

NAVAL SHIPS' TECHNICAL MANUAL  
CHAPTER 589  
**CRANES**

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## CHAPTER 589

### CRANES

#### SECTION 1.

#### GENERAL INFORMATION

##### 589-1.1 INTRODUCTION

589-1.1.1 SCOPE. The intent of this chapter is to establish a basis for implementing a Shipboard Crane Certification Program by identifying and consolidating the various operations, training, maintenance, testing, and inspection requirements for cranes under the cognizance of the Naval Sea Systems Command (NAVSEA). The Crane Certification Program is intended to maintain the reliability and safety of all shipboard cranes, and other cranes under the cognizance of NAVSEA, and to provide the ship Commanding Officer and operational chain-of-command with a vehicle for verifying that the equipment is being operated, maintained, tested, and inspected according to acceptable standards. The requirements set forth in the following sections should be considered minimum standards and should not be construed as limiting the authority of a Command or a Type Commander to impose additional requirements or devise more restrictive requirements. The philosophy of this chapter is that each crane should meet a tightly-drawn set of material requirements upon completion of a shipyard overhaul, or interim availability, so that the gradual relaxing of certain requirements, during the operating cycle, does not affect safe and reliable crane operation. This philosophy is expressed by specific recertification test requirements and a departure-from-specifications program.

589-1.1.2 APPLICABILITY. This chapter applies to the Operation and Maintenance (O & M) of all shipboard mounted cranes and cranes assigned to forces afloat (including mobile cranes used aboard Aircraft Carriers) except for the following:

- a. Shipboard cranes designed and used only to handle reactor plant equipment. The technical requirements for operation, maintenance, testing, and inspection of these cranes shall be accordance with: reactor plant manual NAVSEA 0989-043-0000 **Commissioned Surface Ship General RP Overhaul and Repair Specification** ; reactor plant manual NAVSEA 0989-037-2000 **Commissioned Submarine General RP Overhaul and Repair Specification** ; equipment technical manual NAVSEA 0989-058-0000, **Tender Nuclear Support Facilities Preventive Maintenance Index** ; or other applicable documents. In the absence of such information, the requirements of this chapter shall apply.
- b. Cranes specifically designed and installed only to handle weapons are controlled under **NSTM Chapter 700, Shipboard Ammunition Handling and Stowage**. Where no conflict exists with **NSTM Chapter 700** , the requirements of this chapter may be used for guidance.
- c. Overhead traveling cranes that do not handle weapons (for example, LSD-41 well-deck crane) are controlled under **NSTM Chapter 572, Shipboard Stores and Provision Handling**. Where no conflict exists with **NSTM Chapter 572** , the requirements of this chapter may be used for guidance.
- d. Floating (barge) cranes assigned to forces afloat for O & M and aircraft-crash cranes are controlled under the requirements of Naval Facilities Engineering Command (NAVFAC) P-307, Management of Weight Handling Equipment. Where no conflict exists with NAVFAC P-307, the requirements of this chapter may be used for guidance.
- e. Cranes used to launch and recover Deep Submergence Vehicles and diving systems. Specific design, opera-

tional, and certification guidance is given in NAVSEA SS800-AG-MAN-010/9290, **System Certification Procedures and Criteria Manual for Deep Submergence Systems** and NAVSEA SS521-AA-MAN-010, **U.S. Navy Diving and Manned Hyperbaric Systems Safety Certification Manual**, respectively. The existing guidance shall be followed. Where no conflict exists with the existing guidance, this chapter may be used.

- f. MCM-1 class stern crane, MHC-51 class multi-purpose crane, and MHC-51 class boat crane. The MCM-1 class stern cranes are controlled under the requirements of NAVSEA SG811-BD-MOO-010, **Operation and Maintenance Manual for Nonmagnetic Stern Cranes (Model S-536)**. The MHC-51 class cranes are controlled under the requirements of their respective tech manuals.

589-1.1.3 TYPE COMMANDER IMPLEMENTATION. Full implementation of this chapter satisfies all technical requirements for NAVSEA cognizant cranes, except for items specified in paragraph 589-1.1.2. However, use of this chapter as the basis for implementing a tailored Certification Program, implementation of specific portions of the Certification Program, or of the entire chapter is at the discretion of the specific Type Commander.

589-1.1.4 SAMPLE FORMS. For the convenience of ship force, several forms were devised and are provided as figures (see List of Illustrations) in this chapter. These sample forms may be used as models for preparing tailored forms for local reproduction, stocking, and control. Forms are intended to be used for recording basic crane data, or other pertinent information in implementing a Crane Certification Program and shall be retained in the crane certification file as discussed in paragraph 589-6.2.3.

## 589-1.2 BACKGROUND

589-1.2.1 DEFINITION. For the purpose of this chapter, a crane is defined as a machinery arrangement, or self-contained structure, with associated reeving suitable for lifting loads, either remote from the lifting machinery, or through at least two dimensions of motion. Monorail hoists, stick-booms, and simple chain-falls (that is, come-alongs) are not defined as cranes for this chapter. Cranes which are operated and maintained by forces afloat are either permanently shipboard mounted (shipboard cranes) or, in some cases, are mobile to the extent that they can operate apart from the ship (mobile cranes). Boat and aircraft cranes, boat and missile cranes, and cargo cranes are examples of shipboard cranes. Aircraft-crash cranes, self-propelled cranes, and floating cranes are typical mobile cranes.

589-1.2.1.1 Operational Authority. All of these cranes are under the operational authority of specific Type Commanders. Life cycle management responsibilities (procurement, technical support, and maintenance support) may be assigned to various technical authorities.

589-1.2.1.2 Technical Authority. Shipboard cranes, and certain mobile cranes, are classified under the cognizance of NAVSEA. Floating cranes, aircraft-crash cranes, and virtually all pierside cranes are under the cognizance of NAVFAC. Aircraft-crash cranes purchased after 1985/1986 are under the cognizance of the Naval Air Systems Command (NAVAIR). Figure 589-1-1 depicts life cycle management responsibilities within the Navy and the technical authority providing engineering support for each type crane.

589-1.2.2 SHIPBOARD CRANES. Shipboard cranes are hull systems equipment under the technical authority of NAVSEA Weapons Handling and Aircraft Support Division 05P7, Washington DC. The NAVSEA Philadelphia (Naval Surface Warfare Center, Carderock Division - NSWCCD, Philadelphia, PA) provides life cycle management and inservice crane engineering support for NAVSEA through the Hull and Deck Machinery Department (Code 97). Direct fleet support is provided through the Naval Sea Support Centers, Portsmouth, VA, and San Diego, CA. Other technical commands may have interests in specific cranes (for example, Director, Strategic

Systems Projects for cranes handling strategic weapons). Technical requirements for operation, maintenance, testing, and inspection of shipboard cranes are contained in **NSTM Chapters 572 and 700**, NAVSEA reactor plant manuals, and equipment technical manuals. A comprehensive list of reference documents applicable to this chapter is provided as [Appendix A](#). Figure 589-1-2 illustrates the classification of shipboard crane types.

**589-1.2.3 SHORE-BASED CRANES.** NAVFAC, Alexandria, VA, is responsible for the administration, operation, and procurement of Navy transportation equipment by authority cited in instructions from the Secretary of the Navy (SECNAV) and Chief of Naval Operations (CNO). For example, weight handling equipment is under the cognizance of NAVFAC. NAVFAC P-307 is the document that provides for the maintenance management, testing, and certification of shore-based navy cranes. All shore-based, shipyard, and floating (barge) cranes are managed according to NAVFAC P-307.

**589-1.2.4 AIRCRAFT-CRASH CRANES.** Shipboard aircraft crash cranes are under the cognizance of NAVAIR, and managed according to NAVAIR 00-80T-119, **Management and Procedures Manual, NAVAIR Weight Handling Support Equipment**. NAVAIR is responsible for new shipboard equipment procured after 1985/1986. Previously procured aircraft crash cranes and all shore based aircraft crash cranes remain under NAVFAC cognizance. The Naval Air Warfare Center, Lakehurst, NJ, provides engineering support for post 1985/1986 aircraft crash cranes.

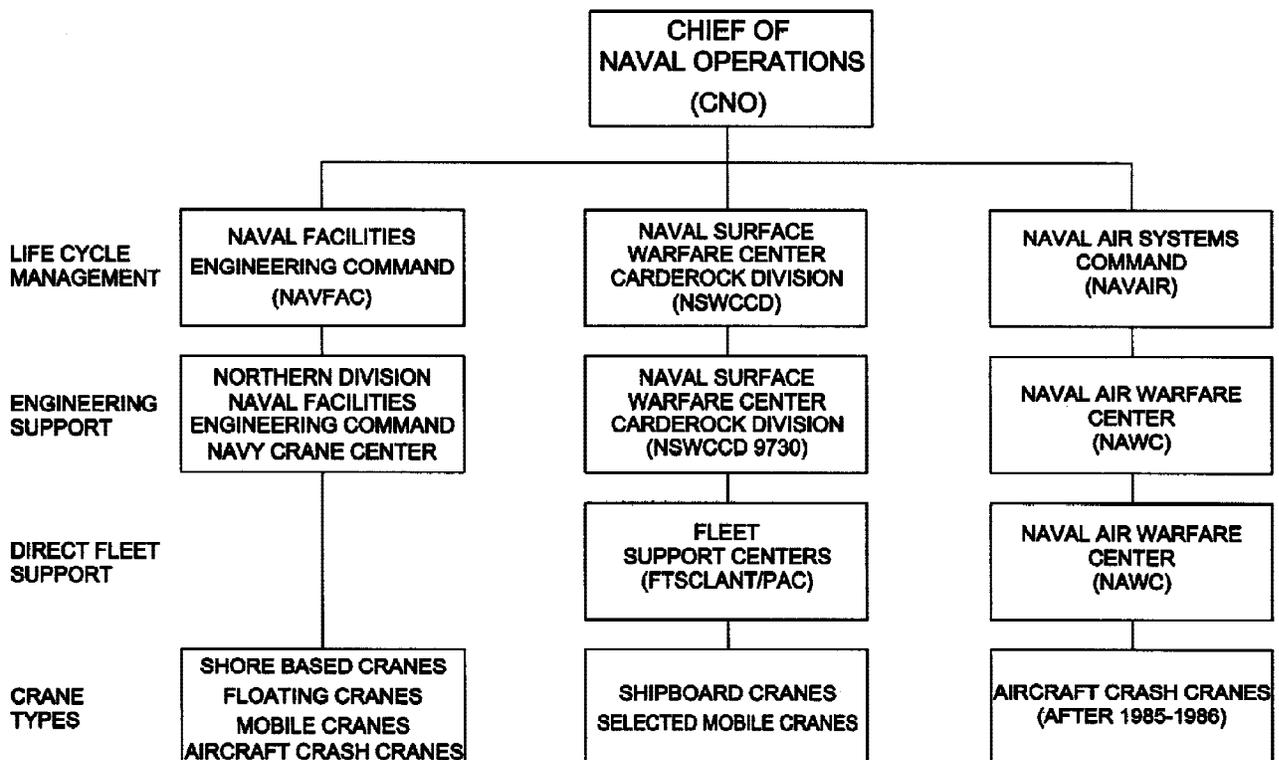


Figure 589-1-1 Navy Technical Responsibilities for Respective Crane Types

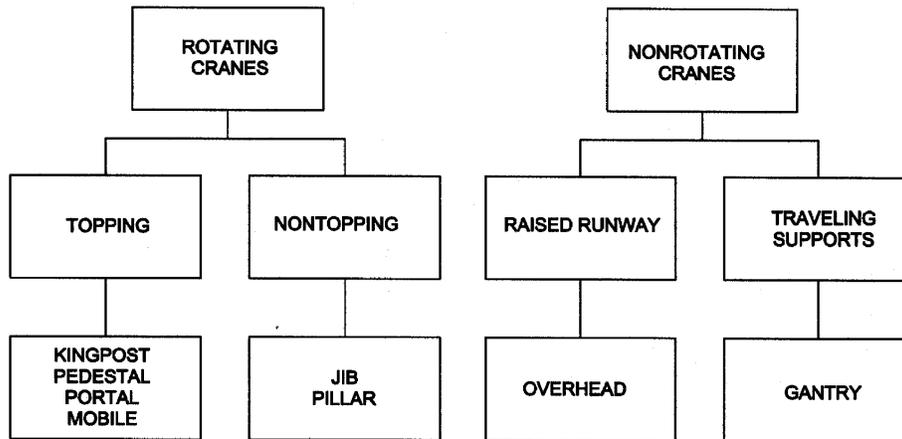


Figure 589-1-2 Classification of Shipboard Crane Types

### 589-1.3 SUMMARY

589-1.3.1 SECTIONAL BREAKDOWN. This chapter is divided into an introductory section, [Section 1](#), and five additional sections. [Section 2](#) provides descriptions of basic shipboard crane types, information for new shipboard personnel, and identifies the different crane types referred to throughout this chapter. [Section 3](#) provides guidance for crane operations. [Section 4](#) describes certain material and maintenance requirements. [Section 5](#) cites test and inspection requirements of cranes. [Section 6](#) describes the Certification Program process for shipboard cranes.

589-1.3.2 IDENTIFICATION OF BILLETS. Officers and Petty Officers are sometimes referred to by assigned billet or function. An introduction to key billets as referred to in this chapter is provided since one officer may discharge several functional responsibilities.

589-1.3.2.1 Crane Officer. A Crane Officer is responsible to the Commanding Officer (Officer in Charge for a noncommissioned ship) for the safe and reliable operation of all cranes assigned to the ship. If more than one officer is designated as a Crane Officer [for example, Boat and Missile (B & M) cranes and non-B & M cranes], that officer is responsible to the Commanding Officer for assigned crane types. Duties and responsibilities of a Crane Officer are identified in paragraph [589-6.2.2](#).

589-1.3.2.2 Training and Qualification Officer. A Crane Officer, or another officer, may be designated to manage and administer the training, testing, and qualification of potential crane crew members according to this chapter. Where an officer other than the Crane Officer is assigned this function, that officer will be responsible to the Crane Officer for adequacy of training and qualification for cranes under the appropriate Crane Officer's cognizance. The fact that another officer is responsible for conducting the training program does not relieve the Crane Officer of the responsibility to ensure that personnel are properly trained and qualified.

589-1.3.2.3 Division Officer. If the officer in charge of a division supplying crane crew personnel is not the Crane Officer, that Division Officer may supervise the training and monitor the performance of assigned trainee personnel (paragraph [589-1.3.2.2](#)).

589-1.3.2.4 Crane Certifying Officer. The Crane Certifying Officer, an officer other than the Crane Officer, monitors the administration of the Crane Certification Program. The Crane Certifying Officer should have no direct responsibilities for crane operation, maintenance, or crew training. The duties and responsibilities of the Crane Certifying Officer are specified in paragraph 589-6.2.4.

589-1.3.3 DEFINITION OF TERMS. Definitions are provided as follows for terms directly associated with cranes or weight handling equipment, or where a particular term has a specific meaning within this chapter:

- a. **A-Frame.** The structural portion, exclusive of the boom, above the rotation platform on cranes equipped with booms.
- b. **Accident.** Any unplanned or unscheduled event that interrupts the normal course of crane operation and causes personnel injury or death, or property or equipment damage (paragraph 589-3.3.10).
- c. **Anti-tip Mechanism.** A mechanical device used on small cranes usually consisting of sets of rollers mounted at each travel truck underneath the crane rail, which prevent tipping of the crane.
- d. **Base.** The portion of the supporting structure immediately below the roller path or rotating structure of a crane (Figure 589-1-3).
- d. **Block (Load).** The assembly of hook, swivel, bearings, sheaves, pins, and frame suspended from the hoisting wire ropes (also called fall block) (Figure 589-1-4).
- e. **Block (Topping).** The assembly of sheaves, bearings, pins, and frame attached to the top of the boom near the boom tip, that enables topping of the boom by means of the topping hoist wire rope (Figure 589-1-4).
- f. **Block (Upper).** A fixed assembly of sheaves, bearings, pins, and frame, usually located on the trolley or boom tip, that supports the load block and the load by means of the wire rope.
- g. **Boom.** An inclined or horizontal spar, strut, or other long member supporting the hoisting tackle (Figure 589-1-3).
- h. **Boom Angle/Radius Indicator.** A digital or analog readout located in the operator's cab which, working in conjunction with a load angle sensor mounted to the boom, gives the crane operator an indication of the working angle and/or radius of the boom.
- h. **Boom Hinge.** The pin and associated parts about which the boom pivots when topped (Figure 589-1-4).
- i. **Boom Tip.** The outer, nonattached end of the boom, opposite the boom hinge, that normally contains the sheaves or upper block assembly which, in turn, supports the lower block and hook assembly.
- i. **Boom Extension.** A feature found on some shipboard cranes which allows the working length of the crane boom to be changed to accommodate the requirements of different types of crane evolutions. This is generally accomplished by use of a separate crane drive using a wire rope rigging arrangement or hydraulic cylinders.
- j. **Boom Tip Extension.** A projection member that can be attached to the boom tip to allow light lifts at long or high reach (sometimes called Jib).
- k. **Brake.** A device, other than a motor, used for stopping or retarding motion through friction or by power.
- l. **Boom Stabilizer.** A mechanical (usually hydraulic) system used to minimize the possibility of slacking of topping wire rope due to wind or ship motion. Generally, hydraulic cylinders are used to impose a stabilizing load on some part of the boom.
- l. **Brake (Control).** A method of controlling load lowering speed by removing energy from the moving load or by imparting energy in the opposite direction (countertorque, dynamic, eddy current, mechanical, or regenerative).

- m. **Brake (Holding).** A friction brake that is automatically applied and prevents motion while power is off.
- n. **Bridge.** The main structural and mechanical portion of an overhead traveling crane, spanning two runway rails and consisting of girders supporting the trolley, the end trucks, the travel drive mechanism, and related parts (Figure 589-1-5).
- o. **Bull Gear and Pinion.**
  - 1. The large gear, usually attached to the nonrotating part of a crane, and its mating pinion gear, usually attached to the rotating superstructure, that transmit rotational motion to the superstructure.
  - 2. Any large gear and pinion, usually the last gear in a machinery reduction gear train.
- p. **Bumper.** A shock absorbing device installed to cushion the impact of contacting a positive stop.
- q. **Cab.** A crane compartment containing normal operating controls, a seat, and shelter for the operator (Figure 589-1-4).
- r. **Collector.** See Slip Ring.
- s. **Controlled Assembly.** An approved procedure whose documentation ensures that proper crane maintenance techniques are applied and verified by qualified personnel while performing certain maintenance on safety devices, load bearing, and load controlling components (paragraph 589-4.5).
- t. **Counterweight.** A balancing weight, usually attached to the rotating part of a crane, providing stability for the rotating superstructure (Figure 589-1-3).
- u. **Critical Lift.** Any of a series of defined lifts (that is, ordnance or nuclear related, at sea, submerged, near crane capacity, or precision lifts that require additional crane crew attention and warrant special provisions in training and qualification programs (paragraphs 589-3.1.2 and 589-3.7).
- u. **Cable Take-Up Reel.** A reel connected to the exterior of ship-powered traveling cranes on which the crane's main power coils or uncoils as needed to allow crane travel, the cable being laid into or taken out of a trough running parallel to the travel tracks.
- v. **Cycle.** The operation of a particular drive motion, or of the entire crane, from one position to another and back to the original position.
- w. **Dead End.** The fixed end of a wire rope that is not attached to the drum.
- x. **Departure-from-Specification.** An interim certification procedure designed to permit continued crane operation in the event of a decertifying event (that is, overdue weight test, major, or minor deficiency), if the means for crane recertification are not immediately available. Departures require the approval of the Commanding Officer, Squadron Commander, or Type Commander, depending upon the severity of the decertifying event and the length of the interim certification (paragraph 589-6.3.3).
- y. **Drift.**
  - 1. Motion after power cutoff until the brakes set or crane motion ceases
  - 2. Change of reach due to load
  - 3. Amount of available vertical travel of hook (from maximum hook height to low point as determined by amount of wire rope on drum).
- z. **Drum.** A cylinder on which wire rope is wound (Figure 589-1-6).
- aa. **Dynamic Load Test.** A load test, normally conducted at 125 percent of the rated load, at maximum attainable speed through the complete range of crane motions (hoist, lower, top, rotate, and travel), including testing of brakes, throughout three cycles. Tests crane operational ability with rated load under dynamic conditions of ship motion (paragraph 589-5.5.3).

- ab. **Dynamometer.** A load measuring or sensing device installed to accurately determine the weight (force) of the load and associated impact loads. It may be installed as an integral component in the rigging or attached between the hook and the load (similar to Load Cell).
- ac. **Eddy Current Brake.** A device consisting of an iron rotor mounted inside a stationary field assembly. When direct current is applied to the field circuit, alternate fields are induced in the rotor causing eddy currents to flow in the rotor. This action produces a retarding torque and the energy is dissipated into heat. The eddy current brake can slow down but cannot stop a load.
- ad. **Equalizer.** A pivoted bar or frame supporting two loads in constant equilibrium regardless of differences in load elevation or horizontal attachment; usually used between trucks on undulating rails or surfaces, and between two wire ropes whose lengths may be slightly unequal.
- ae. **Fleet Angle.** The angle formed between the wire rope and the centerline of the sheave groove or drum groove.
- af. **Fleeting Sheave.** A sheave that moves along its supporting shaft or pin.
- ag. **Gantry.** A leg and truss framework supported at each end so that it spans a distance; used for carrying a traveling crane (Figure 589-1-7).
- ah. **Handling Equipment.** The nonmechanized load bearing portion of a handling complex used for lifting or handling. Handling equipment includes, but is not limited to: lifting rigs, lifting yokes, lifting rods, lifting beams, strongbacks, spreader bars, shackles, turnbuckles, padeyes, hooks that are not attached to lifting equipment, and lifting fasteners that support the components or equipment under vertical and lateral loading.
- ai. **Festoon.** A method of handling the crane power cable on traveling bridge cranes which utilizes a series of small tow cars connected intermittently to the power cable and riding on a rail running parallel to the crane rails. As the crane travels, the motion of the tow cars on the rail allows the power cable to follow the crane as needed without exerting excessive force on the cable.
- ai. **Headache Ball.** A heavy weight attached above the hook on a single line or a whip hoist to provide sufficient force under gravity to lower the unloaded hook (Figure 589-1-6).
- aj. **Hoist Assembly.** A mechanical drive system comprised of a motor, wire rope, drum, reduction gear, couplings, and brakes; used for raising and lowering a load or boom.
- ak. **Hoist (Auxiliary).** A supplemental hoisting unit usually designed to handle lighter loads at higher speeds (Figure 589-1-8).
- al. **Hoist (Main).** The primary hoist mechanism provided for lifting and lowering the rated load of the crane (Figure 589-1-8).
- am. **Gooseneck Boom.** A boom designed with a downward bend near midspan to accommodate lifting of wide loads such as aircraft.
  - a. **A-Frame.** The structural portion, exclusive of the booms, above the rotation platform on cranes equipped with booms.
- an. **Gripperfork.** A structural component on portal cranes which grips the track and prevents tipping of the crane.
- ao. **Guide Rollers.** Used in conjunction with anti-tip rollers, these rollers are mounted to the underside of the crane forward and aft and ride along a rail or trough running parallel to the travel track. They allow the crane to travel in line with the tracks without cocking.
- am. **Hoist (Topping).** The hoist mechanism which operates the topping lift (also called Luffing-Hoist or Boom-Hoist).

- an. **Hoist (Whip).** A hoist utilizing a single line to the hook without other intervening tackle (Figure 589-1-8).
- ao. **Hook (Safety) Latch.** A device used to bridge the throat opening of a hook to prevent slings and lifting devices from inadvertently slipping off the hook.
- ap. **Hydraulic Power Unit.** A combination of components of electrohydraulic cranes (including hydraulic pumps, motors, actuators, and associated valves and piping) that are used in the transmission of energy and to control crane motions.
- aq. **Insulator Link.** A link installed between the hook and running rigging to protect riggers from burns caused by high voltages induced in the crane's metallic components by high frequency shipboard radio transmitters (paragraphs 589-3.6.6 and 589-4.2.1.7).
- ar. **Jib.**
  - 1. A boom supporting a trolley or fall block, and fitted to swing in socketed attachments to a wall or column (Figure 589-1-9).
  - 2. An extension attached to the boom tip to provide added boom length for lifting specified loads.
- as. **Kingpost.** A large vertical steel pin, or hollow tube (located at the center of rotation of a crane and normally attached to the ship structure) that aids in preventing the superstructure from overturning, maintains the center of rotation in place, and contains and passes the electrical wiring (Figure 589-1-4).
- at. **Lift.**
  - 1. Vertical distance of hook travel
  - 2. The load being lifted.
- au. **Lifting Equipment.** The mechanized portion (including attached wire rope and chain) of the load handling complex capable of altering the vertical height, and changing the lateral position of the attached load. Lifting equipment includes cranes, hoists, monorail trolleys, and trucks.
- av. **Lifting Lug.** A bolted or welded-on appendage to a piece of equipment used when lifting or servicing the equipment.
- aw. **Limit Stop.** The preset point at which a mechanical arrangement of shafting and gears halts crane motion.
- ax. **Limit Switch.** An electrical safety device that, when actuated by crane motion, will deenergize the circuit or activate a warning to the operator.
- ay. **Hydraulic Drive Unit.** A combination of components of electrohydraulic cranes (including hydraulic motors, actuators and associated valves and piping) that are used to transmit energy from the hydraulic power unit to power and control crane motions. Electric motors provide energy to the hydraulic power unit to power and control of the crane motions.
- ay. **Load Bearing Members.** Those components or structural support members of the lifting and handling equipment which support the load; a failure could cause dropping, uncontrolled shifting, or movement of the load (paragraph 589-6.4.1).
- az. **Induction Heater.** An electrical input device located in the operator's cab of electro-mechanical cranes which provides a variable electrical signal to the crane control system which uses the signal to generate the desired speed and direction of the drive depending on control lever input provided by the crane operator.
- az. **Load Block.** See Block (Load).
- ba. **Load Controlling Members.** Those components of the weight handling equipment that position, restrain, or control movement of the load or crane; a failure or malfunction could cause dropping, or uncontrolled shifting or movement of the load or the crane (paragraph 589-6.4.1).
- bb. **Luffing.** See Topping.

- bc. **Major Deficiency.** A material deficiency directly affecting the safety or reliability of the crane (paragraph [589-6.4.2](#)).
- bd. **Mast.** A vertical structural member that provides the center of stability for the rotating structure. The mast is either mounted over the kingpost or is an extension of the pedestal or kingpost (Figure [589-1-4](#)).
- be. **Masthead.** The end of the mast or kingpost which supports an arrangement of kingpost which supports an arrangement of sheaves and other components and provides a leverage point for topping the boom.
- bf. **Minor Deficiency.** A material deficiency which does not directly impact safe load handling (paragraph [589-6.4.3](#)).
- bg. **No-Load Test.** Test by which crane functional performance, without a load on the hook, is evaluated (paragraph [589-5.4](#)).
- bh. **Noncritical Lift.** All load lifts, other than those defined as critical lifts, that are conducted on a routine basis.
- bi. **Nondestructive Testing.** Test methods applied to structural materials in order to detect structural flaws or defects; uses techniques such as ultrasonic, magnetic particle, liquid penetrant, or radiographic inspection that will not unduly affect the test object.
- bj. **Outriggers.** Extendible arms attached to a mobile crane mounting, which include a means for relieving the wheels of the crane weight. Outriggers are used to increase crane stability.
- bk. **Load Cell.** An instrument connected in the load path which senses the applied load electrically or hydraulically and transmits the information to a digital or analog readout located in the operator's cab.
- bk. **Pawl.** A gear locking device.
- bl. **Pedestal.** The nonrotating foundation. A base that is permanently attached to the ship structure and supports the rotating portion (Figure [589-1-6](#)).
- bm. **Load Indicator.** A digital or analog readout located in the operator's cab which receives input from the load cell and gives the crane operator an indication of the magnitude of the load on the hook.
- bn. **Parts Purchase.** Refers to any number of rigging arrangements which provide mechanical advantage to assist in handling of boom or load.
- bm. **Pendant.**
  1. A pushbutton control unit, which may be suspended from a fixed location on the trolley, bridge, or messenger track, mounted alongside the footwalk handrail, enabling the crane to be deck-operated.
  2. A standing rope which maintains a constant distance between the points of attachment.
- bn. **Portal.** An opening designed through the base of the crane, or gantry legs, to allow passage of traffic under the crane, or passage of the crane over stored materials or obstructions (Figure [589-1-3](#)).
- bo. **Main System Pump.** The main pump(s) on a hydraulic crane used to circulate fluid around the main loop to allow crane motions.
- bp. **Relief Valve.** A hydraulic safety device used on hydraulic cranes to prevent excessive pressure in the hydraulic system or part of the hydraulic system.
- bq. **Replenishing Pump.** A smaller pump driven from the main pump which replenishes fluid lost from the main loop of the hydraulic system through leakage.
- bo. **Rated Load.** The maximum permissible weight a crane is designated to carry during use (also called Safe Working Load).
- bp. **Rated Load Test.** A load test conducted at 100 percent of the rated load, at rated speed, through the complete range of crane operating motions (hoist, lower, top, rotate, and travel), including testing of brakes and

emergency features, throughout 10 cycles. Test is performed to determine condition of functional operation of crane equipment, repeatability of functions, and heat dissipation ability (paragraph 589-5.5.4).

- bq. **Rails.** The track over which wheel trucks for the crane or trolley travel, supported by the deck, runway beams (overhead), or bridge girders (Figure 589-1-7).
- br. **Reach.** Horizontal distance from the center of rotation of a crane to the hook (also called Working Radius or Outreach).
- bs. **Rotation.** Circular motion of the crane structure in a horizontal plane about the crane's axis (also called Slew or Swing).
- bt. **Safe Working Load.** See Rated Load.
- bt. **Servo Pump.** A smaller pump driven from the main pump which provides hydraulic pressure to allow the functioning of auxiliary system operations such as brake release and pump stroke control.
- bu. **Sheave.** A wheel with a circumferential groove designed to contain a specific size of wire rope and used to change the direction of a running wire rope (also called Pulley).
- bu. **Shock Absorber.** A mechanical device sometimes mounted in the load path near the hook which lessens impact loading on the crane.
- bv. **Side Load.** The horizontal component of the hoist rope force acting on the crane structure when the hoist ropes are not operated in a vertical line (also called Side Pull).
- bw. **Slew.** See Rotation.
- bx. **Slip Ring.** A conducting ring that transfers current, through brushes, between rotating and stationary members of a circuit (also called Collector).
- by. **Spud Lock.** A pin and socket device that prevents travel or rotation of a crane while it is idle.
- bz. **Static Load Test.** A load test normally conducted at 150 percent of the rated load and performed by suspending the required load for a period of 10 minutes. Test is performed to determine structural and mechanical integrity of the crane components (paragraph 589-5.5.2).
- ca. **Stop (Positive).** A fixed structural member located at the limit of motion for topping, rotation, or travel, with or without energy-absorbing ability.
- cb. **Strength Welds.** Those welds in structural members whose failure could cause dropping, uncontrolled shifting, or adverse movement of the load.
- cb. **Stormlocking Device.** A structural device used to positively lock the crane at a designated location to secure it against adverse weather conditions or ship motion.
- cd. **Stowage Cradle.** A structural unit separate from the crane mounted to the ship's deck on which the boom is stowed and secured during periods of inactivity.
- cc. **Test Load.** Any load, weight, or force of known magnitude, maintained within a specified tolerance, that is used for testing
- cd. **Topping.** The raising and lowering of a boom, resulting in a radial inward and outward movement of the load (also called Luffing).
- cd. **Topping Cylinders.** An alternate method of controlling boom motion (vice wire rope) in which hydraulic cylinders pinned at one end to the boom and the other end to the crane structure enable the boom to be raised or lowered by extension or retraction of the cylinders.
- ce. **Travel.** Horizontal motion of a crane or its parts, usually in a straight line.

- ce. **Travel Rack and Pinion Gears.** A gearing system used on small travel cranes in which a low speed pinion mounted to the travel drive on the underside of the crane meshes with a rack gear mounted to and running the full length of the travel track allowing crane travel.
- cf. **Trolley.** A wheeled carriage designed to support and transport a suspended load (Figure 589-1-5 and Figure 589-1-7). The term includes all integral associated equipment for hoisting, suspending, and propelling the load (Figure 589-1-5).
- cg. **Two-Blocking.** Inadvertent physical contact between the load block and either the upper block, or any part of the boom structure.
- ch. **Truck (Wheel).** The complete unit consisting of frame, wheels, integral driving, and associated equipment that supports the traveling crane or a traveling portion of a crane, such as a trolley or gantry (Figure 589-1-7).
- ch. **Wire Rope.** A mechanical device made from wires wrapped into strands which are wrapped around a supporting core to form the finished rope. The wire rope is connected to the drum and runs over sheaves to connect to the hook or fall block and is the primary medium in the load path which supports the weight of the load or boom.
- ci. **Whip Hoist.** See Hoist (Whip).

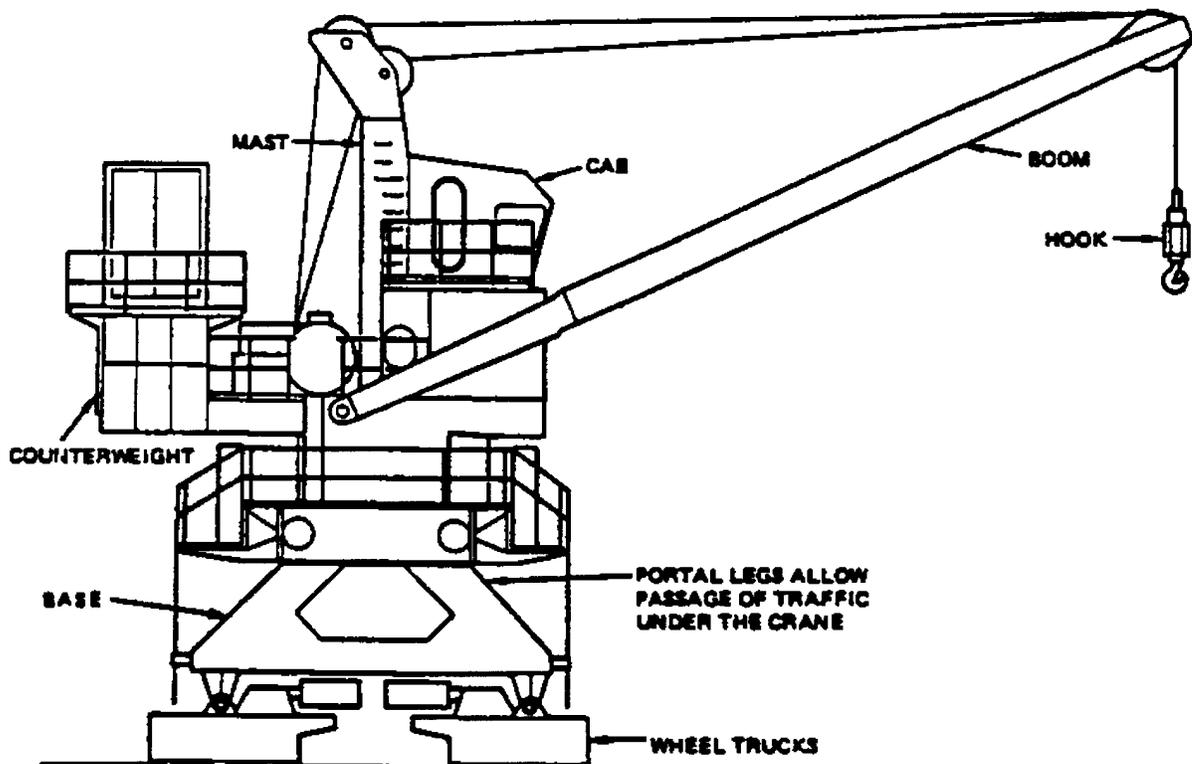


Figure 589-1-3 Portal Crane (Example: ARDM-4 Crane)

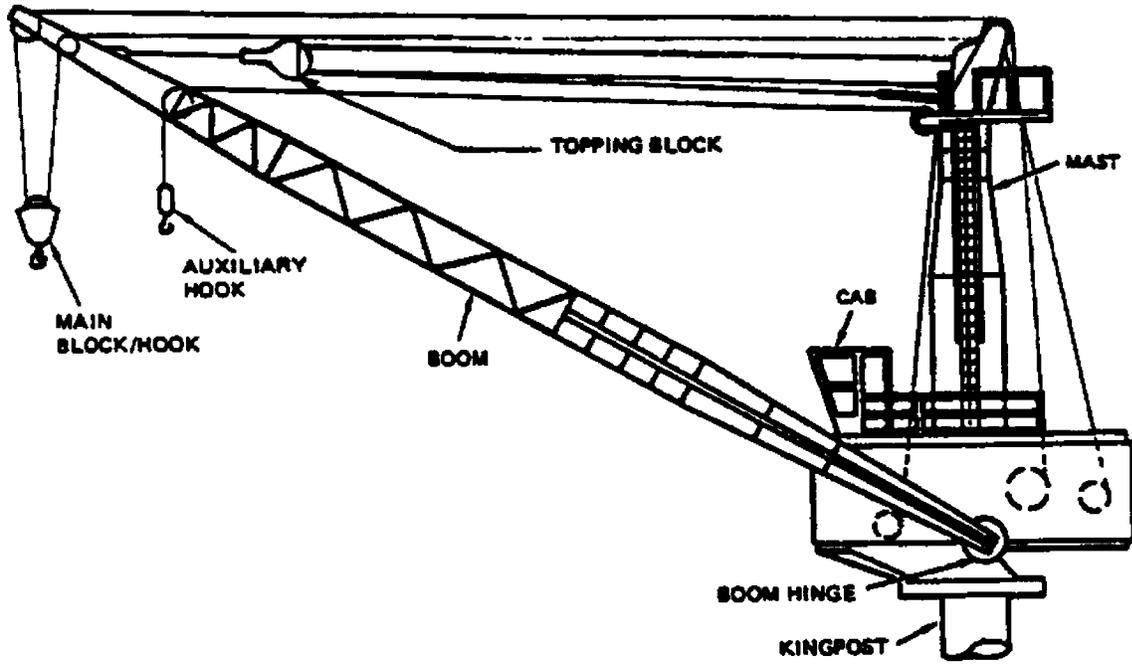


Figure 589-1-4 Kingpost Crane (Example: AS31 through AS34 B & M Cranes)

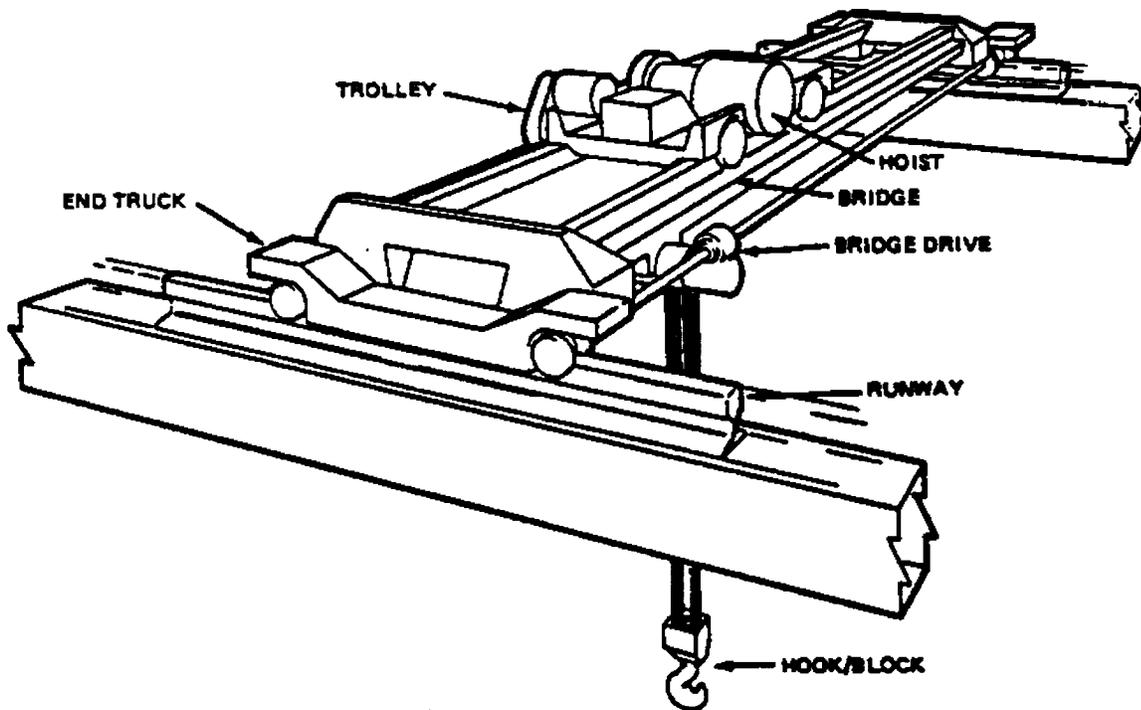


Figure 589-1-5 Overhead Traveling Crane (Example: Similar to LSD 41 Well-Deck Crane)

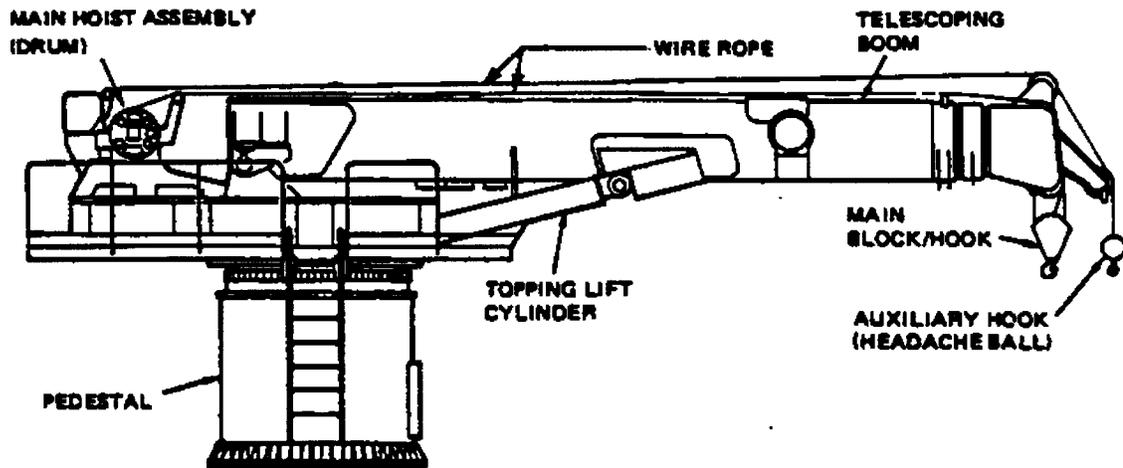


Figure 589-1-6 Pedestal Crane with Telescoping Boom (Example: AS 18 Crane)

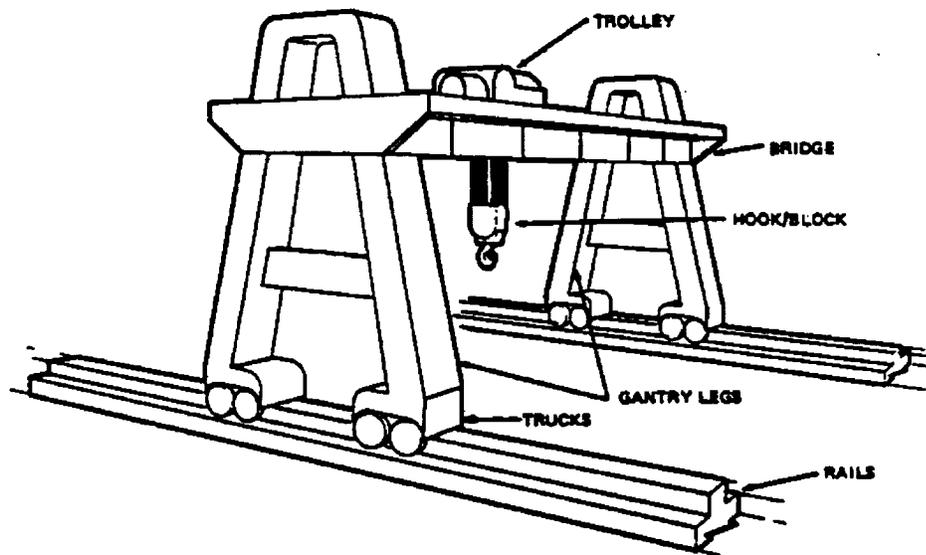


Figure 589-1-7 Gantry Crane (Example: Similar to ASR Crane)

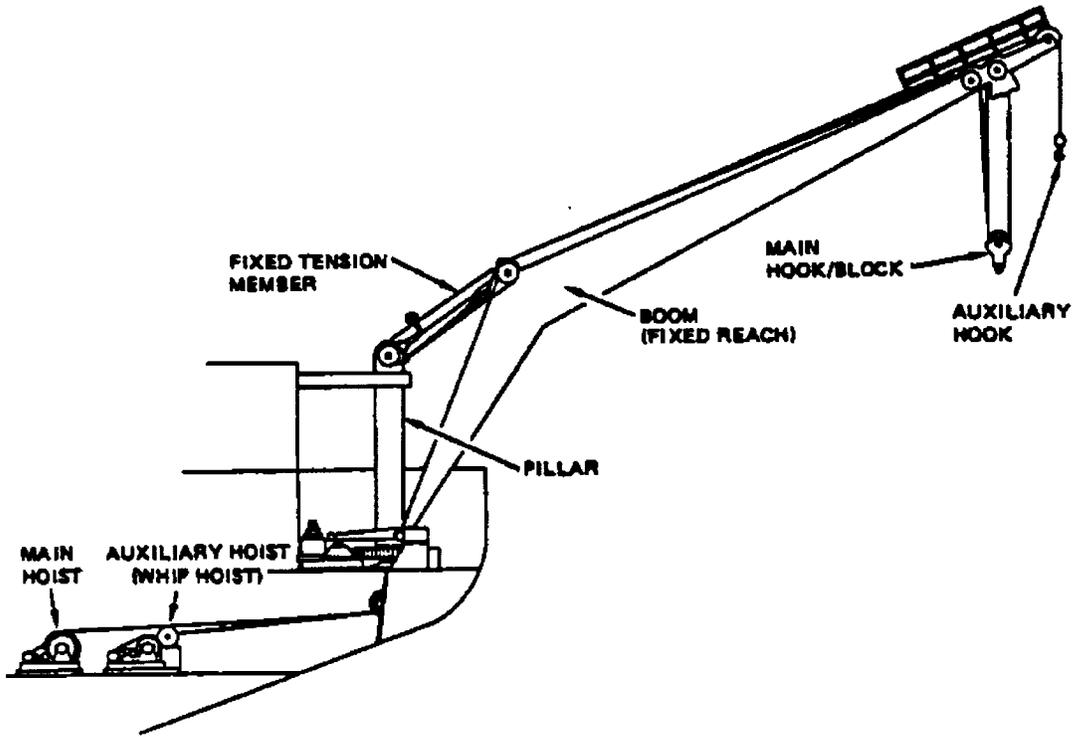


Figure 589-1-8 Pillar Crane (Example: CVN 65 Crane)

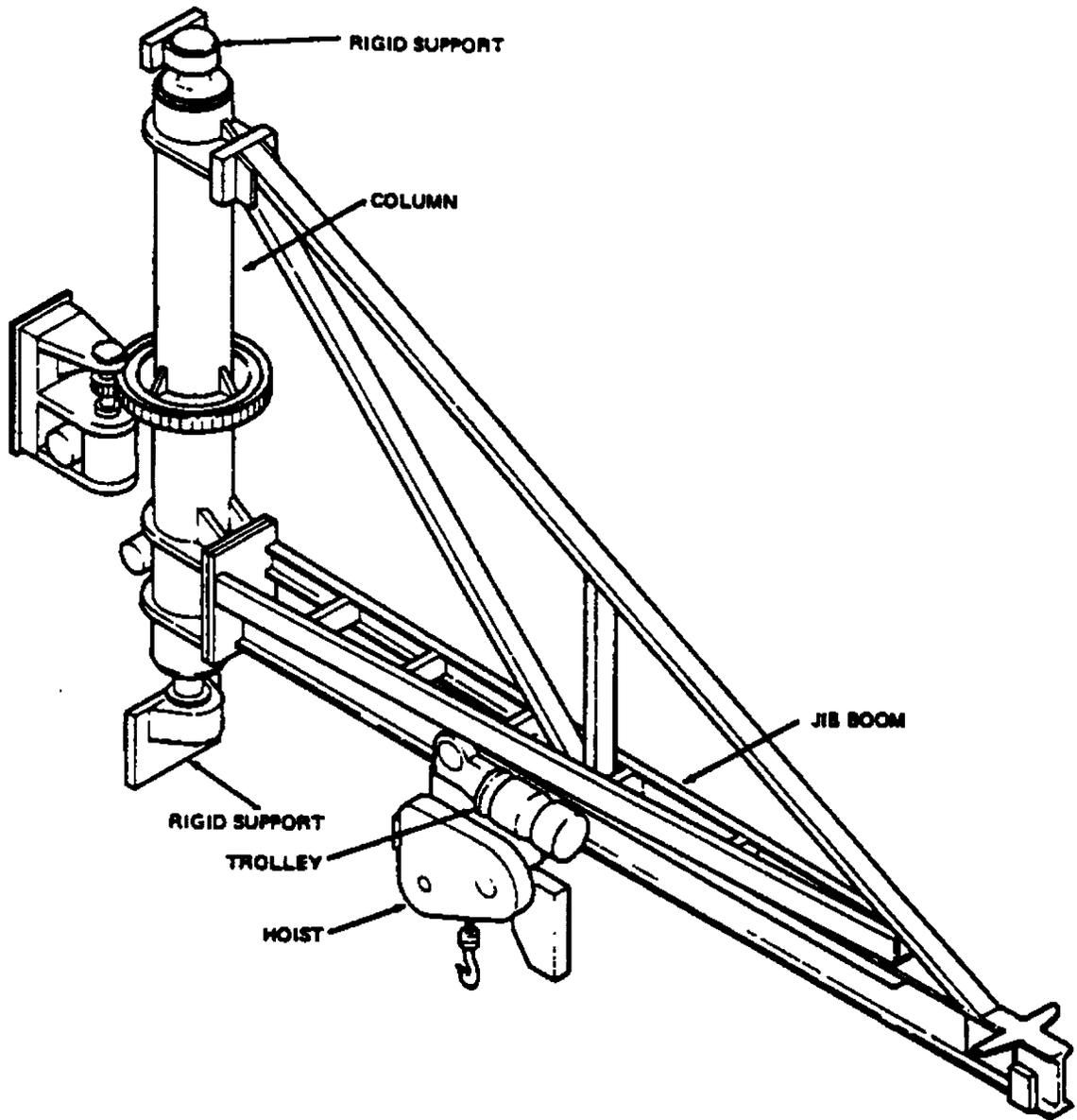


Figure 589-1-9 Jib Crane (Example: Similar to LHA Cranes)

**SECTION 2.**  
**DESCRIPTION**

**589-2.1 NAVY SHIPBOARD CRANES**

589-2.1.1 CLASSIFICATION. Cranes used aboard United States Navy ships are typically classified by the functional use of the crane. For example, the following crane designations are typical of those in Navy ships:

- a. Boat and Aircraft (B & A)
- b. Boat and Repair (B & R)
- c. Boat and Missile (B & M)
- d. Boat and Helicopter (B & H)
- e. Cargo or Stores
- f. Sail-Service
- g. Minesweeping
- h. Salvage
- i. Torpedo.
- j. Mobile.

589-2.1.1.1 Classification of cranes in this chapter is based on crane design and operational features (Figure [589-2-1](#)) rather than shipboard use or location.

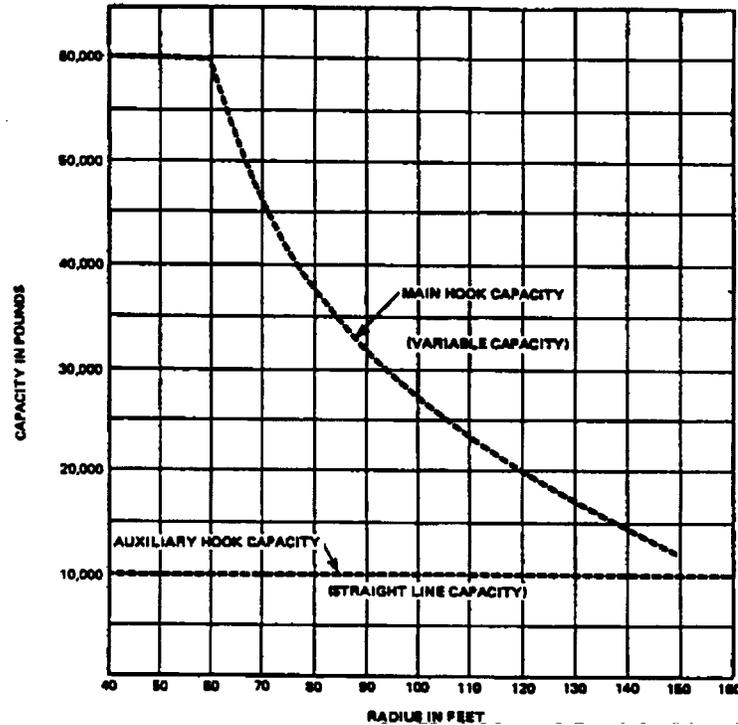


Figure 589-2-1 Typical Reach-Capacity Chart for Variable and Straight Line Capacity Hooks

589-2.1.2 CRANE TYPES. In general, rotating cranes are characterized by a topping boom attached to a king-post or a pedestal that resists the overturning forces created by the boom and attached load, or a boom rigidly attached to a rotating column or base. Nonrotating cranes are characterized by a bridge and trolley arrangement. Hoisting equipment is located on the trolley, that in turn is transported on movable bridge girders and wheel trucks.

