new position. This rig allows a rain tent to be set up for operation in foul weather. For replenishment at sea, a boom or attachment point and a winch on the receiving ship replace the yard boom and winch.



- 1 MAST
- 2 CROSSTREE
- 3 SHROUD
- 4 HATCH BOOM
- 5 YARD BOOM
- 6 GOOSENECK
- 7 HATCH WINCH
- 8 YARD WINCH
- 9 HEEL BLOCK
- 10 SLACK WIRE
- FAIRLEAD
- 11 HEAD BLOCK
- 12 CARGO WHIPS
- 13 CARGO HOOK
- 14 MULTIPLE TOPPING LIFT
- 15 SINGLE TOPPING LIFT
- 16 TOPPING LIFT BLOCK
- 17 FLOUNDER PLATE
- 18 BULL CHAIN
- 19 BULL WIRE
- 20 TOPPING LIFT CLEAT
- 21 STOPPER CHAIN
- 22 SNATCH BLOCK
- 23 SCHOONER GUY
- 24 INBOARD GUY
- 25 OUTBOARD GUY (VANG)
- 26 GUY PENDANT
- 27 GUY TACKLE
- 28 PREVENTER
- 29 JUMBO BOOM
- 30 JUMBO BOOM TOPPING LIFT
- 31 JUMBO BOOM COLLAR

Figure 573-2-1. Yard and Stay Rig

573-2.2.9.2 Housefall Rig. In this rig the shipboard hatch boom, rigged as for use in yard and staying, is retained, while the yard boom is replaced by a block attached to a building. For replenishment at sea the block is attached to the receiving ship. A hoist wire is run from a winch, through this block, and to the hook assembly, to serve in place of the yard boom hoist. Material/equipment transfer is the same as described in paragraph [573-2.2.9.1](#).

573-2.2.9.3 Double-Ganged Rig. This rig, also called the Lunde-Lion Rig, can be used to yard and stay loads which are beyond the capacity of one pair of booms. It can be employed only when the ship has two pairs of booms at the hatch. The two yard booms are spotted and secured with their heads nearly together, then the hatch booms are similarly spotted and fixed. In one method, one hatch hoist and its corresponding yard hoist are reeved through two runner blocks at the hook and shackled to the hoists of the other set of booms. One set of winches is then operated as in the usual yard and stay rig. In another method, each of the four hoists is married to a common hook arrangement. Both sets of winches are then operated to transfer the cargo.

573-2.2.9.4 Farrell and Ebel Rigs. These are modern yard and stay rigs employed on some merchant ships. They achieve ease of spotting by their special topping lift and vang configurations, and employ power winches on all rigging components.

573-2.2.9.5 Single-Swinging-Boom Rig. With this rig, loads up to the SWL of the boom can be lifted. When using the same boom in the yard and stay rig, however, only a percentage of the SWL can be handled safely. For example, a 5-ton SWL boom can swing five tons, but can burton only three tons. The actual burton load permissible will be shown on the ship's Rigging Diagram.

573-2.2.9.6 Swinging Boom. Any off-centerline boom at a hatch may be used as a swinging boom. The other boom is then topped and housed, and its hoist detached from the hook and secured. The remaining hoist is either attached to the hook as a whip or, more commonly, is doubled to give the capacity to lift the SWL of the boom. The load is lifted with the hoist and the boom is swung by tending the inboard and outboard guys manually or by gypsy-head. The topping lift is used to raise or lower the boom as previously described.

573-2.2.9.7 Jumbo Booms. Jumbo booms may be provided on the centerline and used as swinging booms for heavy lifts. In this rig, there is a hoist purchase for raising and lowering the load and a multiple purchase topping lift. Heavy manila or double-braided nylon vangs tended by gypsy-head or wire ropes on winches are employed to swing the boom. The newest jumbo booms employ a twin topping lift, each half of which is powered and tends outboard of the centered boom. This also allows each half of the topping lift to perform the function of a vang, as the boom serves either side of the ship. Jumbo booms and their fittings are generally of heavy construction because they are used for loads beyond the range of the yard and stay gear. To alter the capacity of a jumbo boom it is necessary to alter the hauling rigging. This increases or decreases the rig speed.