589-2.1.3 CRANE SELECTION. Cranes are selected for shipboard use on the basis of:

- a. Type of work to be performed
- b. Desired capacity and reach
- c. Area of coverage
- d. Cost and space savings.

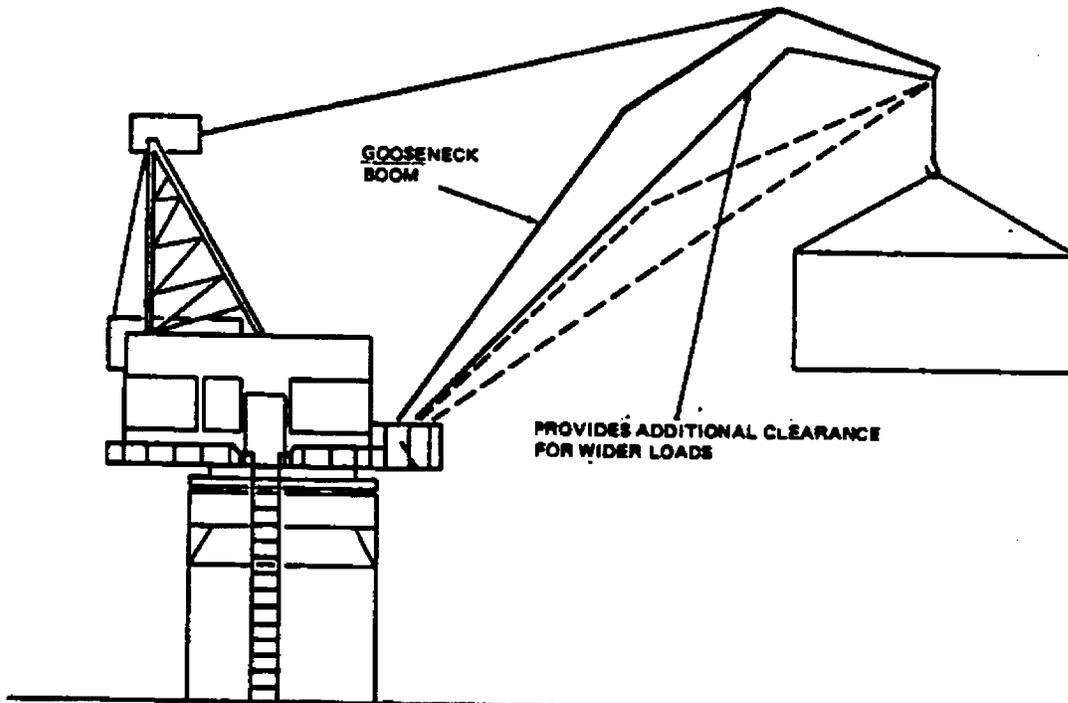


Figure 589-2-2 Topping Crane with Gooseneck Boom (Example: Similar to LPD Crane)

589-2.1.3.1 Other specific application factors include an ability and need to travel with the load and collateral facilities (such as rails, availability of power and support, safety, cost, mobility, clearances, and accuracy of spotting). In general, the following types of cranes offer advantages for the reasons given:

- a. Rotating, Topping Cranes; ability to clear heights or obstacles
- b. Rotating, Nontopping Cranes; cost and space savings
- c. Nonrotating Cranes; high load capacity and ability to operate within enclosed spaces
- d. All Traveling Cranes; broad area of coverage.

589-2.1.3.2 [Table 589-2-1](#) briefly describes the various cranes associated with each major crane type. Detailed information concerning the major types of Navy cranes is given in paragraph [589-2.2](#).

**Table 589-2-1 TYPES OF CRANES**

Type	Description
<b>Rotating</b>	
<b>Topping</b>	
1. Kingpost Crane	A crane with topping boom commonly used where heavy lifts and long boom outreach is required. The kingpost provides an axis of crane rotation and resists the bending moment of the load (Figure <a href="#">589-1-4</a> ).
2. Pedestal Crane	A crane with topping boom which utilizes large bearings to absorb the major stresses imposed by crane motions. Occasionally, these cranes are provided with counterweights and aid stabilization. The base structure may be fixed or traveling (Figure <a href="#">589-1-6</a> ).

**Table 589-2-1** TYPES OF CRANES - Continued

Type	Description
<b>Rotating</b>	
3. Portal Crane	A crane with a topping boom, mounted on an elevated platform so that it can travel (on rails) over objects and personnel on deck (Figure 589-1-3).
4. Mobile Crane (Truck)	A crane with a topping boom and an independent power plant, mounted on a self-propelled truck. Its primary advantage is mobility.
<b>Nontopping</b>	
1. Jib Crane	A fixed crane consisting of a fixed vertical member supported at top and bottom, and a horizontal revolving arm carrying a trolley (Figure 589-1-9).
2. Pillar Crane	A fixed crane consisting of a vertical member, held in position at the base to resist the overturning moment, and a constant-radius revolving boom supported by a tension member (Figure 589-1-8).
<b>Raised Runway</b>	
Overhead Traveling Crane	A crane on a pair of elevated parallel rails adapted to lift and lower a load, and carry it horizontally parallel or at right angles to the rails. Consists of one or more trolleys operating on top or bottom of a bridge, which consists of one or more girders or trusses mounted on trucks operating on elevated rails. Operational area is limited to the space between the bridge rails (Figure 589-1-5).
<b>Traveling Support</b>	
Gantry Crane	A crane, similar to an overhead traveling crane, except that the bridge for carrying the trolley(s) is rigidly supported on two or more gantry legs. The assembly moves on fixed rails (Figure 589-1-7).

## 589-2.2 HULL MOUNTED CRANES

589-2.2.1 ROTATING, TOPPING CRANES. The rotating, topping crane is the most common type of hull mounted crane. This type of crane has a boom attached to a rotating structure by a boom hinge which allows raising and lowering (resulting in inward and outward movement of the load). The rotating structure, which supports the boom and contains the machinery and hoisting systems, is attached to a base structure (kingpost or pedestal) about which the structure rotates (Figure 589-1-4 and Figure 589-1-6). The base structure may be fixed or may travel on wheels mounted on rails. When the base structure is elevated to a height above the deck to permit passage of objects or personnel under the crane, the crane is also a portal type (Figure 589-1-3). Although these portal cranes are often referred to as gantry cranes, a true gantry crane contains a bridge and trolley arrangement elevated above the deck by gantry legs, as described in paragraph 589-2.2.4.

### CAUTION

**Use of variable capacity ratings requires increased operator awareness to ensure that loads are not lifted which exceed crane capacity for a specific radius, or that the boom is not lowered beyond the radius limit for the load attached.**

589-2.2.1.1 Load Capacity. The load capacity (in pounds) of a rotating, topping crane is determined by considering the following factors:

- a. Load capacity of the hoist and rigging equipment
- b. Stresses in the crane structure and rigging
- c. Dynamic load factors.
- d. Stability.

589-2.2.1.2 Hoist Capacity. Hoist capacity is usually stated as a constant value (in pounds), fixed by the design of the hoist and rigging drive train. However, stress and stability vary with the boom angle. Based on these factors, topping crane capacity is usually established according to the design criteria listed in paragraphs [589-2.2.1.3](#) through [589-2.2.1.5](#).

589-2.2.1.3 Straight Line Capacity. Design of the hoist drive and rigging equipment is determined by the desired load capacity at maximum reach (Figure [589-2-1](#)) in the Straight Line Capacity Design Method. Although the topping crane structure could lift greater loads at lesser reach, design limitations set by the capacity of the hoist and rigging sets the maximum load limit.

589-2.2.1.4 Variable Capacity. Topping cranes are also designed according to variable capacity (Figure [589-2-1](#)). Using this design method of rating, increasingly heavier loads are plotted at decreasing reach, the capacity at any reach being determined by crane stability or stress levels. A variable capacity crane is most advantageous where heavier loads can be positioned at lesser radii, and lighter loads can be positioned at maximum reach. The primary disadvantage of the variable capacity rating is an increase in the possibility of operator error, which may result in actual structural damage to the crane.

589-2.2.1.5 Crane Capacity Combinations. Navy topping cranes are also designed by using a combination of crane capacity design methods. For example, crane design may employ straight line capacity for all boom angles above a specified angle (such as, 30 degrees), and variable capacity for boom angles less than the specified angle.

589-2.2.1.6 Traveling Cranes. When provided with the means to travel, a rotating, topping crane has the further advantages of versatility and area of coverage. However, the requirement for a long, straight deck for a rails mount, and the need to locate the crane high in the superstructure of the ship to avoid obstructions, generally restricts traveling cranes to certain ship types (for example, tenders and floating drydocks). Traveling portal cranes, which can work over obstructions on deck, are even more versatile, but are generally limited to floating drydock applications because of at-sea stability considerations.

589-2.2.1.7 Employment. Rotating, topping cranes provide certain advantages for shipboard use. The rotation feature permits flexibility when positioning the load before the lift, even where the crane location is fixed. The topping feature provides the ability to clear obstructions when positioning the load, reduces wind exposure due to the latticed framework, and provides more versatility than bridge and trolley or nontopping cranes. Consequently, typical shipboard cranes (such as B & A, B & R, B & M, and B & H cranes) are often rotating topping cranes, and are found on numerous ship types including Destroyer Tenders (AD), Fast Combat Support Ships (AOE), Repair Ships (AR), Submarine Tenders (AS), Salvage and Rescue Ships (ATS), Amphibious Command Ships (LCC), Amphibious Assault Ships (LHA and LPH), Amphibious Transport Docks (LPD), Amphibious Dock Landing Ships (LSD), and Minesweepers (MSO).

589-2.2.1.8 Major Components. A primary feature of the rotating, topping crane is the topping boom. The boom is attached to the rotating structure at the boom hinge pin and is raised and lowered through an indepen-

dent topping (luffing) drive system. The boom also contains the sheaves and reeving necessary to support the running rigging that connects the main and auxiliary hoist drive trains with their respective hooks and load blocks.

589-2.2.1.8.1 The minimum boom angle of a topping crane is determined by design stress. It is also the angle, above or below the horizontal, that shall be maintained so that the angle between the topping ropes and the boom is not so acute that the boom cannot be raised. The maximum boom angle is physically determined by requiring that the topping ropes remain in tension, so that the boom will not flip over (backwards) in a high wind or following a sudden bounce of the load (for example, rope break or sudden release of the load from its supports during takeup). Boom stabilizers and/or positive stops are usually provided to prevent this occurrence. On cranes that use topping cylinders to raise and lower the boom, minimum and maximum boom angles are determined by the design of the cylinder.

589-2.2.1.8.2 The rotating structure, which supports the boom, contains the machinery and electrical systems necessary to operate and control the crane (main, auxiliary, and topping drive units, including independent hoist drums, hoisting motors, brakes, electrical controllers, and safety devices for each drive). The rotating structure is generally of the kingpost or pedestal type. In a kingpost arrangement, the central mast or kingpost (which may be stationary or rotating) provides an axis for crane rotation and resists the bending moment generated by the lifted load. In a pedestal arrangement, weights of cast iron or concrete are provided at the periphery of the rotating structure to counterbalance the dead weight of the boom. Both types of rotating structures are usually mounted on special thrust roller bearings.

589-2.2.1.8.3 Rotation of the machinery structure and boom is achieved by means of a bull gear and drive pinions. The bull gear is either stationary or attached to the rotating structure, depending upon the crane design. Rotating, topping cranes, when designed to travel, are usually equipped with special wheel trucks that prevent tipping of the crane.

589-2.2.1.8.4 The most common hoist assembly used with this type of shipboard crane is driven by an electrohydraulic power unit. An electric motor, usually Alternating Current (AC), may drive one or more variable-volume or vane-type hydraulic pumps. Each hydraulic pump feeds a constant volume hydraulic motor that turns the main, auxiliary, topping drum, or the rotation pinion. Where variable volume pumps are used, hoist or rotation speed is controlled by varying the angle of a tilt-plate within the hydraulic pump, thereby changing the output volume from zero to maximum. In this type of arrangement, the hoist brakes are usually applied at, or near, the connection of the hydraulic motor to the drum reduction gear.

589-2.2.1.9 Variations. Design variations for the rotating, topping crane include:

- a. Gooseneck Boom. This type of boom (Figure 589-2-2) allows the crane to handle wider loads or clear close obstructions. However, lift capacity is generally reduced, compared to a comparable crane with conventional boom.
- b. Level-Luffing. Level-luffing is a control feature found on a limited number of topping cranes, because it is generally not essential that the load be maintained at the same elevation when raising or lowering the boom. Cranes of this design are arranged so that the boom-topping motion moves the suspended load horizontally without vertical displacement.
- c. Hydraulic Topping Cylinder. A hydraulic cylinder raises or lowers the boom in place of a topping hoist (Figure 589-1-6). The boom itself is often a telescoping type (the boom can be extended or retracted in length by

means of hydraulic cylinders within the boom). Although this type of boom arrangement is frequently used on mobile (truck) cranes because of its ease of transport, application aboard ship has been limited to reduce maintenance requirements.

- d. Electric Drive. Some rotating, topping cranes use all electric drives rather than electrohydraulic drives. Electric motors drive the hoist drums, rotation, or travel assemblies through reduction gears. These motors are often Direct Current (DC) motors because of the variable speed characteristics. AC motors with static-stepless or other variable speed controllers are also used. For larger traveling cranes, such as portal cranes, self-contained electric power may be provided. Portal cranes often contain a diesel generator in the machinery housing which provides all electric power to the crane. Where a traveling crane does not have its own power supply, an electrification system, often containing a cable reel and slip rings, shall be provided to electrify the crane using shipboard power supply.

589-2.2.2 ROTATING, NONTOPPING CRANES. Shipboard rotating, nontopping cranes can be jib or pillar cranes. Both types are fixed (nontraveling) cranes. A jib crane consists of a fixed vertical member, supported at the top and bottom, from which a horizontal arm or jib (boom) extends. The jib rotates about the vertical member and contains a fixed or traveling trolley. A rotating jib crane, with traveling trolley, is shown in Figure 589-1-9. A distinctive feature of this crane is that the jib (boom) cannot be raised or lowered. Load position is accomplished by jib rotation or trolley travel. The load is lifted by the trolley-mounted hoisting unit. A pillar crane (Figure 589-1-8) is similar to a jib crane, except that the pillar crane has a constant-radius boom which is supported by a tension member, attached to the top of the pillar.

589-2.2.2.1 Employment. Rotating, nontopping cranes are normally fixed in the ship and have less reach than comparable topping cranes. Consequently, they are typically installed to perform a specific function, such as loading or off-loading a certain hold or magazine of the ship. They are generally used for handling loads within or onboard the ship, and are sometimes used to work over-the-side. These cranes are generally found on auxiliary ships or other large ships, such as Aircraft Carriers (CV and CVN) and LPH and LHA.

589-2.2.2.2 Major Components. Rotating, nontopping cranes are fairly simple equipment. The rotation device is normally a gearing arrangement driven by an electric motor. Since the nontopping crane structure is not as massive as the structure of a topping crane, the rotation assembly is often smaller and much simpler. The major feature of the jib crane is the traveling trolley. The trolley is normally a self-contained unit with an electric-drive system to permit travel along the length of the jib, and an electric hoist for raising and lowering the load. The trolley also has a braking system. When not traveling or hoisting, the trolley does not move.

589-2.2.2.2.1 Rotating, nontopping cranes are normally controlled from a pushbutton station on the deck close to the crane. A pillar crane has a hoist assembly attached to the hook and load block by wire rope and sheaves for lifting or lowering the load, similar to the arrangement discussed in paragraph 589-2.2.1.8 for rotating, topping cranes. A pillar crane may have an auxiliary hoist and a main hoist but is not equipped with a topping hoist, since the boom is not designed for raising and lowering under load.

589-2.2.2.3 Variations. On jib cranes, a trolley or fixed rigging may be used. Where a traveling trolley is not installed, an electric hoist is generally fixed at the end of the jib. This type of crane is normally used only to hoist a load out of a hold and then rotate to place the load on deck, and vice versa. A design variation of the pillar crane allows disconnection of the tension member connecting the pillar to the boom tip to allow stowage of the boom; the main hoist is used to raise the boom until the tension member becomes slack. A pin is then removed from the tension member, allowing the boom to be fully lowered into a stow position using the main hoist machinery (Figure 589-1-8).

589-2.2.3 NONROTATING, RAISED RUNWAY. Cranes in this category are overhead traveling cranes. The overhead crane is a traveling machine that rides on rails above the working deck (Figure 589-1-5). The crane includes a bridge that spans the tracks and a trolley-mounted hoisting system. Overhead cranes, also called bridge cranes, can be hand, air, or electric powered, top running on rails, or underhung so that the suspended crane rides along the bottom flanges of the rails.

589-2.2.3.1 Employment. A major advantage of the overhead traveling (bridge) crane is its ability to provide a large load capacity over a wide range of coverage in an enclosed space. Overhead cranes are normally used in maintenance areas of the ship or in large bay areas. An additional advantage is that pendant-mounted controls may be used so that the crane operator may be positioned to closely monitor the lift on the working deck near the load. These cranes are located in the well decks of LPD's and LSD's.

589-2.2.3.2 Major Components. The major components of the overhead traveling (bridge) crane are: rails, bridge, trolley, and hoist. The bridge consists of one or more girders attached to a set of end trucks. The end trucks run on a pair of parallel rails called the runway. The trolley rides on the bridge girders and carries the hoisting equipment. Bridge and trolley movement is accomplished by a manual, air, or electric drive system. The hoist may be manual, air, or electric drive. To some extent, the selection of the drive type is dependent upon the capacity of the hoist. Manual drive may be used for hoists with load capacity up to 6 tons; air drive may be specified for hoists with load capacity up to 10 tons; and electric drive may be specified for any load capacity.

589-2.2.3.3 Variations. There are several variations on the design of overhead cranes, depending upon the required lifting height and the amount of headroom and available space. The bridge may ride on top of the rails (top running), or it may be suspended and ride on the bottom flange of the rail (underhung). The trolley on a double girder bridge may be similarly suspended. A top running trolley will provide the maximum lift height, while an underhung trolley would be installed where overhead space is limited. The air drive motors are controlled by a self-seating valve which may be controlled by remote control (pushbutton pendant), hand chains, or lanyards. The electric drive motor may be controlled from a pushbutton pendant (suspended from the trolley), or from a cab mounted on the bridge or trolley.

589-2.2.4 NONROTATING, TRAVELING SUPPORTS. A gantry crane is an elevated bridge and trolley crane mounted on gantry legs (Figure 589-1-7). Each gantry leg is mounted on an end truck which rides on rails mounted on the working deck. The trolley travels on the bridge girders and carries the hoisting equipment.

589-2.2.4.1 Employment. Most notable use of gantry cranes is in ships used to recover deep diving submersibles and recovery vehicles (for example, Submarine Rescue Ships). The major advantage of gantry cranes is that they provide a heavy lift capacity and are not dependent on a supporting bulkhead. Few gantry cranes are used in Navy ships.

589-2.2.4.2 Major Components. The major components of gantry cranes are rails, gantry legs, bridge, trolley, and hoist. The bridge consists of a single or double girder mounted on a set of gantry legs.

589-2.2.5 TRUCKBORNE / MOBILE CRANES. Truckborne cranes are normally rotating, topping cranes mounted on a mobile platform. These cranes are often fitted with a telescoping boom and a hydraulic topping lift (Figure 589-1-6) to allow retraction into the smallest possible configuration when not in use, for ease of transportation and stowage in the ship. A distinguishing feature of these cranes is the use of outriggers. Without outriggers, truckborne cranes would be highly unstable and could topple under a relatively light load.

589-2.2.5.1 Employment. Truckborne cranes are generally carried in aircraft carriers (aircraft-crash cranes), large warships (helicopter-crash cranes), and auxiliary ships (tenders, repair ships). A small number of submarine tenders carry truckborne cranes to use on the pier or wharf for handling a variety of loads. Mobile cranes are often used aboard aircraft carriers to handle cargo in the hangar bay and on the flight deck. If a new crane is purchased or rented, technical data must be sent to NAVSEA 05P7 for approval prior to using the crane. As of 12/1/00, the only three NAVSEA approved general cargo handling mobile cranes aboard aircraft carriers are: Grove AP-308, Grove YB 4410, and Koehring LRT 110. Technical data must also be sent to NAVSEA Philadelphia Code 9731 for development of a preventive maintenance package prior to using the crane. The preventive maintenance package will include an initial visual inspection and test procedure to be conducted prior to first time use and repeated annually thereafter

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**WARNING**

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**Never operate the crane with outriggers in a position other than that specified by the manufacturer's technical manual. Outriggers should be clearly marked to indicate their fully extended position. An interlock should be provided to prevent crane operation when outriggers are not fully extended. A large number of serious crane accidents are directly attributable to crane operation with improperly positioned outriggers.**

589-2.2.5.2 Major Components. Outriggers provided with truckborne mobile cranes are essential to the safe operation of this type of mobile crane. The outriggers provide the necessary stability to the crane and transfer the weight of the load to the deck, pier, or ground, thereby relieving pressure on the wheels or tires. The remaining major components of truckborne cranes are similar to those for rotating, topping cranes (paragraph [589-2.2.1.8](#)).

589-2.2.5.3 Variations. The major design variations on truckborne cranes involve the type of boom, topping hoist, or lift. These variations are discussed in paragraph [589-2.2.1.9.c](#).

## SECTION 3. OPERATIONS GUIDE

### 589-3.1 INTRODUCTION

589-3.1.1 PURPOSE. Section 3 provides personnel requirements, operating and rigging procedures, working conditions, and requirements associated with weight handling evolutions. The personnel requirements are intended to standardize the organization of crane crews by providing minimum requirements. Personnel requirements also establish a method of communication among crane crew members, and stipulate minimum training and qualification standards. Operating and rigging procedures will provide the Crane Officer with a summary of the procedures necessary to establish the framework for a complete weight handling program. Section 3 shall not limit or supersede the equipment technical manual, or other particular requirements, unless stated.

589-3.1.2 GENERAL INFORMATION. Load handling evolutions are divided into two categories: CRITICAL and NONCRITICAL. CRITICAL lifts are those lifts that require additional attention in operational areas such as selection, training, and qualification of crane crew members, organization and supervision of the crane crew, and other specific operational considerations and precautions. CRITICAL lifts are defined in paragraph 589-1.3.3 and discussed in paragraph 589-3.7. CRITICAL lifts include lifts at sea, lifts of ordnance, nuclear propulsion related lifts, submerged object lifts, lifts approaching crane capacity (that is, greater than 85 percent of rated load), and other lifts as designated by the Commanding Officer. Noncritical lifts include all other lifts that are conducted on a routine basis. Every lift, whether CRITICAL or NONCRITICAL, involves some risk to personnel and equipment, and will be conducted in as safe a manner as possible.

### 589-3.2 CREW ORGANIZATION

589-3.2.1 CREW MAKEUP. To perform safe load handling evolutions, each crane crew shall be comprised of the following qualified personnel:

- a. Crane operator
- b. Crane signalman
- c. Rigger
- d. Tagline handler.

589-3.2.2 CRITICAL LIFTS. Additionally, a crane safety observer shall be stationed to supervise a CRITICAL lift (paragraph 589-3.7). Actual count and composition of the crane crew is a function of the load criticality and complexity (bulkiness, unusual shape, or special handling equipment required), the multiplicity of lifts or handling areas, and other considerations (such as weather and ship motion). For example, a routine, noncritical lift of palletized stores in good weather may require a crane crew assignment of a crane operator, a signalman, and a tagline handler. (The signalman will perform the duties of the rigger when the load is at rest, assisted by the tagline handler.) Multiple crane crews may be assigned to more complex lifts, and may consist of two or more signalmen for separate load handling areas, or to supervise rigging of multiple loads; riggers, to rig loads at each handling area; sufficient tagline handlers to safely control each load; and a crane safety observer to monitor the CRITICAL lift.

589-3.2.3 CRANE OPERATOR. The crane operator is responsible for the safe and proper operation of the crane and lifting equipment. The crane operator shall be familiar with crane capacities and limitations, as well as problems and deficiencies that may exist for the particular crane being operated. Awareness of the crane's current condition will include, but not be limited to, the following knowledge:

- a. Expiration of the current load test
- b. Existence of any outstanding departures-from-specifications (paragraph 589-6.3.3)
- c. Significant overdue maintenance
- d. Periodic or corrective maintenance in progress
- e. Existing tag outs
- f. Existing deficiencies in load bearing or controlling components
- g. Abnormal operating conditions (for example, use of local or backup controls)
- h. Inoperability of any safety device.

589-3.2.3.1 Safety Considerations. Confirmation of any one of these conditions may preclude crane operation. The crane operator will then consult the Crane Officer or responsible Division Officer, the departmental tag out or out-of-commission logs, the equipment status/deficiency log, or paragraph 589-6.3.3 for guidance. Although lift safety is the signalman's responsibility, the crane operator shall cease crane operations if instructed to perform an unsafe evolution, or upon sensing any unsafe condition, including operator's own fatigue (paragraph 589-3.5.1).

589-3.2.3.2 Other Duties. The crane operator shall also:

- a. Perform or review the Operator's Daily Checklist (ODCL) (paragraph 589-3.5.3) for the workday before conducting any load lifts.

**WARNING**

**Use of any equipment whose primary safety devices are inoperative requires specific approval of the Commanding Officer.**

- b. Ensure that any deficiencies or questions related to safety devices, load bearing, or load controlling members are reported and resolved before crane operation.
- c. Ensure that the crane is operated safely, within posted load capacities, without danger to crew members or other personnel in the loading area.
- d. Ensure that the signalman (assisted by the rigger) has correctly calculated, or conservatively estimated, the weight of the load being lifted, so that a high degree of confidence exists that the hoisting equipment will not be overloaded. When lifting the load, monitor readily available indicators (that is, ammeters, pressure gauges, and load indicating devices) to ensure that the crane is not overloaded.
- e. Be qualified to handle ordnance or explosives for any ordnance, according to CINCLANTFLT/CINCPACFLT Instruction 8023.5, and supplemental Type Commander directives.

589-3.2.4 **CRANE SIGNALMAN.** The crane signalman is also a qualified rigger, and is normally in charge of the lift. The signalman directs the actions of the crane operator, the tagline handlers, and other riggers assigned to a particular lift. The signalman has demonstrated a knowledge of crane operations and possesses the experience necessary to take charge of, and direct, crane activities. Qualification as a rigger is a prerequisite step for qualifying as signalman. Experience and leadership ability are part of signalman qualification.

589-3.2.4.1 The crane signalman retains overall responsibility for the safe and proper conduct of the load handling evolution (see paragraph 589-3.5.4 and Appendix B), including proper operation of the crane and its associated rigging. The signalman shall be satisfied that safe and proper practices will be employed to rig and hoist the load before lifting. Only then will the signalman alert the crane operator to begin lifting the load. The signalman is directly responsible for the conduct and performance of the assigned riggers and tagline handlers. In addition, the signalman shall:

- a. Ensure that the appropriate handling and lifting equipment is selected, and that the weight of the load being lifted is accurately determined, or conservatively estimated.
- b. Ensure that the handling and lifting equipment is properly certified, and that load test expiration dates have not been exceeded.
- c. Remain alert to any abnormal operating conditions which may affect operation of the crane (that is, use of local or backup controls, and other evolutions in progress nearby).
- d. Assist, if required, in rigging or unrigging the load while load is at rest and the crane is not in motion.

#### NOTE

While the load is under hook or the crane is in motion, the signalman shall be responsible only for directing the crane operator and shall have no simultaneous duties or responsibilities. If additional rigging is required once the load is under hook, a qualified rigger, other than the signalman, shall perform the rigging function.

- e. Remain ultimately responsible for all lifts and will visually inspect all rigging before any load lift; including situations involving repetitive lifts, where an additional qualified signalman is assigned to assist and supervise proper load rigging.

#### NOTE

The presence of a safety observer does not relieve the signalman of any responsibility for safety of the lift.

- f. Ensure that when one individual performs as both rigger and tagline handler, rigging and tagline handling duties are not performed concurrently.

589-3.2.5 **RIGGER.** A rigger is formally qualified to perform rigging functions associated with load handling. The rigger, under the supervision of a qualified signalman, is responsible for ensuring that proper rigging practices and handling equipment are used to rig each load. Rigger training shall include indoctrination in general rigging practices, safety and quality assurance, and specialized training in procedures, or on specialized handling equipment, as required.

589-3.2.5.1 The rigger will assist the signalman in calculating or estimating the weight of the load and selecting appropriate handling gear for conducting a safe lift. When selecting the handling equipment, the rigger shall conduct an inspection of the equipment's condition and verify that load tests have not expired. When performing as both rigger and tagline handler, the rigger shall not discharge both duties concurrently. Rigging shall be performed only when the load is at rest. Tagline handling shall be performed only when the load is set into motion.

589-3.2.6 TAGLINE HANDLER. A tagline handler is usually the junior member of a crane crew. The tagline handler, under the direction of the signalman, assists during a lift by tending the load through the use of a tagline. For more complicated lifts (that is, lifts of large size, or in high wind conditions), additional tagline handlers should be utilized to ensure that the load is always under control.

589-3.2.6.1 Formal qualification as tagline handler requires (see [Appendix C](#)) a general indoctrination lecture, or similar training session, followed by an oral examination given by a qualified signalman, and subsequent certification by the Crane Officer. For noncritical, simple lifts, where the chances of personnel injury or equipment damage due to mishandling are slight, tagline handlers may be occasionally provided by the tended unit. In this case, the signalman for the lift shall ensure that the tended unit tagline handler possesses the basic knowledge needed to perform the tagline handler duties.

589-3.2.7 CRANE SAFETY OBSERVER. The crane safety observer shall be an Officer, a Chief Petty Officer, or a Senior Petty Officer with a level of knowledge similar to that of a signalman, who has demonstrated sufficient maturity and experience with cranes and rigging to identify potentially hazardous or unsafe practices. The presence of a safety observer does not relieve the signalman of any responsibility for safety of the lift. The safety observer normally functions in a backup role, as a trained and experienced observer. If an actual or potential safety violation is observed, the safety observer may direct the signalman to stop the evolution.

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**WARNING**

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**AT NO TIME shall the safety observer be out of eyesight of the crane operator and the signalman. If this situation occurs inadvertently, all crane operations will cease, load remain at rest, or crane motion stopped, until the safety observer regains a suitable position.**

589-3.2.7.1 Responsibilities. A safety observer shall be assigned to monitor each CRITICAL lift and shall be responsible for monitoring only one such lift at a time. When assigned, the safety observer will assume a position at the optimum vantage point in order to observe as much of the load handling evolution as possible within eyesight of the signalman, and without obstruction. The safety observer shall have no concurrent duties which would interfere with monitoring the handling evolution and shall not perform the functions of any other crane crew member. (For special considerations in handling ordnance, see paragraph [589-3.7.3](#).)

589-3.2.7.1.1 If it becomes necessary to use two or more signalmen due to multiple handling or laydown areas, an independent safety observer should be stationed at each area. Should the safety observer detect an unsafe practice, the signalman shall be directed to give a stop signal. In an emergency situation, the safety observer may signal emergency stop (see [Appendix B](#)) directly to the crane operator.

589-3.2.7.1.2 The safety observer is also responsible for monitoring outside events which might impact the safety of the load handling evolution: for example, weather (wind, rain, or ice), wakes from passing ships, or other evolutions (missile handling, ship drills, or casualties). In the event of such an occurrence, the safety observer should direct the signalman to stop the load handling evolution and secure the load until it is safe to proceed.

589-3.2.7.2 Special Safety Considerations. It is not intended that a safety observer be stationed for every non-critical lift. Since every lift and handling evolution involves some risk to personnel and equipment, a Command may require that an appropriate safety observer (usually a qualified signalman) be stationed for each lift and perform in the safety capacity discussed in paragraph 589-3.2.7.1. If special lift considerations exist (that is, two or more cranes operating in close proximity, extremely bulky or cumbersome loads, or adverse weather conditions), or the performance record of crane crews warrant such attention (that is, frequent or commonly recurring safety infractions), the Crane Officer or Commanding Officer may deem it prudent to post such a safety observer.

589-3.2.8 CRANE MAINTENANCE PERSONNEL. Each Command should formally qualify specific maintenance personnel available to perform or directly supervise periodic and corrective maintenance. Formal qualification familiarizes these individuals with the crane's safety devices and load bearing and load controlling components, so that maintenance affecting these items can be identified and appropriate retesting performed. In the event that the assistance of nonqualified maintenance personnel is required (that is, other ship force personnel, outside technical assistance, or intermediate Maintenance Activity support), the qualified maintenance technicians should monitor and supervise all crane maintenance and ensure retest and recertification requirements are met (Section 6). Some maintenance situations may require the use of personnel not formally qualified as maintenance technicians. However, personnel routinely involved in crane maintenance should be so qualified.

589-3.2.9 RELATED PERSONNEL. A Command may require additional crane crew members to perform tasks (that is, deadman switch operator, phone talker, divers, an individual to ensure the track is clear when the crane is traveling with a load) particular to the crane or evolution in progress. Such assignments, as well as any watchstanding and qualification requirements, should be clearly defined in the Command's instructions.

### 589-3.3 TRAINING AND QUALIFICATION

589-3.3.1 ORGANIZATION. Commanding Officers or Officers-In-Charge shall designate in writing:

- a. An officer or officers of the Command (usually the Crane Officer), to be responsible for management and administration of training, testing, and qualification of crane crew members.
- b. Necessary shipboard personnel to support this officer by signing qualification card signature requirements for the various crane crew member candidates.

589-3.3.2 QUALIFICATION PROGRAM. Each Command shall implement a Training and Qualification Program which covers, as a minimum, all applicable topics identified in the qualification guides of Appendix C for each crane crew member. Such a program shall include a course of instruction, formal or self-taught, covering each watch station as well as theoretical knowledge and safety precautions related to lifting and handling operations. Formal qualification through the use of qualification cards, based on the qualification guides (Appendix C), shall be required for every crane crew member specified in Table 589-3-1, with the exception of provisions for temporary tagline handlers. Table 589-3-1 contains the maximum recommended qualification time periods for completing assigned qualifications, following the completion of the recommended prerequisite qualification.

**Table 589-3-1** MAXIMUM QUALIFICATION TIME PERIODS

Watch Station/ Billet	Max Time Period (months)	Prerequisite Qual*
Tagline Handler	1	(Div Officer recommendation)
Rigger	3	Tagline handler
Crane signalman	3	Rigger
Crane operator	6	None
Crane safety observer	VAR	None, knowledge level consistent with signalman
Maintenance technician	3	3M PQS for maintenance personnel

\*These are minimum prerequisites for each crane crew billet; individual Commands may elect to expand upon or amplify these prerequisites.

589-3.3.3 GENERAL PHYSICAL REQUIREMENTS. Because of the skill and responsibility involved in conducting load handling evolutions, due consideration shall be given to each crane crew member's physical qualifications when screening individuals for training and qualification. Such consideration should include evaluation of general health, physical condition, agility and coordination, and physical defects or emotional instability that may adversely affect load handling safety. Recommendation shall be made by the appropriate Division Officer, on the individual qualification card, before qualification as a crane crew member.

589-3.3.3.1 Physical Examination. Crane operators shall meet additional physical requirements:

- a. Ensure operator has had a Navy Physical Examination and that he is not overdue for his next scheduled Physical.
- b. Minimum vision of 20/30 Snellen in one eye and 20/50 in the other, with or without glasses.
- c. Ability to distinguish between the hard hat colors as specified in [Table 589-3-2](#) (this test is required once for the entire life of operator).
- d. Hearing loss shall not exceed 30 db at 500, 1000, 2000 or 3000 Hz and shall not exceed 50 db at 4000 and 6000 Hz unless a greater loss is approved, on a case by case basis, by a licensed or certified audiologist, otologist, or occupational medicine physician.
- e. Evidence of sufficient strength, endurance, and reaction.

**Table 589-3-2** HARDHAT COLORS FOR CRANE CREW PERSONNEL

Function	Hardhat Color*
Crane operator	Brown (mobile cranes and open cabs only)
Crane signalman	Yellow
Rigger	Blue
Tagline handler	Blue
Crane safety observer	White with green cross on sides
Maintenance personnel	Purple

\*If hardhats of the appropriate color are not readily available. Spray paint hardhats using acrylic enamel. Brightly colored vests (for example, dayglow) may be worn in ships which routinely require the wearing of hardhats (that is, floating drydocks, tenders, ships undergoing overhaul). Vests will be colored or affixed with color overlays, according to table. Unqualified crane crew members, participating in an evolution under the supervision of a qualified crew member, should be additionally identified by a broad vertical or fore-and-aft black stripe over the vest or hardhat.

589-3.3.3.1.1 Where the foregoing physical requirements have been satisfied for another (program's) physical screening (for example, personnel reliability program), no additional physical examinations are necessary. Requalification requirements of paragraphs 589-3.3.7 and 589-3.3.8 shall be based on the date of the original physical screening.

589-3.3.3.2 Other Selection Factors. Prospective crane operators shall be evaluated for evidence of physical defects or emotional instability that may adversely affect personnel and load handling safety. No waivers may be granted for disqualification based on these requirements. A Command may impose additional personnel requirements (that is, security clearance, personnel reliability screening) or physical qualifications before operation of specific hoisting equipment.

589-3.3.4 QUALIFICATION REQUIREMENTS. As part of the qualification process for each crane crew watch station, each member shall demonstrate theoretical and practical knowledge of shipboard cranes or handling practices as appropriate, and performance of selected practical factors under the supervision of a fully qualified crane crew member. Signoff of completed theory and practical factors shall be permitted only after demonstration of satisfactory knowledge, or successful performance of the practical factor. Only personnel with appropriate levels of qualification, as specified in paragraph 589-3.3.2 and Appendix C, shall sign off completed qualification items. Progression leading to qualification of crane crew members is:

#### NOTE

Each item requires a specific documentation signature on the qualification card.

- a. For crane operator, physical examination (paragraph 589-3.3.3.1)
- b. Division Officer's recommendation of physical abilities (paragraph 589-3.3.3)
- c. Theoretical knowledge (Appendix C)
- d. Practical factors (Appendix C)
- e. Written examination with a minimum grade of 70 percent
- f. Oral examination (satisfactory or unsatisfactory)
- g. Crane Officer's approval.

589-3.3.4.1 The qualification guides in Appendix C are mandatory minimum requirements as applicable to the configuration and operation of the ship. Development of tailored qualification cards should include formal training and qualification on any special lifting or handling equipment used by the department conducting the lift. If the use of equipment is of a dedicated nature (that is, missile handling), the general rigging training of qualification guides (Appendix C) may be deleted from a Command's qualification cards. However, the Crane Officer is responsible for ensuring that crane crews that are trained according to these tailored qualification cards do not perform lifting or handling evolutions outside the scope of the specific training and qualification received.

589-3.3.5 TESTING. With the exception of tagline handler, each crew member shall satisfactorily perform the required practical factors and pass written and oral tests before final qualification for a prospective watch station. The written test shall be a comprehensive question-and-answer or multiple choice type and shall require a minimum passing grade of 70 percent. Oral examinations shall be administered by the Officer in Charge of the Quali-

fication Program for the respective crane and shall be graded as satisfactory or unsatisfactory. Examination questions should be periodically changed and the results retained in qualification records. Practical factors shall be conducted under the supervision of a designated Qualification Petty Officer and shall be signed off upon satisfactory completion.

589-3.3.6 RECORDS. Training records shall be maintained in audit form. Records shall include completed qualification cards for each crane crew watch station for which a member is qualified, and a copy of the written test, or a cover sheet identifying questions from a question bank. A list, notebook, or log of all qualified watchstanders for each crane crew watch station, shall be maintained. The list shall include: watch station, name, rate, date qualified, date qualification expires, and the signature of the certifying officer. The list shall be kept in the office of the department responsible for the crane. Retain pages until superseded.

589-3.3.6.1 Before assignment of the crane crew members, the supervisor shall ensure that each prospective member is fully qualified for the station by consulting the list of qualified watchstanders. The crane operator shall carry a license, similar to that shown in Figure 589-3-1, indicating qualification. The license will state the operator's name, date of qualification, expiration of qualification, and crane(s) for which qualified. The Command Duty Officer, or any other individual interested in verifying current crane operator qualification before conducting a specific lift, may check the operator's license.

U.S. Government Motor Vehicle Operator's Identification Card					Card No.
Name of Operator			Sex	Date Approved	
Height	Weight	Date of Birth	Social Security Number	Date Expires	
Color of		NOT TRANSFERABLE Card must be visible at all times when operating equipment or vehicle.	Signature of Operator (Not valid until signed)		
Hair	Eyes				
Name and Location of Operating Unit					
Restrictions:					
<b>QUALIFIED TO OPERATE</b>					
Type Vehicle and/or Equipment		Capacity	Qualifying Officer		
OTHER RECORDS (Optional)					

Figure 589-3-1 Crane Operator's License (Sample-Full Size)

589-3.3.7 NONORDNANCE RELATED REQUALIFICATION. Qualification of crew members not involved in handling conventional ordnance or explosives shall be certified for a period of 2 years. In order to avoid a certification delay, requalification by reexamination for physical requirements (paragraph 589-3.3.3) shall be scheduled in a timely manner.

589-3.3.8 ORDNANCE RELATED REQUALIFICATION. Certification of crew members involved in handling conventional ordnance or explosives shall not exceed 1 year, according to CINCLANTFLT/ CINCPACFLT Instruction 8023.5. Requalification shall occur before expiration of certification. Initial qualification requirements shall be repeated, except that theoretical knowledge requirements may be waived by successful completion of a comprehensive examination on related theory. Requalification in practical factors shall be performed for each watch station on current qualification except that requalification as a signalman, or rigger, satisfies the requalification requirements for tagline handler. All practical factors shall be completed and may not be waived or deleted. After the expiration date, unless requalified, the crew member shall be removed from the rolls of qualified watchstanders and shall not be permitted to perform duties for that respective watch station until successful completion of requalification requirements and subsequent certification.

**589-3.3.9 QUALIFICATION OF PERSONNEL FROM OTHER COMMANDS.** In order to utilize already qualified personnel reporting onboard from another Command, each Command may implement a program for this condition that modifies qualification card requirements on a case basis. Following a reasonable period of familiarization with crane equipment, procedures and operating practices, written and practical tests, will be administered. Based upon the examination results, the Officer in Charge of the Qualification Program shall make recommendations, subject to the Commanding Officer's approval, regarding modification of the qualification cards for any noted areas of weakness. Requalification for previously qualified watch stations will be completed within 3 months.

**589-3.3.10 DISQUALIFICATION.** Crane crew members shall be disqualified and removed from watchstanding duties if:

- a. Judged responsible for a reportable accident, according to OPNAVINST 5102.1.
- b. Significant or recurring safety infractions are noted by the Crane Officer or safety observer. Safety violations considered significant infractions include, but are not limited to:
  1. Operating a crane without a current ODCL.
  2. Exceeding crane, or rigging, equipment capacities.
  3. Exceeding crane safety features.
  4. Conducting lifts over personnel or lifts which jeopardize personnel safety.
  5. Lifting in a manner that causes a load drop or materiel damage.

**589-3.3.11 ACTION FOLLOWING DISQUALIFICATION.** Following a reportable accident, license(s) shall be suspended pending a full investigation of the cause. If the Crane Officer determines fault, qualifications shall be revoked and formal requalification shall be required, according to paragraph [589-3.3.7](#) or [589-3.3.8](#) within a reasonable period (usually 30 days). A no-fault finding shall be followed by reinstatement of qualification.

**589-3.3.12 CRANE CREW PROFICIENCY.** In order to maintain proficiency, crane crew members will be assigned at least once every 6 months to each watch station for which they are currently qualified. If the minimum proficiency time limit is exceeded, the work center supervisor shall ensure that the member receives an adequate familiarization checkout before reassignment. Maintain adequate crane crew assignment records in compliance with these requirements.

## **589-3.4 COMMUNICATIONS**

**589-3.4.1 HARDHAT COLORS.** Crane crew members and other individuals in a load handling area (such as, weapons handling personnel) shall wear color coded hardhats identifying their function within the area. Hardhat color coding for noncrane crew personnel in the load handling area shall not conflict with [Table 589-3-2](#).

**589-3.4.2 CRANE SIGNALS.** The signalman and the crane operator shall maintain a positive line of communication, normally through the use of visual commands (hand signals) as shown in [Figure 589-B-1](#), or through verbal commands transmitted by radio or sound-powered phones. Additional hand signals may be used for crane-specific functions. However, no hand signal shall conflict with, nor alter the meaning of the signals illustrated in [Figure 589-B-1](#). Additional hand signals shall be specified in ship instructions.

**589-3.4.2.1 Hand Signals.** If using hand signals while conducting load handling evolutions at night, the signalman and crane operator shall ensure that adequate lighting for visual communication is available. During inclement weather, darkness, reduced visibility, evolutions requiring special directions, and lifts in which the signalman is not visible to the crane operator (that is, in a hold or trunk), radios or sound-powered phones shall be required. The load and load block shall be visible to the signalman AT ALL TIMES during load movement. If the signal-

man assumes a new position in order to maintain visual contact with the load or load block, the signalman shall transfer control to another signalman or secure load movement, take a new position, and reestablish visual or verbal communications with the crane operator before continuing load movement.

589-3.4.2.2 Loss of Communications. If the crane operator loses sight of the signalman, or voice communications cease or are garbled, the crane operator shall stop load movement. Movement shall be secured until communication is restored.

589-3.4.2.3 Speed Control. The speeds used when hoisting or lowering the load shall be indicated by extending one or more fingers. The number of speed control points needed is a function of the ship crane and its type of control. In general, no more than four speed control points will be used. The crane operator shall not exceed the speed control signal directed by the signalman. However, the crane operator may, at any time, use a slower speed if he judges that the directed speed will create an unsafe or hazardous condition for the personnel, the load, or the crane, or will exceed his own ability to control the lift.

589-3.4.2.3.1 Signalmen may use one or both hands to signal independent crane motions (for example, hoisting, topping, rotation, or travel). When giving simultaneous signals that include raising or lowering the boom, both the crane operator and the signalman will exercise extra caution with respect to changing crane capacity. Such evolutions will be conducted at slow speeds.

589-3.4.2.4 Multiple Lifts. If multiple pickup or laydown areas are not readily accessible to one signalman, additional signalmen will be assigned to each pickup or laydown area. A positive means of transferring control of load movement between signalmen shall be used (paragraph 589-3.4.2). Each signalman and the crane operator shall be briefed regarding the transfer of control, before the handling evolution. The signalman in control of the lift shall transfer control to the second signalman by use of the appropriate signal (visual or oral). The second signalman shall acknowledge that he is assuming control by giving an appropriate crane signal. If the second signalman does not assume control of crane movement, the crane operator shall secure movement or place the load in a safe condition until the situation is resolved.

589-3.4.2.5 Backup Communications. While conducting CRITICAL lifts, the signalman shall have a backup means of communication (that is, radio or sound-powered phones) tested and readily available in the event that primary communication is lost, or special directions need to be transmitted to the crane operator.

## **589-3.5 CRANE OPERATING PROCEDURES**

589-3.5.1 CRANE OPERATOR PHYSICAL CONDITION. Before operation, the operator shall make a self-examination for physical fitness, noting the effects of any ingested medication. If by self-examination the crane operator feels unfit to perform the evolution, the operator will request removal from duty. The operator will periodically re-perform this self-analysis while operating a crane. A fatigued or weather-exposed physical condition may adversely affect the crane operator's ability to function and become an attendant risk to personnel and property. When assuming the watch station, the crane operator shall be appropriately dressed, in foul-weather gear if appropriate, for the expected length of the evolution. The signalman, as crew member in charge, will initially and periodically thereafter observe and assess the crane operator's physical condition, having the operator relieved if necessary.

589-3.5.2 GENERAL CRANE REQUIREMENTS. The requirements of the following paragraphs shall be observed for all hull mounted and mobile cranes assigned to U.S. Navy forces afloat.

589-3.5.2.1 Access Control. Select and install the simplest key-and-lock type control that will prevent unauthorized crane operation by unqualified personnel. The Crane Officer shall control custody of the key and may delegate this authority through the department chain-of-command, to the applicable Division Officer or Departmental Duty Officer. Positive key control shall be in effect at all times. The key shall be issued only to an operator qualified on the appropriate crane. The key shall be promptly returned to the controller when crane operations are completed.

589-3.5.2.2 Posted Instructions. Post the following items in the operator's cab, within plain sight of the crane operator, or in a location convenient to the operator:

- a. A copy of the standard crane hand signals shown in [Appendix B](#)
- b. Rated capacity charts (load and outreach)
- c. Basic operating instructions (prepared from applicable technical manuals and shipboard operating instructions)
- d. Ship motion and wind limits for crane operation (paragraph [589-3.7.2](#)).

589-3.5.2.3 Cab Storage. Tools, oil cans, or other necessary articles shall be stored in the tool box. No articles shall be stowed loose in the cab. Necessary clothing and personal belongings shall be stored so that cab access or crane operation is not impaired.

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**WARNING**

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**Carbon tetrachloride fire extinguishers shall not be used.**

589-3.5.2.4 Fire Extinguisher. A carbon dioxide, dry-chemical, or its equivalent, hand-operated fire extinguisher shall be kept within the immediate vicinity of the crane operator's cab. In the event of fire, the extinguisher shall be employed to allow the crane operator to escape from the cab. The crane operator shall be familiar with operation and care of the fire extinguisher.

589-3.5.3 CRANE ODCL. Before beginning crane operations for each new day, a qualified crane operator shall perform an inspection of each crane to check for discrepancies in the crane's structure or operating controls. A crane ODCL shall be used for this inspection. While performing the ODCL, the crane operator shall employ all physical senses, including sight, sound, and touch, in order to detect faults or defects in the crane.

589-3.5.3.1 ODCL Format. An ODCL will not be a detailed document, but will be thorough enough to identify all unsafe conditions. The specific format to be followed in developing an ODCL shall be decided by each Command. Where the applicable technical manual contains a complete list of the daily checks to be conducted, the technical manual requirements may be used in place of the following guidance. The ODCL shall include the following inspection items, where applicable:

- a. Visually check the boom, block, sheaves, wire rope, reeving, hook, hook latch, walks, ladders, wheels, trucks, rails, stops, and outriggers for damage, missing and loose bolts or pins, corrosion, interference, or excessive wear.

- b. Visually inspect for leaks in lines, tanks, valves, pumps, and other parts of air, hydraulic, or lubrication systems.
- c. Check all functional operating mechanisms for proper operation, including main, auxiliary, and topping hoists, and rotation and travel drives. Test all brakes.
- d. Check all primary limit switches without a load on the hook by operating the machinery at slow speed to the operating limits.
- e. Inspect the work area for safety, boom clearance, interference, stability, and visibility.
- f. Check all cab safety devices, indicators, warning devices, and gauges for proper operation, normal readings, and calibration, where required.

589-3.5.3.2 Reporting Discrepancies. A typical ODCL sample guideline is provided as Table 589-3-2a. When performing an ODCL, the crane operator will enter any discrepancies or defects noted in the REMARKS section. If defects are seen in any load bearing, load controlling, or safety devices, the crane operator shall also report these defects to the Crane Officer, and ensure that appropriate corrective action is taken before operating the crane.

**Table 589-3-2a** Guidelines for Crane Daily Checklist

<b>SHIP/CRANE:</b>			
<b>CRANE OPERATOR:</b>			
<b>DATE/TIME:</b>			
<b>DATE CURRENT LOAD TEST EXPIRES:</b>			
<p>The crane operator is the key man in the crane safety program. It is the operator's responsibility to ensure each day that the crane is in safe operating condition. Before operating any crane, the crane operator shall conduct an inspection of those items noted in the Operator's Daily Checklist (ODCL). The crane operator shall document the results of this inspection as either satisfactory (S) or unsatisfactory (U). Any unsatisfactory condition shall be described in detail in the REMARKS section. Completed ODCL shall be reviewed by the Division Officer responsible for the crane or his immediate subordinate, or in their absence, the Departmental Duty Officer, prior to conducting any load handling evolutions.</p> <p>The ODCL shall be a general inspection, conducted using sight, sound, and touch. The inspection is not intended to be in the depth and detail of regular planned maintenance, but should be thorough enough to identify those conditions which may render the crane unsafe.</p> <p>The inspection is in four parts designed to group the items to be inspected in their normal sequence or location. Specific inspection guidelines, for those topics identified in the ODCL, are contained in the following paragraphs. Record any deficiency found during any inspection step in the remarks section of the ODCL.</p>			
A	<b>WALK AROUND INSPECTION:</b>	S	U
1	Crane Operability - review the departmental tag-out and out-of-commission logs to verify that the crane is operable. Verify that crane certification is current and that the crane is not overdue for load test.		
2	Structure and Foundations - check the crane structure and machinery foundations thoroughly for obvious physical damage, such as cracking, bending, and deformation of plates or welds. Inspect carefully for cracking or flaking paint.		
3	General Hardware - inspect for missing or loose hardware such as bolts, nuts, brackets, supports, pins, etc.		
4	Safety Guards and Plates - inspect for missing safety guards or plates.		
5	Wire Rope - inspect external wire rope for wear, broken wires, corrosion, kinks, damaged strands, crushed, or damaged sections.		
6	Reeving - check,for the condition of wire rope reeving and ensure that the wire rope fleet angle has not caused overriding of the drum flange on any of the drums. Check to ensure wire rope is running true in hook block and boom tip sheaves. Inspect reeving components for worn, defective, or misaligned bearings, bushings, shafts, pins, and gears.		
7	Hook and Block Assembly - inspect condition of block and verify that all swivels rotate freely. Inspect the hook for cracks, sharp edges, and distortion and evidence of any broken or missing lubrication fittings. For safety hooks, inspect the safety latch and verify separately.		
8	Sheaves-inspect condition of readily available sheaves to verify that they are free to rotate and there is no evidence of cracking or chipping. Verify that wire rope is properly seated in the sheave grooves.		
9	Boom Assembly -inspect condition of the boom assembly for straightness and evidence of physical damage, such as cracking, bending, or other deformation of structural components or welds.		
10	Bumpers and Stops - inspect condition of all installed bumpers and stops, including those for rotational motion, topping, and travel. Visually inspect boom pendants to ensure that they are of equal length and that the anchor pins are firmly set. Check that telescoping struts are not jammed. Check bumpers and stops to ensure that they are firm and have not worked loose.		
11	Walkways, Ladders and Handrails - check condition of walkways, ladders, and handrails, looking for loose mountings, cracks, excessive rust, loose rungs, or any other unsafe conditions. Verify that installed safety chains are in place.		
12	Windlocks and Chocks - check for the presence of any free action of windlocks. Impact chocks for adequate guidance of lines and freedom from burrs and knicks.		

**Table 589-3-2a** Guidelines for Crane Daily Checklist - Continued

<b>SHIP/CRANE:</b>			
<b>CRANE OPERATOR:</b>			
<b>DATE/TIME:</b>			
<b>DATE CURRENT LOAD TEST EXPIRES:</b>			
13	Tires, Wheel Trucks, and Rails - inspect the condition of tires, wheel trucks, and rails. Make visual inspections of tires for proper inflation, cuts, or excessive wear. Check wheels and trucks to ensure that they are not loose or damaged. On rail mounted cranes, look for obvious defects in the rails or supports.		
14	Leakage - inspect for evidence of any leakage of fuel, lubricating oil, hydraulic fluid, or engine coolant.		
15	Outriggers and Locking Devices - check outriggers to ensure that they function freely and that floats/pads are free. If floats/pads are not permanently installed on the outrigger, be sure that they are in their carrier and that they are not damaged. Inspect track clamps and spud locks to ensure they are functional.		
<b>B</b>	<b>MACHINERY HOUSE INSPECTION</b>		
1	Housekeeping - check to ensure that the machinery house and accesses are clean of oil, grease, or mud. Verify that stored and that tools and authorized materials are properly waste and rags are properly disposed of. Check for broken or missing glass or hardware.		
2	Engines - check oil levels, radiator coolant level, and fuel level. Check fan and drive belts for condition and tension.		
3	Hydraulic Fluid - check sump or reservoir for proper fluid level.		
4	Leaks - check for leaks within the machinery house of lubricating and hydraulic oils, fuel, grease, or watercoolant. Investigate and note any deposits which appear greater than normal seepage.		
5	Brake Linings - visually inspect -all clutch and brake linings for evidence of excess heat, wear, glazing, or grease and oil on the linings.		
6	Wire Rope and Hoist Drums - make a visual inspection of all machinery house wire rope and hoist drums. Check for unusual wear, fraying and kinking. Check drama to ensure correct spooling and inspect drums for distortions, cracked welds, worn wire rope grooves, and lack of lubrication.		
7	Electrical Equipment - visually inspect the exterior of electrical equipment for signs of damage and overheating. Check any installed batteries to ensure fluid level is adequate; note any excessive corrosion which may be present. Verify that breakers and controllers of crane components are shut or closed. Check that all machinery house lights are operable. Visually check all motors for evidence of excessive graphite dust, oil/grease splashings, and indications of overheating.		
8	Fire Extinguishers - ensure fire extinguishers are in place and PMS has been performed and is current.		
<b>C</b>	<b>OPERATOR CAB INSPECTION</b>		
1	Housekeeping-check to ensure that the cab is clean and free of articles adrift.		
2	Instructions and Charts - ensure that applicable operating instructions are available. Verify that correct and certified logs, rating charts are posted in clear vow of the operator's station, as well as approved crane signals.		
3	Gages and indicators - inspect all gages, indicators, and warning lights to ensure that none are broken a missing and that they are operating normally. If installed, perform lamp tests of indicators and lights.		
4	Controls and Brakes - ensure controls are in the NEUTRAL or OFF position. Check to ensure that the spring return is working properly. Verify that brakes are set, if manually operated		

**Table 589-3-2a** Guidelines for Crane Daily Checklist - Continued

<b>SHIP/CRANE:</b>			
<b>CRANE OPERATOR:</b>			
<b>DATE/TIME:</b>			
<b>DATE CURRENT LOAD TEST EXPIRES:</b>			
5	Visibility - check visibility to ensure that all windows and mirrors are clean and unbroken. The operator shall ensure that visibility is unrestricted of the load and boom points in all normal working positions. Test the windshield wipers and ensure their proper operation. Test the boom and cab lights for proper operation.		
6	Boom Angle Indicator - where installed, verify that the indicator is not damaged and the linkage is not disconnected.		
7	Fire Extinguisher - ensure a fire extinguisher is installed and PMS has been performed		
D	<b>OPERATIONAL TESTING</b>		
1	Area Safety - inspect the crane operating area to ensure that the crane structure and rigging are clear of obstructions and personnel. For mobile cranes, ensure that ground conditions are adequate to support the equipment.		
2	Startup - verify that crane controls are in the OFF or NEUTRAL position; energize or startup the crane and allow it sufficient time to warm up. (15 minutes or as specified in the technical manual.)		
3	Unusual Noises - after starting, be alert for unusual noises and fluid leaks, loss of power, or poor response to control of the engines or rotors. Verify proper operation and correct readings of all gauges, indicators, and warning lights.		
4	Boom/Crane Release - after satisfactory warmup, release the crane/boom from stowage position/stops.		
5	Crane Stability (Mobile Cranes Only) - check crane stability. Ensure crane is positioned in the most level position possible. If lift is to be made on the tires, be sure transmission is positioned in neutral and that brakes are applied and the wheels are chocked. Check load rating chart. Ensure correct capacity for "on rubber" and on outriggers. Regardless of the size or weight of the load to be lifted, where possible ALWAYS use the cranes with outriggers set. When using outriggers, ensure all outriggers are fully extended and that the floats/pads are firmly set. If necessary, use mats or blocking beneath the floats/pads. When using outriggers, the crane's tires shall be off the ground for those cranes so designed.		
6	Control Action -check for positive and proper actions of all controls/controllers in all directions of movement, including hook motion (hoist/lower), booms (raise/lower, telescope in/out), rotation (right/left), travel, and bridge and trolley motion.		
7	Brakes (Top, Hoist and Rotate) - exercise and stop all motions using the brakes to ensure that all brakes are functioning normally and that there is no slippage, excessive play, or binding. Exercise brakes to ensure that they are dry.		
8	No Load Test - ensuring that all safety precautions have been taken, operate the crane through its full range. Remain alert for possible malfunctions. Elevate the boom to full height up to but not through upper limit switches. Slowly raise and lower hoist into but not through limit switches. Release rotation lock, rotate machine slowly through full rotation. Lower boom to lowest point into but not through limit switches. While performing these exercises, observe the functions of all controls and safety devices. Pay particular attention to condition of brakes; any evidence of slippage or chatter is unsatisfactory. Note any discrepancies in the crane's operation.		
9	Fleeting Sheave - check operation of the fleeting sheaves to ensure that they travel on the fleeting sheave shaft.		
10	Limit Switches verify that all limit switches operate properly to stop hoisting, topping, and rotating motion, as appropriate. Travel limit switches should be tested if crane travel is anticipated near the bumpers and stops.		

**Table 589-3-2a** Guidelines for Crane Daily Checklist - Continued

<b>SHIP/CRANE:</b>
<b>CRANE OPERATOR:</b>
<b>DATE/TIME:</b>
<b>DATE CURRENT LOAD TEST EXPIRES:</b>
REMARKS:
CRANE OPERATOR:
DIVISION OFFICER:
CRANE OFFICER:

589-3.5.3.3 Operational Checkout. A qualified signalman shall be assigned to direct the crane operator when conducting no-load tests, including those associated with the ODCL. Before performing the operational tests, the signalman shall make sure the area is clear, or warn personnel within the crane operating area of imminent testing. The signalman shall prevent outside interference during test, and alert the crane operator to any unusual noises coming from the crane. The crane operator shall watch the signalman for a STOP, or other appropriate signals. However, the signalman need not direct each crane motion or speed during no-load operational check-out.

### CAUTION

**If defects are noted in load bearing or load controlling components, or in safety devices, tag the crane OUT-OF-SERVICE and DANGER to prevent unsafe operation. Under no circumstances should the Crane Officer or crane operator allow the crane to be operated with in-operative safety devices, or with known defects in load bearing or load controlling members, unless a departure-from-specification has been authorized according to paragraph 589-6.3.3.**

589-3.5.3.4 Completed ODCL. The completed ODCL shall be reviewed by the Division Officer responsible for the particular crane, his immediate subordinate, or, in their absence, the Departmental Duty Officer before conducting any load handling evolution. The completed ODCL shall also be reviewed by the Crane Officer within 1 week. Retain ODCL's audit-ready for a minimum of 2 weeks. Enter any defects noted by the crane operator into the crane Equipment Status/Deficiency Log for subsequent correction or repair.

589-3.5.3.5 Crane Status Board. All completed ODCL's shall be retained in the crane office and a status board shall be mounted in the crane office posting the date and time of the ODCL, the crane operator who performed it, and the defects or discrepancies noted. The status board should also contain the following information:

- a. Rated load and nomenclature for the crane
- b. Performance date and expiration date of the current crane load test.
- c. Applicable information and remarks from the ODCL including date, any outstanding departures-from-specifications (paragraph 589-6.3.3), and other remarks.

589-3.5.4 CRANE OPERATION PRECAUTIONS. The following paragraphs contain precautionary guidelines which shall be observed by all personnel operating Navy cranes.

589-3.5.4.1 Signalman Responsibilities. Operation of the crane is prohibited without the presence of a qualified signalman. No load shall be moved without an approved signal from the signalman, EXCEPT in the event that the crane operator detects an unsafe condition or receives an EMERGENCY STOP signal from any source.

589-3.5.4.2 Unsafe Operating Practices. It is the operator's responsibility in an operating situation that is considered unsafe, or upon observing an unsatisfactory condition of the crane, to immediately cease crane operating, secure the crane, and report the condition or situation to the supervisor.

- a. Operating the crane with inoperative safety devices or with known defects in load bearing or load controlling members without an approved departure-from-specification (paragraph 589-6.3.3).
- b. Operating the crane with faulty or poorly adjusted brakes.
- c. Operating the crane with a bent, dented, or otherwise damaged boom, unless technically evaluated as satisfactory for continued operation by a competent authority; for example, Naval Sea Systems Command (NAVSEA), Naval Ships Systems Engineering Station, Naval Sea Systems Command Support Centers.
- d. Overloading or exceeding the capacity of the crane.
- e. Using hooks which are not safety hooks or are not moused, except when using a tripping line rigged for lowering or hoisting boats only.
- f. Lifting loads on the point of the hook.
- g. Abiding by weight indicators when common-sense judgment indicates an error; or using weight indicators as weighing devices after lifting the load, except as allowed for submerged lifts (paragraph 589-3.7.6.4).
- h. Engaging in activities, (crane crew members) that would divert attention away from the handling evolution.
- i. Allowing personnel to ride the hoist block, the hook, or the load.
- j. Allowing personnel to stand or pass under a load on the hook, or carrying loads over personnel.
- k. Allowing personnel to ascend or descend the crane while it is rotating.
- l. Using the limit switch or stop as an operating control to limit the travel of the load block, boom, or crane.

### CAUTION

**Side loading the crane may cause structural damage to the boom, causing it to collapse.**

589-3.5.4.3 Side Loads. NEVER side load the crane. Examples of side loading include:

- a. Rotating or traveling the crane with the load swaying from side to side (Figure 589-3-3).
- b. Hoisting or topping a load that is at rest where the hook has not been plumbed directly under the upper block.
- c. Attempting to rotate or travel the crane with the hook attached to a load at rest (dragging the load).

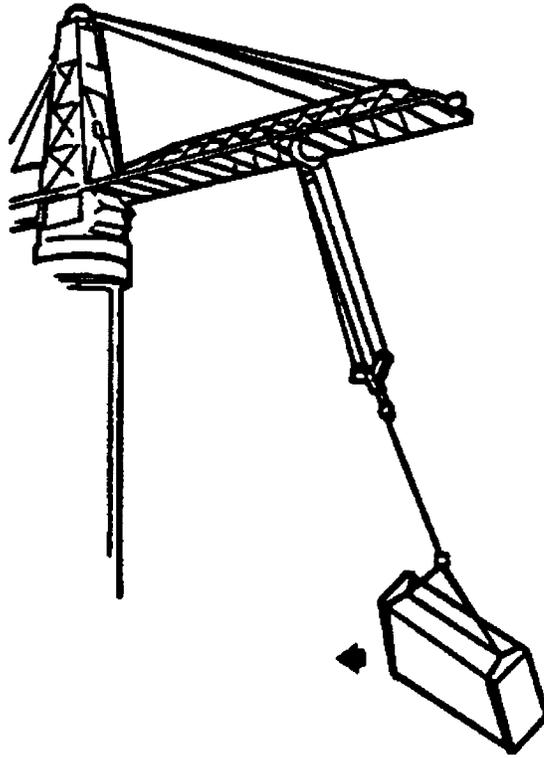


Figure 589-3-3 Never Side Load the Crane

589-3.5.4.4 Going Aloft. If the crane operator is required to go aloft in order to perform inspections, a safety harness with safety lines shall be worn as specified in the ship procedure for man-aloft.

589-3.5.5 CRANE STARTUP PROCEDURES. The following information is provided for crane operator guidance when beginning each new watch or operational period.

589-3.5.5.1 Operability. Before entering the cab, the crane operator shall determine the current crane status by reviewing the ODCL (or crane status board) and the tag out log.

589-3.5.5.2 Startup. Before starting the crane, the operator shall check that operating levers or handwheels are in the OFF or NEUTRAL position, and note any poor startup response or loss of power to the motors at startup. After startup, the operator shall remain alert for unusual noises, fluid leaks, and proper gauge readings.

589-3.5.5.3 Area Safety. The crane operator shall scan the lift area for personnel, or obstructions, before crane movement (see paragraph 589-3.6.2.4). The cab windows shall be clean and kept free of obstructions at all times.

589-3.5.5.4 Crane Control Testing. At the start of each new watch or shift, or upon relieving the previous operator, the crane operator shall test for proper crane control response. If the hook is under load, test the crane controls and the upper limit switch at the first convenient opportunity. Test the upper limit switch of each hoist under no load conditions, exercising extreme care. INCH (operate the hoist at slow speed when approaching operational limit) the block into the limit, or run in at slow speed. If the controls or upper limit switch do not operate properly, discontinue crane operation until appropriate repairs or adjustments have been made. If anticipated operations involve approaching a crane travel, or rotation limit, test the specific limit switch involved.

589-3.5.6 CRANE OPERATIONS. The following guidelines are intended to provide guidance for consistent, and safe, crane operations.

589-3.5.6.1 Crane Log. For each lift, or series of lifts performed, the crane operator shall record the appropriate information in a crane log which shall be kept in the cab. Minimal recorded information shall state:

- a. Name of crane operator
- b. Date
- c. Verification that the latest ODCL (or crane status board) and the tag out log have been reviewed before operation
- d. Time in and time out (operating hours).

589-3.5.6.1.1 Additional information, such as names of other crane crew members, load description and weight, and remarks may be included in the log, as directed by Command. The log shall be reviewed weekly by the cognizant Division Officer, and monthly by the Crane Officer. Superseded log sheets may be discarded following Crane Officer review.

589-3.5.6.2 Hoisting the Load. When positioning the boom, the hook shall be plumbed directly over the estimated center of gravity of the load before attaching the rigging. Avoid attaching capacity loads at maximum reach, because an outward swing of the load (caused by ship heel, list, or outward drift of the boom) may overload the crane. During hoisting, accelerate and decelerate smoothly. Do not allow the boom or load to impact any obstructions.

589-3.5.6.3 Stability. Maximum crane stability is achieved when the boom is at highest working angle (minimum outreach) and, for extendable booms, when boom is fully retracted. Consequently, all lifts should be made with the shortest possible working radius (outreach).

589-3.5.6.4 Topping the Boom. Lower the boom while under load with great caution. Consult the load rating chart and the boom angle indicator, when necessary. Operation of the crane in a high wind (for example, 30 knots) in the vicinity of the upper topping limit shall be avoided. Windgusts may blow the boom back into positive stops or flip the boom over backwards on cranes which are not equipped with positive stops.

589-3.5.6.5 Heavy Lifts. When lifting loads at, or near, the maximum crane capacity (for a given reach), observe precautions given in paragraph [589-3.7.5](#).

589-3.5.6.6 Multiple Loads. Unless the handling equipment has been specifically designed for such a lift, two or more separately rigged loads shall not be hoisted in a single lift, even though the total weight may be within the capacity of the crane.

### CAUTION

**Attach sufficient taglines to prevent load swing.**

589-3.5.6.7 Travel. Traveling a crane with a suspended load will be done with the boom in a position that does not endanger personnel or equipment in the event of load-drop. Boom angle should be high enough to provide adequate stability. If the signalman is on a floating drydock basin, or on a pier, when the crane is travelled, another individual shall be stationed to keep the tracks clear of personnel, and allow the crane operator to concentrate on the load being moved.

589-3.5.6.8 Illumination. Ensure that adequate lighting is available to illuminate work and passage areas, when conducting handling evolutions at night, or during periods of reduced visibility. The lighting shall not interfere with the crane operator's vision.

**WARNING**

**Do not operate crane near power lines if in doubt of the voltage present.**

589-3.5.6.9 Operation Near Power Lines. The crane operator shall be especially cautious when operating in the vicinity of electrical power lines (for example, overhead transmission lines, shore power cables). The operator shall maintain a minimum distance of 10 feet (paragraph 589-3.6.2.5) between power lines and any crane component. When in doubt of the voltage present, operator shall check with ship force or power utility representatives to determine the hazards, and request deenergization of power, if practicable.

589-3.5.6.10 Suspended Loads. Loads shall not be left on cranes. If the operator should leave the crane cab and the load hook is hitched to an object, the crane control panel shall be tagged with a notice such as LOAD HITCHED - DO NOT OPERATE. All controls shall be placed in the OFF position, the main switch opened, brakes set, and the crane locked in a secure position. A guard, or guards, shall be posted to prevent passage under the load and to prevent unauthorized access to the cab.

589-3.5.6.11 Slack Rope. If a slack rope condition occurs, verify that the wire rope is properly seated on the hoist drum and in the sheaves, before proceeding.

**CAUTION**

**Wet brake linings may allow slippage of the boom or load, especially when nearing crane capacity.**

589-3.5.6.12 Inclement Weather. After periods of precipitation (for example rain, sleet, snow, and heavy fog), the crane operator will test the brakes for proper operation. Wet brake linings may prevent the crane from supporting loads that are near the load carrying capacity of the crane.

589-3.5.6.13 Cold Weather. During extremely cold weather, the following procedures shall be observed:

- a. Where canvas or sheet metal covers are installed over parts of the crane machinery, the equipment may be made operable in minimal time by removing the covers frequently to remove any ice buildup and to check equipment condition.
- b. Where equipment is not covered, inspect daily for ice buildup. Ice can foul moving parts and damage the equipment. Remove ice formation with care to prevent damage.
- c. Where heaters are installed, space or unit heaters shall be used to aid in warming up hydraulic fluids and lubricants before operation. If the machinery room temperature is  $-6.65^{\circ}\text{C}$  ( $20^{\circ}\text{F}$ ) or lower, hydraulic transmissions shall be operated with pumps on zero stroke until the hydraulic fluid has been warmed.

589-3.5.7 SHUTDOWN FROM CRANE OPERATIONS. At the conclusion of each crane evolution, the crane boom shall be either secured or stowed.

589-3.5.7.1 Securing. Secure the crane when a watch is interrupted (such as lunch break or shift change). The following steps will be performed when securing the crane:

- a. Land the load.
- b. Secure the hook(s) to prevent displacement by wind, or other forces. If a hook is to be secured to the deck, a nonconducting tiedown shall be used to minimize the possibility of intermodulation interference with ship communications.
- c. Disconnect power to drive systems. Do not disconnect power to strip heaters, hydraulic fluid heaters, or lighting.
- d. Set manual brakes and insert locking devices (as applicable).

589-3.5.7.2 Stowing. Stowing the crane (for extended crane shutdown) is a relatively simple procedure. In conjunction with steps taken to secure the crane listed in paragraph 589-3.5.7.1:

- a. Lower the boom into the cradle.
- b. Apply hook and boom securing devices (as applicable).
- c. Perform other requirements, as specified in equipment technical manuals.

589-3.5.8 EMERGENCY CRANE OPERATIONS. Specific crane emergency operational procedures are provided in equipment technical manuals. If a motor overload or overtemperature switch trips, the EMERGENCY RUN bypass switch shall be used only long enough to place the load in a safe position. In the event of power failure, the crane operator shall:

- a. Apply manual brakes and other locking devices (as applicable).
- b. Move all controls to the OFF position.
- c. Notify immediate supervisor.

### CAUTION

**Use of the manual brake release alone may be an effective method for lowering a suspended load, however, this could be a sensitive operation depending on condition of brake, weight of the suspended load, and other variables. Use of a backup crane (with sufficient capacity to handle the suspended load), if available, or some other suitable backup arrangement in conjunction with or instead of manual brake release may be advisable in order to minimize the possibility of initiating a freefall condition. All variables should be carefully considered in determining the best course of action.**

589-3.5.8.1 If the load is still suspended, the supervisor shall notify maintenance personnel, who shall determine a suitable method for lowering the load to a safe rest.

589-3.5.9 AIRCRAFT CARRIER HANGAR BAY MOBILE CRANE REQUIREMENTS. Overturning of independent mobile cranes is a frequent danger. In addition to following the general requirements for shipboard cranes, the mobile crane operator shall ensure that the following conditions have been satisfied before conducting handling evolutions onboard Aircraft Carriers:

- a. Ensure the subject crane is approved for use by NAVSEA 05P7 and a PMS package is developed (see paragraph 589-2.2.5.1).
- b. The crane shall conduct lifts on the hangar deck, flight deck, and aircraft elevator platforms only.
- c. When the ship is pierside or in a drydock, the crane can be used up to 100% rated capacity. When the ship is at anchor or at sea, the crane shall be downrated to 75% capacity and tied down at four points

- d. At sea lifts shall only be conducted when the ship is in sea state 4 or less.
- e. Outriggers shall be fully extended for all lifts. Outriggers shall not rest on hatches, tracks, track covers or any hardware or appendage above the deck level.
- f. Over the side lifts are permitted only when the ship is pierside or at anchor. Over the side lifts are limited to lifting objects from a pier or a barge. The crane shall be tied down at four points for over the side lifts. Lifting boats from the water is allowed only for cranes approved for boat handling (such as AACC cranes) by NAVSEA.
- g. Ship list shall not exceed 0.5 degrees, except for cranes with outrigger leveling capability that can fully compensate for list.
- h. Personnel lifts are prohibited
- i. Traveling the crane with a load on the hook is prohibited.
- j. An operator's daily checklist shall be developed and used in which all safety control devices are tested.
- k. All lifts require a qualified operator, qualified Signalman, qualified rigger/tagline handler, and qualified safety observer.
- l. Tagline(s) shall be attached to the load to minimize pendulation.
- m. Quick accelerations/decelerations and high speeds shall be avoided.
- n. Use of removable boom extensions is prohibited.
- o. Lifting weapons is prohibited.

589-3.5.10 MOBILE CRANES TEMPORARILY MOUNTED ON BOATS. We do not recommend putting mobile cranes on dynamic platforms such as boats due to inherent stability and structural issues associated with mobile cranes. These problems are further compounded by a boat dynamic operating environment that is not always fully understood or accurately predictable. However, if no feasible alternative exists, the following requirements apply to mobile cranes temporarily mounted on boats:

- a. An engineering activity must select the appropriately sized mobile crane for the job. The mobile crane shall be downrated at least 50% from its land based rating and the engineering activity shall determine if further downrating is necessary. Items that must be considered are, weight of the load, sail area of the load, water depth, underwater current, hydrodynamic area of the load, weight of entrained water, and dynamic response of the boat.
- b. The mobile crane shall be current in its certification program in accordance with NAVFAC P-307, OSHA or NSTM 589 (whichever is applicable).
- c. An engineering activity must conduct an analysis of the ship deck structure for the expected loads the crane's outriggers and tie downs will impose on the ship. Wood blocks shall be placed between the outrigger pads and the deck of the boat.
- d. An engineering activity must develop and approve the tie down installation procedure to prevent the crane from moving around under all lifting conditions. The crane must be on outriggers and tied down. No lifts shall be conducted when the crane is on its tires.
- e. Upon installation of the crane on the boat, the crane shall be inspected and statically and dynamically tested to 150% of the down rated load (not to exceed 3/4 of the land based rating). List and trim shall not exceed 2 degrees during testing. During the test, the crane shall be rotated port, starboard, and over the aft end (or forward end if applicable). If the crane tiedowns are removed for any reason after the crane test is conducted, the crane shall be retested.
- f. The crane shall conduct lifts in calm seas only. This is imperative, especially for lifts conducted below the water surface. Roll and pitch of the boat shall not exceed 3 degrees. Wind shall not exceed 15 knots. Underwater lifts shall be hoisted at very slow speeds.

- g. A load chart shall be posted in the operator's cab that reflects the downrated capacities, the roll and pitch (3 degrees) and wind limitations (15 knot max). The land based capacity chart shall be removed or covered up to eliminate confusion.
- h. A list and trim indicator must be installed in the cab.
- i. The crane must have a working boom angle/load indicating device that displays the outreach, load weight, and sounds an alarm if the downrated capacity is exceeded.
- j. Crane operators shall have a current crane operator's license for operating that type of crane.
- k. Personnel lifts are prohibited.

### **589-3.6 LOAD RIGGING PROCEDURES**

**589-3.6.1 PHYSICAL CONDITION AND SAFETY CLOTHING.** Participation in a load handling evolution requires common sense, an awareness of unsafe conditions, and the avoidance of personnel errors. The safety of crew members and equipment depends on the manner in which a rigging task is accomplished. Poor judgment or carelessness may cause a serious accident.

**589-3.6.1.1 Watchstanding Requirements.** Only thoroughly trained and fully qualified riggers are permitted to rig loads. A rigger, who becomes physically or mentally unable to perform effectively, shall be removed from duty by the signalman in charge of the evolution. Trainees may assist load rigging, only under the direct supervision of a qualified rigger.

**589-3.6.1.2 Safety Clothing Requirements.** All riggers and tagline handlers shall:

- a. Wear protective hardhats ([Table 589-3-2](#)) and approved safety shoes.
- b. Avoid wearing trousers that are too long.
- c. Remove all jewelry (especially rings).
- d. Wear comfortable, prescribed, but not loose-fitting, clothes.
- e. Wear gloves when handling rough or sharp-edged cargo.
- f. Wear safety harness, safety line, and working line when working at high elevations or when suspended over water.
- g. Wear ear protection in a high-noise area.
- h. Wear eye protection (safety goggles) whenever appropriate.
- i. Wear leg guards when handling very heavy objects.
- j. Wear foul weather gear during inclement weather, sufficiently tightened to prevent a loose-fitting condition.
- k. Wear a lifejacket when conducting at-sea lifts, or in port (with safety lines removed) when conducting lifts over (or near) the side of a ship.

**589-3.6.2 LIFT PREPARATION.** Before conducting any load lifts, the weight of the material being lifted shall be carefully calculated, or conservatively estimated, by the signalman. Observe every available precaution when attempting to determine the weight of a load that is near maximum capacity by checking for weight markings, referring to the equipment's technical manual, or by weighing the load, if necessary. [Table 589-3-3](#) provides reference weights of common materials.

**Table 589-3-3** REFERENCE WEIGHTS OF COMMON MATERIALS

<b>Metal</b>	<b>Weight (lb/ft<sup>3</sup> )</b>	<b>Liquid</b>	<b>Weight (lb/ft<sup>3</sup> )</b>
Aluminum	165	Alcohol	49
Brass	535	Gasoline	42
Bronze	500	Oils	58
Copper	560	Petroleum	54
Iron	480	Water	62.4
Lead	710	Seawater	64
Steel	490		
Tin	460		
Steel Plate	40*		

\*lb/ft<sup>2</sup> per .inch of thickness

589-3.6.2.1 Crane Capacity. The signalman in charge shall know the capacity of the crane and ensure that such capacity is not exceeded. A Crane Load Rating chart shall be posted at the foot of the boom, or on the crane pedestal, for easy reference. Unless the handling equipment is specifically designed for such a lift, two or more separately rigged loads shall not be hoisted as a single lift, even if the total weight is well within the load capacity of the crane.

589-3.6.2.2 Handling Equipment. After the weight of the load has been calculated, or conservatively estimated, the rigger shall select handling equipment of sufficiently rated capacity, to safely handle the load; including all slings, shackles, turnbuckles, strongbacks, and chain hoists. See [Section 7](#)

589-3.6.2.3 Use of Nylon Straps. Use of knotted nylon webbing as handling equipment is prohibited.

589-3.6.2.4 Preparation of Load Handling Area. Unauthorized personnel shall be kept away from the lift area. Barriers shall be raised and the area posted, wherever practicable, to limit traffic. A safety watch shall be stationed, or appropriate barriers with warning signs shall be erected, in open hatch or bay areas whenever lifting into, or over, such areas. The safety watch shall warn personnel, working or passing below, to stand clear, and will observe the lift proceedings for signs of equipment failure. Where materials are being loaded or unloaded by crane from any vehicle, all personnel, including the vehicle operator, shall stand clear of the vehicle and lift area. Only members of the rigging crew shall be allowed on or near the vehicle.

589-3.6.2.5 Personnel Lifts. When conducting lifts of personnel, the following requirements shall be imposed:

- a. Personnel platforms (man-baskets) used to lift personnel shall be constructed in accordance with NAVSEA type drawing 53711-804-6397297, **MAN-BASKET, PERSONNEL LIFT, ARRANGEMENT & DETAILS**.
- b. The total weight of the loaded personnel platform and related rigging shall not exceed 50 percent of the rated capacity of the hoist.
- c. The load line hoist and boom topping hoist drums shall have controlled load lowering. Free fall is prohibited. Controlled lowering means a system or device on the power train other than a load brake which can regulate the hoist's lowering rate of speed.
- d. The hoist and topping wire ropes shall have a minimum factor of safety of 5 based on the rated capacity of each hoist.

- e. Where the boom is topped or extended by hydraulic cylinders, the hydraulic line supplying the cylinder shall have a pilot operated check valve to prevent boom motion after loss of hydraulic power.
- f. Lift and lowering speeds shall not exceed 100 feet-per-minute. Hoists capable of speeds in excess of 120 feet-per-minute shall not be used.
- g. The crane shall have an anti-two-blocking device which deactivates hoisting, topping, and boom extension as necessary to prevent contact between the load block or fall ball and the boom tip.
- h. A boom angle indicator shall be installed, which is readily visible to the operator or the signalman.
- i. Telescoping booms shall be marked or equipped with a device to clearly indicate at all times the boom's extended length to the operator or signalman.
- j. Travelling the crane with personnel in the personnel platform is prohibited except for portal cranes operating on a fixed track.
- k. Cranes shall not be used to lift personnel when the ship's list exceeds 5 degrees. Mobile cranes shall not be used to lift personnel when the list exceeds 1 degree.
- l. Cranes provided with outriggers shall have those outriggers fully extended and locked according to manufacturer's specifications.
- m. Hooks shall be of the type that can be closed and locked, eliminating the throat opening. Alternatively, a hook without the positive device shall be moused.
- n. The personnel platform shall be landed on the deck or pier, or secured to the ship's structure before personnel exit or enter.
- o. Safety harnesses shall be worn and attached by a safety line to a convenient grab rod on the man-basket except when personnel are suspended over water, at which time the safety line shall be detached from the man-basket. Personnel suspended over water shall wear lifejackets.
- p. For personnel lifts conducted near electrical power lines of 50 kilovolts (kV) or less, maintain a minimum clearance of 10 feet between the lines and any part of the lifting or handling equipment. For power lines in excess of 50 kV, maintain a distance of 15 feet for 75 KV, 20 feet for 100 KV, etc.
- q. Crane must be manned at all times with men working over the side or aloft in manbaskets.

589-3.6.2.6 Precautions for Boat Handling. When handling boats, the following precautions shall be observed:

- a. The number of people in the boat shall be kept to an absolute minimum. Only those persons necessary to safely operate the boat shall be in the boat while it is being hoisted or lowered.
- b. Ship's speed should be 5 knots or less, but preferably zero. If ship's speed exceeds 5 knots, boat-handling operations should be discontinued.
- c. The safety latch on the hook should be either tied back or removed to permit a quick release.
- d. Additional guidance may be obtained from NAVEDTRA 10121, **Boatswain's Mate 3 and 2 Manual**, and from **NSTM Chapter 583, Boats and Small Craft**.

589-3.6.2.7 Crane Crew Staffing. The signalman in charge of the evolution will ensure that the number of personnel assigned is adequate to support the evolution. Due consideration shall be given to the number of riggers and tagline handlers required due to the size and geometry of the load and current weather conditions.

589-3.6.3 CONDUCT OF THE LIFT. Before attaching the load, plumb the hook and upper block assembly directly over the center of gravity of the load. Avoid attaching capacity lifts at maximum crane reach, because an outward swing of the load (caused by heel, list, or outward drift) may overload the crane and cause harm to personnel or material in the vicinity. Slings shall be properly employed, and dunnage (filler material) shall be used to pad sharp corners on the load to prevent chafing the slings. Before hooking a load, the signalman shall establish positive control through appropriate signals to the crane operator, and rigging personnel shall unhand the hook, and then assume a safe position until motion is secured and permission to proceed is given by the signalman. Rigging personnel shall remain alert for conditions leading to a swinging hook.

589-3.6.3.1 Use of Handling Equipment. Only approved methods for properly fastening slings to the load and the hook shall be used (Figure 589-3-4). Hooks shall be firmly in place before making a lift, and loads shall never be carried on the point of the hook. The hook shall be moused, unless safety hooks are provided; the only exception is during boat-handling operations (paragraph 589-3.6.2.6.c). Box hooks are prohibited, except for raising loads to a height necessary for the placement of slings or dunnage. Only qualified riggers shall perform these evolutions.

**WARNING**

**Never ride the load without authorization and safety equipment.**

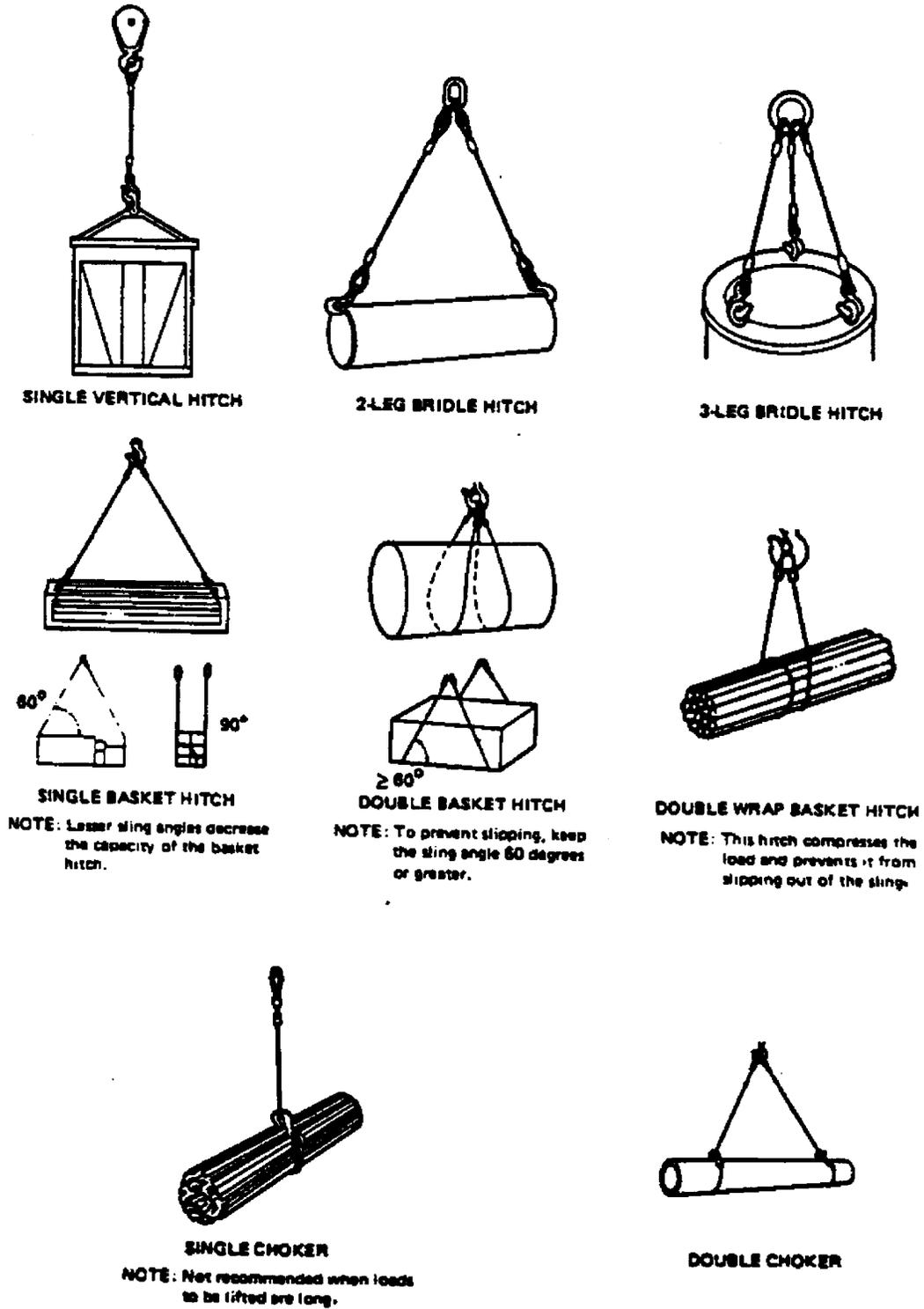


Figure 589-3-4 Standard Sling Attachment Methods

589-3.6.3.2 Area Safety. Noise shall be kept to a minimum in the vicinity of the load lift for the entire evolution. Immediately before lifting the load, the signalman should check that the area is clear and the load is freed from its foundation or tiedowns. Before the load (or empty lifting gear) is raised, lowered, or rotated, distinct and sufficient advance warning shall be given to personnel in the vicinity. No one shall be allowed to ride on the load without the express authorization of the Crane Officer. If riding the load is determined to be necessary, and has been authorized, the signalman shall require the rider to use a safety harness, lifelines, and any other precautionary equipment, as deemed necessary.

589-3.6.3.3 Inspecting the Load. The signalman shall thoroughly inspect the entire rig before lifting the load. All loose parts or objects shall be secured. To avoid swinging, a check shall be made to ensure that the upper block has been plumbed directly over the center of gravity of the load, and that the load is balanced in the sling (Figure 589-3-5). Sufficient taglines shall be attached to prevent the load from shifting out-of-control. Taglines shall be of adequate length, kept free of loops and knots, and of sufficient size to allow gripping the line. Taglines shall not be wrapped around the hand. Minimum tagline size is 1-1/2-inch (circumference) line. Before lifting the load, the signalman shall verify that the taglines and wire ropes are not fouled or crossed.

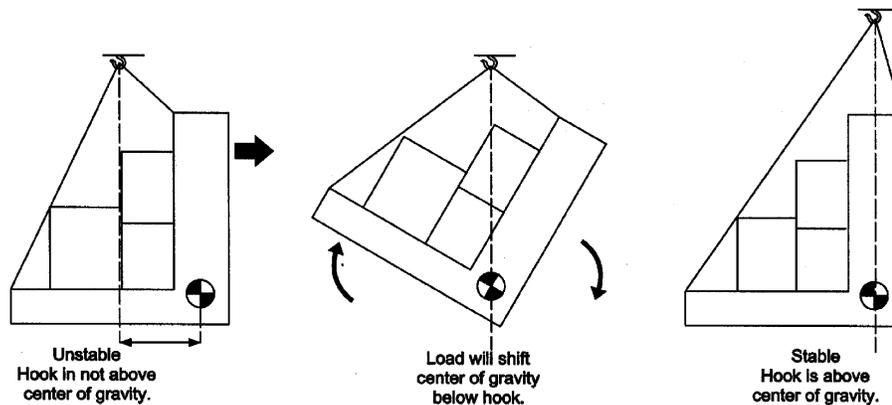


Figure 589-3-5 Plumb Hook Over Center of Gravity of Load

589-3.6.3.4 Lifting the Load. As the load is lifted, the signalman shall focus attention on the load and check for fouling. The load shall be hoisted a few inches off the deck and the rig checked for proper balance, evidence of undue strain, and fouling of the lines. If necessary, the load shall be lowered and rigged. When using slings, the load should be distributed equally on each leg (Figure 589-3-4). Angles should be as large as possible between the sling legs and the load, as shown in Figure 589-3-6, because the load (force) on each sling leg increases rapidly as this angle decreases.

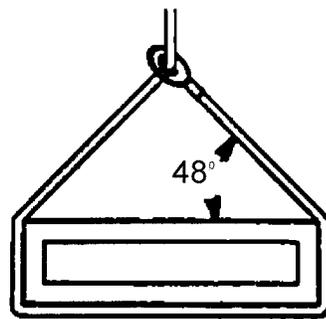


Figure 589-3-6 Sampling of Damage Control Diagram Symbols

589-3.6.3.5 General Rigging Precautions. If shackles are used (Figure 589-3-7), they should be placed so that the pin of the shackle will ride in the eye of the sling pendant, and not in the standing part of the sling, in order to prevent the pin from unscrewing. When chocking (securing) material with either a rope strap or a wire pendant, use a wooden wedge or a short piece of board (two by four) to tighten down the bight (loop). When rigging cylindrical loads (for example, shafting or round stock) by strap, chain, or wire rope, wrap at least two turns around the load. When handling bundles of small materials, verify that all parts of the bundle are secured. Lift small pieces, whenever possible, in a skip-box, rigged with not less than a three-legged bridle. All sling legs shall be secured to the skip-box.

**WARNING**

**A change in sound, during operations, may precede a falling load.**

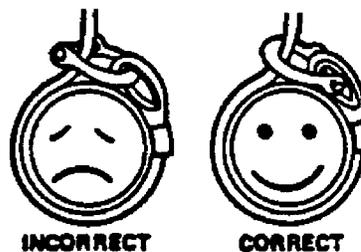


Figure 589-3-7 Proper Method for Attaching Shackles to Choker Slings

589-3.6.3.6 Moving the Load. After the signalman has determined that the load has been properly rigged (paragraph 589-3.6.3.3), movement may proceed. All personnel involved shall concentrate on the load lift operation. LISTEN for any change in sound. Normally, a wire or nylon fiber rope will hum under strain, but when it starts to squeak, ping, or squeal, BEWARE; it is in imminent danger of parting. A faulty block may give warning by squeaking or groaning. Hoist, swing, and lower the load slowly and smoothly. Jerking the load may result in significant impact loads on the rigging and may cause lines to part. Loads shall only be hoisted high enough to clear the coaming and bulwark. All other movement shall be as close to the deck as possible. The adverse effects of a drop will be lessened, if a load is carried close to the deck. A particularly heavy load, raised too high, may affect the stability of the ship and cause considerable list. Chains or slings shall not be permitted to hang or drag under loads. Rigging gear shall not be dragged across the deck. Loose ends of slings shall be secured or attached to the hook.

**WARNING**

**Never wrap tagline around hand or arm.**

589-3.6.3.7 Tagline Handling. When steadying the load, tagline handlers will not stand between the load and any fixed object. Always face the load and keep feet and hands clear. When using a tagline, always stand out of the bight and clear of the throw of the block, and never wrap the tagline around arms or hands.

**WARNING**

**Stand clear of slings being pulled from under loads.**

589-3.6.3.8 Clearing the Area. All personnel shall stand clear of areas under suspended loads, except as authorized by the signalman, who shall personally inspect the area before granting permission. Erect barriers to prevent unauthorized personnel from entering the area under the boom and hook, including rotation and travel load paths, before load movement or handling occurs. Personnel shall stand clear of slings being pulled from under loads (Figure 589-3-8). Riggers shall exercise caution when withdrawing slings, to prevent the slings from whipping loose and striking personnel, or from snagging onto and tipping the load.

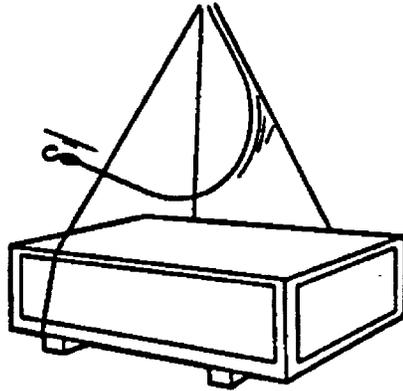


Figure 589-3-8 Stand Clear of Slings When They are Pulled from Underneath Loads

589-3.6.3.9 Securing. Upon completion of the load handling evolution, all handling gear shall be safely secured, including the crane (paragraph 589-3.5.7). Utilize stowage facilities for rigging equipment protection to reduce wear and prolong equipment life.

589-3.6.4 NETS. Cargo nets shall be used when loading or unloading packages, bundled and bagged materials, or other objects prone to rolling or shifting. Appropriate dunnage shall be used as necessary to resist damage due to cargo net pressure on the material.

589-3.6.4.1 Discharging into Trucks. When a cargo net is used to discharge cargo into a truck, the load shall be landed slowly and with caution to prevent injury to personnel or damage to the truck. The net shall be carefully disconnected from the sling and shall remain in the truck with the load.

589-3.6.4.2 Handling Drums and Barrels. Steel nets shall be used to handle drums and barrels because they could cut rope nets and drop onto the deck or hatch. When positioning barrels in cargo nets, do not load barrels on their heads. Resulting pressure buildup could cause the heads to fail.

589-3.6.5 PALLETS. Stable lifting platforms (pallets) and ready-made pallet slings allow rapid and efficient lifting. Pallets prevent damage to crushable cargo items, increase the amount of cargo that can be stacked, and permit higher cargo speeds for cargo transfer. Therefore, pallets are used extensively in load handling operations.

589-3.6.5.1 Pallet Method Hazards. The pallet method of load handling has inherent hazards that require increased awareness:

- a. Attempt to evenly distribute the load on the pallet so that the load's center of gravity is centered between the pallet sling attaching points.
- b. Understand that, unlike most loads lifted, the center of gravity of a palletized load is above the pallet sling attachment points.
- c. For improved stability, attach the slings as illustrated in Figure 589-3-9.
- d. Ensure that no load disruptions or hangups occur during load movement that may cause load instability and

load drop.

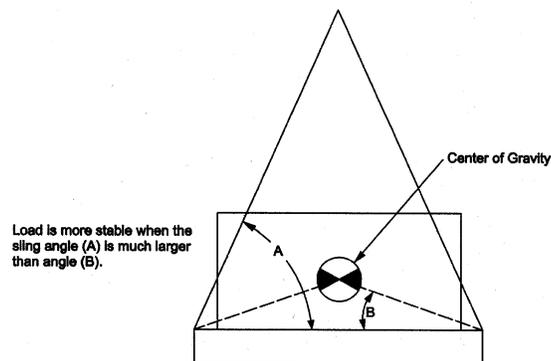


Figure 589-3-9 Improving Load Stability When Lifting Pallets

**589-3.6.5.2 Inspecting the Pallet.** Before loading a pallet or lifting a pre-loaded pallet, the rigger or signalman shall inspect the pallet for structural integrity, particularly end segments where pallet slings are attached. Ensure that pallets are not overloaded. The usual capacity of most metal pallets used by the Navy is 4,000 pounds. The usual capacity for most wood pallets used by the NAVY is 2,000 pounds. If the capacity of the pallet in use is questioned, assume it to be a 4,000-pound for metal or 2,000 pounds for wood, or refer to the applicable military specifications to determine appropriate pallet capacity. If the pallet is damaged or broken, remove it from service and destroy it to prevent inadvertent use by other personnel.

**589-3.6.5.3 Loading the Pallet.** When loading a pallet, safety requires that the cargo be stacked to minimize the possibility of spilling the cargo, and that the pallet be stable and level, when lifted. To load a pallet with cases of uneven size, place the highest and strongest cases at each end of the pallet and distribute the smaller and more fragile cases in the center. One pallet may then be stacked upon another, providing a stronger and more level base. Pallets, supporting loose or unrestrained container goods, which cannot be repalletized, shall be lifted in cargo nets.

**589-3.6.5.4 Round-Shape Commodities.** Commodities (such as gas cylinders) shall be palletized using special chocks constructed to fit the specific cargo. A second row of cylinders shall be laid in the cantlines of the first chock (Figure 589-3-10). Magnets or slings shall not be used. Compressed gas cylinders shall not be lifted by their caps.

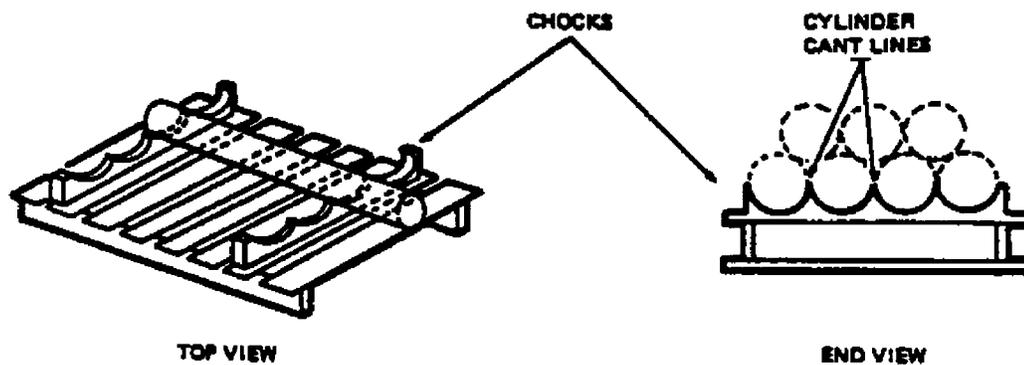


Figure 589-3-10 Handling Cylindrical Objects

589-3.6.5.5 Pallet Slings. Use pallet slings whenever possible for safe, quick, and efficient handling of pallets, especially if pallets contain even-sized cases or cartons. Only military specifications or NAVSEA approved pallet slings, as shown in Figure 589-3-11, shall be used for handling palletized cargo.

### CAUTION

**Kinked, twisted, stretched, worn, bolt-spliced, or knotted chains may fail in service.**

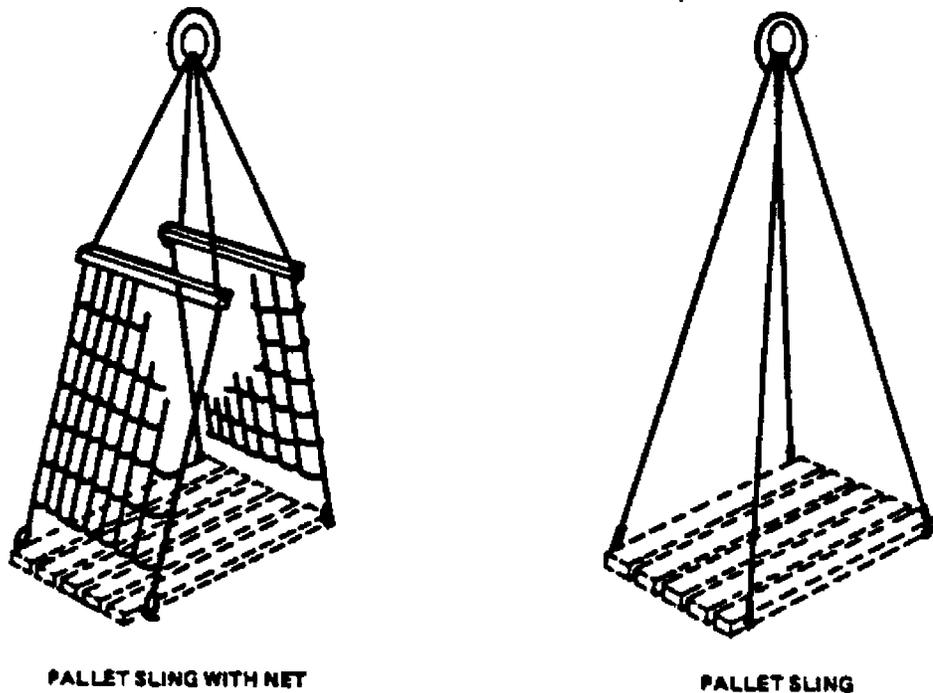


Figure 589-3-11 Approved Pallet Slings

589-3.6.6 RADIO TRANSMITTER HAZARDS. At certain frequencies, high-frequency shipboard radio transmitter antennas in the vicinity of the crane can induce voltage in the rigging that can cause painful burns upon contact. Exercise caution when handling any metallic crane components. To reduce the hazard of Radio Frequency (RF) voltage burns to riggers, implement shipboard procedures to prohibit transmitter operation during load handling (include appropriate checkoff sheets), or install an insulator link between the hook and the wire rope or load block. An insulator link allows riggers to handle the hook and metallic slings without receiving RF voltage burns. However, metallic crane components above the insulator link may still be charged and can cause personnel injury. Insulator links shall be in accordance with NAVSEA Standard Drawing 53711-803-6397257 LINKS, RADIO FREQUENCY, HIGH VOLTAGE INSULATOR or NAVSEA Standard Drawing 53711-803-6397427, LINKS, RADIO FREQUENCY, HIGH VOLTAGE INSULATOR LINK, CYLINDER TYPE. Additional information on insulator links is contained in NAVSEA OP 3565 Vol. 1, **Radio Frequency Hazards to Ordnance Personnel and Fuel**.