573-2.2.9.8 Heavy Lift Booms. Heavy lift booms are widely used aboard merchant ships, and are in limited use on naval auxiliaries. By different means, the booms of the three main types are turned or flipped to serve either of two adjacent hatches. They can handle large lifts and are completely powered to allow total operator control (see [Figure 573-2-2](#)).

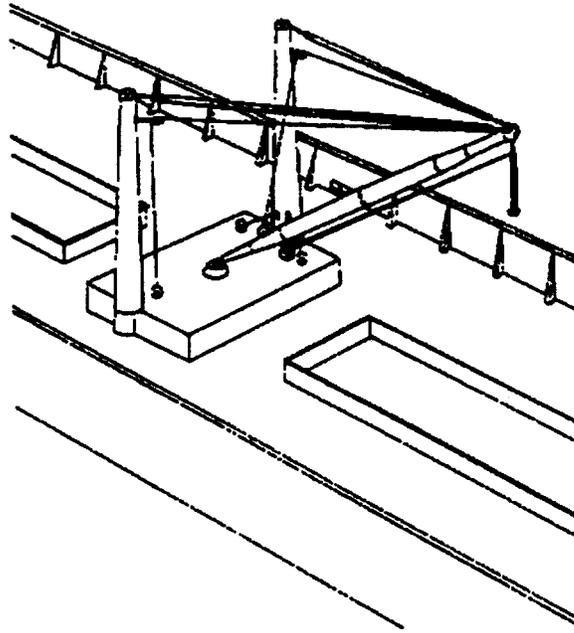


Figure 573-2-2. Heavy Lift Gear

573-2.3 SAFETY PRECAUTIONS

573-2.3.1 GENERAL. When operating booms, the following specific safety precautions shall be exercised at all times.

WARNING

Boom loads shall never be suspended over personnel. . Rigging and handling vangs and guys is a job requiring skill and caution. Vangs and guys often receive larger loads than operating personnel are aware of due to boom position, load weight, tight lining, and dynamic loading due to at-sea operations. When a vang or guy carries away, the boom may swing violently, thus endangering operating personnel.

- a. Care must be exercised not to exceed the SWL or, in some cases, that percentage of the SWL allowed for the particular rig in use. A lift in excess of these limits must never be allowed without an engineering analysis of that particular lift, which takes into account all the existing limiting conditions and approves the execution of that lift.
- b. When placing vangs and guys, problems can be avoided and the rig made safer by strict adherence to the Rigging Diagram. Placing a vang or guy in other than the specified position must never be allowed without an engineering analysis of the rig in the new position. It is sometimes advantageous to rig preventers directly to heavy lift loads, to ease loading on the boom being used.

- c. A major consideration in the rigging of vangs and guys is that they may exert direct loading on the boom which is in addition to that caused by the load. Thus, if a vang or guy is excessively taut or improperly placed, the SWL of the boom may be seriously reduced without the knowledge of operating personnel. Boom failures have resulted from such conditions. Care must also be exercised when topping a boom, to tend the vang and schooner guy so that neither comes up taut and opposes the topping lift.
- d. A critical situation arises when the vang attachment, the boom length, and the inboard guy or schooner guy attachment can be sighted along the same level or plane. In such a situation, a load will place tension on the vang and guy and will overstress the vang and boom, resulting in vang or boom failure.
- e. Another serious condition exists when the vang and guy tend upward from the boom, because loading will then cause the vang and guy to lift the boom. The boom then snaps down and lifts again in a process which is sometimes termed jackknifing.
- f. The use of heavy lift booms with split topping lifts requires special attention. Large lifts will cause a list when swung outboard, and can easily gain excessive momentum. Such loads must be swung slowly and under the best of control. As the boom nears its outboard position, control is seriously reduced or lost if only the split topping lift is used to guy the load. Preventers or additional boom vangs and guys may be employed to give proper load control.
- g. When making a heavy lift, the load shall be hoisted slowly for a minimal distance in order to check the sling for soundness, the load for balance, and the boom and draft for plumbness. Before attempting a heavy lift on older rigs, or on any rig near its capacity, shrouds and stays should be rigged to the mast or kingposts if indicated by the Rigging Plan. Shrouds and stays are attached and the slack taken up uniformly until the turnbuckles are handtight. Each turnbuckle is then tightened until it is shorted by one inch for every sixty feet of wire length. For rigging details see **NSTM Chapter 613, Wire and Fiber Rope and Rigging** .
- h. In any cargo rig, whenever a rope has become slack it must be carefully retightened. It must be wound evenly on the winch drum with no slack under the top turns, and it must be riding in all sheave grooves.
- i. When cargo is to be worked by stevedores, ship's force must top and rig the booms and prepare all cargo handling gear which is to be used. The stevedores will spot the booms as desired.
- j. Caution shall be exercised when handling metallic components of booms. At certain frequencies, high frequency shipboard radio transmitter antennas in the vicinity can induce voltage in the rigging that can cause painful burns on contact.

573-2.3.2 OPERATOR RESPONSIBILITY. Operators shall not leave the winch controls with a load suspended on the rig. They shall deactivate electrical power to all winches in their rig before leaving the controls unattended. A signalman or a winch tender shall be employed to aid an operator who cannot see his winches and both areas of his rig's operation.

573-2.3.3 SUPERVISORY RESPONSIBILITY. All heavy lifting shall be under direct supervision of the First Lieutenant or Weapons Officer. The type of rig used shall conform to the ship's Rigging Diagram. All operators shall be qualified by the Leading Boatswain's Mate before they begin.

573-2.4 INSPECTION, MAINTENANCE, AND TEST

573-2.4.1 PERIODIC INSPECTION AND MAINTENANCE. Inspection and preventive maintenance procedures shall be conducted at regularly scheduled intervals as indicated, and in accordance with the appropriate MRC's when Preventive Maintenance Subsystem has been installed. This description of maintenance requirements and periodicity is by necessity more general than those specified in MIP's and MRC's for specific appli-

cations. For example, heavy lift boom systems, which are used less often and operate at slower speeds than other boom systems, may have less frequent periodicity than that indicated. Where conflicting requirements exist, MIP's and MRC's shall be followed.

573-2.4.1.1 Monthly. The following inspections and maintenance checks shall be performed each month.

- a. All running wire shall be lubricated and inspected for faults in accordance with **NSTM Chapter 613, Wire and Fiber Rope and Rigging** .
- b. All manila or double-braided nylon rope shall be inspected in accordance with **NSTM Chapter 613, Wire and Fiber Rope and Rigging** .
- c. All fittings which evidence corrosion shall be chipped and painted.
- d. All sheaves shall be examined for nicks and wear, and for freedom of movement.
- e. If boom has been operated since previous inspection, all hooks shall be measured for spreading of the throat.
- f. All swivels shall be checked for damage and freedom of movement.
- g. If boom has been operated since last inspection, it shall be inspected for damage and spreading of boom jaws.

NOTE

Booms shall not be unshipped for inspection in a seaway.

- h. All standing rigging shall be inspected for proper tension and for deterioration.
- i. All blocks and boom goosenecks shall be properly lubricated.

573-2.4.1.2 Annually. The following inspections and checks shall be made on a scheduled, annual basis.

- a. On a staggered schedule, all blocks shall be disassembled for inspection. Bearings shall be cleaned and lubricated and all worn parts shall be replaced.
- b. Boom goosenecks shall be jacked-up for pin inspection. All pins shall be cleaned and lubricated.

573-2.4.1.3 General. All structural members and components shall be continually observed for evidence of cracking, deformation, or severe corrosion.