589-3.6.7 GENERAL WIRE ROPE SAFETY. Wire rope maintenance will prevent failures that may result in personal injury and equipment damage. Personnel shall never grab wire rope as it runs on or off the drum, or as it is pulled through a sheave. Personnel shall always stand clear of the bights of a wire rope and of slings being pulled from under loads. Wire rope shall be handled in a manner which prevents twisting or untwisting. Wire rope ends shall always be seized to prevent unlaying. Wire rope shall be stored away from weather and acid fume exposure, since corrosion may quickly develop and weaken wire rope. Protective pads shall always be used where a sling is exposed to sharp edges, generally at load corners.

## 589-3.7 CRITICAL LIFTS

589-3.7.1 DEFINITIONS. Load handling evolutions are divided into two categories: CRITICAL and NON-CRITICAL. A CRITICAL lift is any one of the following:

- a. Any lift performed at sea or under adverse weather conditions
- b. Any lift involving, or conducted over, ordnance
- c. Any lift involving, or conducted over, radioactive material or reactor plant components
- d. Any lift greater than 85 percent of rated crane capacity
- e. Any lift of submerged or partially submerged objects
- f. Any lift or suspension of personnel.
- g. Any other lift designated by the Commanding Officer as warranting precision or special care (for example, placement of separators, personnel transfer, or lifts of high value material).

589-3.7.1.1 Performance of CRITICAL Lifts. Performance of nuclear or ordnance related CRITICAL lifts shall be performed only by cranes designated (in writing) by the Commanding Officer. All CRITICAL lifts shall be performed only by crane operators and signalmen who are certified to conduct CRITICAL lifts. CRITICAL lifts conducted topside shall be performed during daylight hours to the maximum extent practicable.

589-3.7.1.2 CRITICAL Lift Procedures. Commands shall prepare and approve procedures for the conduct of CRITICAL lifts. Such procedures should identify lifting and handling equipment for the lift, inspection and acceptance criteria if applicable, special precautions to be observed, probable crane crew requirements, and outline a proper sequence to be followed during the lift. Approved procedures will aid identification of potential problem areas. Crane crew members shall be briefed on the CRITICAL lift procedure before performing the lift. For conducting lifts onto, or from, adjacent ships or pier structures, where significant wave action is present, the Command prepared and approved procedure shall provide a determination of the relative vertical and horizontal motions between the ship-mounted crane and the adjacent ship or pier. Determination shall be made before commencing handling operations so that handling and spotting capabilities of the crane crew are not exceeded.

589-3.7.1.3 Preparation and Walkthroughs. Preparation for CRITICAL lifts should include walkthroughs when conducting infrequently performed lifts, lifts requiring delicate or precision handling, or lifts by less experienced personnel. Walkthroughs are intended to reduce personnel errors and equipment malfunctions. The Crane Officer should determine the need for walkthroughs before conducting a CRITICAL lift. In preparation for a CRITICAL lift, the signalman shall have a tested and readily available backup communications (such as, radio or sound-powered phones), in the event that primary means of communication are lost, or special directions need to be transmitted to the crane operator.

589-3.7.2 LIFTS AT SEA, OR UNDER ADVERSE WEATHER CONDITIONS. Sea motion causes additional dynamic stress on crane structural components. A crane that is handling a 100-percent rated load on a rolling or pitching ship may be over loaded due to the additional dynamic force. Similarly, the force of strong winds may exert additional stress on the crane structure in excess of design stresses, which can result in exceeding rated load capacity. Load handling operations in winds exceeding 30 knots shall be considered CRITICAL lifts.

589-3.7.2.1 General Limitations. To account for environmental (adverse weather) effects, the following general limitations are imposed upon crane operations. If any ONE of the following parameters is exceeded, or it is anticipated that it will be exceeded during crane operation, rated crane capacity shall be reduced by 50 percent (at any reach):

- a. Roll, or a combination of list and roll, of 5 degrees in either direction
- b. Pitch, or a combination of pitch and trim, of 3 degrees either up or down
- c. Wind speed of 30 knots.

589-3.7.2.2 Suspension of Crane Operations. Crane operations should normally be suspended under the following conditions:

- a. Roll of 10 degrees
- b. Pitch of 6 degrees
- c. Wind speed in excess of 40 knots.

589-3.7.2.3 Calculable Limits. Should the limitations of paragraph 589-3.7.2.2 and this paragraph prove too restrictive for the ship, the actual maximum load that can be handled under roll or pitch conditions without exceeding 100-percent rated capacity can be calculated for a specific crane by using the following simplified equations:

- a. Maximum Allowed Load in Roll (Percentage of Rated Load) =  $100/1 + [0.0025 * r(D_1 + R_m / t_r^2)]$   
Where:

r = roll, in degrees, from horizontal to either side  
 $t_r$  = time, in seconds, to roll (r), in degrees  
 $D_1$  = distance, in feet, from ship centerline to center of rotation  
 $R_m$  = maximum reach, in feet, from center of rotation

- b. Maximum Allowed Load in Pitch (Percentage of Rated Load) =  $100/1 + [0.0025 * p(D_2 + R_m / t_p^2)]$   
Where:

p = pitch, in degrees, from horizontal to up or down  
 $t_p$  = time, in seconds, to pitch (p) up or down in degrees  
 $D_2$  = distance, in feet, from amidships to center of rotation  
 $R_m$  = maximum reach, in feet, from center of rotation

- c. For example, a typical AS 57.5 ton B & M crane located 18 feet off the centerline with a total reach of 91 feet from the center of rotation, rolling 6 degrees to either side in 4 seconds, may handle a 52-ton load, as follows:  
 $100/1 + [0.0025 * 6(18 + 19/4^2)] =$   
 $100/1.102 = 90.7\%$   
 $.907 * 57.5 \text{ tons} = 52 \text{ tons}$

589-3.7.2.3.1 Where calculations show that a load can be handled without exceeding 100 percent of rated capacity, the load may be lifted. As always, care should be taken to minimize impact loading on the crane.

589-3.7.2.4 Wave Action. When lifting loads near the waterline, care should be taken to prevent submerging or dunking the load on roll or pitch. Suction forces and impact forces on the crane are not provided for in the calculations of paragraph 589-3.7.2.3. A wetted load may exceed the crane capacity (paragraph 589-3.7.6).

589-3.7.2.5 General Safety. Environmental limitations are based on the physical capacity of the crane to support the load. The judgment of the Commanding Officer, Crane Officer, signalman, crane operator, or safety observer regarding limiting or terminating crane operations based on operational safety considerations in heavy weather shall take precedence over the guidelines of this chapter.

589-3.7.3 ORDNANCE LIFTS. When handling ordnance, crane usage limitations of paragraphs 589-3.7.2.1 and 589-3.7.2.2 shall be followed unless additional restrictive requirements are found in the Type Commander's directives or applicable ordnance pamphlet (OP) or ordnance data (OD). All weapons handling equipment under the cognizance of NAVSEA, shall be maintained according to NAVSEA drawings until alterations have been formally approved.

589-3.7.3.1 Ordnance Handling Supervisor. The ordnance handling supervisor in charge of the movement of the ordnance should have specific crane experience, or a subordinate with experience to assist the supervisor during actual lifting and load handling. In order to properly maintain overall control of the evolution, the ordnance handling supervisor may serve as the crane safety observer, if qualified, but should not be the signalman for the handling evolution. If the ordnance handling supervisor is not qualified as crane safety observer, a qualified safety observer shall be assigned to monitor the evolution and make appropriate safety recommendations to the ordnance handling supervisor.

589-3.7.3.2 Before Inspection. Before conducting ordnance lifts, a visual inspection and operational test of the handling and lifting equipment shall be conducted. Visual and operational inspection of lifting equipment should be done in conjunction with the ODCL (paragraph 589-3.5.3).

589-3.7.3.3 General Precautions. Ordnance shall not be allowed to become unrestrained during handling. No sources of ignition (for example, sparks, and flames) shall be present when handling high explosives. The area shall be appropriately posted to indicate this, and warnings announced periodically over general circuits. Weapons shall not be handled while underway unless motion is restrained. Handling may then be performed only with permission of the Officer of the Deck, and according to the applicable NAVSEA handling manual or procedure. Nylon lines shall not be used for weapons handling unless authorized by an approved handling procedure (not applicable for taglines). Manila or synthetic fiber lines (that is, Dacron polyester filament lines) are authorized for use. Torpedo shipping and unshipping shall be performed with propeller guides in place.

589-3.7.4 NUCLEAR PROPULSION RELATED LIFTS. When moving nuclear propulsion material (radioactive material or reactor plant components), or conducting lifts over such material, approved lifting and handling equipment designed for such components shall be according to NAVSEA 0989-LP-037-2000, **Overhaul and Repair Specification**, NAVSEA 0989-LP-043-0000, **Surface Ship General RP Overhaul and Repair Specification**, or NAVSEA 0989-LP-058-0000, **Tender Nuclear Support Facilities Preventive Maintenance Index**, as appropriate. Guidance for lifting radioactive material or reactor plant components when NAVSEA approved lifting equipment is not available (that is, use of the B & M crane to lift portable effluent tanks or radioactive waste), is contained in NAVSEA 0989-LP-058-0000, Appendix A, Section 5.

589-3.7.5 LIFTS AT, OR NEAR, CRANE CAPACITY. Heavy lifts greater than 85 percent of rated crane capacity are CRITICAL lifts because the weight lifted approaches the maximum design stresses of structural

components and mechanical systems. When lifts are anticipated to exceed 85 percent of rated capacity, refer to the requirements, precautions, and guidance of paragraphs [589-3.7](#), [589-3.7.5.1](#), and [589-3.7.5.2](#).

**589-3.7.5.1 Variable Capacity Boom Requirements.** On cranes with variable-capacity booms, the boom may be overloaded with lesser weight at greater reaches. Signalmen should exercise caution when calculating and performing lifts that approach the boom capacity, especially when lowering the boom to greater reaches. Compliance with the requirements of paragraph [589-3.7](#) are required if the lift will exceed 85 percent of the rated crane capacity for the working boom length and angle. Crane crew members shall be informed when near capacity loads are handled for a given boom reach.

**589-3.7.5.2 General Heavy Lift Requirements.** The following precautions apply to all lifts in general, and to heavy lifts in particular:

- a. Weight of the material being lifted shall be carefully calculated or conservatively estimated in advance. No lift shall be made on the basis of a quick estimate. No attempt shall be made to lift a load greater than the rated capacity of the equipment being used. For lifts over 85 percent of crane capacity, calculations or estimates shall be reviewed with the safety observer before commencing the lift.
- b. The signalman and the safety observer shall ensure that equipment used is appropriate, of adequate strength, and closely inspected before use.
- c. The riggers and the signalman shall:
  1. Check each piece during loading
  2. Check for proper rigging
  3. Ensure that the load will not exceed rated capacity under given conditions
  4. Ensure that materiel is properly secured to prevent weight shift during lift.
- d. Brakes shall be checked and tested before attaching the load to the crane hook. After rain, or under certain atmospheric conditions, brake linings may be wet. Crane operators shall be satisfied that brake linings are dry before proceeding.
- e. Plumb the load directly under the boom head before attaching to the hook.
- f. Raise the load a few inches after attaching the load to the hook, to test the brakes and determine if there is any undue stress on any part of the sling. If unsatisfactory, lower the load and do not attempt to move it until appropriate adjustments or repairs have been made.
- g. Hoist, rotate, and lower the load slowly and smoothly. Abrupt motions place excessive strain on the lifting and handling equipment and may cause parting. Loads shall be hoisted just high enough to clear obstructions. The Officer of the Deck or the Command Duty Officer shall be made aware before making the lift, since a heavy load may affect the stability of the ship and cause considerable list.
- h. WATCH while the load is being moved and keep every part of the rig under constant observation. LISTEN for any change in sound. Normally a wire rope hums under strain, but when it starts to squeak or squeal, BEWARE of rope failure.

**589-3.7.6 LIFTS OF SUBMERGED OBJECTS.** Lifts of waterlogged, wetted, or submerged objects are considered CRITICAL lifts for the following reasons:

- a. A submerged load resting on the bottom may be subject to suction forces if settling occurs in silt, mud, or sand.

- b. Ship motion can impart significant impact loads on the crane structure while the crane rigging is attached to a suspended submerged object.
- c. The load weight sensed by the crane changes as the object goes from a buoyant, submerged state to one experiencing the full effects of gravity after clearing the water's surface.
- d. After clearing the water's surface, the object may retain a significant volume of water, resulting in a load much heavier than originally calculated, and the load may have uncertain stability due to the free surface effect of the retained water.

589-3.7.6.1 Calculating Load Weights. It is of the utmost importance for the signalman to accurately calculate or conservatively estimate the weight of the load before lifting. Wherever possible, prints or technical documents should be reviewed to determine the weight and volume of the object. Appropriate consideration should be given to include an estimated volume of retained water. For CRITICAL lifts approaching the capacity of the crane (that is, greater than 85 percent), calculations of estimates shall be reviewed by the safety observer before commencing the lift. If possible, the ship should be repositioned before the lift to minimize the effects of forces such as current, tides, wave action, or other appropriate considerations made (such as, performing the lift at slack tide).

589-3.7.6.2 Use of Divers. Before conducting lifts of sunken or submerged objects, divers shall inspect the object, confirm it clear of load hangups, and open any available ports so that water will be allowed to drain on clearing the water's surface. (Such inspections are not required of normally submerged objects, such as separators, which have sufficient drainage and no enclosed spaces to retain water.) Divers who rig sunken or submerged objects shall be qualified riggers or receive specific training on the rigging techniques and precautions to be observed for the load being lifted. After rigging the load, divers shall monitor the lift from a safe distance so that the crane crew can be promptly notified of problems occurring during load ascent (for example, load hangups and currents).

589-3.7.6.3 Conducting the Lift. Immediately before reaching the surface of the water, the operator shall stop raising the load, and taglines shall be attached to the load and passed to shipboard tagline handlers. On recommencing the lift, extra caution shall be observed when clearing the water's surface. The load shall be lifted smoothly to a short height above the surface (sufficient to avoid interaction with the waves), and the lift shall momentarily stop. The load shall be inspected to ensure that there has been no undue shifting, to verify that the rigging is adequate, and to allow drainage of water. The load may then be safely landed. Before lifting any boats from the water, the bilges shall be pumped as much as practical to prevent instability of the load due to shifting of water retained in the boat.

589-3.7.6.4 Crane Capacity for Submerged Lifts. Unless specifically designed and tested for submerged loads, allowable capacity of the crane shall be limited to 50 percent of rated load, unless a load cell or dynamometer is installed (temporarily or permanently) to monitor the weight being lifted. If weight approaches rated load, caution shall be exercised to ensure that crane capacity is not exceeded.

**SECTION 4.**  
**MATERIAL MAINTENANCE**

**589-4.1 INTRODUCTION**

589-4.1.1 PURPOSE. Section 4 describes the safety and special component features that may be incorporated in a crane and provides requirements, instructions, and information to assist the performance of periodic and corrective maintenance.

589-4.1.2 CRANE ADVISORY MEMORANDUM. The Crane Advisory Memorandum, shown in Figure [589-4-1](#), is provided in order to establish a convenient and informal means of communication between forces afloat and the In-Service Engineering Agent / LCM Agent, NAVSEA Philadelphia (NAVSEA Philadelphia). Duplicate and use the memorandum to convey technical information such as test results, suggestions for design improvements, and equipment problems. The memorandum should also be used to provide NAVSEA Philadelphia, Naval Sea Systems Command (NAVSEA), and Director, Strategic Systems Projects with advance copies of alteration requests being forwarded to the Type Commander. No change to crane configuration or operating procedures may be made solely on a NAVSEA Philadelphia response to a Crane Advisory Memorandum. Equipment shall not be altered unless authorized by a Ship Alteration Record or an Alteration Equivalent to a Repair approved by NAVSEA.



authorized by a Ship Alteration Record, Alteration Equivalent to a Repair or another means approved by NAVSEA. The following criteria should be used as guidance in determining when a proposed action constitutes a crane configuration change.

- a. Any installation, removal, alteration or relocation of any crane component or system not authorized as noted above should be suspected as a possible configuration change.
- b. Replacement of APL / COSAL-supported components and systems – if the proposed replacement is not listed as a suitable alternative under the Navy Stock Number (NSN) of the original component or system, it should be a possible configuration change.
- c. Replacement of non – APL / COSAL – supported components and systems – if the proposed replacement differs from that specified in the crane technical manual, it should be suspected as a possible configuration change.
- d. In general, replacement of APL – level piece parts (e.g. nuts, bolts, wires, “O” rings, gaskets, resistors, capacitors, etc.) with like parts is acceptable as long as the replacement is similar to the original part with respect to form, fit and function as defined below:
  - (1). Form: The physical design of the component or system consisting of shape, assembly, material, size, etc.
  - (2). Fit: Physical and functional compatibility with adjoining components or systems.
  - (3). Function: Role or mode of operation (e.g., mechanical, electrical, hydraulic, etc.) of component or system relative to system in which it is installed. Any questions regarding crane configuration should be brought to the attention of NAVSEA Philadelphia, Code 9731 for resolution. Requests for configuration changes should be forwarded to the applicable Type Commander.

## **589-4.2 DESIGN CONSIDERATIONS**

**589-4.2.1 MANDATORY SAFETY FEATURES.** Mandatory safety features shall be installed in each crane to provide adequate protection for personnel and equipment. The Crane Officer shall review applicable crane technical manuals and inspect the crane to determine if these safety devices are installed. If any mandatory safety features are not installed, the Crane Officer shall request an alteration through the Type Commander’s alteration request program. (See the following paragraphs.)

**589-4.2.1.1 Hoist Upper Limit Switches/Stops.** All cranes shall have a hoist upper limit switch or device, which limits the upward travel of the load block to prevent the block from striking the upper sheaves and causing a two-blocking event. Activation of the limiting device will prevent upward operation of the hoist system and apply the holding brake(s). On cranes that are reeved so that it is possible to lower the boom into the block, the hoist upper limit switch shall be interlocked with the topping hoist to prevent lowering the boom into the block, or a separate limit switch shall be installed for this purpose.

### **NOTE**

Paragraph 589–4.2.1.2 does not apply to cranes equipped with topping hydraulic cylinders.

**589-4.2.1.2 Boom Limit Switches/Stops.** Boom limiting devices shall be installed to ensure that:

- a. Maximum boom angle is not exceeded and the topping ropes will remain in tension, so that the boom will not flip over backwards in a high wind or following a sudden drop of the load.
- b. Minimum boom angle is not exceeded, so that the angle between the boom and the topping ropes is so small that the boom cannot be raised or design stresses are exceeded.

c. A minimum of 2-1/2 turns remain on the topping hoist drum.

589-4.2.1.2.1 Actuation of a boom limiting device prevents operation of the topping system in either the upward or downward direction and applies the holding brake(s). However, the system is capable of operation in the reverse direction.

589-4.2.1.3 Emergency Stop/Power Off. This feature removes power to all the drive motors and applies the holding brakes. Additional circuitry may be provided to actuate the emergency stop from a remote location on the ship.

589-4.2.1.4 Travel Warning Device. All traveling cranes shall be equipped with a continuous-sounding warning device which activates during crane travel.

589-4.2.1.5 Machinery Guards. High-speed couplings, fans, belts, and other rotating equipment located in areas easily accessible to personnel, shall have guards installed to prevent personnel injury.

589-4.2.1.6 Loss-of-Power Protection. Upon loss of power to the crane, brakes are applied and crane motion is stopped.

589-4.2.1.7 Insulator Links. For some cranes, a determination has been made that shipboard Radio Frequency (RF) transmitters can induce voltage into the crane rigging. For cranes that have a known RF interference problem, insulator links shall be installed between the hooks and wire ropes to reduce or eliminate the possibility of RF burn when rigging and handling loads. Insulator links shall be in accordance with NAVSEA Standard Drawing 53711-803-63972 57 LINKS, RADIO FREQUENCY, HIGH VOLTAGE INSULATOR. Additional information on insulator links is contained in OP 3565, Electromagnetic Radiation Hazards.

589-4.2.2 OTHER SAFETY FEATURES. Some nonmandatory safety features are normally incorporated into crane design to provide an additional safety factor. (See the following paragraphs.)

589-4.2.2.1 Hoist Lower Limit Switch/Stop. A hoist lower limit device may be installed on cranes that are capable of working over the side or below deck level. This limit device is designed to actuate when a minimum of 2-1/2 turns of wire rope remain on the hoisting drum during operations.

589-4.2.2.2 Rotation Limit Switches/Stops. Rotation limiting devices are provided to prevent operation of the rotation system when predetermined limits are reached, and to apply the rotation brake(s) to prevent the boom from striking the superstructure or other obstruction.

589-4.2.2.3 Travel and Trolley Limit Switches. Travel and trolley limit switches cut power to the drive system and apply the brakes before the travel or trolley bumpers are contacted.

589-4.2.2.4 Slack Rope Limit Switch. If a slack rope condition is sensed at any of the drums, all drives are stopped by the slack rope limit switch until the condition is corrected. A slack rope condition may cause improper reeving or damage to the wire rope.

589-4.2.2.5 Backup Limit Switches. Additional limit switches are sometimes provided to reinforce the operation of the primary limit switch. These switches may be of the rotary or lever-type.

589-4.2.2.6 Neutral Interlocks. Cranes are normally equipped with neutral interlocks or similar devices that prevent motors from starting unless the appropriate control is in the neutral position.

589-4.2.2.7 Boom Stop. If the boom travels past its upper limit switches, a structural stop mounted on the mast or A-frame will arrest boom motion.

589-4.2.2.8 Rotation Stop. Shock absorbers or bumpers may be mounted under the machinery house to provide a means of decelerating the crane and limiting its arc of travel, if the rotation limit switches fail.

589-4.2.2.9 Travel and Trolley Bumpers. Travel and trolley bumpers decelerate and stop overtravel of the crane.

589-4.2.2.10 Warning Horn. Cranes may be equipped with a warning horn, sounded by the crane operator to alert personnel in the area of crane movement.

589-4.2.2.11 Boom Angle Indicator. Boom angle indicators inform the operator and signalman that crane limitations are not exceeded. Some cranes have remote boom angle indicators in the operator cab. Other cranes have gravity devices hung on the boom, or angles painted on the cab of the crane (where the boom itself is used as a pointer). A boom angle indicator, visible to both the operator and signalman (if possible), is recommended for all cranes.

589-4.2.2.12 Emergency Run. An emergency run switch allows the crane to be operated after a motor has automatically shut off because of overheating or overloading. Emergency run is used only to allow the crane and its load to be placed in a safe condition.

589-4.2.2.13 Aircraft Warning Lights. If the crane is the highest point on the ship, an aircraft warning light will be installed.

589-4.2.2.14 Automatic Centering Controls. The control levers for each drive system are normally the type that have a spring return to the neutral position.

589-4.2.3 SPECIAL COMPONENT FEATURES. Certain cranes (recent design) are provided with special features to aid in handling loads and prevent the crane from being overloaded. Some of these special features are described in the following paragraphs.

589-4.2.3.1 Load Cells. Load cells are used to judge the load a crane is handling. The load cell may provide an indication of the weight being handled, or it may be incorporated in the crane control system to stop the lift if an overload condition exists.

589-4.2.3.2 Horsepower Limiter or Pressure Override. Hydraulic cranes may be provided with a horsepower limiter or pressure override switch which is designed to prevent overloading the electric motors or overpressurizing the hydraulic system.

589-4.2.3.3 Load Moment Indicator. For variable capacity cranes, a control circuit may be provided to monitor the percentage of load capacity being handled based on load, boom angle, and boom length. The load is compared to the load rating factor stored in a microprocessor for the given boom angle and boom length. If the rated capacity is exceeded, the drive motors will stop and holding brakes will set. The load may then be lowered until the overload condition is ended.

589-4.2.3.4 Bypass/Override Switches. Bypass/override switches may be installed to allow a safety device or automatic control device to be overridden. Bypass/override switches are normally used only in the performance of special functions (for example, stowing, inspection of components, or testing redundant safety devices).

589-4.2.4 COMPONENT PROBLEM AREAS. Common or recurring problems associated with crane components, and guidance for resolving or correcting problems, where available, are identified in the following paragraphs.

589-4.2.4.1 Power Cables. Occasionally, cable reels associated with the power supply to a traveling crane will fail to operate freely. Should this occur, special maintenance attention is warranted to preclude the possibility of the cable being run over by the crane, which might result in serious personnel injury.

589-4.2.4.2 Limit Switches. Some lever-operated limit switches employed on shipboard cranes have a history of unreliability. In many cases, the switch can be replaced by a more reliable model involving only minor modification to the mounting bracket. Where replacement appears appropriate, a Crane Advisory Memorandum (Figure 589-4-1) shall be submitted, advising NAVSEA Philadelphia of limit switch function and location. NAVSEA Philadelphia will investigate and provide recommendations.

589-4.2.4.3 Calibrations. Requirements for calibration of gauges and meters will vary from crane to crane. Calibration, or verification of accuracy of gauges and meters, will be according to Planned Maintenance System (PMS) procedures.

589-4.2.4.4 Hydraulic System Pressure Gauges. Hydraulic system pressure gauges are frequently damaged by vibration or pressure surges. This problem may be alleviated by installing liquid-filled gauges which resist both vibration and pressure surges. Where replacement gauges are needed, ships will submit a Crane Advisory Memorandum (Figure 589-4-1) to NAVSEA Philadelphia. NAVSEA Philadelphia will investigate and provide recommendations.

589-4.2.4.5 Hydraulic System Maintenance. Cleanliness of hydraulic system fluid is difficult to maintain in many older cranes. To ensure hydraulic fluid cleanliness, fluid samples should be drawn and visually inspected on a quarterly basis in accordance with the PMS for that crane. Once a year a sample should be sent to a Navy Oil Analysis Program (NOAP) Lab for a fluid analysis. Unless otherwise specified, the fluid shall meet acceptance levels listed in Table 589-4-1. If the fluid sample exceeds any acceptance levels and filtering or treating the fluid (see **NSTM Chapter 556**) cannot bring it within acceptable limits, then NAVSEA Philadelphia (Code 9731) should be contacted for additional guidance on identifying contamination source, possible system flushing, or fluid replacement.

**Table 589-4-1** HYDRAULIC SYSTEMS FLUID ACCEPTANCE LEVELS

Fluid	Acceptance Level (NAS 1638)
Filtered replenishing fluid to the high-pressure circuit	Class 9
Fluid within the high-pressure circuit	Class 10
Fluid within the reservoir or sump (reservoir or sump sample taken from mid-level)	Class 10

589-4.2.4.5.1 The following considerations apply to hydraulic systems and maintenance of fluid cleanliness:

- a. Replenishment fluid to the high-pressure circuit should always be filtered, and a means should be provided for extracting a sample downstream of the filter. A Crane Advisory Memorandum (Figure 589-4-1) will be submitted if these capabilities do not exist.
- b. High point vents can be used to extract samples from the high-pressure circuit where other means are not provided.
- c. Many cranes have quick-disconnect fittings installed for attachment of a portable filtration unit to maintain acceptable cleanliness levels within the reservoir or sump.
- d. Procedures of **NSTM Chapter 556** should be adhered to regarding hydraulic system maintenance and sampling requirements.
- e. During normal operations, hydraulic system temperature at the pump inlet shall be maintained between a minimum of 21.1°C (70°F), and a maximum of 71.1°C (160°F). It is generally desirable to keep the hydraulic fluid to a minimum of 40.0°C (104°F).
- f. If possible, hydraulic system piping or reservoirs shall be drained from system low points to remove as many particulate contaminants as possible.

589-4.2.4.6 Rotation Bearings. Where rotation bearings were initially oil-filled, oil leaks eventually become a maintenance problem requiring seal repair or replacement. In many cases, these bearings can be converted to grease-lubrication, alleviating the problems associated with lube-oil seal repair, complicated by site inaccessibility. If conversion is required, contact NAVSEA Philadelphia via a Crane Advisory Memorandum (Figure 589-4-1) and an Alteration Request will be submitted.

589-4.2.4.7 Brakes. Brake-associated maintenance items are as follows:

- a. Adjustment. If out of adjustment, brakes may not support the load. Adjustment shall be made according to equipment planned maintenance (PMS) or technical manual procedures. If equipment planned maintenance (PMS) or technical manual procedures are insufficient, a PMS OPNAV form 4790/7B (Technical Feedback Report), or a NAVSEA Form 9086/10, NAVSEA (User) Technical Manual Deficiency/Evaluation Report (TMDER), will be submitted.
- b. Cleaning of Brake Shoes. Dirt, grease, or built-up oil reduces the holding capability of the brake. This buildup cannot be verified unless the brake shoes are removed.
- c. Contact. Brake wheel and shoes may be scored, pitted, or deformed, which reduces contact between the brake shoe and the wheel. A minimum contact of 80 percent is required. Where less than 80-percent contact exists, repairs shall be accomplished by:

- (1). Grinding or machining the brake wheel as required without exceeding minimum brake wheel diameter requirements as specified by original equipment manufacturer. (In the absolute absence of manufacturer's specification, use minimum brake diameters in table 4-1a, or a reduction of no less than 1% of the brake wheel diameter.)
- (2). replace pads
- (3). some combination of all of the above

**Table 589-4-1a** Minimum Brake Wheel Diameter \*

Brake Wheel Original Diameter in inches	Minimum Wheel Diameter in inches **
8	7.92
10	9.92
13	12.90
16	15.87
19	18.87
23	22.87
30	29.87
* Only use when original when all resources to obtain original OEM values have been tried without success.	
** From NEMA standard Part ICS 2-220	

589-4.2.4.8 Gearboxes. Access to a gearbox may be inadequate for performing proper maintenance. The following guidelines may be used to assist gearbox maintenance:

- a. In general, gearboxes with fluid capacities of less than 5 gallons will have fluid replaced (or replenished) annually. Gearboxes with capacities in excess of 5 gallons will undergo visual inspection of the fluid annually.
- b. Visual samples shall be drawn when gearboxes are at normal operating temperatures, and before the fluid has a chance to settle. Water may not be detected in a visual sample, unless the action of the gears has been sufficient to provide mixing.
- c. If possible, drains will be opened and the reservoir checked for an accumulation of water (condensation) at the bottom of the tank. If the drain valve is located at the bottom of the gearbox, it is acceptable to drain the gearbox until the condensate is removed. Add new lube oil to achieve proper level, unless visual sample indicates the need for fluid replacement.
- d. For gearboxes with access plates located below the fluid level, clean lube oil may be drained into a transparent (clear) container and reused after internal inspection of the gears has been accomplished. Gearboxes lacking access plates should be reported to NAVSEA Philadelphia on a Crane Advisory Memorandum (Figure 589-4-1), so that NAVSEA Philadelphia can consider appropriate design changes.
- e. For contaminated gearboxes, where drains are located so that complete draining is impossible, a hand pump can be used to remove residual fluid and contaminants.

589-4.2.4.9 Wire Rope. Wire rope deteriorates internally and shall be replaced periodically. The recommended service life for crane wire rope is 8 years, since deterioration is not easily detected and in-place wire rope (particularly the topping rope) is often difficult to inspect. Provided proper lubrication is maintained, the 8-year periodicity for replacement of wire rope should allow cranes to operate from overhaul to overhaul without replacing the wire rope. (See paragraph 589-5.2.8.1.)

589-4.2.4.10 Discontinued Replacement Parts. Specified replacement parts are not always available. Where specified replacement parts are no longer available and suitable substitutes have been obtained, a Crane Advisory Memorandum (Figure 589-4-1) shall be submitted, identifying both the replacement parts and the substitutes, so that technical manuals and associated documentation may be updated.

#### 589-4.2.5 Mobile Crane Safety/Design Features

- a. Crane shall have a level indicator and outriggers with leveling capability.
- b. Crane shall have two rated load/outreach charts mounted in the operator's cab. One chart for pierside lifts, the other for at sea lifts. Each chart shall state the applicable operational restrictions listed in paragraph 589-3.5.9.
- c. Crane shall have controlled lowering (that is, the hydraulic control system shall provide dynamic braking).
- d. Crane control system shall be deadman type (that is the brakes shall set when the operator releases the joystick).
- e. Crane shall have a hoist two block limit switch.
- f. Crane shall have a travel alarm horn or bell.
- g. Crane shall have a lower limit switch to ensure at least two and one half turns of wire rope remain on drum at all times.
- h. Crane's hydraulic topping, boom extension and outrigger cylinders shall have fail safe counterbalance check valves mounted on the cylinders.
- i. A failure of any hydraulic hose shall not cause the load to fall, crane to rotate, outriggers to lower or boom to retract.
- j. Crane shall have a load/outreach indicator with a visual display near the operator and an audio alarm that sounds when an overload condition occurs.
- k. Crane shall meet all applicable OSHA and ANSI B 30.5 Standards.

### 589-4.3 PERIODIC MAINTENANCE

#### CAUTION

**Before disassembling load-bearing components, ensure that crane, supporting structure, and accessory equipment will remain stable during all stages of repair. If doubt exists, seek technical guidance from NAVSEA Philadelphia, shipyard or Intermediate Maintenance Activity (IMA) personnel.**

589-4.3.1 PRECAUTIONS. Before beginning adjustments, repairs, or inspections on a crane, the following precautions shall be observed and implemented as applicable:

- a. The crane to be repaired will be positioned in a location where it will cause the least interference with other cranes and operations.
- b. The boom shall be placed in the stowed position when work on the topping system is to be accomplished.
- c. All controls shall be placed in the OFF position.

- d. The power supplies shall be deenergized and the power supply breaker (in the OFF position) shall be tagged DANGER, except as required for testing or adjustment.
- e. Maintenance may be performed on energized electrical equipment only when specifically authorized by the Commanding Officer.
- f. After completion of adjustments or repairs, the crane shall not be restored to service until all guards have been reinstalled, safety devices reactivated, maintenance equipment removed, and required testing completed.
- g. Maintenance on cranes shall be performed only by formally qualified personnel, unless specifically authorized by the Crane Officer on a case basis for unusual repairs.

589-4.3.2 PLANNED MAINTENANCE. PMS requirements shall be accomplished according to instructions provided on the Planned Maintenance System. If the PMS does not exist for a particular equipment or component, the Crane Officer should institute interim maintenance according to the manufacturer's recommendations. A PMS OPNAV Form 4790/7B, **Technical Feedback Report**, shall be submitted according to OPNAVINST 4790.4, requesting coverage for the equipment.

589-4.3.2.1 Standard Maintenance. The following maintenance items will be included in each crane PMS package:

- a. **Lubrication.** Lubricate moving parts as specified by the manufacturer, including touch up lubrication of the wire rope.
- b. **Safety Inspection.** Test operate the crane to check safety devices and to exercise the crane whenever it has been idle during the previous 30 days.
- c. **Lube Oil Maintenance.** Provide an oil sample for visual inspection. Renew lube oil which shows contamination or, for small reservoirs, renew fluid periodically in place of sampling.
- d. **Wire Rope.** Clean and flush lubricant from sample sections of wire ropes. Inspect according to paragraph [589-5.6.4.3](#). Apply lubricant to wire rope.
- e. **Brakes.** Inspect brake drums for wear, scoring, and corrosion. Inspect brake lining thickness. Adjust brakes as required.
- f. **Instrumentation.** Perform and record calibration and accuracy checks.
- g. **Electrical.** Check electrical enclosures and electric motor inspections.

589-4.3.2.2 Additional Maintenance. The following additional maintenance procedure shall be included in the PMS package when applicable to a specific crane:

- a. Provide a hydraulic fluid sample for chemical analysis. Clean or renew contaminated hydraulic fluid.
- b. Inspect, clean, or renew hydraulic filters.
- c. Inspect slip ring.
- d. Perform diesel engine maintenance.
- e. Clean and inspect heat exchanger and ventilation systems.

589-4.3.3 ADJUSTMENT AND ALIGNMENT. Certain electrical and mechanical components will require periodic adjustment and alignment. The periodicity of these actions are specified on the applicable MRC. Proce-

dures for accomplishing the adjustments and alignments are found in the appropriate component technical manual. For hydraulic cranes, however, a consistent procedure for setting hydraulic system main relief valves is needed as provided in paragraph 589-4.3.3.1.

589-4.3.3.1 Hydraulic System Main Relief Valves. The following procedure will be used to set hydraulic system main relief valves:

**NOTE**

The pressure instrument, used to determine working pressure and to set relief valves, shall have been calibrated within 30 days before the rated load test date.

1. Determine the 100-percent working hydraulic pressure of each of the individual hydraulic circuits (main hoist, auxiliary hoist, topping hoist, rotation, and if applicable, travel) during the rated load test (paragraph 589-5.5.4). The 100-percent working pressure is the measured hydraulic pressure with the rated load at rated speed (hoist, rotation, topping, and travel).
2. If the relief valve setpoint, specified in the crane technical manual, is less than 130 percent of the working pressure determined by step 1, set the relief valve at the stated technical manual value. If the setpoint specified in the technical manual is greater than 130 percent, set each system main relief valve at 128 percent to 130 percent of the determined working system pressure.
3. When a single hydraulic system serves a dual function (for example, hoist and rotation), establish the setpoint of the main relief valve as the larger of the 100-percent working pressures. Set control and replenishing system relief valves as specified in the appropriate technical manual.

589-4.3.3.2 Hydraulic Pump Output. Most hydraulic pumps installed on shipboard cranes are provided with a means for limiting the maximum pump output, to ensure that an excessive amount of fluid is not delivered to the hydraulic motor, or cylinder. Maximum pump output would cause the hydraulic motor to rotate at a speed that would damage the motor or allow an unsafe speed for the given crane subsystem. For maximum pump output restrictions, the following guidelines apply:

- a. Whenever a pump is outfitted with a means for limiting the fluid output, the limiting device shall be used to control fluid delivery to the hydraulic motor or cylinder.
- b. For systems in which pump output cannot be controlled by a limiting device, physically limit the output by restricting the movement of the control lever or wheel. Some systems are furnished with electrical controls which may be adjusted to limit pump output.
- c. The pump should not be allowed to deliver an amount of fluid to the hydraulic motor that would create a speed in excess of the manufacturer's specification.

589-4.3.3.3 Limit Switches and Stops. In the absence of specific guidelines or detailed instructions in the crane manufacturer's technical manual, or authoritative directive, the following general guidance shall apply:

- a. Load Hoist Limit Switch. The load block upper limit switch shall be set to activate approximately 3 to 5 feet below the upper block. The two-block limit switch shall be set to activate approximately 1 foot above the upper limit switch (that is, with approximately 2 to 4 feet between the blocks). The load block lower limit

switch should be set to allow the hook to work at its lowest point with the boom at its highest working angle, provided that a minimum 2-1/2 turns of wire rope remain on the drum. The switch shall activate when no less than 2-1/2 turns of wire rope remain on the drum.

- b. **Boom Limit Switches.** Boom limit switches shall be set to activate within the boom design limits.
- c. **Rotation Limit Switch.** A rotation limit switch shall be set to activate when the crane rotates to within 2 feet of the rotation stops, or other limit of rotation.
- d. **Travel Limit Switch.** The travel limit switch shall be set to activate when the crane has traveled to within 1 foot of its limit of travel.

#### 589-4.4 OVERHAUL GUIDELINES

589-4.4.1 **PREOVERHAUL TEST AND INSPECTION.** In order to identify maintenance actions to be performed during regular overhaul, the Type Commander may direct the following inspections and tests to be performed during the preoverhaul period. The results of these inspections or tests may then be used by the Type Commander to authorize shipyard and at-sea maintenance actions.

589-4.4.1.1 **Component Inspection.** Perform the annual component inspection, as discussed in paragraphs 589-5.3.2 through 589-5.5.4.4.

589-4.4.1.2 **Rated Load Test.** Perform the rated load test as discussed in paragraph 589-5.5.4.

589-4.4.1.3 **Special Preoverhaul Tests.** Apply where special preoverhaul test procedures have been established.

589-4.4.2 **OVERHAUL MAINTENANCE.** In addition to the specific repair actions identified by performing preoverhaul tests and inspections, the following specific maintenance tasks will be considered for inclusion into the crane overhaul work package:

- a. **Inaccessible Components.** Components not inspected and tested before overhaul due to inaccessibility will be disassembled and inspected to allow for necessary repairs.
- b. **Power Cable.** Inspect the main power cable and ensure that resistance readings are within specifications for the installed cable as specified in the Power Cable Resistance vs Insulation Temperature figure located in **NSTM Chapter 300 Electric Plant General**.
- c. **Hydraulic Hoses.** Determine service life of installed hydraulic hoses and replace those which are due for replacement, based on a maximum service life of 5 years.
- d. **Relief Valves.** Verify proper settings for all relief valves.
- e. **Foundation Bolts.** Inspect foundation bolts for corrosion, wear, cracks or deformation, and retorque.
- f. **Wire Rope.** Replace wire ropes which have been in service for 6 or more years (see paragraph 589-4.2.4.9).
- g. **Accessible Voids.** Inspect accessible voids within the crane structure; clean and preserve as necessary.
- h. **Hydraulic Fluid.** Replace all hydraulic fluid. Flush systems found to be contaminated.
- i. **Lubrication.** Replace lube oil in all gearboxes and perform complete lubrication of the remainder of the crane.
- j. **Electrical Motors.** Verify motor insulation is clean, dry, and has a high resistance to ground. Inspect all electrical connections for tightness and ensure the motor is in good mechanical condition.

589-4.4.3 POSTOVERHAUL TESTING. On completion of overhaul (or other industrial availability), all crane overhaul maintenance shall be proven by performing the complete series of inspections and tests contained in [Section 5](#). The shipyard should provide documentation for retention on the ship, including the equipment replacements, equipment settings, and test results used in support of all overhaul maintenance performed on the crane. Tests do not require witnessing by ship personnel (paragraph [589-6.2.3](#)). Test documentation will serve as baseline data for future maintenance and testing by ship force or IMA. A completed and signed copy of the test shall be retained by the Crane Officer as part of the crane certification file (paragraph [589-6.6](#)).

589-4.4.4 POSTREPAIR OR ADJUSTMENT TESTING. Load testing is required before the resumption of load handling operations, following corrective maintenance on load bearing and load controlling components of the crane. Corrective maintenance or adjustment of safety features can normally be tested without weight-handling (for example, no-load testing). These general testing rules are incorporated in [Table 589-4-2](#) which covers the testing requirements for recertifying a crane that has been decertified as a result of material deficiencies. Load bearing components, load controlling components, and crane safety features are identified in [Appendix E](#).

589-4.4.4.1 Component Test Requirements. Corrective maintenance of certain load bearing or load controlling components can be tested by methods other than load testing. Specific test requirements, following certain identified maintenance tasks, are found in [Table 589-4-3](#). Load tests specified in [Table 589-4-3](#) shall be preceded by appropriate visual inspection and no-load test. In some cases, [Table 589-4-3](#) supplements, or provides exceptions to, the general recertification testing rules of [Table 589-4-2](#). For maintenance activities not specified in [Table 589-4-3](#), the general requirements of [Table 589-4-2](#) apply. [Table 589-4-3](#) is based on the principles that except where a NAVSEA Philadelphia-approved Controlled Assembly is allowed ([Table 589-4-3](#)), load testing is always required where the repaired or adjusted component is the last line of defense against uncontrolled movement of the load or crane (for example, brakes). Any inconsistencies between these principles and the application of [Table 589-4-3](#) to a specific crane should be brought to the attention of NAVSEA Philadelphia using a Crane Advisory Memorandum (Figure [589-4-1](#)).

589-4.4.4.2 Applicability. The requirements of paragraph [589-4.4.4.1](#) apply only to ship force or IMA repairs or adjustments during the operating cycle of the ship. Requirements do not apply to work performed during a regular overhaul, or other shipyard availability, where full load testing is required at the completion of the overhaul or availability (paragraph [589-6.3.1.2](#)).

## 589-4.5 CONTROLLED ASSEMBLY

589-4.5.1 GENERAL. Controlled Assembly is a procedure for documenting proper, thorough, and approved maintenance. Verification is performed by ship force or IMA Quality Assurance (QA) Division personnel (Weapons QA Division, where existing), other than the maintenance technician who verifies satisfactory performance of the work procedure. Controlled Assembly is not always required but is required to support crane certification in the following two instances:

- a. Type A. For certain routine maintenance actions, as specified in [Table 589-4-2](#), Controlled Assembly is used as an alternative to load testing. Performance of Controlled Assembly procedures (and no-load test), on completion of certain maintenance tasks described in [Table 589-4-3](#), is sufficient to retain crane certification. No departure-from-specification is required where type A Controlled Assembly is applied.
- b. Type B. Controlled Assembly may be used after corrective maintenance actions that cannot be followed by the required load testing before the resumption of crane operations. Type B Controlled Assembly may provide a basis for a departure-from-specification request during the interval before load testing is accomplished.

589-4.5.2 DOCUMENTATION. Procedures shall be written into a Controlled Assembly Work Package and shall be reviewed and approved by the Crane Officer and the QA Officer responsible for the verification personnel (paragraph 589-4.5.5). An example of a Controlled Assembly Work Package is shown in [Appendix D](#).

**Table 589-4-2** RECERTIFICATION REQUIREMENTS, RECERTIFICATION FOLLOWING A DECERTIFYING EVENT

<b>Certification Deficiency</b>	<b>Approval Authority</b>	<b>Expected Operational Restriction (To be determined by the Approval Authority)</b>	<b>Recertification Requirements See note 1</b>
1. LAPSE OF TIME (in months)			
Certification Expired (beyond 12)	Squadron Commander	None	Certification checklist
Certification Expired (beyond 18)	Type Commander	50% load limit	Certification checklist
Certification Expired (beyond 24)	Type Commander	50% load limit/No CRITICAL lifts	Certification checklist
Type Commander Audit Expired (beyond 18)	Type Commander	None	Type Commander audit
2. PERSONNEL TRAINING			
Qualified personnel not available	Squadron Commander	None	Complete operator qualification
Personnel requalification overdue	Squadron Commander	None	Conduct requalification
3. DEGRADED COMPONENTS (See notes 2 & 3)			
Deficiency in load-bearing member			
Major deficiency	Type Commander	50% load limit/No CRITICAL lifts	1. Static load test 2. Dynamic load test
Minor deficiency	Squadron Commander	None	1. Post repair visual inspection
Deficiency in load-controlling member			
Major deficiency	Squadron Commander	50% load limit	1. Dynamic load test 2. Rated load test
Minor deficiency	Commanding Officer	None	1. Post repair visual inspection
Deficiency in installed safety device			
Major deficiency	Type Commander	None <sup>(4)</sup>	1. No-load test
Minor deficiency	Squadron Commander	None <sup>(4)</sup>	1. Post repair visual inspection
Deficiency in rotation or travel system			
Major deficiency	Squadron Commander	50% load limit	1. Dynamic load test 2. Rated load test
Minor deficiency	Commanding Officer	None	1. Post repair visual inspection

**Table 589-4-2** RECERTIFICATION REQUIREMENTS, RECERTIFICATION  
FOLLOWING A DECERTIFYING EVENT - Continued

<b>Certification Deficiency</b>	<b>Approval Authority</b>	<b>Expected Operational Restriction (To be determined by the Approval Authority)</b>	<b>Recertification Requirements See note 1</b>
<b>4. CRANE OVERLOAD</b>			
100% rated load capacity exceeded (see notes 5 and 6)	Type Commander	50% load limit/No CRITICAL lifts	1. Annual Inspection 2. Static load test (with NDT) 3. Dynamic load test 4. Rated load test
<b>5. MAINTENANCE DEFICIENCY</b>			
Planned maintenance not accomplished (overdue to two consecutive periods)	Squadron Commander	None	Perform maintenance

Notes (1) Paragraph 589-4.4.4.1 provides testing requirements following corrective maintenance or adjustments to specific crane components. Paragraph 589-4.4.4.1 supplements, or in some cases provides exceptions to the test requirements of this item of table 589-5-1.

(2) Load bearing members, load-controlling members, safety devices, and rotation and travel system components are identified in Appendix E.

(3) Major and minor deficiencies are defined in paragraphs 589-6.4.2 and 589-6.4.3, respectively.

(4) Additional precautions, such as stationing an observer in the cab to caution against exceeding a safety device limit, may be required.

(5) For additional details on testing requirements when 100% rated capacity has been exceeded, see paragraph 589-5.6.2. Testing requirements of this table consider that the extent of the overload is not known. Where the degree of overload is known, the requirements of paragraph 589-5.6.2 apply.

(6) For assistance please contact NAVSEA Philadelphia (NAVSEA Philadelphia) code 9731 at (215) 897-7676 or 1435 or E-Mail us to our unclassified Sailor to Engineer Support site ay help@phdnswc.navy.mil . When E-Mailing, make sure to include "Code 9731" in the message body to expedite response.

**Table 589-4-3** COMPONENT TEST REQUIREMENTS

<b>Maintenance Task</b>	<b>Test Requirements (see footnotes at the end of this table)</b>	<b>Reason</b>
1. Diesel-Generator repair (without load banks)	No-load test <sup>1</sup> (use simultaneous crane motions to electrically load generator)	Rotation, travel, and topping will demonstrate generator capability under electrical load conditions.
2. Diesel-Generator repair (with load banks)	See PMS for procedure on running Diesel-Generator with load bank. Run under full-load bank load for 10 min.	A full load bank will demonstrate the generator capability under load condition.

**Table 589-4-3 COMPONENT TEST REQUIREMENTS - Continued**

<b>Maintenance Task</b>	<b>Test Requirements</b> (see footnotes at the end of this table)	<b>Reason</b>
Power distribution system repairs	Electrical checks <sup>2</sup> No-load test <sup>1</sup>	These types of repairs can be verified by continuity checks, voltage readings, or other electrical checks. No-load test verifies operability.
Electrical control circuitry adjustments, alignments, or repairs	No-load test <sup>1</sup> (weight-handling may be required to perform alignments)	Satisfactory performance is verified under no-load conditions.
Electric motors on electromechanical cranes:		
1. Hoist, travel, or rotation motor disassembly or replacement	Motor performance checks <sup>3</sup> Dynamic load test <sup>5</sup> Rated load test <sup>6</sup>	Testing determines if motors can develop sufficient torque under simulated dynamic ship motion conditions, and rated speed with rated load.
2. Motor bearing replacement where motor disassembly is not required	Controlled Assembly <sup>4</sup> Motor performance checks <sup>3</sup> No-load test <sup>1</sup>	Bearing failure will not cause load drop. Testing determines if motor performance has been degraded through improper bearing installation.
Electric motors on electrohydraulic cranes (electric motors for hydraulic power units):		
1. Hoist, travel, or rotation motor disassembly or replacement (Hoist units that have a brake between the motor and the load only.)	Motor performance checks <sup>3</sup> Dynamic load test <sup>5</sup> Rated load test <sup>6</sup>	Testing determines if motors can develop sufficient torque under simulated dynamic ship motion conditions, and rated speed with rated load.
2. Hoist motor disassembly or replacement when no brake is between the motor and the load.	Motor performance checks (see note 3) Static load test (see note 8) Dynamic load test (see note 5) Rated load test (see note 6)	Testing determine if the repair/replacement has the structural integrity, as well as to determine if the motor can develop the sufficient torque under simulated dynamic ship motion condition, and rated speed with rated load.
3. Hoist, travel, or rotation motor disassembly or bearing replacement (Hoist units that have a brake between the motor and the load only.)	Motor performance checks <sup>3</sup> No-load test <sup>1</sup>	Testing determines if motor performance has been degraded through improper installation.
Limit switch repair or replacement	No-load test <sup>1</sup>	Testing verifies operability.
Hydraulic system components:		
1. Hydraulic pump or motor repair or replacement	Hydraulic system test <sup>7</sup> Rated load test <sup>6</sup>	Testing determines if pumps or motors develop sufficient torque for rated speed with rated load.
2. Servo valve, high pressure piping, and components repair or replacement	Hydraulic system test <sup>7</sup> No-load test <sup>1</sup>	Testing verifies system integrity and operability.
3. All other hydraulic system components and piping repair or replacement	No-load test <sup>1</sup>	No-load test verifies low-pressure system capability.
Couplings, bearing, shafts:		

**Table 589-4-3 COMPONENT TEST REQUIREMENTS - Continued**

<b>Maintenance Task</b>	<b>Test Requirements</b> (see footnotes at the end of this table)	<b>Reason</b>
1. Coupling removal and reassembly, where a brakes is located between the coupling and the load or boom	Controlled Assembly <sup>4</sup> (including alignment checks) No-load test <sup>1</sup>	Controlled Assembly ensures proper parts and assembly techniques are used. Alignment checks and no-load test verify operability. Load testing is not necessary unless the coupling is in the last line of defense against uncontrolled movement of the load or crane.
2. Non-load bearing shafts or bearing repair or replacement	No-load test <sup>1</sup>	Failure will not cause uncontrolled movement of the load or crane. Testing verifies operability.
3. Coupling, shaft, or bearing repair or replacement (load hoist or topping hoist systems)	Static load test <sup>4</sup> Dynamic load test <sup>5</sup> Rated load test <sup>6</sup>	Load bearing capabilities shall be fully tested to verify last line of defense against load or boom drop.
4. Coupling, shaft, or bearing repair or replacement (other than load hoist or topping hoist systems)	Dynamic load test <sup>5</sup> Rated load test <sup>6</sup>	Load bearing capability shall be verified under simulated dynamic ship motion conditions.
Brakes on electromechanical cranes:		
1. Brake repair or replacement (load hoist or topping hoist systems)	Static load test <sup>8</sup> Dynamic load test <sup>5</sup> Rated load test <sup>6</sup> and test <sup>9</sup>	Brake capacity shall be fully tested to verify last line of defense against load or boom drop.
Brakes on electromechanical Cranes :		
2. Brake repair or replacement (other than load hoist or topping hoist systems).	Dynamic load test <sup>5</sup> Rated load test <sup>6</sup>	Brake capacity shall be tested under simulated dynamic ship motion conditions.
3. Routine adjustment or alignment of any brake		
	NAVSEA Philadelphia Approved Controlled Assembly <sup>10</sup> No-load test <sup>1</sup>	Procedure has been validated by NAVSEA Philadelphia and will produce an increase in brake torque. No-load test verifies operability.
Brakes on electrohydraulic cranes:		
1. Brake repair or replacement (load hoist or topping hoist systems)	Static load test <sup>8</sup> Dynamic load test <sup>5</sup> Rated load test <sup>6</sup>	Brake capacity shall be fully tested to verify last line defense against load or boom drop.
2. Brake repair or replacement (other than load hoist or topping hoist systems).	Hydraulic system test <sup>7</sup> No-load test <sup>1</sup>	Testing verifies brake capacity under simulated dynamic ship motion conditions and verifies operability.
3. Routine adjustment or alignment of any brake	NAVSEA Philadelphia Approved Controlled Assembly <sup>10</sup> No-load test <sup>1</sup>	Procedure has been validated by NAVSEA Philadelphia and will produce an increase in brake torque. No-load test verifies operability.
Gears:		

**Table 589-4-3 COMPONENT TEST REQUIREMENTS - Continued**

<b>Maintenance Task</b>	<b>Test Requirements</b> (see footnotes at the end of this table)	<b>Reason</b>
1. Gear repair or replacement (load hoist or topping hoist systems)	Static load test <sup>8</sup> Dynamic load test <sup>5</sup> Rated load test <sup>6</sup>	Load bearing capacity shall be fully tested to verify last line of defense against load or boom drop.
2. Gear repair or replacement (other than load hoist or topping hoist systems)	Dynamic load test <sup>5</sup> Rated load test <sup>6</sup>	Load bearing capability shall be verified under simulated dynamic ship motion conditions.
3. Gear bearing oil-seal replacement	Controlled Assembly <sup>4</sup> No-load test <sup>1</sup>	Controlled Assembly ensures proper replacement procedures are used. No-load test verifies operability.
Change to alternate reeving configuration, where more than one is specified in the technical manual	NAVSEA Philadelphia Approved Controlled Assembly <sup>10</sup> No-load test <sup>1</sup>	Procedure has been validated by NAVSEA Philadelphia for technical accuracy and safety precautions. No-load test verifies operability.
Drum, sheave, or wire rope repair or replacement	Static load test <sup>8</sup> Dynamic load test <sup>5</sup> Rated load test <sup>6</sup>	Load bearing capability shall be fully tested to verify last line of defense against load or boom drop.
Hook repair or replacement	Static load test <sup>8</sup>	Load bearing capability shall be tested to verify last line of defense against load drop.
Boom, bridge, machinery pedestal, anti-tip rollers, or other major structural component repair or replacement	Static load test <sup>8</sup> Dynamic load test <sup>5</sup>	Load bearing capability shall be fully tested to verify last line of defense against load or boom drop.
Load Cell:		
Repair or replacement of a load cell assembly loaded in shear or bending.	Static load test (see note 8)	Load bearing capability shall be tested to verify load cell assembly structural integrity. Test verifies last line of defense against an uncontrolled load movement or load drop.

NOTE: These footnotes provide additional information regarding the testing requirements as established in this table.

<sup>1</sup>No-load test. The system or component which has been affected by the maintenance action shall be operated in all of its modes, without a load on the crane, to verify operability. Specific portions of the no-load test of paragraph 589-5.4 may be used for this purpose. The entire no-load test of paragraph 589-5.4 is not required.

<sup>2</sup>Electrical checks. Continuity checks, voltage readings, current readings, or other electrical checks appropriate to the maintenance action, should be obtained and verified against manufacturer's data or other baseline information.

<sup>3</sup>Motor performance checks. Motor currents shall be taken during the designated test (that is, no-load test or rated load test) and compared to the established baseline values. Motor currents should not increase.

<sup>5</sup>Dynamic load test. Perform those portions of the dynamic load test necessary to verify the specific maintenance action. Dynamic load test requirements are given in paragraph 589-5.5.3.

<sup>6</sup>Rated load test. Perform those portions of the rated load test necessary to verify the specific maintenance action. Rated load test requirements are given in paragraph 589-5.5.4.

<sup>4</sup>Controlled Assembly. Controlled Assembly (includes alignment check) is a procedure for documenting proper, thorough, and verified maintenance. Controlled Assembly procedures are specified in paragraph 589-4.5.4.

<sup>7</sup>Hydraulic system test. The hydraulic system shall be operated at a pressure up to the relief valve setting with the crane brake set. Setting the brake may require deenergizing a solenoid or disconnecting and blanking a hydraulic line. System integrity shall be verified while the system pressure is being maintained. Refer to paragraph 589-4.6.2 for guidance.

<sup>8</sup>Static load test. The static load test shall be performed according to paragraph 589-5.5.2. Nondestructive testing following the static test shall be aimed at verifying the integrity of the component being tested.

<sup>9</sup>Redundant brakes. Where brake repair or replacement has been accomplished on load hoist or topping hoist systems with redundant brakes, a 100-percent rated load should be lifted approximately 1 foot above the deck and each brake manually released and reset, one at a time, to verify that each brake is capable of holding 100-percent load. On completion of this check, a rated load test is performed in the normal manner according to note 6.

<sup>10</sup>NAVSEA Philadelphia-approved Controlled Assembly. This procedure is the same as that shown on note 4, except that it has been approved by NAVSEA Philadelphia. This procedure is not allowed as an alternative to load testing after corrective maintenance (such as brake component repair or replacement).

589-4.5.3 AUTHORIZATION OF WORK. The Crane Officer shall authorize performance of the Controlled Assembly Work Package (Appendix D) when the procedure has been approved and all required parts have been obtained. The Duty Officer or Departmental Duty Officer shall authorize the commencement of work, once all precautions and prerequisites of the Controlled Assembly Work Package have been met.

589-4.5.4 PROCEDURE. The Controlled Assembly procedure shall contain sufficiently detailed instruction to ensure that the certification is maintained. The Controlled Assembly procedure shall:

- a. Identify the general scope of work to be performed (for example, disassemble and inspect main hoist motor coupling).
- b. Identify the specific piece of equipment to be worked on (for example, main hoist motor coupling assembly).
- c. List all applicable reference sources.
- d. Identify the required precautions to be observed (for example, all power sources OFF, DANGER tags attached).
- e. Identify any special conditions to be observed (for example, boom in stow position).
- f. List required tools (for example, 1/2-inch drive ratchet and 1/2-inch and 3/4-inch sockets).
- g. List required replacement parts by National Stock Number (NSN) (for example, coupling, one each, NSN 9N-0900-00-999-0000).
- h. Provide a step-by-step work procedure with appropriate signature blanks for each step, detailing disassembly, repair, assembly, inspection, and adjustments. All specified torque values and adjustments shall be listed, and the actual values of each shall be recorded.
- i. Provide a step-by-step test procedure with appropriate signature blanks for each step, and include initial conditions, precautions, and the test sequence.
- j. Provide for review and certification of proper accomplishment by designated QA personnel.

589-4.5.5 VERIFICATION. Controlled Assembly accomplishment shall be verified by an independent checker or witness (QA representative), and consist of a single verification statement signed by the witness at the completion of the following:

- a. Precautions
- b. Prerequisites
- c. Work procedure
- d. Test procedure.

This statement shall state:

The above precautions, prerequisites, and procedural steps or testing have been personally witnessed by me and verified to have been accomplished properly to the requirements of this document.

Signature & Date

589-4.5.5.1 Upon completion of the assembly, but before testing, the Crane Officer shall review the Controlled Assembly package and authorize the required testing.

589-4.5.6 DESIGNATION OF PERSONNEL. Ship instructions shall specifically designate which personnel are responsible for verification of maintenance, review of work procedures, and witnessing of testing for each crane. Crane testing shall be witnessed by IMA weapons QA personnel (paragraph 589-6.2.3) if possible.

589-4.5.7 CONTROLLED ASSEMBLY TESTING. On completion of a Controlled Assembly, a portion of the no-load functional test shall be performed to test the affected equipment or system. Test procedures shall be specifically recorded, documented, reviewed, and verified in the Controlled Assembly test procedure ([Appendix D](#)).

589-4.5.8 **HYDRAULIC AND PNEUMATIC SYSTEM CHECKS.** For hydraulic or pneumatic system maintenance, the following checks constitute a satisfactory Controlled Assembly test (in place of no-load/load testing):

- a. Verification that the gasket and O-ring groove sealing surfaces are smooth and will provide adequate sealing.
- b. Verification that fastener material and installation (including torque values) are according to applicable specifications.
- c. Verification that gaskets and O-rings are properly installed and are according to applicable specifications.

589-4.5.9 **REVIEW AND RETENTION OF CONTROLLED ASSEMBLY PACKAGE.** After testing, the Crane Officer shall review the Controlled Assembly package and forward it to the Crane Certifying Officer for review. The Controlled Assembly package shall be maintained in an accountable method for a period of 5 years or until the completion of the next major crane overhaul, whichever is longer.

#### **589-4.6 HYDRAULIC SYSTEM TEST**

589-4.6.1 **GENERAL.** The hydraulic system test is a procedure for checking the normal operation of a hydraulic system and associated components in place of lifting test weights. The procedure involves operating a hydraulic pump against the system brake and monitoring the effects. When testing, the brake(s) will be prevented from releasing; thus, when the pump delivers fluid to the hydraulic motor, the motor should not turn because the shaft is being held by the brake. Since fluid from the pump is not allowed to rotate the hydraulic motor, system pressure increases rapidly and forces open the main relief valve, unless internal leakage in the pump or motor is so great that relief valve pressure cannot be reached. The hydraulic system test exposes a system to forces in excess of those created during dynamic load testing.

589-4.6.2 **APPLICATION.** Performing the hydraulic system test will enhance postrepair testing, or verify the integrity of the hydraulic system and associated components (of electrohydraulic cranes only), in the following instances:

- a. After repair of a servo valve
- b. After repair of high-pressure hydraulic system components and piping
- c. After routine brake adjustment
- d. After repair of brakes, other than those on hoist systems
- e. To verify normal brake holding capacity
- f. To determine that hydraulic system efficiency is within acceptable limits
- g. To verify proper settings of hydraulic system main relief valves
- h. To reset hydraulic system main relief valves.

589-4.6.3 **DOCUMENTATION.** Written procedures for performing the hydraulic system test shall be prepared according to the guidelines of paragraphs 589-4.6.5 through 589-4.6.5.4 and approved by the Crane Officer and the appropriate QA Officer. In some cases, additional information pertaining to a hydraulic system test is available in the applicable component technical manual. The procedure shall be retained for use as needed. Consideration may be given to including this procedure in the equipment technical manual by submittal of a TMDER.

589-4.6.4 PRETEST AUTHORIZATION. The Crane Officer shall authorize the performance of a hydraulic system test after verifying that the equipment needed to perform the test is present (that is, plugs, blanks, and test gauges).

589-4.6.5 PROCEDURE. Utilize the guidelines provided in paragraphs 589-4.6.5.2 through 589-4.6.5.4, and other available information, to develop a hydraulic system test procedure. If any problems are encountered when developing a procedure, contact NAVSEA Philadelphia (Code 9731) for additional guidance.

589-4.6.5.1 Precautions. The following precautions shall be understood and observed in order to ensure safe performance of a hydraulic system test:

- a. Do not continue operation if slippage occurs while a brake is set. This might cause damage to the brake through overheating.
- b. Do not permit the system pressure to exceed the specified relief valve setting while testing relief valves. Overpressurization of the hydraulic circuit may damage the pump.
- c. Do not allow relief valves to remain open for longer than 5 seconds. Rapid heat buildup within the high-pressure hydraulic loops may damage major hydraulic system components. If a relief valve sticks in the open position, return control immediately to neutral.

589-4.6.5.2 Brake Release Prevention. The guidelines in the following paragraphs should be considered in developing a procedure to keep brakes set when pump is placed on stroke.

589-4.6.5.2.1 For electrically released brakes, determine which electrical leads to disconnect in order to prevent the brakes from releasing. Identify the easiest lead to disconnect for each of the brakes, and identify them in the procedure. For solenoid-actuated hydraulic release brakes, blank off brake release hydraulic line and let the solenoid actuate the bypass valve, if installed, to prevent fluid from passing through the valve to the low pressure side of the piping loop.

589-4.6.5.2.2 For brakes released solely through operation of the hydraulic system, determine which line(s) shall be blanked (disconnected and plugged) to prevent the brakes from releasing. Identify them in the procedure. Obtain and place the plugs and blanks in storage so that they are available for accomplishing the test when required.

589-4.6.5.2.3 If it becomes obvious during testing that a brake will not hold at fluid pressures up to the relief valve setting, adjust the brake before continuing the test.

589-4.6.5.3 Hydraulic System Efficiency Verification. The guidelines in the following paragraphs are provided for estimating hydraulic circuit efficiency.

#### NOTE

It is emphasized that this test provides only an estimate of circuit efficiency. In some cases, outside assistance may be required to verify that a problem exists. An estimated circuit efficiency of less than 85 percent is unacceptable for the crane hydraulic power unit. For systems incorporating more than one hydraulic motor, an estimated efficiency of less than 80 percent would be unacceptable.

Where problems exist (for example, an excessively hot case drain line from a pump or motor), determine the source and correct before continued testing.

589-4.6.5.3.1 System efficiency should be estimated based on required pump output at 2,000 lb/in<sup>2</sup> g, or a pressure approximately 100 lb/in<sup>2</sup> g below the specified relief valve setting, whichever is lower. With a brake set to prevent rotation of the hydraulic motor, all fluid delivered from the pump valve group passes through the hydraulic pump and motor case until the main relief valve opens. An excessive amount of internal leakage may prevent the relief valve from lifting the crane from moving a rated load, or cause excessive heat buildup within the hydraulic system.

589-4.6.5.3.2 For pumps that have external means of monitoring pump output available, the side of the pump may be scribed, or a placard placed to indicate what percentage of pump output is being discharged, to assist personnel in determining efficiency of the hydraulic circuit. An external indicator may be directly attached to the tilt plate so that pump stroke can be noted when the required pressure is reached. For example, a tilt plate may have the capability of moving 20 degrees from neutral to achieve full output. A 2-degree movement in either direction would indicate an approximate pump output of 10 percent. This would correspond to an estimated pump efficiency of 90 percent.

#### NOTE

When using the following method to determine pump efficiency, it is important to know (by prior experience) the point at which continued movement of the control lever will not produce any increase in pump output, and the percentage of maximum pump output at this point. (Refer to applicable technical documentation as required.)

589-4.6.5.3.3 For pumps without external means of monitoring pump output, the subsystem control lever may be used to indicate pump output. The percentage of output is indicated by the relative position of the control lever, but maximum movement of the control lever may not correspond to maximum pump output, because some crane systems have pumps whose maximum output exceeds the amount of fluid required to drive the hydraulic motors at full speed. (For example, if a system requires 60-percent pump output to drive the hydraulic motor at full speed, maximum movement of the control lever would correspond to 60-percent output. Moving the control lever through 1/3 of its distance would correspond to 20-percent pump output.)

589-4.6.5.4 Check Relief Valve Settings. Relief valve settings should be verified as described in the following paragraphs.

589-4.6.5.4.1 The hydraulic system test procedure should include a check of relief valve settings. This can be accomplished by slowly moving the control to increase system pressure, being very careful not to exceed the specified setting in the applicable technical manual. If the relief valve setting is not within the permissible range, an adjustment shall be made and the procedure repeated until the setting is acceptable. The relief valve should not remain open more than 5 seconds, as this will cause a buildup of heat that may cause damage to the hydraulic pump.

589-4.6.5.4.2 A brake is most likely to slip during a check of relief valve settings. If a brake slips, return the control device to neutral immediately. It will not be uncommon to find travel or rotation brakes out of adjustment during this phase, because forces exerted on these subsystems are normally greater during the hydraulic system test than during the dynamic load test.

589-4.6.5.4.3 Due to high-pressure buildup, leakage at joints and seals is most likely to occur during checks of relief valve settings. If excessive leakage is noted at any location, repairs should be accomplished and the circuit retested.

## SECTION 5. INSPECTION AND TESTING

### 589-5.1 PURPOSE

589-5.1.1 Section 5 describes the requirements, instructions, and general information that will aid in the inspection and testing of Naval Sea Systems Command (NAVSEA) cranes. Appropriate technical manuals, instructions, and Planned Maintenance System (PMS) for each specific piece of equipment should be reviewed for detailed information regarding specific inspection and testing procedures. Specific test requirements following repair or adjustment are contained in paragraphs [589-4.4.4](#) through [589-4.4.4.2](#).

### 589-5.2 REQUIREMENTS

589-5.2.1 GENERAL. Critical crane components are monitored for wear, deterioration, or malfunction by a series of periodic inspections and tests. The annual component inspection, performed in conjunction with a no-load test, provides assurance that the crane equipment is operating properly, obvious deficiencies are corrected, and adjustments critical to safety and reliability are made.

589-5.2.2 LOAD TESTS. Each of the load tests is designed to monitor the performance of a specific crane load-bearing or load-controlling component. The static load test is performed to determine if any long term degradation of the crane structure has occurred. The dynamic load test is designed to measure the performance of the crane hoisting train (for example, mechanical or hydraulic equipment and running rigging) under simulated dynamic ship motion conditions. The rated load test is designed to evaluate the performance of the electrical and hydraulic systems when lifting a rated load at rated speeds.

589-5.2.3 TESTING PERIODICITY. Load tests are performed at 4-year intervals and after major repairs, and are generally associated with ship and crane overhaul, or availability. When load tests are to be performed, they should be preceded by a complete component inspection and a no-load test. The load tests should then be conducted in the following order: static, dynamic, and rated. Major inspections and tests should be performed according to [Table 589-5-1](#).

**Table 589-5-1 SEQUENCE AND PERIODICITY OF MAJOR  
INSPECTIONS AND TESTS**

Sequence	Major Inspection or Test	Periodicity
1	Component Inspection	Annually (and before load testing)
2	No-Load Test	Annually (see NOTE) (and before load testing)
3	Static Load Test	4 years
4	Dynamic Load Test	4 years
5	Rated Load Test	4 years

#### NOTE

A System Operability Test (SOT) will be required, for many cranes, semiannually.

589-5.2.4 INITIAL ACCEPTANCE. Before initial use, new cranes are tested according to the procurement specifications, which generally require higher test loads and more cycles than this chapter. All modified or extensively repaired cranes shall be inspected and tested according to paragraphs 589-5.3 through 589-5.5.5 before they are returned to service.

589-5.2.5 INSPECTION CRITERIA. Any required equipment repairs and adjustments shall be made before inspection and testing. Inspections shall consist of observations on the functional condition of all component parts before, during, and after operation. Inspection shall be performed by sight, sound, touch, measurement, and instrumentation. Inspections are conducted to ensure that the equipment is functioning properly in all operating modes, obvious deficiencies are corrected, and adjustments critical to safety and reliability are made. Personnel performing inspections or load tests shall be thoroughly familiar with the equipment and its function. Repairs or adjustments found necessary during any inspection or testing phase shall be completed, and the previous inspection and testing shall be repeated before the next phase begins.

589-5.2.6 TEST LOADS. Load testing of cranes controlled by this chapter, including those which handle weapons, will normally be conducted at the percentage of rated load as listed in Table 589-5-2. However, some cranes are required to be statically and dynamically tested at loads other than the normal 125 percent because of the limits of original design or use. Specific examples are:

- a. Salvage cranes, cranes routinely conducting submerged lifts, and cranes which handle deep submergence vessels shall conduct static and dynamic tests at 200 percent and 150 percent of rated load, respectively.
- b. Independent mobile cranes shall conduct static and dynamic load tests at 110 percent of rated load.
- c. Cranes currently tested to less than 125 percent (static) or 125 percent (dynamic) of rated load because of the limits of original design shall conduct static and dynamic load tests at the value specified by the original design (for example, the portal cranes on ARDM-4 are tested to 120-percent static, 120-percent dynamic).

**Table 589-5-2** NORMAL LOAD TEST

Load Test	Percent of Rated Load
Static	125
Dynamic	125
Rated	100

589-5.2.6.1 Crane Officers who cannot identify, or who are uncertain of the test requirements, should direct their inquiries to Naval Ship Systems Engineering Station (NAVSEA Philadelphia) (Code 9731).

589-5.2.7 PLANNED MAINTENANCE SYSTEM. Inspections and tests shall be conducted according to applicable maintenance requirement cards. If the applicable inspections and tests required by this chapter are not included in the PMS package, a PMS OPNAV Form 4790/7B, **Technical Feedback Report** should be submitted according to OPNAVINST 4790.4.

589-5.2.8 DATA RECORDING. During postrepair or postoverhaul testing (paragraph 589-4.4.3 or 589-4.4.4) involving no-load, dynamic load, or rated load, record test data (paragraph 589-5.4.2) according to format shown in Table 589-5-2A.

**Table 589-5-2A** Test Memo for Topping Hoist Subsystem on an Electrohydraulic Crane (Example)

Parameter	Acceptable Values	First Cycle or Initial Values *	Final Cycle or Final Values
Neutrals			
Motor Temperature Rise	65.6°C (150°F max)	21.1°C (70°F max)	23.9°C (75°F max)
Motor Amperage	50A (max)	49A	48A
Hydraulic Fluid Temperature (at pump inlet)	71.1°C (160°F max)	48.9°C (120°F max)	60°C (140°F max)
Servo Pressure	290 lb/ing ±10%	310 lb/ing	285 lb/ing
Replenishing Pressure	100 lb/ing ±10%	100 lb/ing	100 lb/ing
Raise (Full Speed)			
Motor Amperage	90A (max)	87A	83A
Servo Pressure	290 lb/ing ±10%	315 lb/ing	280 lb/ing
Main Loop Pressure	2,000 lb/ing max	1,960 lb/ing	1,940 lb/ing
Drum Speed	11 to 12 r/min	11.7 r/min	11.7 r/min
Lower (Full Speed)			
Motor Amperage	90A (max)	69A	66A
Servo Pressure	290 lb/ing ±10%	318 lb/ing	290 lb/ing
Main Loop Pressure	2,000 lb/ing max	1,700 lb/ing	1,650 lb/ing
Drum Speed	11 to 12 r/min	11.4 r/min	11.4 r/min

\* Taken from technical manual, manufacture's specifications, and baseline data, as appropriate.

589-5.2.8.1 Wire Rope Service Life. The Crane Officer shall maintain a record of the installation date of all wire rope to ensure that recommended service life is not exceeded (paragraph 589-4.2.4.9).

589-5.2.8.2 Initial Hook Throat Openings. Dimensions of hook throat openings, measured before use, shall be recorded and a record maintained by the Crane Officer. If a preuse dimension has not been recorded, the current hook throat opening should be logged. Initial hook throat opening dimensions are used to assess hook degradation following static load tests (paragraph 589-5.5.2.5 item d.5).

### 589-5.3 INSPECTIONS

589-5.3.1 DAILY INSPECTION. The crane operator shall perform a daily inspection of the assigned equipment before conducting any load handling operations. A crane Operator's Daily Checklist (ODCL) shall be used for this purpose (Table 589-3-2a). Inspection requirements are discussed in paragraph 589-3.5.3. The ODCL shall be completed every 24 hours while the crane is in continuous use.

589-5.3.2 ANNUAL INSPECTION. The following inspections of crane components should be performed annually in conjunction with PMS requirements. Component inspection shall be performed before load testing or equipment operability tests if scheduled concurrently. Refer to the applicable technical manual for disassembly and reassembly instructions. Component inspections need not be performed to the extent that they would require disassembly of adjacent components. (See paragraph 589-4.4.2.a)

589-5.3.3 CRANE STRUCTURAL COMPONENTS. Crane structural components shall be inspected as described in the following paragraphs.

**NOTE**

Boom and masthead are **CRITICAL** components. Correct discrepancies before crane recertification.

**NOTE**

Remove immediately from service lattice boom cranes with structural damage to the main chords of the boom.

589-5.3.3.1 Boom and Masthead. Inspect the boom and masthead for:

- a. Boom, boom hinge, and masthead structure:
  - 1. Broken and damaged parts
  - 2. Cracked, corroded, and missing members, including pendants
  - 3. Loose fasteners, rivets, and bolts
  - 4. Cracked welds
  - 5. Support pins, bushings, and retainers:
    - (a) Proper installation
    - (b) Excessive wear and distortion
    - (c) Proper lubrication.
- b. Vent and drain openings in closed spaces clear of foreign matter.

**NOTE**

Hydraulic telescoping booms are **CRITICAL** components. Correct discrepancies before crane recertification.

- c. Hydraulic telescoping booms (extend fully for inspection):
  - 1. Scoring of hydraulic ram
  - 2. Cracked and leaking hydraulic seals.
- d. Stowage cradle:
  - 1. Broken or damaged parts
  - 2. Cracked, corroded, and missing members
  - 3. Loose fasteners, rivets, and bolts
  - 4. Cracked welds.

589-5.3.3.2 Pedestal and Base Supports. Inspect pedestal and base supports for:

- a. Damage, cracking, and corrosion
- b. Loose fasteners, rivets, or bolts
- c. Cracked welds.

**NOTE**

Bridge and trolley crane girders are **CRITICAL** components. Correct discrepancies before crane recertification.

589-5.3.3.3 Girders. For bridge and trolley cranes, inspect complete (girder) structure for:

- a. Broken, damaged, cracked, and corroded members
- b. Loose fasteners, rivets, and bolts
- c. Cracked welds.

**NOTE**

Counterweights are **CRITICAL** components. Correct discrepancies before crane recertification.

589-5.3.3.4 Counterweights. Inspect the counterweight and counterweight support structure for:

- a. Corrosion
- b. Deterioration
- c. Loose or degraded fasteners.

**NOTE**

Wheels and wheel trucks (traveling or bridge and trolley cranes only) are **CRITICAL** components. Correct discrepancies before crane recertification.

589-5.3.3.5 Wheels and Wheel Trucks. Inspect wheels and wheel trucks (traveling or bridge and trolley cranes) for:

- a. Wheels:
  - 1. Uneven wear
  - 2. Flat spots
  - 3. Chips
  - 4. Flange wear
  - 5. Cracks
  - 6. Loose axle pins.
- b. Wheel bearings:
  - 1. Proper lubrication
  - 2. Wear
  - 3. Loose bearing caps
  - 4. Loose wheel lugs.

- c. Wheel trucks and gantry legs:
  - 1. Broken, damaged, cracked, or corroded members
  - 2. Loose fasteners, rivets, and bolts
  - 3. Cracked welds
  - 4. Proper installation of guards over moving parts (no interference)
  - 5. Damage to rail sweeps and fasteners
  - 6. Secure attachment and proper alignment of rail sweeps (no interference).

**NOTE**

Bumpers and stops are **CRITICAL** components. Correct discrepancies before crane recertification.

589-5.3.3.6 Bumpers and Stops. Inspect bumpers and stops for:

- a. Distortion, cracking, corrosion, or excessive wear of spring bumpers
- b. Cracked or broken seals, or evidence of leakage of hydraulic or pneumatic bumpers
- c. Damage to bumper attachment bolts
- d. Broken, cracked, or excessively worn bumper pads and stops.

589-5.3.3.7 Rails. Inspect traveling crane rails (Figure 589-5-2) for:

- a. Proper alignment
- b. Bent or damaged sections of rail
- c. Cracked welds or corrosion in rail sections
- d. Loose, missing, or broken rail clamps, bolts, wedges, connectors, rail end stops, or bumpers
- e. Proper engagement of rail clamps; wear or damage to rail clamps.

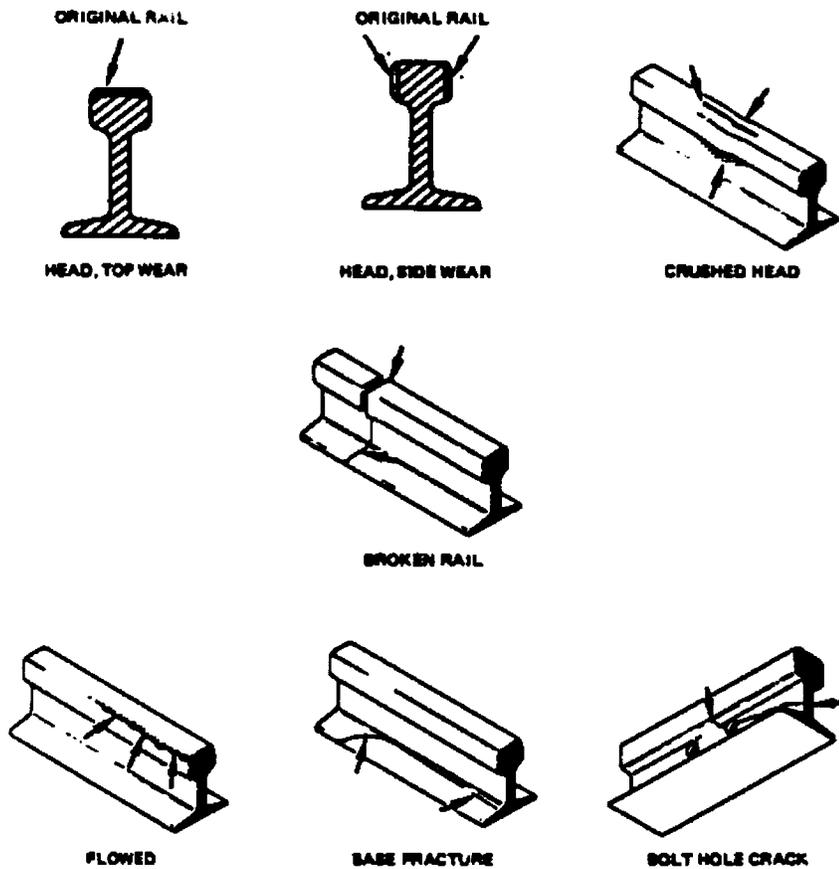


Figure 589-5-2 Common Rail Defects

589-5.3.3.8 Handrails, Ladders, Walkways, and Personnel Safety Guides. Inspect for:

- a. Excessive wear of rungs and steps
- b. Damaged ladder rails
- c. Loose mounting connections
- d. Cracked welds
- e. Loose or missing rivets
- f. Deformed members
- g. Proper operation of retractable access ladders
- h. Nonskid surface on footwalks
- i. Safety chains
- j. Ladder sleeves
- k. Ladder cages
- l. Ladder climber safety devices
- m. Other personnel safety guides, as required.

589-5.3.4 CRANE MECHANICAL COMPONENTS. Inspect crane mechanical components listed according to paragraphs 589-5.3.4.1 through 589-5.3.4.14. Noted discrepancies shall be corrected before crane recertification.

589-5.3.4.1 General Mechanical Inspection. Inspect the following general items:

**NOTE**

Machinery foundation discrepancies shall be corrected before crane recertification.

a. Inspect machinery foundations for:

1. Distortion
2. Cracked welds
3. Misalignment
4. Corrosion.

**NOTE**

Bolted connection discrepancies shall be corrected before crane certification. If one fastener is found defective, inspect all remaining fasteners in the group, one at a time.

b. Inspect bolted connections for:

1. Proper mating of adjoining surfaces
2. Missing or defective components
3. Proper bearing surfaces of fasteners
4. Proper fastener torque
5. Defective fasteners (one defective, inspect all in group)
6. Replacement fasteners shall be as specified in equipment manufacturer's technical manual for original installation.

c. Inspect moving parts guards for:

1. Proper installation
2. Damage.

d. Inspect lubrication lines and fittings (where installed) for:

1. Bent or crimped lines
2. Damaged or missing line fittings
3. Adequate lubrication to remote components.

e. Levers, control rods, and control linkages; items used primarily for remote operation of brakes and control systems shall be inspected for:

1. Damage
2. Ability of mechanical linkages to function without binding.

f. Inspect enclosed spaces for:

1. Leaks

2. Broken glass
  3. Corrosion.
- g. Inspect machinery house and operator's cab for posting of warnings, cautions, and label plates.

**NOTE**

Sheave discrepancies shall be corrected before crane recertification.

589-5.3.4.2 Sheaves. Inspect sheaves (Figure 589-5-3) for:

- a. Wear and damage
- b. Worn bearings and pins
- c. Damaged and missing lubrication fittings
- d. Wear in wire rope sheave grooves (use radius gauge)
- e. Wear and corrosion of wire rope sections in contact with equalizer sheaves (expose and examine for poor drainage)
- f. Adequate lubrication in remote sections
- g. Loose or damaged sheave guards (used to keep wire rope in place), where mounted.

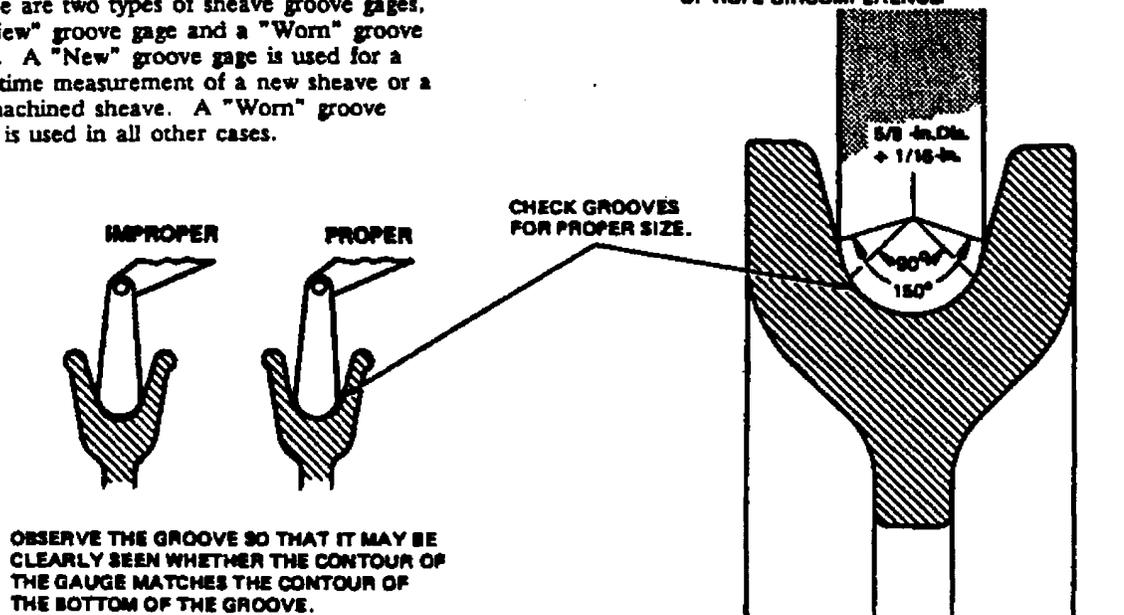
**NOTE**

Wire rope discrepancies (such as indications of slippage wear, deformation, and damage at fittings, sockets, swaged end connections, and swaged collars) shall be corrected before crane recertification.

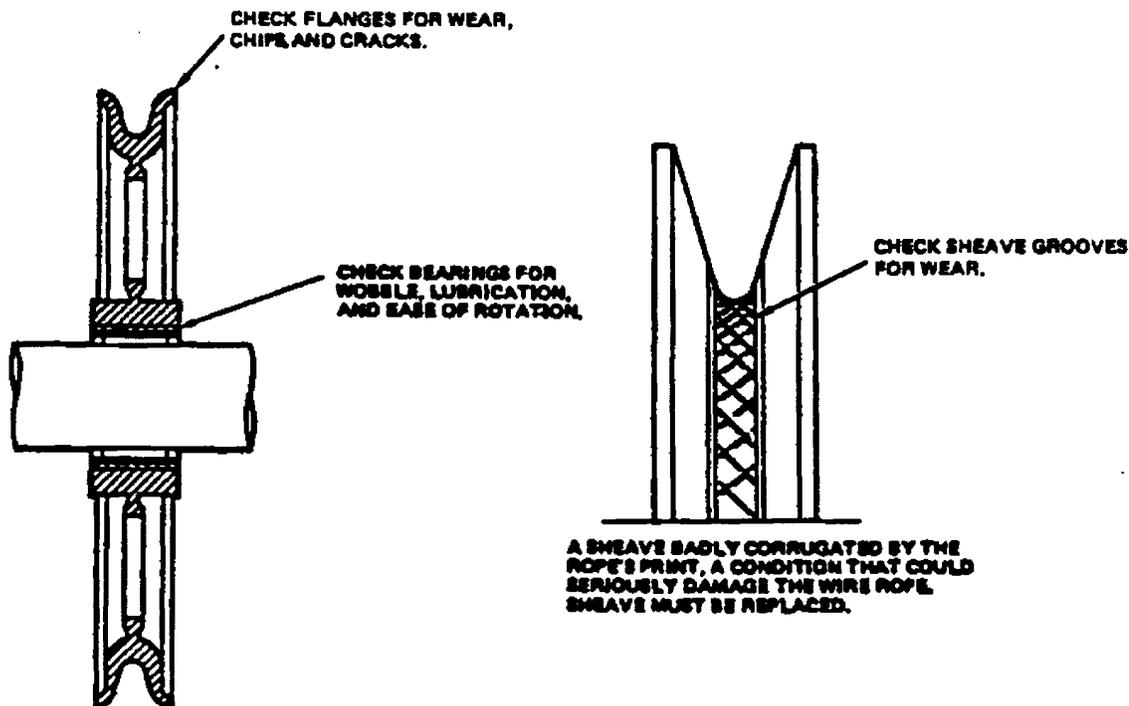
**NOTE**

There are two types of sheave groove gages, a "New" groove gage and a "Worn" groove gage. A "New" groove gage is used for a first time measurement of a new sheave or a re-machined sheave. A "Worn" groove gage is used in all other cases.

**A PROPER FITTING SHEAVE GROOVE SHOULD SUPPORT THE ROPE OVER 90-150 DEGREES OF ROPE CIRCUMFERENCE.**



OBSERVE THE GROOVE SO THAT IT MAY BE CLEARLY SEEN WHETHER THE CONTOUR OF THE GAUGE MATCHES THE CONTOUR OF THE BOTTOM OF THE GROOVE.

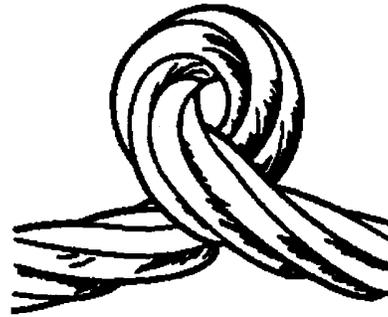


A SHEAVE BADLY CORRUGATED BY THE ROPE'S PRINT, A CONDITION THAT COULD SERIOUSLY DAMAGE THE WIRE ROPE. SHEAVE MUST BE REPLACED.

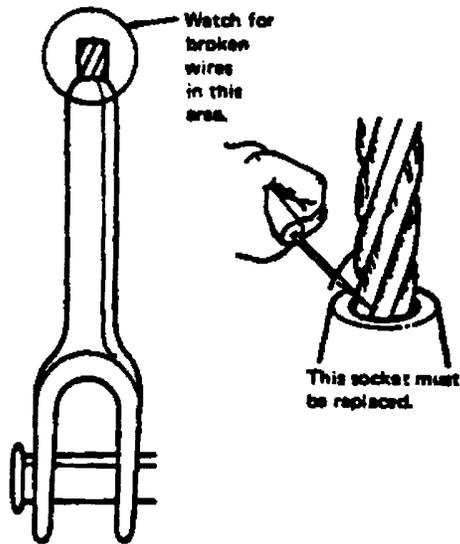
Figure 589-5-3 Sheave (Pulley) Inspection



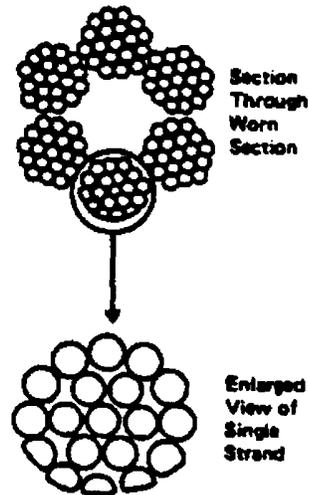
**Bird Cage**



**Kink**

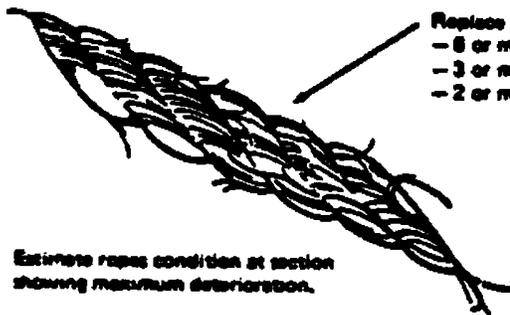


**Broken Wires Near Fittings**



When the surface wires are worn by 1/3 or more of their diameter, the rope must be replaced.

**Wear of Outer Wires**



- Replace rope if there are
- 8 or more broken wires in one Lay
  - 3 or more broken wires in one strand in one Lay
  - 2 or more broken wires in one Lay in Standing Ropes.

**Rope Replacement Criteria Based on the Number of Broken Wires**

Figure 589-5-4 Common Wire Rope Defects

589-5.3.4.3 Wire Rope. Conduct wire rope inspection (Figure 589-5-4), where practical, with all of the wire rope payed out. Wire rope that has been exposed to, or immersed in seawater shall be flushed with fresh water and cleaned with a suitable solvent before inspection. Use JP-5 or turbine oil (2190) to remove wire rope lubricant from running lengths exposed to maximum wear, exposure, and abuse. Relubricate after inspection. Pay close attention to rope parts in constant or routine contact with the hoisting mechanism during periods of routine rigging, traveling, or when deenergized. Use vernier calipers to measure wire rope diameter, according to **NSTM Chapter 613, Wire and Fiber Rope and Rigging**, at six or more places. Compute the average diameter. Count the number of broken wires in each rope lay length and each strand lay length. Also check the interior of the rope by carefully using a marlinespike. Inspect for the following physical damage to rope structure (see Table 589-5-3):

**Table 589-5-3 ALLOWABLE REDUCTION IN WIRE ROPE DIAMETER**

Wire Rope Diameter (Fractional Inch)	Permissible Reduction (Fractional Inch)
Up to 5/16	1/64
Over 5/16 to 1/2	1/32
Over 1/2 to 3/4	3/64
Over 3/4 to 1-1/8	1/16
Over 1-1/8 to 1-1/2	3/32
Over 1-1/2 to 2	1/8
Over 2 to 2-1/2	5/32

- a. Broken wires
- b. Wear
- c. Corrosion
- d. Slippage, wear, deformation, or damage at fittings, sockets, swaged end connections, and swaged collars.

589-5.3.4.3.1 Replace wire rope, according to criteria in **NSTM Chapter 613**. Replace with equivalent of wire rope removed, or if not otherwise specified, according to RR-W-410, type 1, class 3, Warrington-Seale, or its equivalent, independent wire rope core, 6 by 37, improved plow steel, or extra-improved plow steel, uncoated, preformed, and right regular lay (or left regular lay if applicable).

#### NOTE

Discrepancies in hoisting blocks and hooks shall be corrected before crane recertification.

589-5.3.4.4 Hoisting Blocks and Hooks. Perform the following inspections on topping blocks, load blocks, and hooks:

- a. Inspect hoisting blocks (Figure 589-5-5) for:
  1. Cleanliness
  2. Binding sheaves
  3. Damaged or worn sheaves

4. Worn or distorted sheave pins
  5. Broken bolts
  6. Missing or damaged cheek weights.
- b. Inspect hooks for:
1. Damage
  2. Excessive wear to the hook safety latch, hook swivel trunnions, thrust collar, and securing nuts
  3. Damaged or missing lubrication fittings
  4. Proper lubrication
  5. Cracks and gouges parallel (lengthwise) to hook contour (remove by surface abrasion, if possible, or remove hook from service)
  6. Cracks and gouges transverse to the hook contour (examine nondestructively)
  7. Visibly bent or twisted hooks (remove from service).

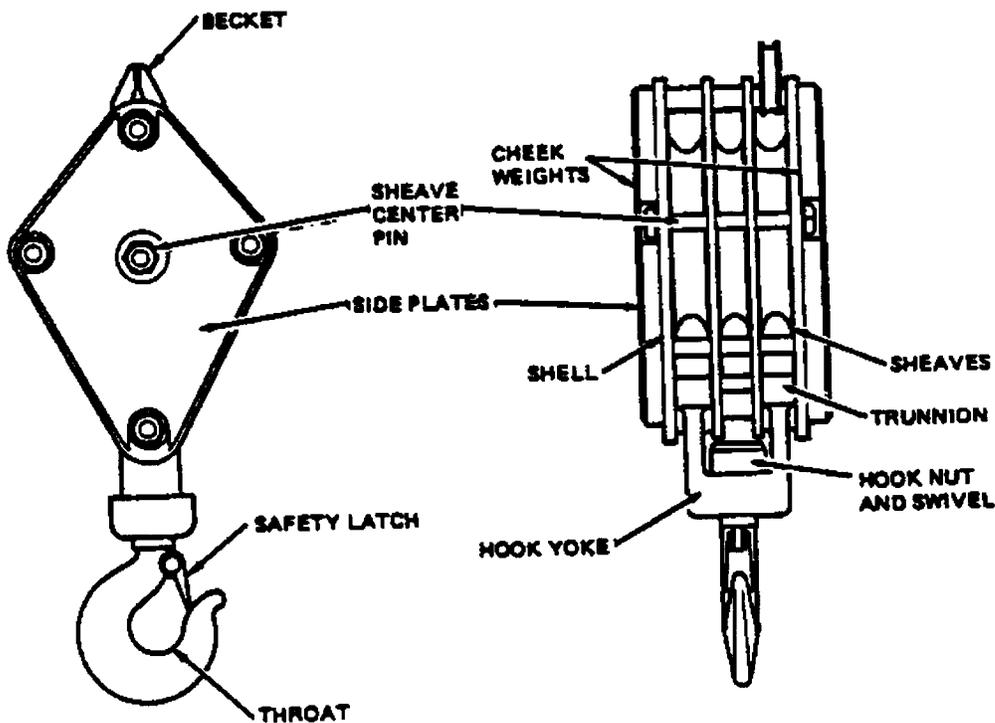


Figure 589-5-5 Hook and Block Inspection Points

**NOTE**

Insulator link discrepancies shall be corrected before crane recertification.

589-5.3.4.5 Hook Insulator Links. Inspect hook insulator links for:

- a. Cracked, excessively worn, or corroded steel saddles.
- b. Exposed or damaged fiberglass bands.
- c. Permanent elongation.

- d. Leakage current across link.

**NOTE**

Drive shaft discrepancies shall be corrected before crane recertification.

589-5.3.4.6 Shafts. Inspect drive shafts for:

- a. Damage
- b. Misalignment
- c. Worn keys or keyways
- d. Loose keys or covers.

**NOTE**

Coupling discrepancies shall be corrected before crane recertification.

589-5.3.4.7 Couplings. Inspect couplings for:

- a. Looseness
- b. Binding (due to misalignment, or improperly installed bolts or keys)
- c. Evidence of leakage or cracks in sealed couplings
- d. Damage or corrosion in open couplings
- e. Tightness of coupling bolts, nuts, screws, and snap rings.

**NOTE**

Bearing and bushing discrepancies shall be corrected before crane recertification.

589-5.3.4.8 Bearings. Inspect bearings and bushings for:

- a. Discoloration (due to excessive heat)
- b. Metallic particles, chips, or displaced metal
- c. Broken or distorted bearing retainers or seals
- d. Adequate lubrication
- e. Tight bearing caps.

**NOTE**

Correct brake discrepancies before crane recertification.

589-5.3.4.9 Brakes (Mechanical). Check all brake types (mechanical) for proper adjustment and alignment according to the applicable technical manual. Inspect brakes for:

- a. Drum brakes:

1. Smooth brake linings (no excessive wear)
  2. Loose or worn pins
  3. Missing or broken parts
  4. Exposed rivet heads for riveted brake linings (any scoring shall not exceed criteria of paragraph 589-4.2.4.7).
  5. Full brake lining contact
  6. Unequal brake lining wear.
- b. Disc brakes, check for dirt accumulation between brake pads
- c. Solenoid air gap (according to technical manual or PMS):
1. Overheating
  2. Worn or damaged brass, or air gap material
  3. Loose core laminations.
- d. Magnet air gap setting (check and set according to technical manual or PMS)
- e. Operating linkage adjustment (according to technical manual or PMS)
- f. Hydraulic brakes:
1. Fluid level in master cylinders
  2. Leakage (if fluid at low level or rapid decrease noted)
  3. Damaged hydraulic lines
  4. Loose connections.
- g. Air brakes:
1. Operation of air valves
  2. Air leaks
  3. Damaged air lines
  4. Loose connections.

**NOTE**

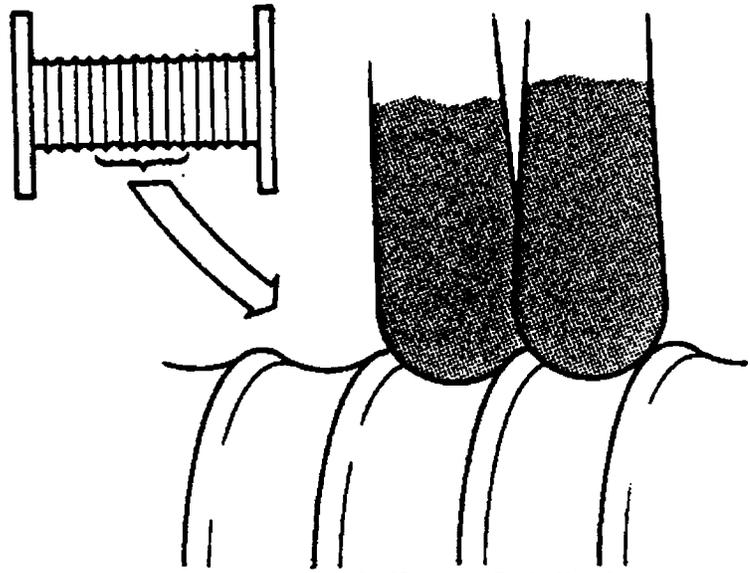
Gear and reducer discrepancies shall be corrected before crane recertification.

589-5.3.4.10 Gears and Reducers. Inspect gears and reducers as follows:

- a. External (to gear case):
1. Uneven wear of gear teeth (uneven bright metal pattern, pitting, flaking, or discoloration)
  2. Adequate lubrication.
- b. Enclosed:
1. Proper level of gear case lubrication oil (where possible)
  2. Leaking gaskets
  3. Worn gears and shafting (chipping, looseness, lack of full tooth contact, or excessive tooth wear)
  4. Proper installation of bearing caps, or covers
  5. Clean vent lines or breather caps
  6. Free ventilation of gear case.

**NOTE**

Hoist drum discrepancies shall be corrected before crane recertification.