- a. Non-destructive tests (dye penetrant, magnetic particle, reflectoscope, X-ray) shall be performed on all suspect areas.
- b. All suspected class problems shall be investigated as directed by the Naval Ships Engineering Center (NAVSEC).
- c. Cracks in steel booms shall be repaired by grinding down to sound metal, and welding.

NOTE

Welding shall be performed by qualified welders, using low hydrogen electrodes.

- d. Checks and cracks in wood booms shall be generously drenched with wood preservative, then coated with two

applications of linseed oil, 24 hours apart. Large checks shall be caulked with oakum then leveled with white lead putty. Finally, two coats of aluminum paint shall be applied, followed by two coats of enamel.

573-2.4.2 TESTS. Assembled gear tests shall be performed following new installations, after major repairs or modifications, for maritime ships being refitted for naval service, for reactivated ships, and at the discretion of the Commanding Officer when deterioration or deformation is suspected. The date of such tests and identification of the facility conducting the test shall be marked on the boom near the heel, using steel stencil or raised weld bead.

NOTE

Repair or replacement of wire rope or loose gear does not require test of assembled gear.

573-2.4.2.1 Loose Gear/Wire. All loose gear is tested (usually by the manufacturer) before installation. New gear and wire need not be tested if it has been purchased to military specification and delivered to the ship through the Naval Supply System. Naval shipyards have facilities for conducting loose gear tests on any gear otherwise procured. Generally this test is a static test equal to 200 percent SWL of the fitting in question. For wire rope, a sample shall be tested to breaking strength.

573-2.4.2.2 Blocks and Hooks. Blocks and hooks shall bear the manufacturer's test stamp (SWL, test date, facility abbreviation). If any block or hook is delivered to the ship which does not bear this stamp, it shall be tested by tender or shore facility in accordance with applicable specifications. Both tests are static tests equal to 200 percent of the SWL. In this case, the SWL is determined by the intended use of the block or hook and the ship's Rigging Diagram. In the block test, the load shall be applied to a wire or loop passed over the sheave and pulling against the block fitting.

573-2.4.2.3 Wire Vangs, Preventers, and Pendants. Wire vangs, preventers, and pendants shall be made up with all end-fittings, and need not be tested if assembled by a rigger qualified by previous destructive pull tests of sample wire rope terminations. (Assembled components must fail at or above the rated breaking strength of the wire rope used.) Such components shall be made up and so certified before delivery to the ships.

573-2.4.2.4 Static Gear Unit Test. Static gear testing requires that the boom be rigged as a swinging boom. Testing shall be at the maximum outboard position and the lowest boom angle indicated on the boom heel and Rigging Diagrams. The load shall be placed on the hook but shall not be hoisted, nor shall the boom be topped up. Test weights shall be as follows:

- a. Less than 20-ton booms: 200% SWL
- b. 20-ton to less than 40-ton: SWL + 20 tons
- c. 40-ton and above: 150% SWL

573-2.4.2.5 Dynamic Gear Unit Tests. Dynamic gear testing also requires that the boom be rigged as a swinging boom. It shall be operated through its full swing and topping range. Test weights shall be as follows:

- a. Less than 20-ton booms: 150% SWL

- b. 20-ton to less than 40-ton: SWL + 10 tons
- c. 40-ton and above: 125% SWL

NOTE

Only powered topping lifts shall be operated under load, and the load shall be hoisted. No speed is specified.

573-2.4.2.6 Inspection. Following performance of the tests described in paragraphs [573-2.4.2.4](#) and [573-2.4.2.5](#), the blocks shall be disassembled for inspection. All gear shall be examined for any signs of damage or permanent set introduced by the testing.

REAR SECTION

NOTE

TECHNICAL MANUAL DEFICIENCY/EVALUATION EVALUATION
REPORT (TMDER) Forms can be found at the bottom of the CD list of books.
Click on the TMDER form to display the form.