**EVEN THOUGH BOTH THESE GAUGES PROPERLY FOLLOW GROOVE CONTOURS, WHEN USED SIDE-BY-SIDE THEY INDICATE GROOVES ARE TOO CLOSE, TWO GAUGES WHICH OVERLAP IN THIS MANNER REVEAL THAT WRAPS OF ROPE WILL SCRUB WHEN SPOOLING ON OR OFF THE DRUM.**

Figure 589-5-6 Drum Groove Inspection

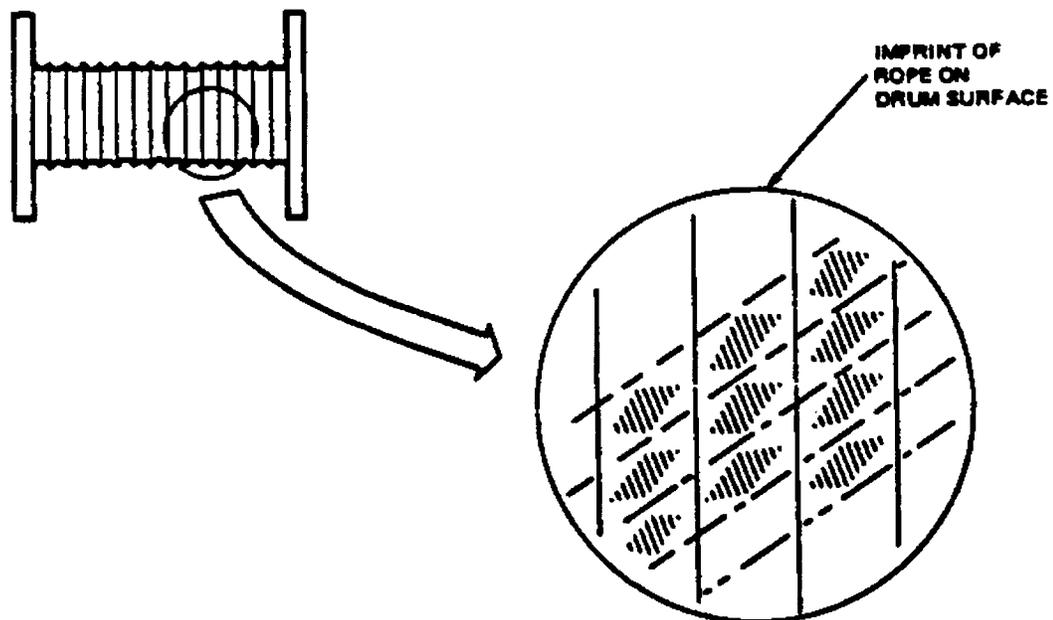


Figure 589-5-7 Drum Scoring

589-5.3.4.11 Hoist Drums. Inspect hoist drums for:

- a. Cracks or distortion

- b. Missing or loose fasteners
- c. Cracked welds
- d. Worn or scored wire rope grooves (Figure 589-5-6 and Figure 589-5-7)
- e. Worn shaft bearings
- f. Proper lubrication
- g. Two and one-half wraps (minimum) of wire rope remaining on drums with hooks or boom at lowest working level or at lower limit switch setting

**NOTE**

End fittings need to be disconnected or disassembled only when experience or visual indications deem it necessary.

- h. Torque values of wire rope drum end fittings (according to technical manual or PMS requirements)

**NOTE**

Control system discrepancies shall be corrected before crane recertification.

589-5.3.4.12 Control Systems. Inspect the control systems as follows:

- a. Hydraulic control system (valves, cylinders, lines, regulators, and gauges):
  - 1. Worn or missing parts
  - 2. Leaking gaskets or seals
  - 3. Loose connections
  - 4. Proper fluid level in reservoir.
- b. Air control system:
  - 1. Clean air filters
  - 2. Air compressor motor alignment
  - 3. Loose holddown bolts
  - 4. Air leaks
  - 5. V-belt tension and wear
  - 6. Valves, cylinders, lines, regulators, and gauges:
    - (a) Worn or missing parts
    - (b) Leaking gaskets or seals
    - (c) Loose connections.
- c. Air supply system:
  - 1. Wear or damage to air hose carrier or hose track suspension
  - 2. Proper operation of hose track suspension
  - 3. Piping, hoses, fittings, valves, lubricators, and pendant controls:
    - (a) Loose connections
    - (b) Excessive water (drain separators, if necessary).
    - (c) Proper pressure of air supply (reset pressure regulators, if necessary, according to technical manual).

**NOTE**

Spud lock, pawl, and ratchet discrepancies shall be corrected before crane recertification.

589-5.3.4.13 Spud Locks, Pawls, and Ratchets. Inspect for:

- a. Loose, damaged, or worn pawls and ratchets
- b. Proper engagement of the spud lock and pawl device
- c. Operating linkages:
  1. Worn keys
  2. Loose securing bolts
  3. Broken springs.

589-5.3.4.14 Hydraulic System. Inspect hydraulic system components and piping for:

- a. Leakage from connections and valves
- b. Leakage at hydraulic pump (and motor) shaft seals
- c. Sump or reservoir:
  1. Free ventilation of tank through vent line or breather caps
  2. Sightglass (easily readable)
  3. Leakage at tank seams
  4. Leakage at access cover gasket.

589-5.3.5 CRANE ELECTRICAL COMPONENTS. Electrical components shall be inspected according to the following paragraphs. Noted discrepancies shall be corrected before crane recertification.

**WARNING**

**Inspection of electrical components shall be performed by qualified electricians. Systems and components shall be deenergized and DANGER tagged according to tag out procedures before inspection, as required by PMS or when prudence dictates.**

**NOTE**

Motor and generator discrepancies shall be corrected before recertification.

589-5.3.5.1 Motors and Generators. Inspect motors and generators for:

- a. Weather damage or moisture
- b. Collector rings and commutators:
  1. Pitting
  2. Burn spots
  3. Uneven wear.

- c. Motor brush wear and tension according to technical manual
- d. Leads and insulators:
  - 1. Frayed and cracked insulation
  - 2. Loose wires and connections.
- e. Insulation resistance
- f. Loose holddown bolts
- g. Bent shafts or covers
- h. Proper lubrication.

**NOTE**

Controller discrepancies shall be corrected before crane recertification.

589-5.3.5.2 Controllers. Inspect controllers for:

- a. Broken, cracked, or loose springs
- b. Cracked or loose handles
- c. Pitted or burned contact points or segments
- d. Broken segment dividers or insulators
- e. Evidence of excessive arcing
- f. Worn or loose cams, pins, rollers, or chains
- g. Frayed or cracked insulation
- h. Loose connections
- i. Identifying label plates installed.

**NOTE**

Brake electrical component discrepancies shall be corrected before crane recertification.

589-5.3.5.3 Brake Electrical Components. Inspect magnetic brake coils and leads for proper electrical connections and coil resistances. Check eddy-current brakes for proper insulation resistance.

589-5.3.5.4 Resistors and Insulators. Inspect resistors and insulators for:

- a. Damaged or loose connections, securing bolts, or brackets
- b. Corrosion
- c. High-resistance connections.

**NOTE**

Panel wiring, relay, coil and protection device discrepancies shall be corrected before crane recertification.

589-5.3.5.5 Panels, Panel Wiring, Relays, and Connections. Inspect panels, panel wiring, relays, and connections for:

- a. General condition of wiring, relays, coils, and protection devices:
  - 1. Deterioration
  - 2. Cracked or frayed insulation
  - 3. Loose wire connections.

**NOTE**

If a megger is to be used, verify that its use will not damage circuits before performing ground checks.

- b. Grounded circuits
- c. Cable tag and identification labels on wiring and relays
- d. Contacts:
  - 1. Proper alignment
  - 2. Signs of excessive heating or arcing.
- e. Coil and contact leads, shunts, and wiring
- f. Loose connections or signs of overheating in fuses or other overload protection devices
- g. General condition of electrical
  - 1. Deterioration
  - 2. Corrosion
  - 3. Loose components or fasteners
  - 4. Missing label plates.
- h. No cracks or excessive wear in the rubber matting (on the deck in front of panels)
- i. Panel boards and arc shields:
  - 1. Cracked or loose securing bolts
  - 2. Dirt or moisture.

**NOTE**

Collector assembly discrepancies shall be corrected before crane recertification.

589-5.3.5.6 Collector Assembly. The collector assembly (on traveling or rotating cranes) should be inspected for:

- a. Center collector assemblies:
  - 1. Loose or bent supports
  - 2. Broken wires or tubing
  - 3. Loose connections
  - 4. Worn brushes
  - 5. Frayed insulation.
- b. Collector ring:
  - 1. Alignment
  - 2. Proper spring tension.
- c. Check runway collector insulators and clamps.

- d. Conductors:
  - 1. Loose connectors
  - 2. Bent, pitted, or damaged wires or collectors
  - 3. Loose or damaged staff, staff insulation or shoes.
- e. Wheels:
  - 1. Loose
  - 2. Damaged
  - 3. Misaligned.

**NOTE**

Limit and limit bypass switch discrepancies shall be corrected before crane recertification.

**NOTE**

If limit switches are sealed after final setting and testing, do not break the seal. Verify that the switch is not overdue for adjustment and planned maintenance, and inspect the exterior for leakage. Remove covers and inspect all electrical and mechanical components.

589-5.3.5.7 Limit and Limit Bypass Switches. Perform inspections on the following:

- a. Contacts, springs, ratchets, pins, arms and insulators, rollers, chains, cams, and dogs for:
  - 1. Deterioration
  - 2. Corrosion
  - 3. Excessive wear.
- b. Cover gaskets, counterweights, control weights, suspension guides, wiring and mountings for:
  - 1. Deterioration
  - 2. Excessive wear
  - 3. Looseness.

**NOTE**

Warning device discrepancies shall be corrected before crane recertification.

589-5.3.5.8 Warning Devices. Inspect the horns, bells, lights, or other electrical and mechanical warning devices.

- a. Inspect associated wiring, connections, and control switches for:
  - 1. Deterioration
  - 2. Loose connections.
- b. Inspect fixtures, mountings, linkage, pins, springs, and bell hammers for excessive wear.

589-5.3.5.9 Lighting. Inspect light fixtures for:

- a. Cracks

- b. Missing globes
- c. Properly positioned boom floodlights (for adequate illumination of the under hook work area).

**NOTE**

Grounding discrepancies shall be corrected before crane recertification.

589-5.3.5.10 Grounding. If the crane receives electrical power from an outside source, verify proper grounding of rails or crane.

589-5.3.5.11 Load Cell (Electrical). Inspect for:

- a. Crack or deform pins, cleaves or any loose member.
- b. Fry insulation, broken wires or loose connection.
  - a. Missing cotter pins.

589-5.3.6 CRANE OPERATOR CAB. Cab components shall be inspected according to the following paragraphs. Noted discrepancies shall be corrected before crane recertification. Inspect operator cab for:

- a. Leaks
- b. Broken glass
- c. Corrosion
- d. Proper door and window operation
- e. Cleanliness of cab and louvers
- f. Deteriorated wiper blade(s).

589-5.3.6.1 Heating and Ventilation. Inspect heating and ventilation system for:

- a. Proper cleanliness
- b. Damage to fans, ducts, dampers, switches, and wiring (impaired functioning).

**NOTE**

Cab and control locking device discrepancies shall be corrected before crane recertification.

589-5.3.6.2 Cab and Control Locking Devices. Verify that a functional positive locking system exists on each crane to preclude unauthorized operation.

589-5.3.7 MOBILE CRANES. The following additional items shall be inspected on mobile cranes. Noted discrepancies shall be corrected before crane recertification.

589-5.3.7.1 Tires. Inspect tires for:

- a. Proper inflation (according to air pressure chart)

- b. Damage
- c. Excessively worn tread.

**NOTE**

Outrigger discrepancies shall be corrected before crane recertification.

589-5.3.7.2 Outriggers. Inspect condition of the outrigger beams, boxes, pads, wedges, or locks and cylinder mountings for:

- a. Bent or damaged (deformed) members
- b. Loose or missing fasteners or pins
- c. Cracked welds.

589-5.3.8 DIESEL POWER PLANTS. The following inspection items apply to diesel power plants. For further information, refer to **NSTM Chapter 233, Diesel Engines**. Noted discrepancies shall be corrected before crane recertification.

**NOTE**

Cooling system hose, thermostat, and pump discrepancies shall be corrected before crane recertification.

589-5.3.8.1 Cooling System Hoses, Thermostat, Pump. Inspect for:

- a. Hoses:
  - 1. Cracks
  - 2. Leaks.
- b. Clamp tightness
- c. Radiator (leaks or obstructed cooling channels)
- d. Proper shutter operation
- e. Adequate antifreeze
- f. Water pump (leaking seals).

**NOTE**

Lube oil line and lube oil pressure discrepancies shall be corrected before crane recertification.

589-5.3.8.2 Lube Oil Lines and Lube Oil Pressure. Inspect for:

- a. Lube oil lines:
  - 1. Loose connections
  - 2. Leakage
  - 3. Damage.
- b. Gauges (for proper lube oil pressure)

c. Serviced or replaced filters and strainers.

589-5.3.8.3 Fuel Oil Lines. Inspect for:

- a. Loose connections
- b. Leakage
- c. Damage.

589-5.3.8.4 Air Starting Lines. Inspect for:

- a. Loose connections
- b. Leakage
- c. Damage.

**NOTE**

Drive belt discrepancies shall be corrected before crane recertification.

589-5.3.8.5 V-Belts. Inspect drive belts on fan, water pump, oil pumps, supercharger, alternator, and external fuel oil transfer pumps for:

- a. Proper belt tension
- b. Wear or deterioration.

**NOTE**

Gauge discrepancies shall be corrected before crane recertification.

589-5.3.8.6 Gauges. Inspect oil, fuel, temperature, ammeter, tachometer, and hour-meter gauges for:

- a. Proper shielding and mountings
- b. Identification and legibility
- c. Operating condition
- d. Loose electrical or mechanical connections
- e. Calibration date.

589-5.3.8.7 Supercharger and Drive. Inspect for:

- a. Wear
- b. Loose mounting bolts or parts
- c. Wear on external drive shaft and couplings.

589-5.3.8.8 Engine Wiring. Inspect all battery wiring to lights, warning devices, and meter connections for:

- a. Cracks
- b. Frayed or peeled insulation
- c. Loose connections
- d. Deterioration.

#### **589-5.4 NO-LOAD TESTING**

589-5.4.1 Paragraph [589-5.4.2](#) describes general no-load test requirements to be accomplished annually and before load test. The specific PMS package, for a particular crane, may contain an SOT. However, a SOT does not normally require repetitive crane motions, as specified in paragraph [589-5.6](#). If the dynamic load test, or rated load test, is required as a result of repairs, perform only the applicable portion of the SOT or the no-load test before load test.

**589-5.4.2 NO-LOAD TEST REQUIREMENTS.** During the test, cranes shall be operated through full ranges and directions. The equipment shall be operated and component performance shall be verified as follows:

- a. Load hook(s) shall be raised and lowered through the full range of travel at rated speed for three complete cycles.
- b. Hoist trolleys shall operate through full limits of travel.
- c. Bridge cranes shall operate through full limits of travel.
- d. Traveling cranes (except mobile traveling cranes) shall operate through full limits of travel.
- e. Rotating cranes shall operate through full rotational range.
- f. Cranes shall be topped through full range of travel, at rated speed, for three complete cycles.
- g. Cranes with telescoping booms shall be operated through full extension range (maximum to minimum lengths) for three complete cycles.

589-5.4.2.1 Test all of the crane operating modes (hoisting, topping, rotating, traveling) at each speed to verify proper operation. Check for unusual noise, vibration, or overheating in machinery and control components. Check for proper operation of all indicator lights and gauges. Cranes equipped with continuously variable controls (for example, static-stepless) shall be tested at minimum, midrange, and maximum speeds.

589-5.4.2.2 During the test, all travel-limiting devices (such as switches, valves, or mechanical stops) shall be tested or operated a sufficient number of times to demonstrate proper operation. Operate at slow speed near ends of travel. Equipment with unusual operating features or modes shall be operated sufficiently to demonstrate proper operation of such features or modes. A data sheet similar to Table [589-5-2A](#) should be prepared to record data (paragraph [589-5.2.8](#)). Compare with baseline data for evidence of degradation (paragraph [589-4.4.3](#)).

589-5.4.2.3 Demonstrate the function of hoist brakes for a loss of power condition. The loss of power check shall be performed by hoisting the hook approximately 10 feet above the deck or pier. Lower the hook at slow speed, and with the controller in the SLOW position, disconnect the power source by pushing the main POWER STOP button(s). The hook should stop lowering upon loss of power. Repeat procedure for the topping hoist by lowering the boom slowly.

589-5.4.3 PREPARATION FOR LOAD TESTING. Where the PMS package for a specific crane requires a SOT rather than a no-load test, the SOT should be performed in preparation for load testing, repeating hoist, top-ping, and telescoping motions three times, as described in paragraph 589-5.4.2. When a no-load test is performed in preparation for load testing, repeatability of crane motions is desirable before performing repeated motions under load.

## 589-5.5 LOAD TESTING

589-5.5.1 REQUIREMENTS. Cranes shall be load tested according to procurement specifications before initial use. Cranes shall have static, dynamic, and rated load tests conducted upon completion of a crane overhaul and at intervals not to exceed 4 years (paragraph 589-5.2 and Table 589-5-1). Static, dynamic, and rated load tests shall be accomplished after repair or replacement of crane components according to Table 589-4-3.

589-5.5.1.1 Where alternate reeving configurations are specified in the crane technical manual, the crane shall be tested in the maximum load configuration. However, if testing is required due to repair of the load hoist, the test may be done in the lighter load configuration, provided that the configuration change is done with a NAVSEA Philadelphia-approved Controlled Assembly (Table 589-4-3). Load testing shall be preceded by the applicable portions of the annual component inspection (paragraph 589-5.3.2) and the no-load test (paragraph 589-5.4).

589-5.5.1.2 Where more than one hoist is installed on the crane, each hoist shall be tested separately. Only the hoist under test shall be loaded. All load testing shall (normally) be witnessed by the Intermediate Maintenance Activity (IMA) Weapons Quality Assurance (QA) personnel, where available (paragraph 589-6.2.3). Records of load test results shall be maintained according to paragraph 589-5.5.5.

589-5.5.2 STATIC LOAD TEST. A static load test physically verifies the structural integrity of the crane. Loads may be applied as test weights, or by mechanical devices with load-measuring gauges, depending upon the test requirements and facility availability. Paragraphs 589-5.5.2.1 through 589-5.5.2.5 outline general static load test procedures for this equipment. The procedures were developed to cover broad applications and may be used as guidance in applying the most suitable items to the equipment undergoing testing.

589-5.5.2.1 Precautions. The equipment, or installation, shall be positioned to provide the most critical loading to equipment and support structure. For instance, cranes shall be topped to the lowest boom angle capable of handling the highest rated loads. Bridge cranes and trolley hoists shall be positioned in the center of the longest support rail span. Equipment shall be positioned to provide maximum protection in case of failure. Topside cranes shall be positioned with test load outboard, and suspended just clear of the pier or barge. Wherever practical, loads may be applied by a support crane, using dynamometers or other load-measuring devices in place of test weights.

589-5.5.2.2 Static Test Load. The static test load shall be equal to 125 percent (minimum) to 130 percent (maximum) of rated load unless otherwise specified (paragraph 589-5.2.6), and shall be applied while the ship is at pierside or moored in calm seas. If the static test will be conducted while the ship is at sea, the static test load shall be a maximum 125 percent of the rated load while the ship is underway in a sea state of 3 or less (Beaufort scale). The equipment undergoing testing shall hold the (static) test load for a minimum of 10 minutes. Equipment shall be visually inspected for evidence of permanent deformation, brake slippage, or other damage.

589-5.5.2.3 Mobile Cranes. Mobile cranes shall be tested under a static test load equal to 110 percent (minimum) to 115 percent (maximum) of rated load. The test shall be performed at an appropriate land-based facility. The boom shall be positioned at a safe angle for crane stability before loading.

589-5.5.2.4 Static Load Testing Methods. Test loads on cranes may be applied by one of the following methods:

a. Static Loading Method 1:

1. Attach a test load, up to a maximum of 125 percent of rated load, to the crane undergoing test and lift clear of the test load support. The test load should not exceed the overload limit for cranes equipped with overload limit devices.
2. For cranes that require a 200% static test, slowly add the remainder of the static test load with a support crane.
3. Suspend the test load from the hoist for 10 minutes.
4. For cranes that require a 200% static test, remove the additional load.
5. Lower the partial test load back to the support.

b. Static Loading Method 2:

1. Attach two sets of slings to the test load.
2. Lift test load about 6-inches clear of the deck using a support crane with a rated capacity at least equal to test load.
3. Slip the hook, or load fitting, of the crane being tested through the second sling and take up slack.
4. Slowly lower the test load (with the support crane), stopping at least twice, until slack develops in the support crane.
5. Suspend the test load from the crane for 10 minutes.
6. Raise the test load (with the support crane) until the test load is removed from the crane undergoing weight test.

589-5.5.2.4.1 Mobile Cranes. An alternate means of applying static test loads is through the use of jacks (or other safe means). In this case, the crane hoisting mechanism shall not lift more than 125 percent of rated load. A mobile crane shall hoist the static test load and suspend it for a minimum of 10 minutes, since the static test for mobile cranes will not exceed 125 percent of rated load.

589-5.5.2.5 Inspection and Observations. Inspections and observations shall be made during, and immediately following, static load testing of the following items:

a. Structural, inspect for:

1. Binding
2. Warping
3. Permanent deformation
4. Cracking
5. Malfunction of components.

b. Inspect wire rope for slippage in rope sockets and fittings.

c. Inspect brakes for load-handling without slippage.

- d. Inspect hooks for:
1. Wear on hook swivels and pins
  2. Wear on hook throat
  3. Cracks
  4. Gouges
  5. Deformation.

#### NOTE

Hook repairs are never permitted, except as noted in paragraph 589-5.3.4.4.

589-5.5.2.5.1 Replace the complete hook when material or section loss exceeds 10 percent, when hook throat opening is more than 5 percent in excess of the pretest dimension, or 15 percent over the original preuse dimension (paragraph 589-5.2.8.2), or when there is more than a 10-degree twist from the vertical plane of the unbent hook. Two tram points shall be permanently marked (scribed) on the hook as shown in Figure 589-5-8. Measure and record the distance between tram points (+ 1/64 inch) before loading the hook, and upon completion of the static load test. These measurements are used to verify that the pretest dimension has not been exceeded by more than 5% and the original preuse dimension has not been exceeded by more than 15 percent.

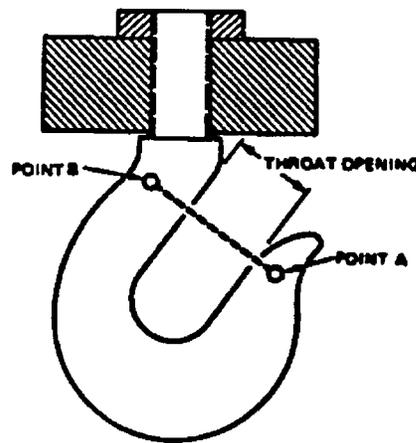


Figure 589-5-8 Hook Throat Measurement

589-5.5.2.5.2 After a static load test, all load bearing parts, strength welds, and repaired areas shall be visually inspected. If any cracking or deformation is sighted, or suspect, paint shall be removed from the suspect area, and a qualified nondestructive test (NDT) inspector shall perform magnetic particle or liquid penetrant tests in accordance with MIL-STD-271, **Non-Destructive Testing Requirements for Metals**, and shall meet the acceptance criteria of MIL-STD-278, **Fabrication, Welding and Inspection; and Casting Inspection and Repair, for Machinery, Piping, and Pressure Vessels for Ships of the U.S. Navy**, and NAVSEA 0900-LP-003-8000, **Metals, Surface Inspection Acceptance Standards**. The specific load bearing parts and strength welds to be inspected shall be determined by the test activity. If the static load test is to be followed by a dynamic load test, the visual inspection may be performed after completion of the dynamic load test.

#### NOTE

For hydraulic systems only; before performing a dynamic or rated load test, check holding capability of the brakes and relief valve settings according to a hydraulic systems test, as described in paragraph 589-4.6.

589-5.5.3 DYNAMIC LOAD TEST. At intervals not to exceed 4 years (or after repairs, as stated in [Table 589-4-1](#)), a dynamic load test shall be conducted. A dynamic load test demonstrates the capability of a crane to operate with a rated load under the dynamic conditions of ship motion and equipment operation. The following dynamic load test general procedures were developed to cover broad applications and may be used as guidance in applying the most suitable items to the equipment undergoing test.

**NOTE**

If the crane uses hydraulic power, the system relief valves shall be checked for proper settings before performing a dynamic load test.

589-5.5.3.1 Precautions. The dynamic load test shall be conducted to demonstrate handling equipment load capabilities throughout the complete operating range. Suspended loads shall be kept clear of facilities and equipment located within operating limits to avoid damage to such structures in the event of equipment failure. If practical, facilities and equipment not immediately involved in test work shall be moved clear of test operational area. If the test load weight could cause the ship to list, lines and shore services shall be checked for adequate length to accommodate the list.

589-5.5.3.2 Dynamic Test Load. Do not exceed the specified operating limits of equipment being tested. Main hook and auxiliary hook test loads shall not be lifted simultaneously. Dynamic test load shall be equal to 125 percent (minimum) to 130 percent (maximum) of rated load unless otherwise specified ([paragraph 589-5.2.6](#)) while the ship is pierside, or moored in calm seas. If the dynamic load test will be conducted while the ship is at sea, dynamic test load shall be a maximum of 100 percent of rated load while the ship is underway in a sea state of 3 or less (Beaufort scale), and the crane shall be downrated to 80 percent of the test load.

589-5.5.3.3 Mobile Cranes. Mobile cranes shall be tested with a dynamic test load equal to 110 percent (minimum) to 115 percent (maximum) of rated load. The dynamic load test for a mobile crane shall be performed at an appropriate land-based facility.

589-5.5.3.4 Dynamic Load Testing Requirements. As far as practicable, test loads shall be moved completely through the equipment operating range, within the limits of all operating modes (hoisting, rotating, traversing, raising, lowering, and traveling). The equipment with test load shall be stopped at least three times in each direction to ensure proper brake operation. No speed is specified; however, the maximum speed attainable with the required test load shall be used. The load shall be accelerated and decelerated slowly and smoothly at all times. Speeds and operating ranges may be reduced somewhat for safety considerations, at the discretion of the test director.

589-5.5.3.5 Inspection and Observations. During, and immediately following, the dynamic load test, information similar to that of [Table 589-5-2A](#) shall be recorded and the following inspections shall be made:

- a. Structural, inspect for:
  1. Binding
  2. Warping
  3. Permanent deformation
  4. Cracking
  5. Malfunction of components.
- b. Inspect wire rope for slippage in rope sockets and fittings.
- c. Inspect brakes for:
  1. Overheating in brake operation
  2. Proper stopping.
- d. Inspect machinery drive for:

1. Abnormal noise or vibration
  2. Overheating (in machinery drive components).
- e. Hoisting trains, inspect wire rope sheaves and drum spooling for:
1. Proper operation
  2. Freedom of movement
  3. Abnormal noise or vibration.
- f. Inspect electrical drive components for:
1. Proper operation
  2. Freedom from chatter or noise
  3. Overheating.
- g. Inspect hydraulic system for:
1. Smooth operation
  2. Proper stroke of operating cylinders
  3. Slamming, as valves open and close
  4. Other abnormal noise or vibration.
- h. Inspect reduction and open gears for:
1. Abnormal wear patterns
  2. Damage
  3. Inadequate lubrication.

589-5.5.4 RATED LOAD TEST. Following satisfactory completion of the dynamic load test, the crane shall be subjected to a rated load test. Rated load tests are used to demonstrate crane capability to operate with a full load, at rated speed, through the complete range of operating limits.

#### NOTE

If the crane uses hydraulic power, the system relief valves shall be checked for proper settings before performing a rated load test.

589-5.5.4.1 Precautions. Precautions for rated load test are parallel to those specified for dynamic load test (paragraph 589-5.5.3.1).

589-5.5.4.2 Rated Test Load. Do not exceed the specified operating limits of the equipment undergoing test. Main hook and auxiliary hook test loads shall not be lifted simultaneously. Rated test load shall be equal to 100 percent (minimum) to 105 percent (maximum) of rated load, unless otherwise specified (paragraph 589-5.2.6) while the ship is pierside or moored in calm seas. If the rated load test will be conducted while the ship is at sea, rated test load shall be a maximum of 80 percent of rated load while the ship is underway in a sea state of 3 or less (Beaufort scale), and the crane shall be downrated to equal the value of the test load.

589-5.5.4.3 Rated Load Test Requirements. As far as practicable, test loads shall be moved completely through the equipment operating range, within the limits of all operating modes (hoisting, rotating, traversing, raising, lowering, and traveling). The rated load test shall be repeated for at least 10 cycles to demonstrate proper operation and repeatability of all functions without overheating drive motors, gear boxes, resistors, or brakes, and without showing other signs of malfunction. The 10 cycles shall include at least 1 cycle at rated speed through the complete operating range of the travel mode, and at least 3 cycles at rated speed through the complete operating range of all other modes. The remaining cycles may be run at various speeds through partial ranges, roughly simulating typical crane operations. In all operating modes, the crane shall demonstrate proper operational functions, at each speed. Cranes equipped with continuously variable control systems (that is, static-stepless) shall be tested at minimum, midrange, and maximum speeds. The load shall always be accelerated and decelerated smoothly, and slow speed shall be used near the end of each range of motion.

589-5.5.4.4 Inspection and Observations. During the test at rated speed, values for the following parameters shall be observed and recorded on a test memo (Table 589-5-2A). Results should be compared with postoverhaul baseline data.

- a. Motor current
- b. Motor voltage
- c. Motor temperature rise
- d. Bearing temperatures
- e. Hydraulic fluid temperatures
- f. Hydraulic system pressure
- g. Hoisting, topping, traveling, and rotation speeds.

589-5.5.5 INSPECTION AND TEST RECORDS. Following satisfactory completion of annual inspections and 4-year or regular overhaul load tests, all test information and data shall be recorded in a permanent log, and the equipment shall be tagged with suitable labels or plates indicating:

- a. Equipment identification
- b. Date of test or inspection
- c. Test weight (in pounds)
- d. Testing activity.

## **589-5.6 EXCEEDING RATED LOAD**

589-5.6.1 Paragraphs 589-5.6.2 through 589-5.6.4 explain the inspection, testing, and reporting requirements to recertify a crane after its rated load has been exceeded inadvertently.

589-5.6.2 DETERMINING OVERLOAD CONDITION. When a 100-percent rated load capacity has been exceeded, or when it is likely that the crane capacity has been exceeded, the crane should be decertified. The Crane Officer should determine, as accurately as possible, the extent of the overload by calculations, weighing the load or portions of the load, by best estimate, or another appropriate method. If the extent of the overload cannot be determined (that is, load drop, or lifting a fixed load), the overload condition should be considered to have been in excess of 150 percent of rated load.

589-5.6.2.1 Once the extent of the overload has been determined, a departure-from-specification should be forwarded to the Type Commander according to paragraph 589-6.3.3. The departure-from-specification should describe the overload condition, identify inspections and tests to be performed before recertification (according to paragraphs 589-5.6.3 and 589-5.6.4), and recommend crane restrictions pending recertification. Generally, a crane which has been overloaded should not be used for load handling before recertification. Based upon satisfactory component inspections and no-load test, however, a crane which was not overloaded in excess of 150 percent of rated load may handle limited noncritical lifts (less than 50 percent of rated load) before load testing.

589-5.6.3 INSPECTION REQUIREMENTS. A visual inspection of all load bearing and load controlling components shall be performed following the guidance outlined in paragraph 589-5.3.2. Discrepancies noted in load bearing and load controlling components shall be corrected before load testing for crane recertification. If imme-

diate repairs or replacements of defective components cannot be accomplished due to the nature of the deficiency, load testing and limited load handling operations may be authorized by the departure-from-specification procedures (paragraph 589-6.3.3).

589-5.6.4 TESTING REQUIREMENTS. Following satisfactory completion of the inspections defined in paragraph 589-5.6.3, a no-load test shall be performed according to paragraph 589-5.4. Upon satisfactory completion of the no-load test, one or more of the following tests may be required, depending on the extent of the overload condition.

589-5.6.4.1 Static Load Test. A static load test shall be performed if the crane was determined to have exceeded 125 percent of rated load or if the overload could not be determined. The static load test shall be performed according to paragraph 589-5.5.2. Upon satisfactory completion of the static load test, dynamic and rated load tests shall be performed according to paragraphs 589-5.5.3 and 589-5.5.4, respectively.

589-5.6.4.2 Dynamic Load Test. A dynamic load test shall be performed if the crane was determined to have lifted a load greater than 125 percent (up to 150 percent) of rated load. The dynamic load test shall be performed according to paragraph 589-5.5.3. A rated load test (paragraph 589-5.5.4) shall be performed following the satisfactory completion of the dynamic load test.

589-5.6.4.3 Rated Load Test. A rated load test shall be performed if the crane was determined to have lifted a load greater than 100 percent (up to 125 percent) of rated load. The rated load test shall be performed according to paragraph 589-5.5.4.

589-5.6.5 RECERTIFICATION. Upon the satisfactory completion of the required inspections and test, the crane may be recertified according to paragraph 589-6.3.4.

## **SECTION 6.**

### **CERTIFICATION**

#### **589-6.1 CERTIFICATION PROGRAM**

589-6.1.1 The guidelines in this section describe the certification process and identify the audit and recordkeeping requirements, including the responsibilities of personnel designated to administer a Crane Certification Program. A Crane Certification Program shall be implemented in each ship with a crane installed or assigned, as directed by the Type Commander (see paragraph [589-1.1.3](#)).

#### **589-6.2 CERTIFICATION AUTHORITY**

589-6.2.1 **COMMANDING OFFICER.** Certification authority for shipboard cranes, or assigned mobile cranes under the cognizance of the Naval Sea Systems Command (NAVSEA), rests with the ship Commanding Officer. For noncommissioned ships, the Officer in Charge performs all functions ascribed to the Commanding Officer throughout this section. The Commanding Officer (or Officer in Charge) shall formally approve certification, decertification, departures-from-specification, and recertification of all shipboard or assigned cranes. Where departures-from-specification require approval by authorities external to the ship, the Commanding Officer's request for a departure-from-specification implies that the Commanding Officer recommends that the departure be granted.

589-6.2.2 **CRANE OFFICER.** The Crane Officer is responsible to the Commanding Officer for the safe and reliable operation of all cranes assigned to that officer. The Crane Officer shall be designated in writing by the Commanding Officer and shall administer the crane certification program for the assigned cranes. The Crane Officer can recommend certifications, decertifications, departures-from-specification, and recertifications to the Commanding Officer, and shall keep all records necessary to support these recommendations, including documentation of departure approval by outside authority where appropriate. The Crane Officer can approve the qualification of crane-operating personnel, and recommend qualified personnel requiring Commanding Officer approval.

589-6.2.3 **TEST DIRECTORS.** Crane inspections, no-load tests, and load tests shall be performed under the supervision of a test director. Test directors shall be designated, in writing, by the Commanding Officer. The test directors shall:

- a. Affirm technical competence of test and inspection personnel
- b. Witness and direct testing
- c. Ensure that all tests and inspections are safely and properly performed.

589-6.2.3.1 Tests or inspections that reveal deficiencies affecting the certification of a crane shall be reported immediately by the cognizant test director to the Crane Officer and the Crane Certifying Officer. Test directors should perform as Intermediate Maintenance Activity (IMA) Weapons Quality Assurance (QA) personnel, where required. If an inspection, no-load test, or load test is performed by an industrial activity (for example, by shipyard personnel during regular overhaul), the test director may be provided by the industrial activity (see paragraph [589-4.4.3](#)). In this case, the Crane Officer will review the applicable procedure to ensure compatibility with the crane to be tested or inspected.

589-6.2.4 **CRANE CERTIFYING OFFICER.** The Crane Certifying Officer will be a ship officer, not responsible for crane operation or maintenance (for example, the Weapons QA Officer at IMA's), designated, in writing, by the Commanding Officer. The Crane Certifying Officer is responsible to the Commanding Officer for monitoring the Crane Certification Program and shall perform the following functions:

- a. Conduct an annual audit of the Crane Certification Program for each installed or assigned crane.
- b. Concur in recommendations to the Commanding Officer for crane certifications, decertifications, departures-from-specification, and recertifications.
- c. Concur in corrective action, proposed by the Crane Officer as a result of crane certification audits (both annual ship audits and Type Commander audits).
- d. Perform periodic checks of compliance with crane certification requirements at random intervals between annual audits.
- e. Witness precautions, prerequisites, and procedural steps associated with crane Controlled Assembly procedures (paragraph 589-4.5).

### 589-6.3 CERTIFICATION PROCESS

589-6.3.1 **INITIAL CERTIFICATION.** Initial crane certification will generally be established during each regular overhaul of the ship. Initially, the material condition of all cranes will be certified by the overhauling industrial activity, based on satisfactory completion of crane repair and maintenance work, plus the satisfactory performance of tests and inspections which meet the requirements of this chapter. The industrial activity will normally be a shipyard or ship repair facility. In some cases, however, the industrial activity will be an IMA, or crane manufacturer. After the industrial activity has certified the material condition of the crane, and the non-material requirements of the Certification Program are satisfied, the Commanding Officer may certify the crane for use, establishing initial certification. Certification remains valid for a period of 1 year, or until a decertification occurs for other reasons (see paragraph 589-6.3.2).

589-6.3.1.1 **Ships Within an Operating Cycle.** For ships within an operating cycle, a Certification Program shall begin with an initial certification, established by the satisfactory completion of a Crane Certification Checklist (Figure 589-6-1). Approval of the checklist by the Commanding Officer will serve as initial certification until the next regular overhaul, at which time, a new certification cycle begins with the certification of crane material condition by the overhauling industrial activity (paragraph 589-6.3.1).

589-6.3.1.2 **Certification Cycle.** A crane certification cycle is the interval from ship overhaul to ship overhaul. When a ship regular overhaul cycle extends beyond 4 years, arrangement will be made to perform load testing (paragraph 589-5.5.3) to ensure that the stipulated 4-year periodicity of load testing is not exceeded. In either case, complete load testing and inspection shall be performed during regular overhaul in order to establish a crane certification cycle which allows certification of crane material condition by the overhauling industrial activity (paragraph 589-4.4.4.1).

589-6.3.1.3 **Annual Certification.** A crane certification is valid for 1 year, unless a decertifying event occurs (paragraph 589-6.3.2). The Crane Certification Checklist (Figure 589-6-1) shall be redone before this time limit. Load test(s) need not be performed, if expiration date(s) have not been exceeded.

589-6.3.2 DECERTIFICATION. Decertifying events are identified in [Table 589-4-2](#) as certification deficiencies. Examples include: exceeding the rated capacity of the crane during operations (other than load tests witnessed by authorized test personnel), 18 months expiring since latest Type Commander (or Type Commander's representative) audit, and deficiencies in the crane certification envelope, as described in paragraph [589-6.4](#). Complete the applicable portions of the Crane Decertification/Recertification Crane Certification Checklist (Sample Form) (2 Sheets). Form (Figure [589-6-2](#)). An example of the completed form is provided in Figure [589-6-3](#). A decertified crane shall not be used for load handling until recertified, or a departure-from-specification (paragraph [589-6.3.3](#)) has been granted.

589-6.3.3 DEPARTURES-FROM-SPECIFICATION. Departures-from-specification are interim certification procedures used to authorize crane operations in the interval between a decertifying event (paragraph [589-6.3.2](#)) and full recertification. Departures-from-specification may or may not place restrictions on crane operation. Departures-from-specification are approved by the Commanding Officer, or appropriate authorities external to the ship as specified in [Table 589-4-2](#). Where applicable, the departure-from-specification forms from the appropriate Type Commander's QA manual shall be used to document approval of crane departures-from-specification. Alternately, prepare a form similar to that of Figure [589-6-4](#). All departures-from-specification pertaining to major deficiencies in load bearing members, load controlling members, and safety features will be sent (in message format) to the appropriate Type Commander for action. Send copies to:

NAVSEA - Codes 05P7 and either PMS 308 or (for CV/CVN) PMS 312.

NAVSEA Philadelphia - Code 9731

DIRSSP - Code 262 (for cranes handling strategic weapons).

589-6.3.3.1 If the departure-from-specification is approved by the cognizant authority authorizing interim operation following a decertifying event, the crane may be operated contingent upon restrictions imposed by the departure. Applicable portions of Figure [589-6-2](#) shall be completed to document authority to operate the crane. Departures-from-specification responses from approving authority will specify actions necessary to clear the departure. Once the action has been taken, the departure may be cleared according to the Type Commander's normal procedure. If a crane is subject to a departure-from-specification at the time of annual recertification, a Crane Certification Checklist (Figure [589-6-1](#)) will be performed, and the departure-from-specification recorded on the checklist as an outstanding item. Upon correction of deficiencies, and clearance of the departure-from-specification, a complete Crane Certification Checklist need not be performed unless required by [Table 589-4-2](#).

<b>CRANE CERTIFICATION CHECKLIST</b>		
<b>FORM CONTROL NO.</b>	Sheet <u>   </u> of <u>   </u>	
<b>SHIP</b>	<b>DATE</b>	
Crane Designation: _____		
a. Technical Manual _____ (Onboard <input type="checkbox"/> YES <input type="checkbox"/> NO)		
b. Special safety precautions in technical manual not otherwise covered by NSTM Chapter 589: _____ _____		
c. Testing and Inspection Requirements for this crane*: <ol style="list-style-type: none"> <li>1. Component Inspection-Annually</li> <li>2. No-load test-Annually</li> <li>3. ___% static load test every 4 years</li> <li>4. ___% dynamic load test every 4 years</li> <li>5. 100% rated load test every 4 years.</li> </ol>		
*Unless special considerations of paragraph 589-5.9 apply, testing will be as follows: 150% static load test every 4 years 125% dynamic load test every 4 years 100% rated load test every 4 years		
<b>PERSONNEL</b>		<b>INITIALS</b>
1. Crane crew organized, trained, and qualified in accordance with chapter 589, section 3.		_____
<b>PMS</b>		
1. MIP'S and MRC's up to date in accordance with LOEP.		_____
<b>TECHNICAL MANUAL</b>		
1. All changes incorporated in accordance with E-STEPS publication master.		_____
<b>OPERATIONS</b>		
1. ODCL available, in-use, and reviewed.		_____
2. Safety precautions posted.		_____
3. Ship motion and wind limits posted.		_____
4. Design limitations posted		_____
5. Crane log available and up to date.		_____
<b>MATERIAL**</b>		
1. Minimum safety features installed.		_____
2. Required maintenance performed.		_____
<b>INSPECTION**</b>		
1. Required Inspection Performed		
a. Annual Component Inspection	_____	_____

Figure 589-6-1 Crane Certification Checklist (Sample Form) (Sheet 1 of 2)

<b>CRANE CERTIFICATION CHECKLIST</b>	
<b>FORM CONTROL NO.</b>	Sheet <u>   </u> of <u>   </u>
<b>SHIP</b>	<b>DATE</b>
<b>TESTING*</b>	
<b>1. Required Testing Performed</b>	
a. Annual No-load Test	_____
b. Static Load Test (performed at <u>   </u> % within last 4 years)	_____
c. Dynamic Load Test (performed at <u>   </u> % within last 4 years)	_____
d. 100% Rated Load Test (performed within last 4 years)	_____
<b>**If certification of material condition, inspection, or testing is provided by an industrial activity (such as, shipyard, SRF), identify the letter or document number and attach the pertinent correspondence:</b>	
	<b>Document No.</b>
<b>Material</b>	_____
<b>Inspection</b>	_____
<b>Testing</b>	_____
<b>DEPARTURES-FROM-SPECIFICATION</b>	
<b>1. List any outstanding deficiencies, including documentation of the applicable departures-from-specification:</b>	
<b>DEFICIENCY</b>	<b>DEPARTURE APPROVAL</b>
	<b>RESTRICTION</b>
<b>CERTIFICATION</b>	
<b>1. Certification Recommended:</b>	_____
	<b>Crane Officer/date</b>
<b>2. Concurrence in Recommendation:</b>	_____
	<b>Crane Certifying Officer/date</b>
<b>3. Certification Approved:</b>	_____
	<b>Commanding Officer/date</b>
<b>Certification Expires</b>	_____
	<b>(1 year from certification date; that is, CO's signature</b>

Figure 589-6-1 Crane Certification Checklist (Sample Form) (Sheet 2 of 2)

**CRANE DECERTIFICATION/RECERTIFICATION FORM**

SHIP	DATE
A. CRANE DESIGNATION _____	
B. DECERTIFYING EVENT (See paragraph 589-6.14) _____ _____	
How Discovered _____	
C. DEPARTURE-FROM-SPECIFICATION	
1. Approval Authority (See table 589-6)	_____
2. Approval Document	_____
3. Restrictions	_____
4. Special precautions	_____ _____ _____
5. Tagout	_____
D. RECERTIFICATION	
1. Action to Correct Deficiency	_____
2. Requisition	_____
3. Required Testing	_____ _____
4. Satisfactory Test Complete	_____
5. Recertification Recommended	_____
	<b>Test Director</b>
	_____
	<b>Crane Officer</b>
	_____
	<b>Certifying Officer</b>
6. Recertification Approved	_____
	<b>Commanding Officer</b>
7. Departure Cleared	_____

Figure 589-6-2. Crane Decertification/Recertification Form (Sample)

**CRANE DECERTIFICATION/RECERTIFICATION FORM**USS CANOPUS (AS 34)  
SHIP5 Aug 1983  
DATE

- A. CRANE DESIGNATION Starboard 57-1/2 Ton B & M Crane
- B. DECERTIFYING EVENT (See paragraph 589-6.3.3) Main hoist upper limit switch failed

How Discovered ODCL**C. DEPARTURE-FROM-SPECIFICATION**

- |   |  |
|---|--|
| 1. Approval Authority (See table 589-6) | <u>COMSUBLANT</u>  |
| 2. Approval Document                    | <u>CSL 071525Z Aug 83</u>                                      |
| 3. Restrictions                         | <u>50% Load</u>  |
| 4. Special precautions                  | <u>Station observer in cab to caution against two-blocking</u> |
| 5. Tagout                               | <u>Caution Tag 83-362</u>                                      |

**D. RECERTIFICATION**

- |                                 |  |
|---------------------------------|--|
| 1. Action to Correct Deficiency | <u>Replace switch</u>                    |
| 2. Requisition                  | <u>USS CANOPUS 051905Z Aug 83</u>        |
| 3. Required Testing             | <u>Visual Inspection/ No-Load Test</u>   |
| 4. Satisfactory Test Complete   | <u>(signature)</u><br>Test Director      |
| 5. Recertification Recommended  | <u>(signature)</u><br>Crane Officer      |
|                                 | <u>(signature)</u><br>Certifying Officer |
| 6. Recertification Approved     | <u>(signature)</u><br>Commanding Officer |
| 7. Departure Cleared            | <u>USS CANOPUS 241110Z Aug 83</u>        |

Figure 589-6-3. Crane Decertification/Recertification Form (Example)

**FM: SQUADRON COMMANDER**  
**TO: TYPE COMMANDER**  
**INFO: COMNAVSEASYS COM WASHINGTON DC**  
**NAVSES PHILADELPHIA PA**  
**DIRSSP WASHINGTON DC<sup>1</sup>**  
**COGNIZANT IMA**  
**SHIP**

**CLASSIFICATION//09589//**

**SUBJ: DEPARTURE-FROM-SPEC REQUEST NUMBER (No.<sup>1</sup> - yr) FOR CRANE ON**  
**USS \_\_\_\_\_ (HULL NO.)**

**A. NSTM Chapter 589**

- 1. Copies to: NAVSEA Codes 56W4 and either 931 or (CV/CVN only) 912; NAVSES Code 07; DIRSSP<sup>2</sup> Code 262.**
- 2. Type Departure: (such as, Major/Load Bearing Member)**
- 3. System/Component/Location: (such as, Topping Hoist/Drum/Machinery Space)**
- 4. NAVSEA DWG/Plan No./Piece No.: (list)**
- 5. Ship Info Book/Tech Man Reference: (list)**
- 6. Applicable Specification: (list)**
- 7. Situation/Degree of Noncompliance: (describe)**
- 8. Comments/Recommendations (Tests Conducted/Proposed Restrictions): (list)**
- 9. Answer Requested by: (date).**

---

<sup>1</sup> Sequential number without regard to specific crane addressed.

<sup>2</sup> For cranes handling strategic weapons.

**NOTE: Refer to NTP 3, Telecommunications Users Manual**

Figure 589-6-4. Departure-From-Specification Request (Sample Message Format)

589-6.3.4 RECERTIFICATION. Recertification requirements, following a decertifying event, are specified in Table 589-4-2. Recertification may involve satisfactory completion and signoff of a new Crane Certification Checklist (Figure 589-6-1), or only specific portions of the initial certification process as specified by the departure-from-specification approval authority, depending upon the nature of the deficiency. When the specific recertification process has been completed, the Crane Officer, in conjunction with the Crane Certifying Officer, may recommend recertification to the Commanding Officer by completing item D.5 of Figure 589-6-2. If a complete Crane Certification Checklist is done as part of the recertification process, certification will be valid for 1 year, barring an interim disqualifying event. If only limited specific testing, or other inspection, is performed, the

periodicity of the certification shall be 1 year from the date of the last complete Crane Certification Checklist. Records of all tests and inspections associated with recertification shall be retained in the crane certification file (paragraph 589-6.6).

#### **589-6.4 CRANE COMPONENT CERTIFICATION ENVELOPE**

589-6.4.1 DEFINITION. The crane certification envelope is comprised of the load bearing members, load controlling members, safety features, and travel drive systems of the crane. All equipment items and crane components essential to safe and reliable load handling are considered a part of the certification envelope. Crane certification depends on the continued satisfactory material condition of the equipment within the certification envelope. When a material deficiency exists within the certification envelope, the deficient item shall be repaired or replaced, and the crane recertified, or a departure-from-specification requested according to paragraph 589-6.3.3. Crane operation with deficient certification envelope components is unauthorized unless a departure-from-specification has been granted.

589-6.4.1.1 A crane component certification envelope for various types of shipboard cranes is shown in Appendix E. If necessary, slight modifications may be made to the certification envelope shown in Appendix E to accommodate minor design differences within crane types. Certification envelope modifications should be forwarded to Naval Ship Systems Engineering Station (NAVSEA Philadelphia) (Code 9731) for concurrence. The component certification envelope of Appendix E lists minimum requirements and should not be construed as limiting the authority of Commanding Officers to add items or components. The envelope of Appendix E was derived as follows:

- a. Load Bearing Members. Crane components which transmit the weight of a suspended load to the supporting structure.
- b. Load Controlling Members. Crane components, or systems, installed to permit the motion of a suspended load.
- c. Safety Features. Items installed to prevent possible injury to personnel or damage to equipment as a result of crane operation.
- d. Rotation and Travel Drive Systems. Crane components or systems necessary to cause the crane to rotate or to travel from one location to another.

589-6.4.1.2 If the component certification envelope of Appendix E is not appropriate to a specific shipboard crane because of crane design or uniqueness of installation, NAVSEA Philadelphia (Code 9731) should be informed (by letter), identifying the appropriate technical manual. NAVSEA Philadelphia will provide the ship with an appropriate certification envelope.

589-6.4.2 MAJOR DEFICIENCIES. Major deficiencies in the crane certification envelope are those deficiencies which directly involve the ability to safely and reliably handle loads up to the rated capacity of the crane. Deteriorated wire rope, defective brakes, hydraulic pump or motor failure, electric drive motor failure, inoperative limit switches, and inoperative interlocks are examples of major deficiencies. Major deficiencies that cannot be resolved shall be the subject of a departure-from-specification request. See Table 589-4-2 for approval authority.

589-6.4.3 MINOR DEFICIENCIES. Minor deficiencies in the crane certification envelope are those deficiencies which affect the capability of the crane to perform according to design specifications, but otherwise do not directly impact safe load handling. Inability to operate at rated speed, limited travel or topping capability, out-of-

calibration instruments, inoperative travel warning device, and overdue maintenance actions are examples of minor deficiencies. In identifying minor deficiencies, ensure that a minor deficiency is not merely a symptom of an underlying major deficiency (affecting safety). Minor deficiencies that cannot be resolved shall be the subject of a departure-from-specification request. See [Table 589-4-2](#) for approval authority.

## 589-6.5 AUDITS

589-6.5.1 POLICY. Periodic audits shall be performed to ensure that the crane certification program is being properly administered. Audits will be conducted according to the audit plan provided as [Appendix F](#). In general, audits should be performed to the intent of the requirement, rather than to exact requirements of specific attributes. Where a specific attribute requires a procedure to be in place, the auditor will check beyond the mere existence of a procedure and evaluate the procedure effectiveness by examining associated documents, such as the tag out log and material history.

589-6.5.1.1 Audit results should be reported to the Crane Officer and the Crane Certifying Officer on the day of the audit, so that the Crane Officer may identify certification envelope deficiencies (if any) and take appropriate action. Certification envelope deficiencies will result in decertification, or departures-from-specification, and recertification according to normal procedure. Audit results and the Crane Officer's recommended corrective action, shall be promptly forwarded to the Commanding Officer upon completion of the audit. A followup report by the Crane Officer stating corrective action taken, or remaining to be accomplished, should be forwarded to the Commanding Officer within 45 days of the audit.

589-6.5.2 PERIODICITY. The Crane Certifying Officer will conduct an annual shipboard audit of the certification program for each crane. The audit will precede the annual recertification of the cranes in a timely manner. In addition, audits will be conducted by the Type Commander's staff or the Type Commander-sponsored technical team at 9- to 18- month intervals (approximately). The Type Commander's audit may examine all areas for compliance with this chapter, or related directives.

## 589-6.6 CRANE CERTIFICATION FILE

589-6.6.1 Appropriate forms and records will be maintained in an auditable manner and remain available for review during certification audits ([Table 589-6-4](#)). The records may be in the custody of the Crane Officer, Division Officer, or other ship officer with crane responsibility.

**Table 589-6-4 RECORD RETENTION PERIOD**

Form/Record	Reference Paragraph	Retention Period
Completed Qualification Records	<a href="#">589-3.3.6</a>	Until transfer of individual
Qualified Watchstanders Notebook	<a href="#">589-3.3.6</a>	Until superseded
Operator's Daily Checklist	<a href="#">589-3.5.3</a>	2 weeks
Controlled Assembly Work Packages	<a href="#">589-4.5</a>	5 years, or until next overhaul, whichever is longer
Annual Component Inspections	<a href="#">589-5.3.2</a>	End of next overhaul
No-Load and Load Test Information and Data	<a href="#">589-5.4&amp;</a> <a href="#">589-5.5</a>	Life of crane
Type Commander's Promulgated Load Test Forms (such as, COMSUBLANTINST C8000.15)		

**Table 589-6-4** RECORD RETENTION PERIOD - Continued

<b>Form/Record</b>	<b>Reference Paragraph</b>	<b>Retention Period</b>
Crane Certification Checklist	<a href="#">589-6.3.1.1</a>	End of next overhaul
Decertification/Recertification Forms	<a href="#">589-6.3.2</a>	End of next overhaul
Departures-from-Specification	<a href="#">589-6.3.3</a>	End of next overhaul
Audit Form	<a href="#">589-6.5</a>	End of next overhaul
Audit Corrective Actions	<a href="#">589-6.5.1.1</a>	End of next overhaul
Audit Follow-Up Report	<a href="#">589-6.5.1.1</a>	End of next overhaul

589-6.6.2 The Crane Officer shall maintain a crane certification file for each shipboard crane or mobile crane assigned to the ship. The initial Crane Certification Checklist (Figure [589-6-1](#)) with certification by the industrial activity (paragraph [589-6.3](#)) shall be retained in the file, along with all subsequent departures-from-specification and recertifications. Decertification/recertification forms (Figure [589-6-2](#)) are completed for each decertifying event, as discussed in paragraph [589-6.3.2](#). For every decertification/recertification form, there may be one or more departures-from-specification and test and inspection results documenting recertification requirements. Documents in the crane certification file shall be retained until completion of the next crane overhaul, after which the file contents may be disposed of at the option of the ship.

## SECTION 7. CRANE RIGGING GEAR

### 589-7.1 Introduction

This section is intended to provide fabrication, test, and inspection requirements for crane rigging gear and miscellaneous rigging gear (see Table 589-7-8 for a summary of this chapter). For load rigging procedures, see 589-3.6. For rigger qualification requirements, see 589-3.2.5. The requirements contained within this section apply to Navy and contractor owned rigging gear used for handling general cargo with Navy owned shipboard cranes. Rigging gear requirements for non-cargo handling applications can be found in the following documents:

- a. For weapons handling applications refer to NSTM Chapter 700 "Shipboard Ammunition Handling and Stowage" and NAVSEA SW023-AH-WHM-010 "Handling Ammunition, Explosives and Hazardous Material with Industrial Materials Handling Equipment".
- b. For boat handling applications refer to NSTM Chapter 583 "Boat and Small Craft"
- c. For underway replenishment applications refer to NSTM Chapter 571 "Underway Replenishment"
- d. For nuclear material handling applications refer to NAVSEA 0989-043-0000 "Commissioned Surface Ship General RP Overhaul and Repair Specification".
- e. For deep submergence vehicles and diving systems refer to NAVSEA SS800-AG-MAN-010/9290 "System Certification Procedures and Criteria Manual for Deep Submergence Systems" and NAVSEA SS521-AA-MAN-010 "U.S. Navy Diving and Manned Hyperbaric Systems Safety Certification Manual".

Shore-based rigging gear and portable hoists meeting the requirements specified in NAVFAC P-307 "Management of Weight Handling Equipment" can be used aboard the ship and with shipboard cranes when the ship is pierside. This section applies to the following shipboard equipment:

### 589-7.2 Crane Rigging Gear and Miscellaneous Rigging Gear

#### 589-7.2.1 Rigging Gear.

- a. Slings:
  - Wire Rope
  - Chain
  - Synthetic Rope
  - Synthetic Webbing
  - Synthetic Roundslings
- b. Accessories:
  - Shackles
  - Links
  - Rings
  - Eye Bolts
  - Turnbuckles

- Hooks
- Swivels
- Tackle Blocks
- Swivel Hoist Rings

589-7.2.2 Miscellaneous Rigging Gear -Portable Load Indicators.

- Dynamometers
- Scales

589-7.2.3 Miscellaneous Rigging Gear - Portable Chain Falls and Hoists.

- Chainfalls
- Hoists

589-7.2.4 Definition of Terms. Definitions are provided as follows for terms directly associated with shipboard crane rigging gear or weight handling equipment, or where a particular term has a specific meaning within this section:

- a. **Angle of Choke (wire rope slings).** The angle formed in wire rope body as it passes through the choking eye (see Figure 589-7-1).

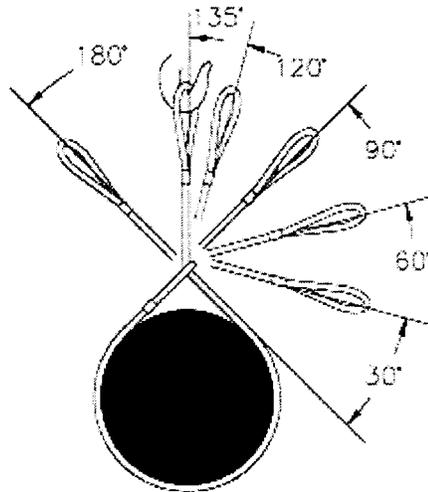
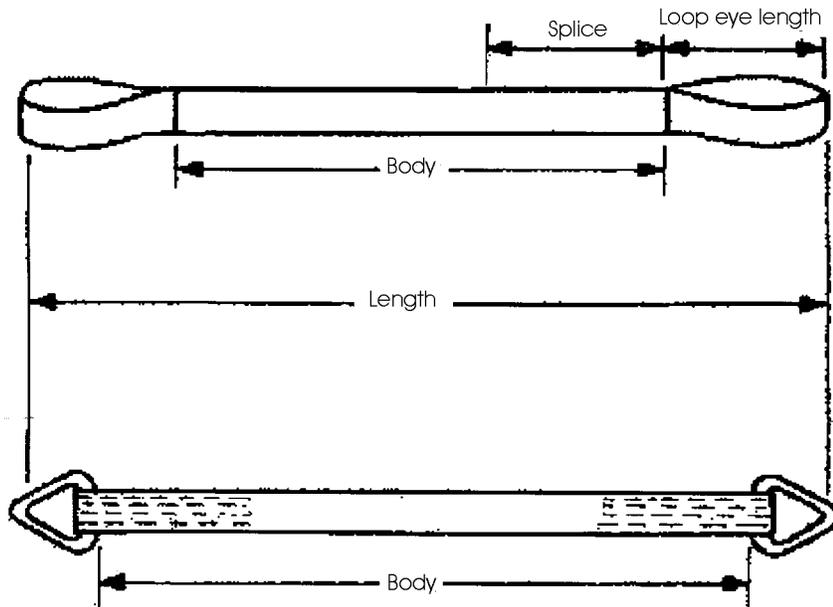


Figure 589-7-1 Slings In Choker Hitch

Angle of Choke	Sling Rated Load Percentage of Single Leg Sling Capacity
120 - 180	75%
90 - 119	65%
60 - 89	55%
30 - 59	40%

- b. **Angle of Loading.** Slope of a leg or branch of a sling, may be measured from the horizontal or vertical plane (See Figure 589-7-5).
- c. **Bridle Sling.** A sling composed of multiple legs with top ends gathered in a fitting that goes over the lifting hook.
- d. **End Fitting.** Terminal hardware on the end of a sling.
- e. **Endless Sling.** A sling formed by a single rope or web that is bent into a loop and whose ends are attached to each other by means of one or more mechanical end fittings.
- f. **Eye, Sling.** The opening in the end of a sling for the attachment of the hook, shackle, other lifting device or the load itself.
- g. **Factor of Safety.** Ratio between nominal or minimum acceptance breaking strength and rated capacity of a sling or component.
- h. **Hitch Basket.** A method of rigging a sling in which the sling is passed around the load and both loop eyes or end fittings are attached to the lifting device.
- i. **Hitch Choker.** A method of rigging a sling in which the sling is passed around the load, then through one loop eye, end fitting, or other device with the other loop eye or end fitting attached to the lifting device. This hitch can be done with a sliding choker hook or similar device.
- j. **Loop Eye (Web Slings).** A length of webbing which has been folded back upon itself, forming an opening, and joined to the sling body to form a bearing surface (see Figure 589-7-2).
- k. **Nick or Gouge.** Sharp notch in a surface which may act as a stress riser in the area of the notch.
- l. **Proof Load.** The specific load applied in performance of the proof tests.
- m. **Proof Test.** A nondestructive load test made to a specific multiple of the rated load of the sling or device.
- n. **Rigging Gear.** Equipment used by itself or in conjunction with other equipment to support or move loads.
- o. **Reach (Alloy Steel Chain).** Effective length of an alloy steel chain sling measured between the bearing surfaces of the end fittings (see Figure 589-7-3).
- p. **Selvage Edge.** The woven or knitted edge of synthetic webbing so formed as to prevent raveling.



BODY - the part of a sling which is between  
The end fittings or loop eyes.

LENGTH - the distance between extreme end bearing  
points on the sling, including the fittings.

Figure 589-7-2 Web Slings

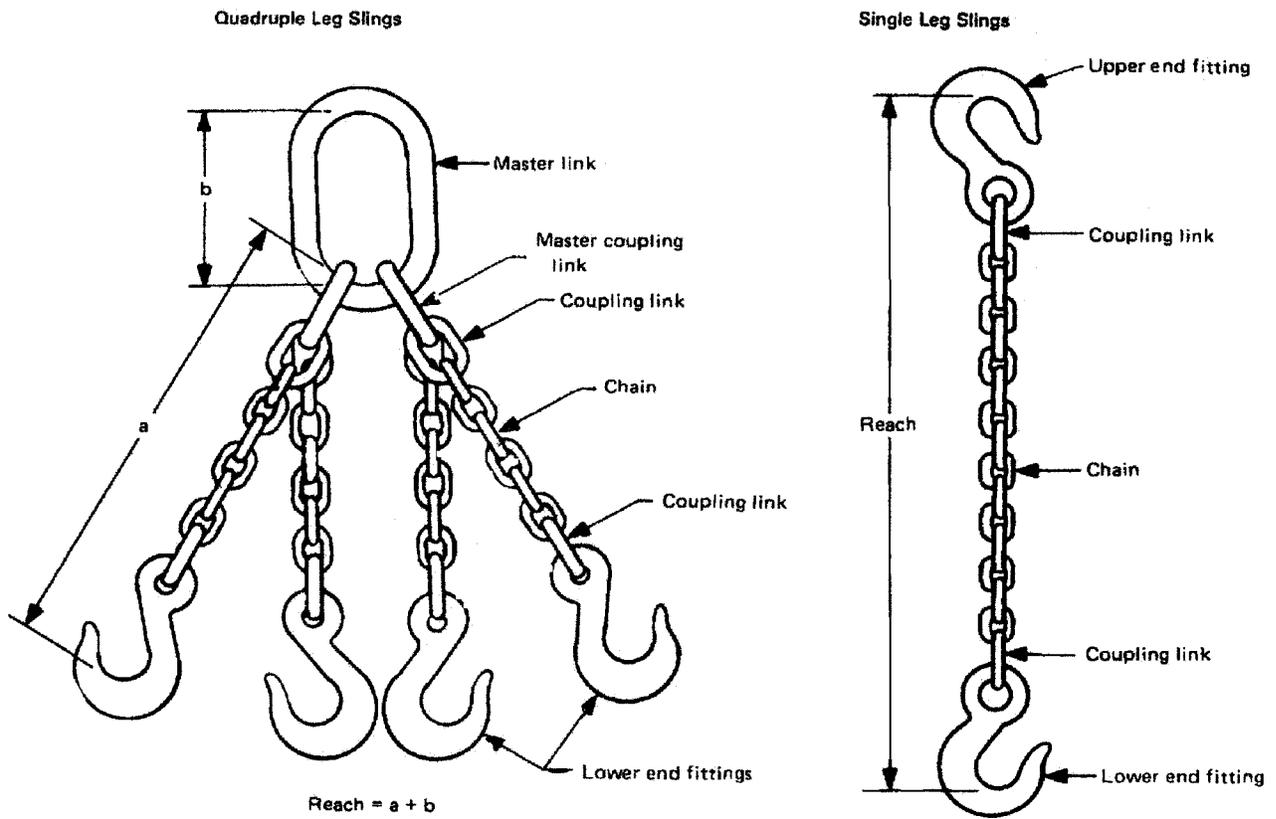


Figure 589-7-3 Chain Sling Major Components

### 589-7.3 Design.

This section provides general design guidance for crane rigging gear. Though detail fabrication information (i.e. drawings, etc) is not included within this section, sufficient information is provided to construct many types of rigging assemblies.

#### 589-7.3.1 Rigging Gear.

589-7.3.1.1 New Rigging Gear Markings. The preferred method of marking crane rigging gear covered by this document is to have a permanently affixed durable identification marked with the following:

- Name, symbol, or trademark of equipment manufacturer
- Rated load
- Date tested or inspected
- Test or Inspection Expiration date

- Name of facility that conducted test or inspection

Markings shall be such that the strength of the component will not be affected. For multiple part equipment that can be separated (e.g. shackles with pins), the subordinate part (the pin) shall be identified to the primary part (bow). In the case of slings: multiple-leg sling assemblies shall be marked with the rated load of each leg and the link shall be marked with the maximum load for the assembly. Where it is not feasible, as determined by the responsible activity, to attach an identification marker to the rigging gear, the following alternative identification method may be used. The rigging gear shall be marked by a serial number or color code that can be used by the responsible activity to refer to documentation containing the same information that would be placed on a identification tag.

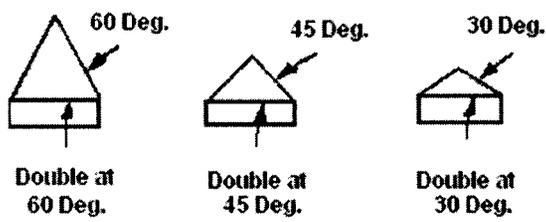
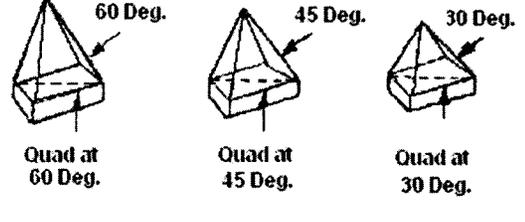
589-7.3.1.2 Slings. The factors of safety based on breaking strength for the various sling constructions are provided in Table 589-7-1.

**Table 589-7-1** Sling Factors of Safety

Sling Material	Factor of Safety
Wire Rope	5 to 1
Synthetic Fiber Rope: (Including Roundslings) • Nylon, Polyester, Polypropylene	5 to 1
Alloy Steel Chain	5 to 1
Synthetic Webbing	4 to 1

- Wire Rope Slings.** Wire rope slings are the most common construction sling in use. Wire rope slings shall be constructed of rope meeting Federal Specification RR-W-410. Rated load shall be based upon the acceptance breaking strength of the specific wire rope and nominal splicing or end fitting efficiency. Refer to Table 589-7-1 for the required factor of safety for wire rope slings. Refer to Tables 589-7-2 and 589-7-3 and Figure 589-7-5 for capacity requirements of various slings configurations. Wire rope end fittings shall be made in accordance with NSTM Chapter 613 "Wire and Fiber Rope and Rigging".
- Chain Slings.** Chain slings are recommended for use in high abrasive and high temperature environments (below 400 degrees F) that may damage other types of slings. Chain slings should not be used where their use increases the risk of electrical shock or electrocution. Chain slings shall be constructed from chain meeting ASTM A391/A391 M and assembled in accordance with ASTM A906/A906M. Refer to Table 589-7-1 for the required factor of safety for chain slings. Refer to Tables 589-7-2 and 589-7-3 and Figure 589-7-5 for capacity requirements of various slings configurations.
- Synthetic Fiber Rope Slings.** Fiber rope slings constructed from conventional three-strand construction fiber rope should have the factors of safety listed in Table 589-7-1. Fiber rope slings shall be fabricated in accordance with ANSI/ASME B30.9 or OSHA 1910.184. Refer to Tables 589-7-2 and 589-7-3 and Figure 589-7-5 for capacity requirements of various slings configurations. All splices shall be made in accordance with the following or with fiber rope manufacturer's recommendations.
  - Synthetic Fiber Rope - Eye splices shall contain at least four full tucks, and short splices shall contain at least eight full tucks (4 on each side of the centerline of the splice).

Table 589-7-2 Rated Loads of Slings

								
			Multipliers for Rated Load of Double Leg Slings			Multipliers for Rated Load of Triple and Quadruple Leg Slings (See Note 4)		
Breaking Strength (B.S.)	Factor of Safety (F.S.)	Equivalent B.S.	60 Deg	45 Deg	30 Deg	60 Deg	45 Deg	30 Deg
See Note 1	See Note 2	See Note 3	1.7321	1.4142	1.0000	1.7321	1.4142	1.000
Multiply the Equivalent B.S. by the corresponding Multiplier and round down to the nearest 25 lbs increment to get Rated Load. See Note 5. Examples below are for slings made from 1/2" Dia. 6x19 IWRC, IPS wire rope								
23000 lbs	5	4600 lbs	7,950 lbs	6,500 lbs	4,600 lbs	7,950 lbs	6,500 lbs	4,600 lbs
Note 1: Insert the Nominal Breaking Strength (Minimum Acceptance Strength if using RR-W-410) of the sling material or the lowest ultimate strength of any accessory rigging components. Note 2: Insert the Factor of Safety per Table 589-7-1. Note 3: The Equivalent Breaking Strength is the Breaking Strength divided by the Factor of Safety. Note 4: Quadruple and triple sling ratings are the same as double leg because normal lifting practices may not distribute load uniformly on all three or four legs. Select two diagonally opposing legs for calculations. Note 5: Sling ratings are typically rounded down to the nearest 25 lbs increment from the value calculated using the multipliers.								

**Table 589-7-3** Rated Loads for Basket Hitch Slings

			Rated Load Multipliers for Eye and Eye Sling						Rated Load Multipliers for Endless Sling					
			Vertical Hitch	Choker Hitch	BASKET HITCH (See Note 5)				Vertical Hitch	Choker Hitch	BASKET HITCH (See Note 5)			
					Angle of Rope to Horizontal						Angle of Rope to Horizontal			
					60 Deg	45 Deg	30 Deg				60 Deg	45 Deg	30 Deg	
Breaking Strength (B.S.)	Factor of Safety (F.S.)	Equivalent B.S.	Angle of Rope to Vertical				Angle of Rope to Vertical							
0 Deg	30 Deg	45 Deg	60 Deg	0 Deg	30 Deg	45 Deg	60 Deg	0 Deg	30 Deg	45 Deg	60 Deg			
See Note 1	See Note 2	See Note 3	1.0000	0.7500	2.0000	1.7320	1.4140	1.0000	1.0000	0.7500	4.0000	3.4640	2.8280	2.0000
Multiply the Equivalent B.S. by the corresponding Multiplier and the D/d Efficiency Percentage of Figure 589-7-4 and round down to the nearest 25 lbs increment to get Rated Load. See Note 4.														
Examples below are for slings made from 1/2" Dia. 6x19 IWRC, IPS wire rope, D/d ratio over 40:1														
23000 lbs	5	4600 lbs	4,600 lbs	3,450 lbs	9,200 lbs	7,950 lbs	6,500 lbs	4,600 lbs	4,600 lbs	3,450 lbs	18,400 lbs	15,925 lbs	13,000 lbs	9,200 lbs
<p><b>Note 1:</b> Insert the Nominal Breaking Strength (Acceptance Breaking strength if using RR-W-410) of the sling material or the lowest ultimate strength of any accessory rigging components.</p> <p><b>Note 2:</b> Insert the factor of safety per Table 589-7-1.</p> <p><b>Note 3:</b> The Equivalent Breaking Strength is the Breaking Strength divided by the Factor of Safety.</p> <p><b>Note 4:</b> Sling ratings are typically rounded down to the nearest 25 lbs increment from the value calculated using the multipliers.</p> <p><b>Note 5:</b> For wire rope basket slings refer to Figure 589-7-5 for minimum D/d ratios.</p>														

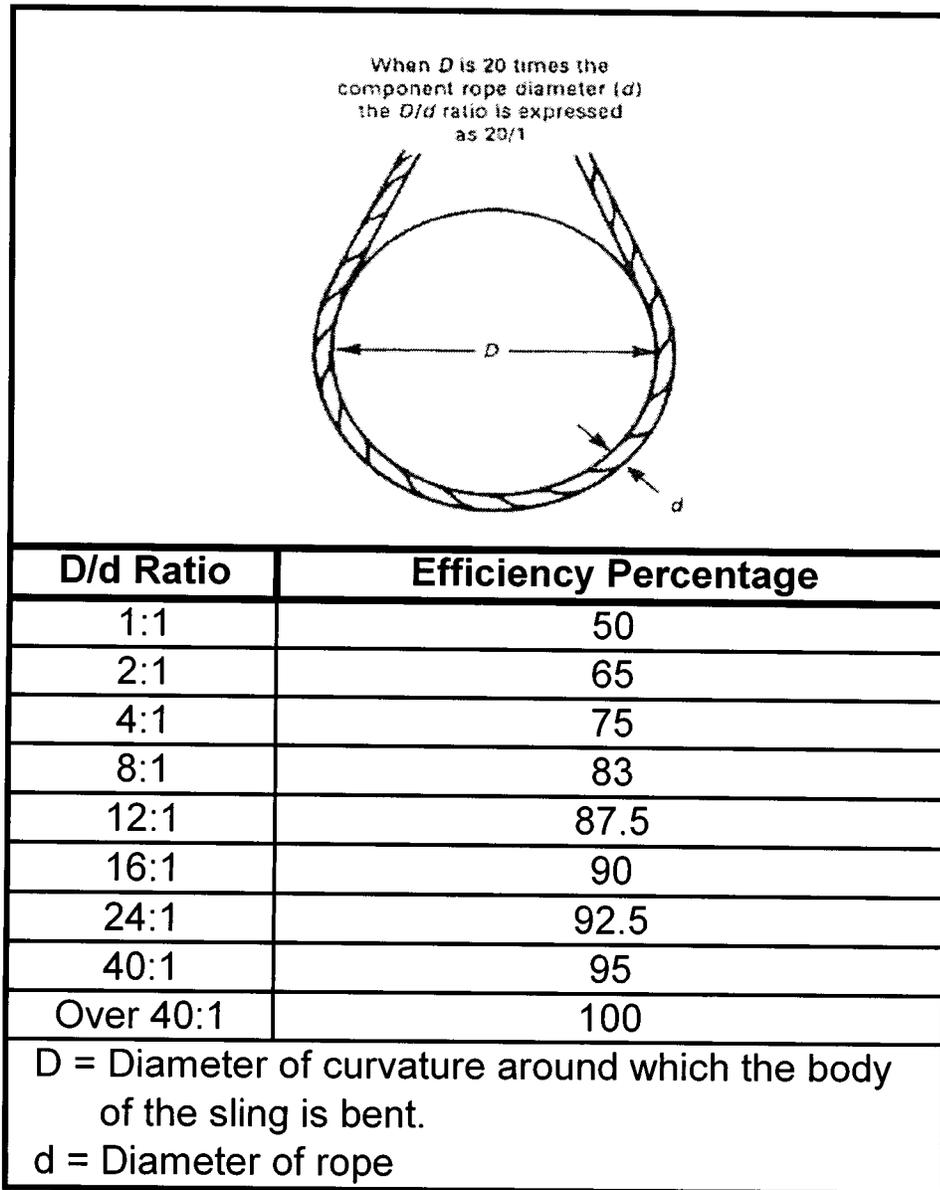
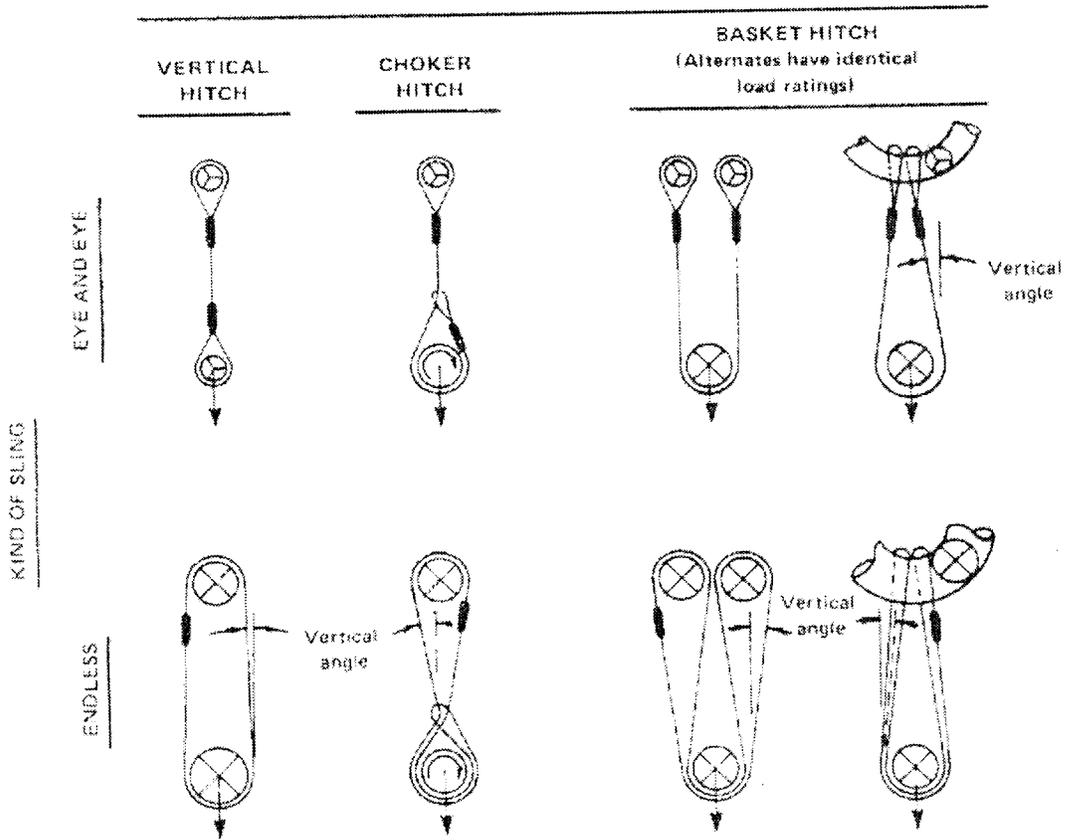


Figure 589-7-4 Wire Rope Efficiencies for Basket Style Slings



**These symbols represent load or support surfaces in contact with the sling:**

- ⊗ Represent a contact surface which shall have a diameter of curvature at least 8 times the diameter of the rope.
- ⊗ Represents a load in choker hitch and illustrates the rotary force on the load and/or the slippage of the rope in contact with the load.
- ⊙ Diameter of curvature of load surface shall be at least double the diameter of the rope.

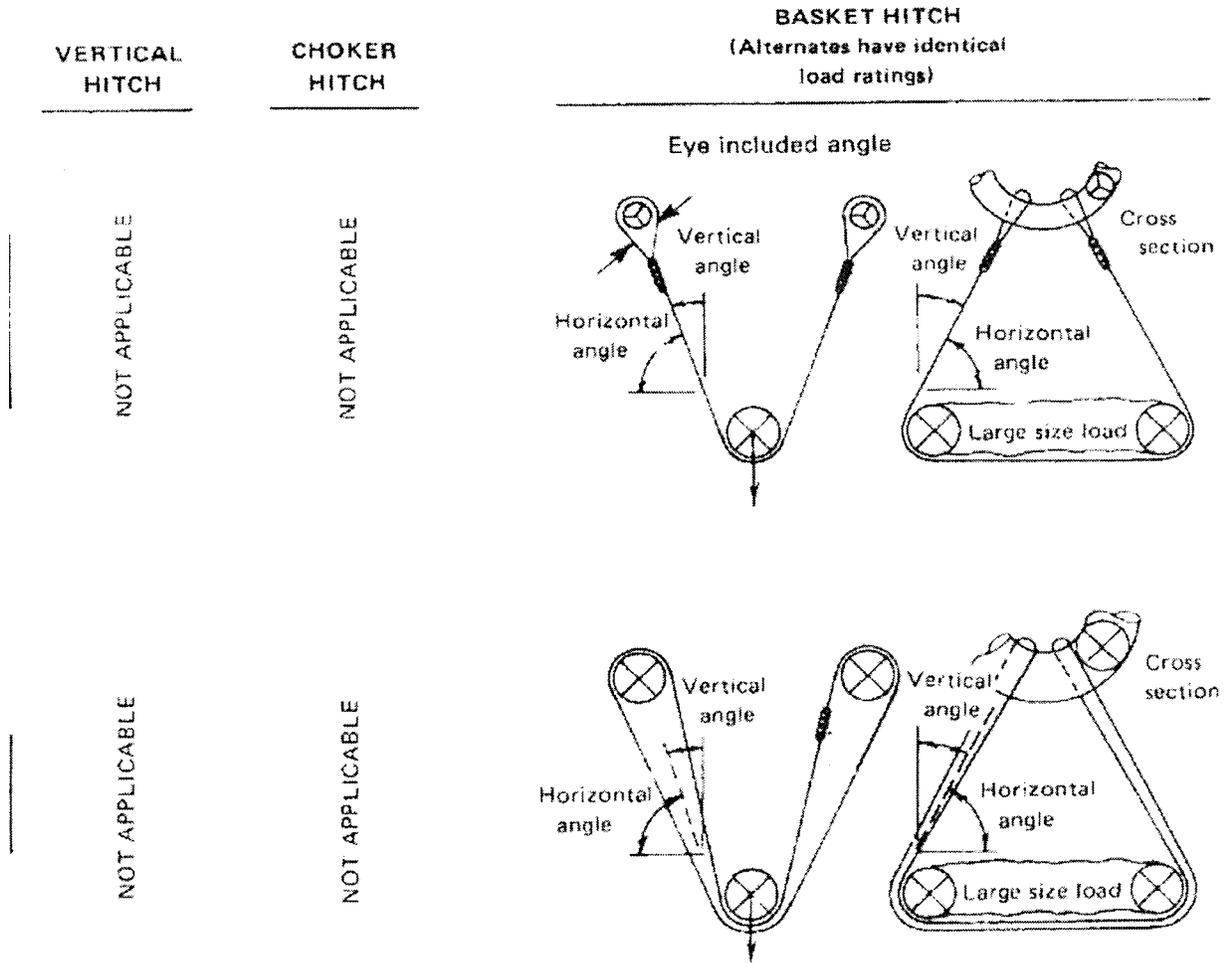


Figure 589-7-5Sh2 Minimum Diameter of Curvature for Basic Sling Configurations (Sheet 2 of 2)

d. **Synthetic Webbing Slings.** Use of knotted synthetic webbing is prohibited. Synthetic webbing slings should be woven of high tenacity synthetic yarns, that can be easily fabricated into slings. Web slings shall be fabricated in accordance with ANSI/ASME B30.9 or OSHA 1910.184. Webbing material should have the following characteristics:

1. Sufficient certified tensile strength to meet the load requirements.
2. Uniform thickness and width.
3. Full woven width, including selvage edges.
4. Webbing ends should be sealed by heat, or other suitable means, to prevent raveling.

Synthetic webbing slings should be constructed with a factor of safety in accordance with Table 589-7-1. Refer to Tables 589-7-2 and 589-7-3 and Figure 589-7-5 for capacity requirements of various slings configurations.

e. **Synthetic Roundslings.** Synthetic roundslings consists of a continuous, or endless, loop of synthetic fibers known as a bundle. The accumulation of fiber strands determines the strength of the sling. The multiple fiber construction makes roundslings soft and flexible allowing the sling to easily contour around a load. The bundle of fibers is protected by cover thus preventing the fibers from coming into direct contact with the load and weather elements. Roundslings shall be fabricated in accordance with ANSI/ASME B30.9 or OSHA 1910.184. Roundslings shall have a factor of safety as listed in Table 589-7-1. Refer to Tables 589-7-2 and 589-7-3 and Figure 589-7-5 for capacity requirements of various slings configurations.

589-7.3.1.3 Accessory Gear. Accessory rigging components that are typically used for crane rigging gear are listed below:

Shackles

Links

Rings

Eye Bolts

Turnbuckles

Hooks

Swivels

Tackle Blocks

Swivel Hoist Rings

Accessory gear used with slings or other hoisting gear shall have a rated load at least equal to the rated load of the sling (wire rope, chain, etc.). Shackles, links, rings, and swivels shall meet Federal Specification RR-C-271. Turnbuckles shall meet ASTM F 1145. Carbon steel eyebolts shall meet ASTM A489 and Alloy steel eyebolts shall meet ASTM F541. Shoulder and non-shouldered eyebolts shall be used in accordance with Original Equipment Manufacturer (OEM) instructions. Loads applied at angles out of the plane of the eye are not permitted on eyebolts. Shoulder eyebolts capacities are reduced when loaded at angles within the plane of the eye, see Table 589-7-4. Non-shouldered eyebolts shall not have load applied greater than five degrees in the plane of the eye. Wire rope tackle blocks shall meet or exceed Commercial Item Description (CID) A-A-59390. Synthetic rope tackle blocks shall meet or exceed MIL-B-24220. Wire rope and synthetic running rigging for tackle blocks shall have a safety factor of 5.0 on the minimum breaking strength of the rope. If a piece of accessory gear has a rated capacity less than that of the sling material then the entire assembly shall be tagged to indicate the reduced rated load. All rigging gear accessories, with the exception of tackle blocks and hooks, shall have a minimum factor of safety of 5. Tackle blocks and hooks shall have a minimum factor of safety of 4.

Swivel hoist rings may be used at any angle up to 90 degrees with no reduction in rated load when used in accordance with OEM recommendations. They shall be used in threaded holes where they can be installed with the shoulder flush to the face of the mounting surface. Threaded holes in the piece lifted shall be of sufficient length to allow full thread contact. Where retaining nuts are approved for use, use only those nuts specified by the OEM. Where a nut is used, the nut shall

have full thread engagement. It is critical that the OEM recommended installation torque be applied to the attaching bolt. If screwed into a base material of questionable grade or strength, the installation torque and rated load shall be reduced as recommended by OEM or the activity engineering organization.

**Table 589-7-4** Eye Bolt Loading for Shoulder Eyebolts

Direction of Loading (in plane of eye)	Maximum Allowable Rated Load
Along axis of the shank	100%
15 degrees	65%
30 degrees	35%
45 degrees	25%
60 degrees	20%
90 degrees (As permitted by OEM)	15%

589-7.3.2 Portable Load Indicators. Portable load indicating devices such as dynamometers and scales should have a minimum factor of safety of 5. Load indicators that have aluminum load bearing parts shall have a factor of safety of 7. Load indicators that have factors of safety less than those specified shall only be used and tagged for loads within the proper safety factor.

589-7.3.3 Portable Chain Falls and Hoists. Devices such as chainfalls and lever-operated hoists shall have a minimum factor of safety of 5 and shall meet or exceed ASME HST-1 through 6 as applicable .

#### 589-7.4 Test and Inspection Requirements.

This section provides the criteria for test and inspection requirements for crane rigging gear, including portable load indicators, and portable chain falls and hoists. Each activity that possesses shipboard crane rigging gear shall establish a program for its periodic inspection and testing. Any gear determined to be unsatisfactory shall be removed from service and disposed of or repaired and re-tested. Except as noted, each piece of rigging gear shall be given an initial load test prior to being put in service. A certificate of load (proof) test from the supplier of purchased equipment will satisfy this requirement, provided the proof loads used meet or exceed the loads specified in Table 589-7-5. See Table 589-7-8 for a summary of the fabrication, inspection, and testing requirements of this section.

**Table 589-7-5** Initial Test Load Requirements

Item	Test Load Percentages of Rated Load
Rigging Gear (Slings, Shackles, Swivels, Links, Turnbuckles, Tackle Blocks, etc.)	150%
Portable Load Indicators	150%
Portable Chain Falls and Hoists	125%

For each component tested the test load will be applied for a period of two minutes, except for hoists where the time will be 10 minutes. No permanent deformation shall be allowed. When testing wire rope and synthetic slings, ensure the slings are prevented from unlaying. Rigging assemblies made up of components (slings, shackles, links, etc.) that are reserved for that particular assembly may be tested as a complete assembly. A rigging component tested as a part of an assembly shall not be removed and used independently, unless it can be proven that the component was tested at the applicable percentage shown in Table 589-7-5.

589-7.4.1 In-Service Equipment Markings. Test and inspections performed on in-service rigging equipment shall be marked with the information provided in paragraph 589-7.3.1.1.

589-7.4.2 Rigging Gear, Test and Inspection Requirements. Rigging gear shall be initially tested to the value shown in Table 589-7-5 prior to initial use. The legs of a multiple leg sling shall be tested individually (or two legs at a time with the

legs 180 degrees apart). The master link (and master coupling links if used) shall be tested at the appropriate test load for each sling leg multiplied by the number of sling legs supported by that link. Following successful completion of the initial load test, rigging gear does not require periodic load tests.. A certificate of proof test of the gear to at least the value shown in Table 589-7-5 is an acceptable substitute for a Navy accomplished test. If a certificate of proof test is provided with a piece of rigging gear then the gear shall still be marked in accordance with paragraph 589-7.3.1.1. Shore-based crane rigging gear, in accordance with Naval Facilities Engineering Command (NAVFAC P-307), can be used aboard the ship and with shipboard cranes when the ship is pierside provided that the gear test and inspection tags are within periodicity.

589-7.4.2.1 Frequent Inspection Requirements. The user shall visually inspect rigging gear each day it is used. These visual observations are intended to discover gross damage that may be an immediate hazard. In general these frequent inspections should at a minimum look for the following discrepancies:

- a. Distortion or damage of sling material (wire rope, chain, etc.). Such distortion can take the form of kinking, tears, broken wires, heat damage, cut or frayed strands, etc.
- b. Evidence of serious corrosion such that the physical integrity of the sling is compromised.
- c. Permanently deformed or damaged components such as hooks, shackles and links.

589-7.4.2.2 Periodic Inspection Requirements. All rigging gear used for shipboard cranes shall be required to have an annual detailed inspection. A qualified person shall perform the periodic inspection. Slings shall be inspected along their entire length including splices, end attachments, and fittings. Dependent upon the type of sling construction the following detailed inspection instructions shall be used. Upon satisfactory completion of the inspection the sling shall be marked in accordance with paragraph 589-7.3.1.1. The previous marking shall be removed and the new marking applied.

589-7.4.2.3 Sling Test and Inspection Criteria. Slings shall be initially tested to the value shown in Table 589-7-5 prior to initial use. Following successful completion of the initial load test, a piece of rigging gear does not require periodic load tests.

- a. **Wire Rope Slings.** Each leg of the wire rope sling shall be inspected as follows:
  1. Inspect the entire length of the wire rope or strand for broken wires. Six or more broken wires in one rope per lay length or three or more broken wires in one strand per lay length shall be cause for removal.
  2. Inspect for discoloration due to heat damage. If heat damage is observed, the sling leg shall be removed from service.
  3. Inspect for kinking, crushing, birdcaging, or any other damage resulting in distortion of the rope structure. If any of these conditions is observed, the sling leg shall be removed from service.
  4. Inspect for wear by measuring rope diameter at six or more places with vernier calipers. If the rope diameter is reduced by more than the amount shown in Table 589-7-6 for the applicable size rope, or there is an unexpected increase in lay length as compared to previous lay length measurements, the sling shall be removed from service.
  5. Inspect wire rope near end fittings. If one or more broken wires within one rope lay length of any end fitting is observed, the sling leg shall be removed from service.
  6. Inspect the core of the rope using a marlin spike. The wire rope can be opened for internal inspection only when completely relaxed. Use care to avoid damaging the strands or core, open the wire rope in six or more places, by working a marlin spike beneath two strands. Carefully rotate the spike to expose the core and underside of the strands. If internal corrosion, broken wires, or core failure is observed, the sling leg shall be removed from service. Particular attention shall be given to the wire rope in areas close to end fittings, those lengths that pass over sheaves, onto drums, or that remain exposed to or immersed in seawater. If a wire rope has been opened properly and carefully, and internal condition does not show cause for removal, the strands can be returned to their original working positions without distorting the wire rope or impairing future usefulness

7. Inspect end attachments. If cracks, deformation, or wear to the extent that the strength of the sling is effected, the sling leg shall be removed from service.

**Table 589-7-6** Wire Rope Allowable Diameter Reduction

Nominal Rope Diameter (Inches)	Reduction (Inches)
5/16 and smaller	1/64
3/8 to 1/2	1/32
9/16 to 3/4	3/64
7/8 to 1-1/8	1/16
1-1/4 to 1-1/2	3/32
1-9/16 to 2	1/8
2-1/8 to 2-1/2	5/32

- b. Chain Slings. Each leg of the chain sling shall be inspected over its entire length as follows:

1. Inspect each link and end attachment individually. Examine the inner link surfaces of the chain and chain attachments. If nicks, cracks, breaks, gouges, stretch, bends, discoloration from excessive temperature, or excessive throat opening of hooks is observed, the sling leg shall be removed from service.
2. Inspect each link to ensure that it rotates and slips with its respective connected links. If binding is observed, the sling leg shall be removed from service.
3. Inspect and measure the diameter of several links in each leg of the sling. The number of links chosen for measurement should be at least ten percent (10%) of the total number of links in the sling leg. If a link is found to have a diameter less than those provided in Table 589-7-7, the sling leg shall be removed from service.

**Table 589-7-7** Minimum Allowable Diameter for Chain Links

Chain Size		Actual Dia.		Minimum Allowable Dia.
Inches	MM	Inches	MM	(inches)
1/4	7	.276	7.00	.239
3/8	10	.394	10.00	.342
1/2	13	.512	13.00	.443
5/8	16	.630	16.00	.546
3/4	20	.781	19.84	.687
7/8	22	.906	23.01	.750
1	25	1.031	26.19	.887
1 1/4	32	1.281	32.54	1.091

- c. Synthetic Fiber Rope Slings. Each leg of the rope sling shall be inspected over its entire length as follows:

1. Inspect the rope sling's physical condition. If gouges, kinks, cuts, or worn fibers or yarns are observed, the sling leg shall be removed from service.
2. Inspect the rope for filament of fiber breakage along the line where adjacent strands meet (light fuzzing is acceptable). If these conditions are observed, the sling leg shall be removed from service.
3. Inspect for discoloration or harshness that may mean chemical damage or excessive exposure to sunlight. Inspect filaments or fibers for weakness or brittleness. If these conditions are observed, the sling leg shall be removed from service.
4. Inspect the rope for broken filaments or fibers inside the rope between the strands. If these conditions are observed, the sling leg shall be removed from service.

- d. Synthetic Webbing Slings. Each leg of the synthetic webbing sling shall be inspected over its entire length as follows:

1. Inspect the webbing material for evidence of acid or caustic burns, melting or charring, holes, tears, cuts, snags, knots, or broken stitching. If any of these conditions are observed, the sling leg shall be replaced.

2. Inspect sling end fittings for excessive corrosion or pitting, or cracked or distorted pieces. If any of these conditions are observed, the sling leg shall be removed from service.

e. **Synthetic Roundslings.** Synthetic roundslings shall be inspected over their entire length as follows:

1. Inspect the sling for gouges, kinks, cuts, or worn fibers or yarns. If any of these conditions are observed, the sling leg shall be removed from service.
2. Inspect the sling cover for breakage or wear that causes the internal fibers of the sling to be visible. If any of these conditions are observed, the sling leg shall be removed from service.
3. Inspect for discoloration or harshness that may mean chemical damage or excessive exposure to sunlight. If any of these conditions are observed, the sling leg shall be removed from service.

589-7.4.2.4 Accessory Rigging Gear Test and Inspection Requirements. Accessory rigging gear shall be initially tested to the value shown in Table 589-7-5 prior to initial use. Following successful completion of the initial load test, a piece of rigging gear does not require periodic load tests.

- a. **Shackles.** Shackles must conform to Federal Specification RR-C-271. Shackles shall be visually inspected for manufacturer's marking (i.e., raised or stamped letters with the identifying manufacturer's name or trademark, size, and Working Load Limit). Refer to NSTM Chapter 572, Shipboard Stores and Provision Handling, for inspection criteria on shackles.
- b. **Turnbuckles.** Turnbuckles shall be visually inspected for manufacturer's marking (i.e., raised or stamped letters with the identifying manufacturer's name or trademark, size, and Working Load Limit). Also check for cracks, corrosion, distortion (bending, spreading, or twisting), and peening/wear (including nicks or gouges). Replace turnbuckle if any of the above conditions are not satisfied. Figure 589-7-6 shows the various classes of turnbuckles. Turnbuckle end fittings shall be measured as is shown in Figure 589-7-7. The turnbuckle shall be replaced if a five percent or greater reduction from the nominal diameter is measured, Table 589-7-8 shows minimum allowable diameters.
- c. **Links, Rings, Swivels, and Swivel Hoist Rings.** Links, rings, and swivels shall be inspected for proper operation and for wear and excessive corrosion. Visually inspect for manufacturer's marking (i.e., raised or stamped letters with the identifying manufacturer's name or trademark, size, and Working Load Limit). Also check for cracks, corrosion, distortion (bending, spreading, or twisting), and peening/wear (including nicks or gouges). Replace the component if any of the above conditions are not satisfied. Links, rings, and swivels shall be replaced if a five percent, or greater, reduction from nominal diameter is measured, Table 589-7-8 shows minimum allowable diameters.
- d. **Eye Bolts.** Eye bolts shall be inspected for the following:
  1. bent or distorted eye or shank
  2. nicks and gouges
  3. obvious evidence of wear
  4. worn and/or distorted threads
  5. cracks
- e. If any of these defects are noted, the eyebolt shall be removed from service. Eyebolts shall be measured as is shown in Figure 589-7-8. The eye bolt shall be replaced if a five percent or greater reduction from nominal diameter is measured, Table 589-7-8 shows minimum allowable diameters.

**Table 589-7-8** Turnbuckle, Link, Ring, Swivel, Swivel Hoist Rings, and Eyebolt Replacement Diameters

Nominal Diameter	Remove from Service When Diameter Equals
1/2	.475
5/8	.5938
3/4	.7125

**Table 589-7-8** Turnbuckle, Link, Ring, Swivel, Swivel Hoist Rings, and  
 Eyebolt Replacement Diameters - Continued

7/8	.8313
1	.950
1-1/4	1.1875
1-3/8	1.306
1-1/2	1.425
1-3/4	1.6625
2	1.900
2-1/4	2.1375
2-1/2	2.375

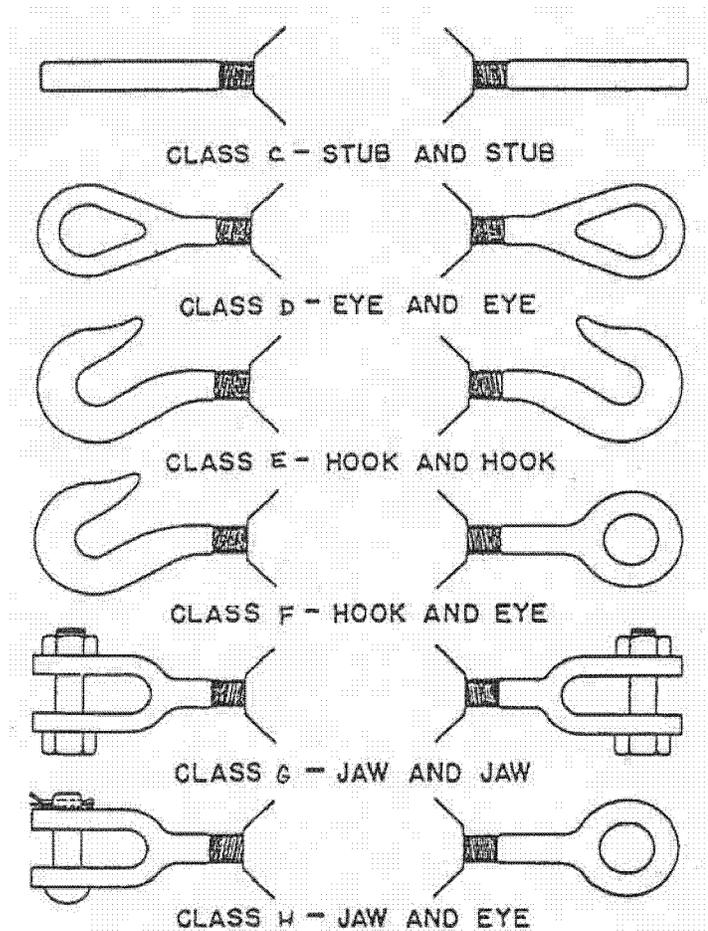


Figure 589-7-6 Classes of Turnbuckles

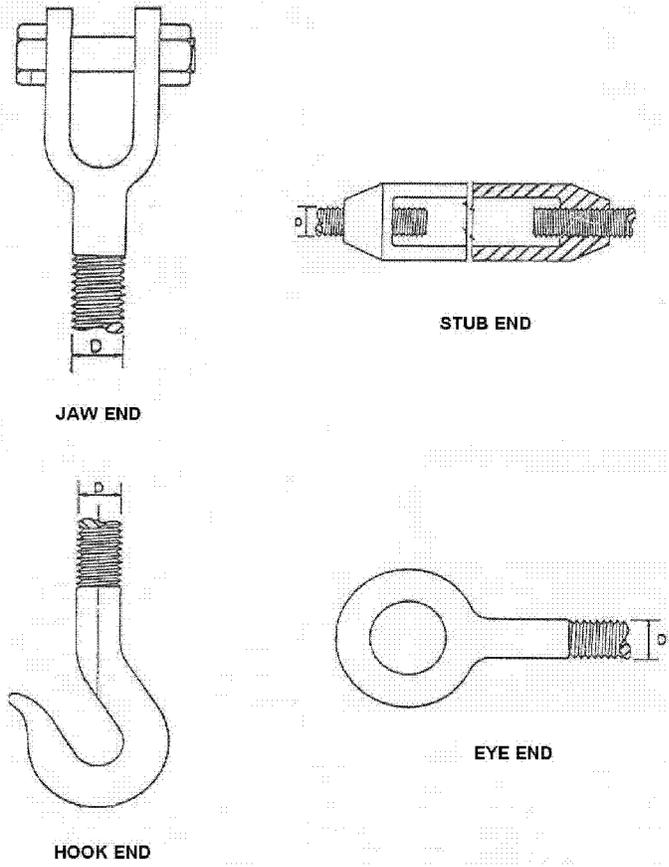


Figure 589-7-7 Turnbuckle Endfitting Inspections

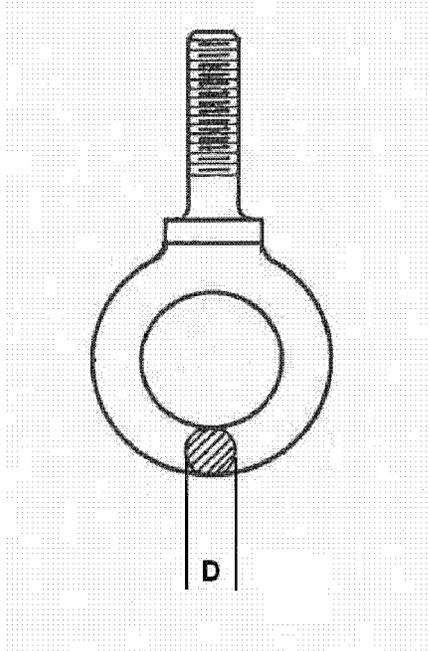


Figure 589-7-8 Eye Bolt Diameter Measurement

f. **Hooks.** Hooks shall be visually inspected for the following.

1. Inspect for cracks, nicks, and gouges. Light filing by hand is permitted to remove slight surface cracks, nicks, and gouges. If cracks nicks or gouges more than surface type, the hook shall be removed from service.
2. Inspect hook for wear by measuring several places on the hook, as recommended in Figure 589-7-9. Wear exceeding 10% of the original sectional dimensions per manufacturers' catalog information, the hook shall be removed from service.
3. Inspect hook for bending or twisting. If a bend or twist exceeds 10 degrees from the plane of an unbent hook, the hook shall be removed from service.
4. Inspect hook for an increase in the throat opening. If the throat opening has exceeded 15% of the original manufacturers' dimension, the hook shall be removed from service.
5. Inspect self locking hooks for ability to self lock. The hook shall be removed from service if the hook has difficulty or cannot self lock.
6. Inspect self latching hooks for the ability of the latch to automatically close the hook's throat. If the latch does not automatically close, the hook shall be removed from service.

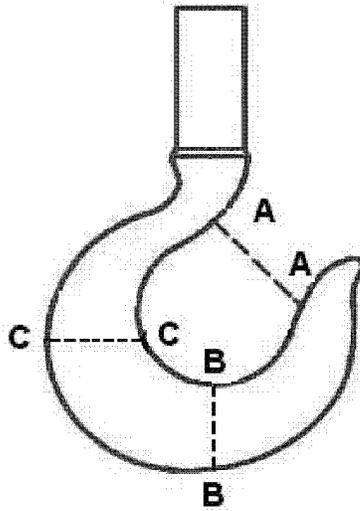


Figure 589-7-9 Typical Hook Measurement Locations

g. Tackle Blocks. Tackle blocks shall be visually inspected and removed from service if the inspection reveals any of the following:

1. Any evidence of distortion.
2. Any cracks in the block housing or sheaves.
3. Any damage to the sheaves.
4. Any binding or abnormal sheave play.

589-7.4.3 Portable Load Indicators Test and Inspection Requirements. Portable load indicators such as dynamometers and scales shall be initially tested to the value shown in Table 589-7-5. Following successful completion of the initial load test, a portable load indicating device does not require periodic load tests. Portable load indicating devices do require periodic calibration every year. The device shall be labeled following successful calibration with a durable tag indicating the date calibration was performed, the expiration date of the calibration, and the activity or company that performed the calibration.

589-7.4.3.1 Frequent Inspection Requirements. The user shall visually inspect portable load indicators each day they are used. These visual observations are intended to discover gross damage that may be an immediate hazard. Portable load indicators shall be removed from service if the inspection reveals any of the following:

- a. Distortion or damage of the piece of gear.
- b. Evidence of serious corrosion such that the physical integrity of the gear is compromised.

589-7.4.3.2 Periodic Inspection Requirements. Each portable load indicating device used for shipboard cranes rigging shall be required to have an annual detailed inspection. A qualified person shall perform the periodic inspection. Upon satisfactory completion of the inspection the device shall be marked in accordance with paragraph 589-7.3.1.1. Portable load indicators shall be removed from service if the inspection reveals any of the following:

- a. Bent or distorted parts.

- b. Nicks and gouges.
- c. Obvious evidence of wear.
- d. Worn distorted threads end fittings.

589-7.4.4 Portable Chain Falls and Hoists Test and Inspection Requirements. Portable chain falls and hoists shall be initially tested to the value shown in Table 589-7-5. Following successful completion of the initial load test, a lifting device requires periodic load test every five years.

589-7.4.4.1 Frequent Inspection Requirements. The user shall visually inspect each portable chain fall or hoist each day it is used. These visual observations are intended to discover gross damage that may be an immediate hazard. Portable chain falls and hoists shall be removed from service if the inspection reveals any of the following:

- a. Structural deformation, cracks, or excessive wear on any part of the device.
- b. Loose or missing guards, fasteners, covers, stops, or nameplates.
- c. Misadjustments of all functional operating mechanisms and automatic hold and release mechanisms that will interfere with operation.

589-7.4.4.2 Periodic Inspection Requirements. Each portable chain fall or hoist used for shipboard cranes shall be required to have an annual detailed inspection. Additionally, a detailed inspection shall be accomplished prior to the periodic load test. A qualified person shall perform the periodic inspection. Upon satisfactory completion of the inspection and subsequent load test the device shall be marked in accordance with paragraph 589-7.3.1. Portable chain falls and hoists shall be removed from service if the inspection reveals any of the following:

- a. Loose or missing bolts or fasteners.
- b. Cracked or worn gears, pulleys, sheaves, sprockets, bearings, chains, and belts.
- c. Excessive wear of friction pads, linkages, hoisting hook points, load support clevises, pins and other mechanical parts.

Table 589-7-9 Shipboard Crane Rigging Gear and Miscellaneous Rigging Gear Reference Chart

Equipment Category	Equipment	Fabrication Design Requirements	Inspection Requirements	Test Requirements
Rigging Gear - Slings	Wire Rope	5 to 1 F.S. BREAKING STRENGTH Fed Spec RR-W-410 see para. 589-7.3.1.2.a	Frequent Inspection per para. 589-7.4.2.1 Annual inspection per para. 589-7.4.2.2 and para. 589-7.4.2.3.a	Initial 150% rated capacity load test per para 589-7.4.2 No periodic load test required
	Chain	4 to 1 F.S. BREAKING STRENGTH ASTM A391/ASTM A906 see para. 589-7.3.1.2.b	Frequent Inspection per para. 589-7.4.2.1 Annual inspection per para. 589-7.4.2.2 and para. 589-7.4.2.3.b	Initial 150% rated capacity load test per para 589-7.4.2 No periodic load test required
	Synthetic Rope	F.S. per Table 589-7-1 ANSI B30.9/OSHA 1910 see para. 589-7.3.1.2.c	Frequent Inspection per para. 589-7.4.2.1 Annual inspection per para. 589-7.4.2.2 and para. 589-7.4.2.3.c	Initial 150% rated capacity load test per para 589-7.4.2 No periodic load test required
	Synthetic Web	5 to 1 F.S. BREAKING STRENGTH ANSI B30.9/OSHA 1910 see para. 589-7.3.1.2.d	Frequent Inspection per para. 589-7.4.2.1 Annual inspection per para. 589-7.4.2.2 and para. 589-7.4.2.3.d	Initial 150% rated capacity load test per para 589-7.4.2 No periodic load test required
	Roundslings	F.S. per Table 589-7-1 ANSI B30.9/OSHA 1910 see para. 589-7.3.1.2.e	Frequent Inspection per para. 589-7.4.2.1 Annual inspection per para. 589-7.4.2.2 and para. 589-7.4.2.3.e	Initial 150% rated capacity load test per para 589-7.4.2 No periodic load test required
Rigging Gear - Accessories	Shackles	5 to 1 FS BREAKING STRENGTH . Fed Spec RR-C-271	Frequent Inspection per para. 589-7.4.2.1 Annual inspection per para. 589-7.4.2.2 and para. 589-7.4.2.4.a	Initial 150% rated capacity load test per para 589-7.4.2.4 No periodic load test required
	Turnbuckles	5 to 1 FS BREAKING STRENGTH . ASTM F 1145	Frequent Inspection per para. 589-7.4.2.1 Annual inspection per para. 589-7.4.2.2 and para. 589-7.4.2.4.b	Initial 150% rated capacity load test per para 589-7.4.2.4 No periodic load test required
	Links, Rings, Swivels, and Swivel Rings	5 to 1 F.S. BREAKING STRENGTH Fed Spec RR-C-271	Frequent Inspection per para. 589-7.4.2.1 Annual inspection per para. 589-7.4.2.2 and para. 589-7.4.2.4.c	Initial 150% rated capacity load test per para 589-7.4.2.4 No periodic load test required
	Eye Bolts	5 to 1 F.S. BREAKING STRENGTH ASTM A 489 ASTM F 541	Frequent Inspection per para. 589-7.4.2.1 Annual inspection per para. 589-7.4.2.2 and para. 589-7.4.2.4.d	Initial 150% rated capacity load test per para 589-7.4.2.4 No periodic load test required
	Hooks	4 to 1 F.S. YIELD STRENGTH	Frequent Inspection per para. 589-7.4.2.1 Annual inspection per para. 589-7.4.2.2 and para. 589-7.4.2.4.e	Initial 150% rated capacity load test per para 589-7.4.2.4 No periodic load test required
	Tackle Blocks	4 to 1 , 5 to 1 F.S. BREAKING STRENGTH (CID) A-A-59390 MIL-B-2422 see para 589-7.3.1.3	Frequent Inspection per para. 589-7.4.2.1 Annual inspection per para. 589-7.4.2.2 and para. 589-7.4.2.4.f	Initial 150% rated capacity load test per para 589-7.4.2.4 No periodic test required
Portable Load Indicators	Dynamometers	5 to 1 F.S. BREAKING STRENGTH	Frequent Inspection per para. 589-7.4.3.1 Annual inspection per para. 589-7.4.3.2	Initial 150% rated capacity load test per para 589-7.4.3 No periodic load test required Annual calibration required
Portable Chain Falls and Hoists	Chainfalls	5 to 1 FS BREAKING STRENGTH ASME HST-1 thru 6 see para 589-7.3.3 .	Frequent Inspection per para. 589-7.4.4.1	Initial 125% rated capacity load test per para 589-7.4.4

**APPENDIX A.****REFERENCE DOCUMENTS****589-A.1 DOCUMENTS AND PUBLICATIONS**

- a. ANSI B30.2.0, **Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)**
- b. ANSI B30.4, **Portal, Tower and Pillar Cranes**
- c. ANSI B30.15, **Mobile Hydraulic Cranes**
- d. CINCLANTFLT/CINCPACFLTINST 8023.5, **Non-Nuclear Ordnance/Explosives Handling Qualification and Certification Program**
- e. COMSUBLANTINST C8000.15, **Conventional Weapons Manual**
- f. MIL-STD-271, **Non-Destructive Testing Requirements for Metals**
- g. MIL-STD-278, **Fabrication, Welding, and Inspection; and Casting Inspection and Repair, for Machinery, Piping, and Pressure Vessels for Ships of the U.S. Navy**
- h. NAVEDTRA 10121, **Boatswain's Mate 3 & 2 Manual**
- i. NAVFAC P-307, NSN 0525-LP-019-3050, **Management of Transportation Equipment**
- j. NAVFAC P-306, NSN 0525-LP-020-5069, **Testing and Licensing of Weight Handling and Construction Equipment Operators**
- k. NAVMAT P-9290, NSN 0518-LP-394-0000, **Deep Submergence Systems, System Certification and Criteria Manual for**
- l. NAVSEA/NAVFACINST 11230.1, **Inspection, Certification and Audit of Crane and Railroad Trackage**
- m. NAVSEAINST 11200.2, **Alteration and Modification of Shipyard Weight Handling Equipment**
- n. NAVSEA OP 4, Vol. 2, **Ammunition Afloat**
- o. NAVSEA OP 3565, **Electromagnetic Radiation Hazards (Vol. 1, Hazards to Personnel, Fuel, and Other Flammable Material; Vol. 2, Hazards to Ordnance)**
- p. NAVSEA STANDARD DRAWING 53711-803-6397257, **Links, Radio Frequency High Voltage Insulator**
- q. NAVSEA TYPE DRAWING 53711-804-6397297, **Man-Basket, Personnel Lift, Arrangement and Details**
- r. NAVSEA 0900-LP-003-8000, **Metals, Surface Inspection Acceptance Standards**
- s. NAVSEA 0989-LP-037-2000, **Overhaul and Repair Specification**
- t. NAVSEA 0989-LP-043-0000, **Surface Ship General RP Overhaul and Repair Specification**
- u. NAVSEA 0989-LP-058-0000, **Tender Nuclear Support Facilities Preventive Maintenance Index**
- v. NTP 3, **Telecommunications Users Manual**
- w. NWP 4-01.4, **Underway Replenishment**
- x. OPNAVINST 3120.32, **Standard Organization and Regulations of the U.S. Navy**
- y. OPNAVINST 4790.4, **Ship's Maintenance and Material Management (3M) Manual**

- z. OPNAVINST 5100.19, **Navy Safety Precautions for Forces Afloat**
- aa. OPNAVINST 5102.1, **Mishap Reporting and Investigating**
- ab. S9086-HB-STM-000/CH-233, **Diesel Engines**
- ac. S9086-S4-STM-000/CH-556, **Hydraulic Equipment (Power Transmission and Control)**
- ad. S9086-TL-STM-000/CH-572, **Shipboard Stores and Provision Handling**
- ae. S9086-TX-STM-000/CH-583, **Boats and Small Craft**
- af. S9086-UU-STM-000/CH-613, **Wire and Fiber Rope and Rigging**
- ag. S9086-XG-STM-000/CH-700, **Shipboard Ammunition Handling and Stowage**
- ah. **Crane Handbook** (Construction Safety Association of Ontario)
- ai. **Rigging Manual** (Construction Safety Association of Ontario)
- aj. **Type Commander's Quality Assurance Manuals**
- ak. NAVSEA STANDARD DRAWING 53711-803-6397427, **Link, Radio Frequency, High Voltage Insulator Link, Cylinder Type.**
- al. MIL-P-23312, **Pallets, Material Handling, Metal (for ordinance items) Mark 3 Mod 0, Mark 12 Mod 0 and Mod 1 .**
- am. MIL-P-52999, **Pallet, Material Handling, Wood Stringer Construction, 4-way Partial, 48 by 40 inches.**
- an. MIL-S-3905, **Slings, Pallet**
- ao. MIL-S-18313, **Slings, Cargo, Net, Nylon Webbing.**

## APPENDIX B.

### STANDARD HAND SIGNALS FOR CONTROLLING SHIPBOARD CRANE OPERATIONS

#### 589-B.1 GENERAL

589-B.1.1 While hoisting or moving loads using a crane, the signalman and crane operator shall maintain a continuous line of communication, normally accomplished by using hand signals. The approved hand signals contained in this appendix shall be used when conducting crane operations by forces afloat. Additional hand signals may be necessary for specific commands; however, no signals used shall conflict with, or alter the meaning of, hand signals contained in this appendix. Additional hand signals shall be specified in ship instructions.

#### 589-B.2 SPEED CONTROL

589-B.2.1 The speeds used while hoisting or lowering the load shall be indicated by pointing one or more fingers of the hand directing crane movement. The number of speed control points needed is a function of the crane and type of control. However, no more than four speed control points should be used. The crane operator shall not exceed the speed control signal directed by the signalman. If the operator feels that use of the directed speed may create an unsafe or hazardous condition for the load or the crane, or exceed operator's ability to control the lift, the crane operator may use a slower speed. The signalman may use one or both hands to signal independent crane motions (that is, hoisting, topping, rotation, or travel). When giving simultaneous signals that include raising or lowering the boom, both the crane operator and the signalman should exercise care with regard to the changing crane capacity; conduct such evolutions at slow speeds.

#### 589-B.3 MULTIPLE LIFTS

589-B.3.1 Where multiple pickup or laydown areas are not readily accessible to one signalman, additional signalmen should be assigned to respective areas. Positive means of transferring control of load movement between the signalmen shall be used. All signalmen and the crane operator shall be briefed and made aware of the transfer of control before commencing the handling evolution. The signalman in control of the lift shall transfer control to the second signalman by use of the proper signal (visual or oral), which shall be properly acknowledged by the second signalman by giving an appropriate crane signal. If the second signalman does not assume proper control of crane movement, the crane operator shall secure movement or place the load in a safe condition until the situation is resolved.

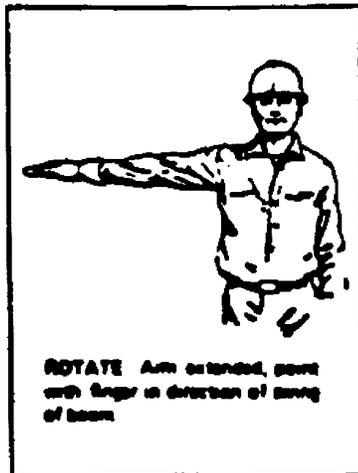
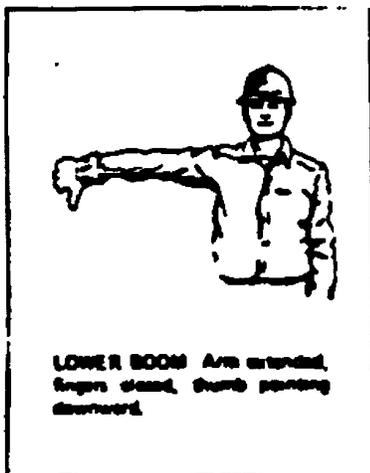
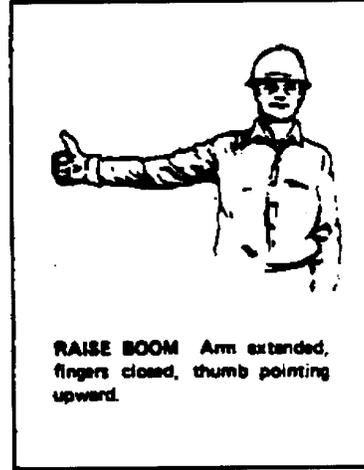
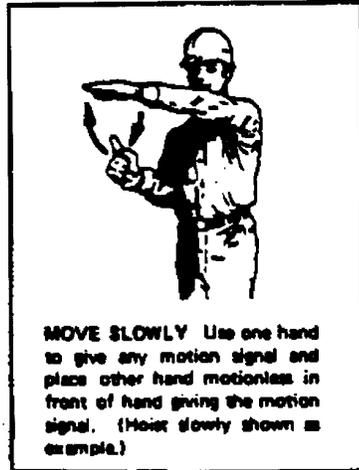
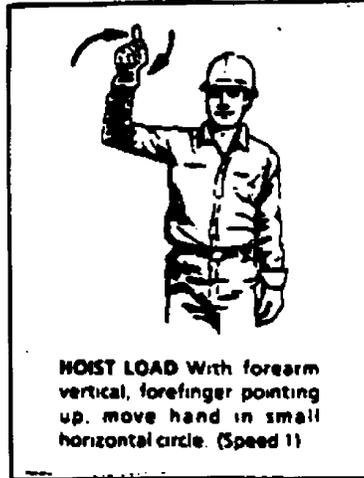


Figure 589-B-1. Standard Hand Signals (Sheet 1 of 2)

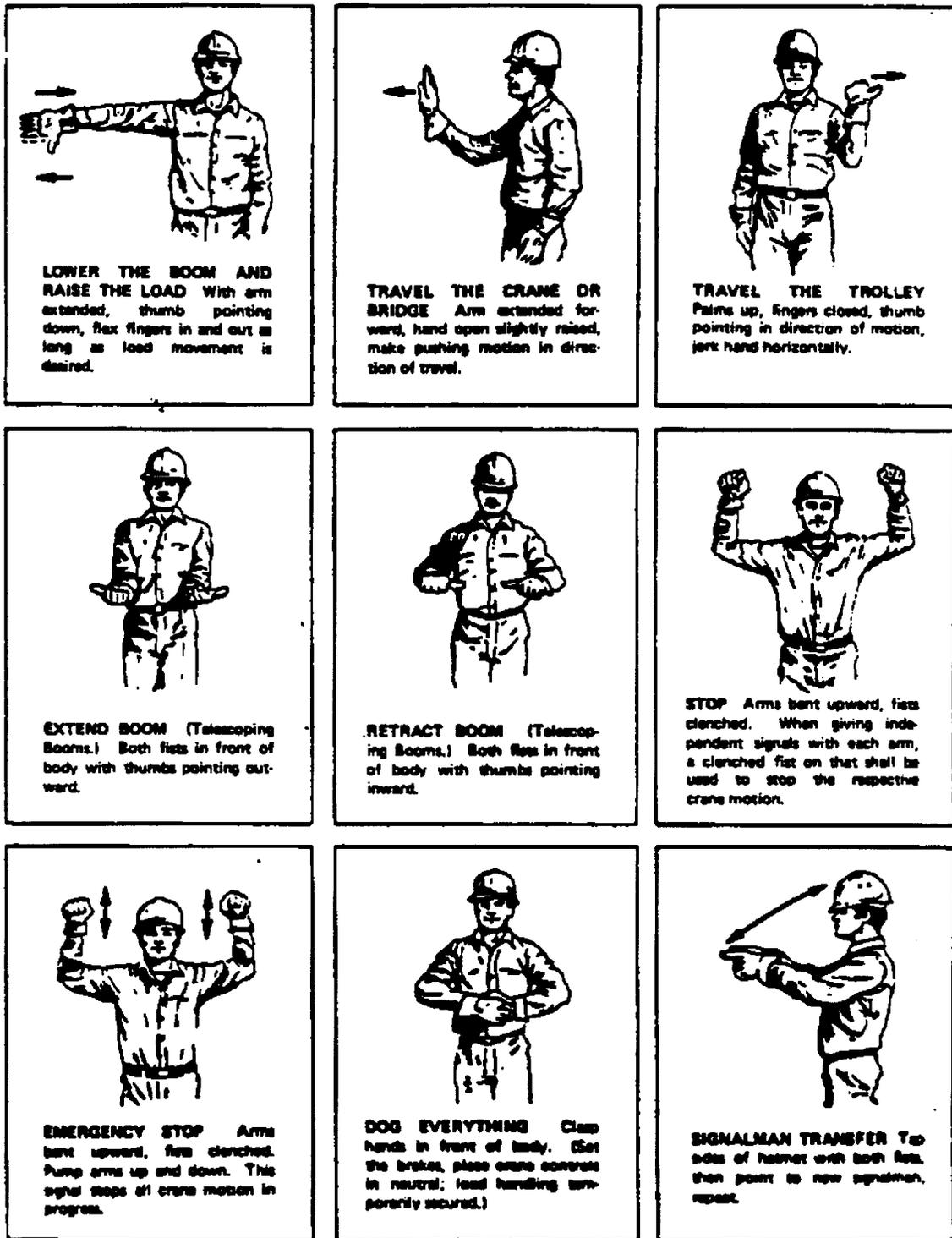


Figure 589-B-1. Standard Hand Signals (Sheet 2 of 2)



## APPENDIX C.

### CRANE CREW QUALIFICATION GUIDES

#### 589-C.1 QUALIFICATION GUIDELINES

589-C.1.1 The following crane crew qualification guides have been developed for use in shipboard qualification programs:

- a. Tagline handler
- b. Ringer
- c. Signalman
- d. Crane operator
- e. Crane safety observer
- f. Crane maintenance technician.

589-C.1.2 The qualification guides outlined in this appendix are mandatory minimum requirements, as applicable to the configuration and operation of the ship. Commands should develop and implement their own qualification cards with appropriate signature blanks for certifying completion of specific requirements, using this appendix as a guideline. Development of tailored qualification cards should include formal training and qualification on any special lifting or handling equipment used by the department conducting the lift. If equipment use is of a dedicated nature (for example, missile handling), the general rigging training of these qualification guides may be deleted from the Command's qualification cards. However, the Crane Officer is responsible for ensuring that crane crews, trained on tailored qualification standards, do not perform lifting or handling evolutions outside the scope of the training and qualification received. Should a need arise to perform such an evolution, another crane crew, appropriately trained, shall perform the evolution.

#### 589-C.2 AVAILABLE NAVAL EDUCATION AND TRAINING (NAVEDTRA) PQS

589-C.2.1 The following NAVEDTRA Personnel Qualification Standards (PQS) series are currently available and should be used to supplement qualification guides in this appendix where applicable:

- a. NAVEDTRA 43310, **Booms and Cranes.**
- b. NAVEDTRA 43383, **LHA Class Assault Subsystems Operation.**
- c. NAVEDTRA 43396, **Deck Unrep for Receiving and Deliver Ships.**
- d. NAVEDTRA 43416, **LSD/LPD Well Deck and Deck Operations.**
- e. NAVEDTRA 43426, **LST 1179 Class Deck Operations.**

#### 589-C.3 QUALIFICATION GUIDES

Mobile crane operators applying for licensing (both initial qualification and requalification) shall take a formal course of instruction that covers the applicable topics of paragraphs 589-C.3.4.3 thru 589-C.3.4.6, is applicable to the crane being operated, and includes at least one day of hands on operating instructions

589-C.3.1 TAGLINE HANDLER. Mandatory minimum requirements for qualification as a crane crew tagline handler are contained in the following paragraphs.

589-C.3.1.1 Prerequisites. Division Officer's recommendation for physical qualifications (paragraph 589-3.3.3).

589-C.3.1.2 General Indoctrination. Participation in a general indoctrination lecture covering the following topics:

- a. Crane crew organization and chain-of-command
- b. Description and terminology of lifting and handling equipment
- c. Safety, including general topside safety, load handling safety, and clothing requirements
- d. Tagline handler duties and responsibilities.

589-C.3.1.3 Theoretical Knowledge References:

- a. NAVEDTRA 10120, **Seaman**
- b. NAVEDTRA 10121, **Boatswain's Mate 3 & 2**
- c. S9086-T4-STM-010/CH-589, **Cranes** .

589-C.3.1.4 Demonstration of Knowledge. The following items shall be discussed, explained, or otherwise demonstrated to the satisfaction of a qualified signalman:

- a. The purpose of the tagline and tagline handler.
- b. The inspections of the tagline to be performed before and after attachment to the load.
- c. The requirements for roping off load handling areas and open cargo hatches, and why the areas should be kept clear of noninvolved personnel and equipment.
- d. Why loads are never lifted over personnel, and why personnel are not allowed to pass or stand under lifted loads; explain what the tagline handler should do upon noticing these adverse situations.
- e. The importance of minimizing noise during crane operations.
- f. Considerations for determining the number of taglines needed for a particular load.
- g. The proper techniques, including safety considerations, to be used for steadying the load with the tagline.
- h. The dangers of side loading the crane.
- i. The warnings that may be seen or heard from faulty equipment or equipment under strain.
- j. Actions taken in the event of a fouled tagline.

589-C.3.1.5 Examinations. Oral examination shall be administered by a qualified signalman.

589-C.3.1.6 Qualification. Qualification shall be certified by the Crane Officer.

589-C.3.2 RIGGER. Mandatory minimum requirements for qualification as a crane crew rigger are:

## 589-C.3.2.1 Prerequisites:

- a. Qualified as a tagline handler.
- b. Division Officer's recommendation for physical qualifications (paragraph 589-3.3.3).
- c. Special screening requirements (that is, personnel reliability program, security clearance).

## 589-C.3.2.2 Theoretical Knowledge References:

- a. NAVEDTRA 10120, **Seaman**
- b. NAVEDTRA 10121, **Boatswain's Mate 3 & 2**
- c. NWP 4-01.4, **Underway Replenishment**
- d. S9086-T4-STM-010/CH-589, **Cranes** .

589-C.3.2.3 Demonstration of Knowledge. The following items shall be discussed, explained, or otherwise demonstrated to the satisfaction of a qualified signalman or other individuals designated according to paragraph 589-3.3.1.

- a. For wire rope, natural fiber line, and synthetic fiber line, discuss the following:
  - 1. Size determination
  - 2. Type determination
  - 3. Line/wire construction
  - 4. Proper care
  - 5. How to determine serviceability
  - 6. Restrictions on use
  - 7. Specific applications
  - 8. The material used and their characteristics.
- b. How to mouse a hook and seize a shackle
- c. How to use a self-mousing or safety lock hook
- d. The proper method of spooling and unspooling a reel of wire rope
- e. The proper method of coiling down a wire rope
- f. The proper method of working out kinks in a wire rope
- g. Identify the following blocks and tackles:
  - 1. Single whip
  - 2. Runner
  - 3. Gun tackle
  - 4. Luff tackle
  - 5. Diamond blocks
  - 6. Oval blocks
  - 7. Roller bearing blocks

8. Snatch blocks
  9. Twofold
  10. Double luff
  11. Threefold
  12. Beam clamps
  13. Save-all
  14. Fiber rope blocks.
- h. Discuss the use and application of the following sling configurations:
1. Single vertical hitch
  2. Bridle hitch (2-, 3-, and 4-leg)
  3. Single basket hitch
  4. Double basket hitch
  5. Double wrap basket hitch
  6. Single choker hitch
  7. Double choker hitch
  8. Double wrap choker hitch
  9. Endless slings
  10. Braided slings.
- i. Explain the method for determining the rated load of the following:
1. Natural/synthetic line
  2. Wire rope
  3. Hooks
  4. Shackles
  5. Slings
  6. Eye bolts.
- j. Explain the application and proper use of the following handling equipment:
1. Shortener
  2. Spreader bars
  3. Taglines
  4. Chain slings
  5. Beam clamps
  6. Tripping line
  7. Come-along
  8. Cargo nets
  9. Nylon straps
  10. Mast clamps
  11. Skip box
  12. Chain hoist
  13. Aircraft slings
  14. Pallet slings

15. Barrel slings
  16. Boat slings
  17. Vehicle slings
  18. Brow slings
  19. Mast and antenna slings.
- k. The proper use of shackles
  - l. The proper use of eye bolts
  - m. How to determine the size of block to be used
  - n. How to determine the correct size of line to be used in a block
  - o. How to apply wire rope clips
  - p. Why an insulator link is installed between the hook and the running rigging.

589-C.3.2.4 Safety Reference: OPNAV 5100.19 - Navy Safety Precautions for Forces Afloat

589-C.3.2.5 Demonstration of Safety Knowledge. The following safety topics shall be discussed or explained to the satisfaction of a qualified signalman or other individuals designated according to paragraph [589-3.3.1](#):

- a. Why pallet slings shall be secured together.
- b. What to do if the clearance for removing equipment from a hatch is limited.
- c. Some of the warnings that may be seen or heard from faulty equipment or equipment under heavy strain.
- d. What protection should be provided to slings that shall go around sharp corners.
- e. Why angles between legs on a sling should be kept as small as possible.
- f. The minimum number of turns that should be wrapped around cylindrical loads.
- g. The types of discrepancies which would cause a piece of rigging equipment to be unsafe to use.
- h. How to inspect handling and rigging equipment.
- i. Why slings and straps should not be dragged across the deck.
- j. What safety clothing should be worn by the crane crew members.

589-C.3.2.6 Quality Assurance (QA) Reference: Applicable Type Commander's QA manual.

589-C.3.2.7 Demonstration of QA Knowledge. The following QA items shall be discussed, described, or otherwise explained to the satisfaction of a qualified signalman, or other individuals designated according to paragraph [589-3.3.1](#):

- a. The purpose of the QA program with regard to load testing
- b. The equipment that shall be inspected and tested according to the QA program
- c. The information found on a QA tag:
  1. Test due date

2. Static load test
  3. Dynamic load test
  4. Rated load test
  5. QA number.
- d. The actions to be taken in the event a QA tag is missing from load handling equipment
- e. How to identify equipment that has been load tested.

589-C.3.2.8 Practical Factors. The following practical factors shall be completed to the satisfaction of a qualified signalman:

- a. Demonstrate the ability to properly connect all handling equipment to crane hooks.
- b. Hook and unhook taglines and trip lines.
- c. Demonstrate the ability to rig the following slings:
  1. Single vertical hitch
  2. 2-leg bridle hitch
  3. 3-leg bridle hitch
  4. 4-leg bridle hitch
  5. Single basket hitch
  6. Double basket hitch
  7. Double wrap basket hitch
  8. Single choker hitch
  9. Double choker hitch
  10. Double wrap choker hitch
  11. Endless sling
  12. Braided sling
  13. Pallet sling
  14. Barrel sling
  15. Boat sling
  16. Mast and antenna sling
  17. Aircraft sling.
- d. Demonstrate use of the following:
  1. Shortener
  2. Spreader bar
  3. Skip box
  4. Beam clamps
  5. Mast clamps
  6. Cargo nets
  7. Nylon straps
  8. Come-along
  9. Chain hoist.

- e. Demonstrate the ability to mouse a hook.
- f. Demonstrate the ability to properly seize a shackle.
- g. Demonstrate the ability to inspect handling equipment before use.
- h. Act as a member of the crane crew for five handling evolutions.

589-C.3.2.9 Examinations. The following examinations shall be completed:

- a. Written examination with a minimum passing grade of 70 percent.
- b. Oral examination administered by the Crane Officer or designated examiner.

589-C.3.2.10 Qualification. Qualification should be certified by the Crane Officer.

589-C.3.3 CRANE SIGNALMAN. Mandatory minimum requirements for qualification as a crane crew signalman are:

#### NOTE

Qualification requirements denoted by an asterisk (\*) in this crane signalman qualification guide shall be completed by candidates qualifying to conduct CRITICAL lifts.

- a. Prerequisites:
  - 1. Qualified as a rigger
  - 2. Division Officer's recommendation for physical qualifications (paragraph 589-3.3.3)
  - 3. Special screening requirements (that is, personnel reliability program, security clearance)
  - 4. \*Crane Officer's recommendation.
- b. Theoretical Knowledge References:
  - 1. NAVEDTRA 10120, **Seaman**
  - 2. NAVEDTRA 10121, **Boatswain's Mate 3 & 2**
  - 3. S9086-T4-STM-010/CH-589, **Cranes**
  - 4. Manufacturer's technical manual.

589-C.3.3.1 Demonstration of Knowledge. The following items shall be discussed, explained, or otherwise demonstrated to the satisfaction of a qualified signalman or other individuals designated according to paragraph 589-3.3.1:

- a. Describe the capabilities, capacities, and limitations of the cranes assigned to the ship.
- b. Identify the following components found on cranes:
  - 1. Kingpost
  - 2. Boom

3. Machinery housing
  4. Operator's cab
  5. Pedestal
  6. Mast
  7. Main hoist block
  8. Auxiliary hoist block
  9. Sheaves and wire rope
  10. Main hoist
  11. Auxiliary hoist
  12. Topping hoist.
- c. Describe the hand signals used when operating cranes.
- d. Define the load handling area of a crane.
- e. Describe a no-load test.
- f. Explain how external factors affect crane performance, such as ship roll and pitch, list and trim, and adverse weather conditions.
- g. Define the functions and responsibilities of the following members of a crane crew:
1. Crane safety observer
  2. Crane operator
  3. Signalman
  4. Rigger
  5. Tagline handler.
- h. Discuss the following situations/incidents/accidents and the actions a signalman should take to ensure safety:
1. Congested operating area
  2. Rigging malfunction
  3. Swinging load
  4. Fouled tagline
  5. Loss of power
  6. Improper rigging or overload
  7. Load drop
  8. Load striking an object
  9. Imbalanced load
  10. Load hangup.
- i. \*Describe CRITICAL and noncritical lifts.
- j. Discuss items checked on an Operator's Daily Checklist (ODCL).
- k. \*Discuss the precautions and procedures for performing the following CRITICAL lifts:
1. Lifts performed at sea
  2. Lifts of or over ordnance
  3. Lifts of or over nuclear propulsion related equipment
  4. Lifts of loads greater than 85 percent of rated crane capacity

5. Lifts of submerged loads
6. Precision lifts as defined in ship instructions.

#### 589-C.3.3.2 Safety References:

- a. NAVEDTRA 10120, **Son Lifts as Defined in Ship Instructions**
- b. NAVEDTRA 10120, **Seaman**
- c. NAVEDTRA 10121, **Boatswain's Mate 3 & 2**
- d. OPNAVINST 5100.19, **Navy Safety Precautions for Forces Afloat**
- e. OPNAVINST 5102.1, **Mishap Reporting and Investigating**

589-C.3.3.3 Demonstration of Safety Knowledge. The following safety topics shall be discussed or explained to the satisfaction of a qualified signalman or other individuals designated according to paragraph [589-3.3.1](#):

- a. The color and significance of the color of the hardhats required for crane crew members.
- b. Why taglines are required on lifts.
- c. The requirements for roping off load handling areas and open cargo hatches, and why the area shall be cleared of personnel and equipment.
- d. Why loads should never be lifted over personnel.
- e. The importance of minimizing noise during crane operations.
- f. How to determine if a member of the crane crew is qualified.
- g. The maximum height a load should be lifted, and why the landing area shall be clear before lifting the load.
- h. Why it is necessary to know the weight of the load to be lifted.
- i. The makeup of a crane crew.
- j. The dangers of side loading the crane.
- k. The circumstances when a crane operator should not follow the signals of the signalman, and operator actions that should be taken.
- l. What to do with load handling gear that is found to be defective.
- m. What to do if a QA load test tag is missing.
- n. The danger involved if equipment (for example, a shackle) is thrown from the ship to the pier.
- o. The authorized method for lifting compressed gas cylinders.
- p. Some of the warnings that may be seen or heard from faulty equipment or equipment under heavy strain.
- q. What special precautions shall be taken when lifting a load from the water.
- r. The maximum wind velocity allowed for making lifts.
- s. The extra precautions to be observed when handling near the rated load of the crane.
- t. The danger when working near power lines.
- u. Why sudden starts and stops shall be avoided.

- v. What two-blocking is, and the dangers involved.
- w. The minimum number of turns allowed on the wire rope drums.
- x. The use of tag out procedures (including color coding of tags).
- y. Why the crane safety observer is never allowed to get involved in the operation of the crane or the rigging evolutions.
- z. Why the crane operator should obey the signalman exactly.
- aa. Why indiscriminate use of safety signs, securing an area for crane lifts when no crane is being operated, is a bad practice.
- ab. The dangers of exceeding limits when topping down or up.
- ac. The added precautions to be observed when lifting loads with a list on the ship or under conditions of ship motions.

589-C.3.3.4 Practical Factors. The following practical factors shall be completed to the satisfaction of a qualified signalman:

- a. Transmit, receive, and understand all crane hand signals.
- b. Check to see that the crane crew is dressed in proper hard hats, safety shoes, and other safety articles.
- c. Determine the safe working load of various slings.
- d. Perform a no-load test.
- e. Demonstrate the ability to hoist/lower a small boat.
- f. Perform an ODCL.
- g. Act as a signalman for five handling evolutions (at least two evolutions for each crane type onboard).
- h. \*Observe, and then perform under instruction, at least two CRITICAL lifts as signalman.

589-C.3.3.5 Examinations. The following examinations shall be completed (paragraph [589-3.3.5](#)):

- a. Separate written examinations for CRITICAL and noncritical lifts, with a minimum passing grade of 70 percent for each exam.
- b. Oral examination administered by the Crane Officer or designated examiner.
- c. \*Oral examination administered by the Crane Officer.

589-C.3.3.6 Qualification. Qualification for CRITICAL and noncritical lifts shall be individually certified by the Crane Officer.

589-C.3.4 CRANE OPERATOR. Mandatory minimum requirements for qualification as a crane operator are:

**NOTE**

Qualification requirements denoted by an asterisk (\*) in this crane operator qualification guide shall be completed by candidates who are qualifying to conduct CRITICAL lifts.

## 589-C.3.4.1 Prerequisites:

- a. Division Officer's recommendation for physical qualifications (paragraph 589-3.3.3)
- b. Physical examination (paragraph 589-3.3.3.1)
- c. Special screening requirements (that is, personnel reliability program, security clearance)
- d. \*Crane Officer's recommendation.
- e. Mobile crane operators applying for licensing (both initial qualification and requalification) shall take a formal course of instruction that covers the applicable topics of paragraphs 589-C.4.3 through C.3.4.6 is applicable to the crane being operated, and includes at least one day of hands on operating instructions.

## 589-C.3.4.2 Crane Systems and Theory References:

- a. Manufacturer's technical manual
- b. S9086-T4-STM-010/CH-589, **Cranes** .

589-C.3.4.3 Demonstration of Knowledge. The following items shall be discussed, explained, or otherwise demonstrated to the satisfaction of a qualified crane operator or other individuals designated according to paragraph 589-3.3.1:

- a. Identify the components, functions, and location of each of the following:
  1. Main hoist system
  2. Auxiliary hoist system
  3. Topping system
  4. Rotation system
  5. Travel system
  6. Electrical system
  7. Structural components
  8. Rails
  9. Hydraulic system
  10. Power system
  11. Air system
  12. Boom telescoping system.
- b. Identify the power sources for the following:
  1. Main hoist motor
  2. Auxiliary hoist motor

3. Topping hoist motor
  4. Rotation motor(s)
  5. Travel motor(s)
  6. Controllers
  7. Indicators
  8. Warning devices
  9. Lighting
  10. Ventilation.
- c. The function of all protective devices, limit switches, and safety features.
  - d. The function of the controls available to the operator.
  - e. The indicators and gauges available to the operator, and their expected readings and sensory points.
  - f. The path of electrical power from the power supply breaker to each of the main electrical components.
  - g. The effects on the crane system of the loss of power.
  - h. The capacities, limitations and operating area of the crane.
  - i. The hand signals used in operating a crane.
  - j. How external factors affect crane performance, such as ship roll and pitch, list and trim, and adverse weather conditions.
  - k. The purpose and procedures for conducting the ODCL.
  - l. The no-load test.
  - m. The purpose and use of the load and boom angle indicators.
  - n. The precautions and procedures for lifting objects out of the water.
  - o. Why an insulator link is installed between the hook and the running rigging.
  - p. \*The precautions and limitations for performing the following CRITICAL lifts:
    1. Lifts performed at sea
    2. Lifts of or over ordnance
    3. Lifts of or over nuclear propulsion related equipment
    4. Lifts of loads greater than 85 percent of rated crane capacity
    5. Lifts of submerged loads
    6. Precision lifts as defined in ship instructions.
  - q.

#### NOTE

In addition to the items above, the following items apply to operators of mobile cranes on aircraft carriers.

A thorough understanding of the mobile crane load chart.

- r. The mobile crane lift restrictions at sea or at anchor.
- s. The mobile crane lift location restrictions.

- t. The mobile crane over the side lift restrictions.
- u. The leveling requirement or maximum ship list condition.
- v. The mobile crane personnel lifts prohibition.
- w. The travel restrictions.
- x. The outrigger use and restrictions

#### 589-C.3.4.4 Safety References:

- a. NAVEDTRA 10120, **Seaman**
- b. NAVEDTRA 10121, **Boatswain's Mate 3 & 2**
- c. OPNAVINST 5100.19, **Navy Safety Precautions for Forces Afloat**
- d. OPNAVINST 5102.1, **Mishap Reporting and Investigating**

589-C.3.4.5 Demonstration of Safety Knowledge. The following safety topics shall be discussed or explained to the satisfaction of a qualified signalman or other individuals designated according to paragraph [589-3.3.1](#):

- a. The color and significance of the color of the hardhats required for crane crew members.
- b. When taglines are required on lifts.
- c. The requirements for roping off load handling areas and open cargo hatches, and why the area shall be cleared of personnel and equipment.
- d. Why loads should never be lifted over personnel.
- e. The importance of minimizing noise during crane operations.
- f. The maximum height a load should be lifted, and why the landing area shall be clear before lifting the load.
- g. Why it is necessary to know the weight of the load to be lifted.
- h. The dangers of side loading the crane.
- i. The circumstances when a crane operator should not follow the signals of the signalman, and operator actions that should be taken.
- j. Some of the warnings that may be seen or heard from faulty equipment or equipment under heavy strain.
- k. What special precautions shall be taken when lifting a load from the water.
- l. The maximum wind velocity allowed for making lifts.
- m. The extra precautions observed when load handling near the rated load of the crane.
- n. The danger of working near power lines.
- o. Why sudden starts and stops shall be avoided.
- p. What two-blocking is, and the dangers involved.
- q. The minimum number of turns allowed on the wire rope drums.
- r. The use of tag out procedures (including color coding of tags).

- s. Why the crane safety observer is never allowed to get involved in the operation of the crane or the rigging evolutions.
- t. Why the crane operator should obey the signalman exactly.
- u. The dangers of exceeding limits when topping down or up.
- v. The added precautions to be observed when lifting loads with a list on the ship or under conditions of ship motion.
- w. The operation and use of the fire extinguisher located in the operator's cab.
- x. The ship procedures and safety precautions for going aloft on the crane.

589-C.3.4.6 Practical Factors. The following practical factors shall be completed to the satisfaction of a qualified crane operator:

- a. Perform the inspections and operational checks of the ODCL.
- b. Demonstrate the proper procedure to energize and secure the crane.
- c. Stow and unstow the crane.
- d. Perform a no-load test.
- e. Discuss safety precautions when operating the crane.
- f. Demonstrate the ability to calculate the maximum lift capacity based on boom length and angle.
- g. Demonstrate the ability to locate all controls, switches, indicators, and gauges.
- h. Demonstrate familiarity with the operation of all controls.
- i. Demonstrate the ability to follow hand signals.
- j. Following posted procedures, make general lifts demonstrating the ability to raise and lower the hook at various speeds, raise and lower the boom, rotate, and travel.
- k. For the following casualties, discuss the probable causes, discuss or simulate the corrective actions, and discuss other problems which may arise if the casualty is allowed to continue:
  - 1. Overloading the crane
  - 2. Loss of electrical power
  - 3. Two-blocking
  - 4. Load hangup
  - 5. Wire rope jumping from sheave or drum
  - 6. Load drop
  - 7. Frayed wire rope
  - 8. Hoist failure.
- l. Operate the crane for a minimum of 10 hours.
- m. \*Observe, and then perform under the supervision of a CRITICAL -lift qualified crane operator, at least two CRITICAL lifts.

589-C.3.4.7 Examinations. The following examinations shall be completed:

- a. Separate written examinations for CRITICAL and noncritical lifts, with a minimum passing grade of 70 percent for each exam.
- b. Oral examination administered by the Crane Officer or designated examiner.
- c. \*Oral examination administered by the Crane Officer.

589-C.3.4.8 Qualification. Qualification for CRITICAL and noncritical lifts should be independently certified by the Crane Officer.

589-C.3.5 CRANE SAFETY OBSERVER. Mandatory minimum requirements for crane crew safety observer are

589-C.3.5.1 Prerequisites:

- a. Officer rank, Chief Petty Officer rate, or senior Petty Officer rate, and a level of knowledge comparable to that of signalman
- b. Special screening requirements (that is, personnel reliability program, security clearance)
- c. Crane Officer's recommendation.

589-C.3.5.2 Theoretical Knowledge References:

- a. Manufacturer's technical manual
- b. S9086-T4-STM-010/CH-589, **Cranes**

589-C.3.5.3 Demonstration of Knowledge. The following items shall be discussed, explained, or otherwise demonstrated to the satisfaction of a qualified crane safety observer or other individuals designated according to paragraph [589-3.3.1](#):

- a. Hand signals used in crane operation.
- b. Capabilities, capacities, and limitations of all cranes assigned to the ship.
- c. Requirements of the ODCL.
- d. Requirements of a no-load test.
- e. Situations in which the crane safety observer would stop a lift.
- f. Types of CRITICAL lifts.
- g. Precautions and limitations for operating the crane at sea.
- h. Precautions and procedures for handling nuclear propulsion related equipment.
- i. Precautions and procedures for handling ordnance.
- j. Precautions and procedures for handling a load at or near rated load.
- k. Precautions and procedures for lifting a submerged load.
- l. Ship procedures and safety precautions for going aloft on the crane.

589-C.3.5.4 Safety References:

- a. NAVEDTRA 10120, **Seaman**
- b. NAVEDTRA 10121, **Boatswain's Mate 3 & 2**
- c. OPNAVINST 5100.19, **Naval Safety Precautions for Forces Afloat**
- d. OPNAVINST 5102.1, **Mishap Reporting and Investigating**

589-C.3.5.5 Demonstration of Safety Knowledge. The following safety topics shall be discussed or explained to the satisfaction of a qualified signalman or other individuals designated according to paragraph [589-3.3.1](#):

- a. The color and significance of the color of the hardhats required for crane crew members.
- b. What type of shoes are required to be worn by crane crew members.
- c. When gloves and other safety clothing should be worn.
- d. When taglines are required on lifts.
- e. The requirements for roping off load handling areas and open cargo hatches, and why the area shall be cleared of personnel and equipment.
- f. Why loads should never be lifted over personnel.
- g. The importance of minimizing noise during crane operations.
- h. How to determine if a member of the crane crew is qualified.
- i. The maximum height a load should be lifted, and why the landing area shall be clear before lifting the load.
- j. Why it is necessary to know the weight of the load to be lifted.
- k. The makeup of a crane crew.
- l. The dangers of side loading the crane.
- m. The circumstances when a crane operator should not follow the signals of the signalman, and operator actions that should be taken.
- n. What to do with load handling gear found to be defective.
- o. What to do if a QA load test tag is missing.
- p. The authorized method for lifting compressed gas cylinders.
- q. Why slings and straps should not be dragged across the deck.
- r. The danger involved if the tagline is wrapped around the hand.
- s. Why pallet slings shall be secured together.
- t. Some of the warning signs that may be seen or heard from faulty equipment or equipment under heavy strain.
- u. What protection should be provided to slings that shall go around sharp corners.
- v. Why angles between legs on a sling should be kept as small as possible.
- w. The minimum number of turns that should be wrapped around cylindrical loads.
- x. The special precautions that shall be taken when lifting a load from the water.

- y. The maximum wind velocity allowed for making lifts.
- z. The extra precautions to be observed when handling near the rated load of the crane.
- aa. The dangers of working near power lines.
- ab. Why sudden starts and stops shall be avoided.
- ac. What two-blocking is and the dangers involved.
- ad. The minimum number of turns allowed on the wire rope drums.
- ae. The use of tag out procedures (including color coding of tags).
- af. Why the crane safety observer is never allowed to get involved in the operation of the crane or rigging evolutions.
- ag. Why the crane operator should obey the signalman exactly.
- ah. Functions or evolutions occurring onboard ship which may adversely affect handling safety, and recommended actions to be taken.
- ai. The danger of exceeding limits when topping down or up.
- aj. The added precautions observed when lifting a load with a list on the ship or under conditions of ship motion.

589-C.3.5.6 Practical Factors. The following practical factors shall be completed to the satisfaction of a qualified crane safety observer:

- a. Demonstrate the ability to enforce personnel and rigging safety precautions.
- b. Demonstrate the ability to understand hand signals.
- c. Discuss or simulate the corrective actions for the following load handling casualties:
  - 1. Two-block
  - 2. Loss of power
  - 3. Load hangup
  - 4. Overloading the crane
  - 5. Hoist failure.
- d. Observe at least two of the following classes of CRITICAL lifts, if applicable:
  - 1. Nuclear materials
  - 2. Weapons
  - 3. Greater than 85 percent of rated load
  - 4. At sea.

589-C.3.5.7 Examinations. The following examinations shall be completed:

- a. Written examination with a passing grade of 70 percent.
- b. Oral examination administered by the Crane Officer.

589-C.3.5.8 Qualification. Qualification shall be certified by the Crane Officer.

589-C.3.6 CRANE MAINTENANCE TECHNICIAN. Mandatory minimum requirements for crane maintenance technician are:

589-C.3.6.1 Prerequisites:

- a. Qualification completed for 3M PQS for maintenance personnel (NAVEDTRA 43241)
- b. Division Officer recommendation for physical qualifications (paragraph [589-3.3.3](#)).

589-C.3.6.2 Theoretical Knowledge References:

- a. Manufacturer's technical manual.
- b. S9086-T4-STM-010/CH-589, **Cranes** .

589-C.3.6.3 Demonstration of Knowledge. The following items shall be discussed, explained, or otherwise demonstrated to the satisfaction of the Division Work Center Supervisor or other individuals designated according to paragraph [589-3.3.1](#):

- a. Identify the load bearing and load controlling members, as safety devices associated with the following crane systems and components:
  1. Structural systems:
    - (a) Boom
    - (b) Foundation
    - (c) Kingpost or pedestal
    - (d) Wheel trucks, wheels and rails.
  2. Mechanical systems:
    - (a) Motors and pumps
    - (b) Brakes
    - (c) Reducers
    - (d) Drums
    - (e) Reeving systems
    - (f) Sheaves
    - (g) Wire rope.
  3. Electrical systems:
    - (a) Main power supplies
    - (b) Control power
    - (c) Lighting
    - (d) Controllers
    - (e) Limit switches.
- b. Identify the setpoints of installed system relief valves and limit switches
- c. Discuss the procedures for performing the following tests, and the periodic or situational requirements for performing each test:

1. No-load test
2. Static load test
3. Dynamic load test
4. Rated load test
5. System operability test.

589-C.3.6.4 Safety Reference: OPNAVINST 3120.32, **Standard Organization and Regulations of the U.S. Navy** .

589-C.3.6.5 Demonstration of Safety Knowledge. The following safety topics shall be discussed or explained to the satisfaction of the Division Work Center Supervisor or other individuals designated according to paragraph [589-3.3.1](#):

- a. Discuss in detail ship procedures for performing tag outs, including authorization and use of the following:
  1. DANGER tags
  2. CAUTION tags
  3. Out-of-calibration labels
  4. Out-of-commission labels.
- b. Describe how to determine component power sources by using cable tags.
- c. Discuss precautions and procedures to be observed before entering electrical panels or controllers.

589-C.3.6.6 QA Reference. Applicable Type Commander's QA manual.

589-C.3.6.7 Demonstration of QA. The following QA items shall be discussed, described, or otherwise explained to the satisfaction of the Division Work Center Supervisor or other individuals designated according to paragraph [589-3.3.1](#):

- a. Corrosion of crane components and the requirements for nondestructive testing.
- b. Responsibilities when observing or supervising maintenance by technicians not qualified on the crane's systems and components, such as Intermediate Maintenance Activity or shipyard personnel, when ship force is responsible for the crane (that is, nonoverhaul situation).
- c. Ship procedures for controlled assembly and the purpose for such procedures.
- d. Demonstrate basic knowledge of and discuss the method for submitting departures-from-specification, and identify the decertifying events for which departures may be submitted.

589-C.3.6.8 Practical Factors. The following practical factors shall be completed to the satisfaction of a qualified signalman:

- a. Perform a tag out of a crane mechanical or electrical system or component.
- b. Participate in the performance of a monthly, quarterly, and annual maintenance requirement.
- c. Demonstrate the ability to perform a controlled assembly work package.

589-C.3.6.9 Examinations. The following examinations shall be completed:

- a. Written examination with a minimum passing grade of 70 percent.
- b. Oral examination administered by the Crane Officer or designated examiner.

589-C.3.6.10 Qualification. Qualification should be certified by the Crane Officer.

**APPENDIX D.**

**CONTROLLED ASSEMBLY WORK PACKAGE (EXAMPLE)**  
(SEE [SECTION 4](#))

**APPENDIX D**  
**CONTROLLED ASSEMBLY WORK PACKAGE (EXAMPLE)**  
(See Section 4)

CONTROLLED ASSEMBLY WORK PACKAGE		
1. SHIP	HULL NO.	JOB CONTROL NO.
USS SIMON LAKE	AS 33	WK02-56
2. SERIAL		3. LEAD WORK CENTER
02-83		WK02
4. CRANE IDENTITY/LOCATION		5. EQUIPMENT/SYSTEM
Starboard B&M Crane		Topping Hoist Motor Coupling
6. REFERENCES		
1. NAVSEA 0920-LP-111-1010 57.5-Ton Boat and Missile Crane		
7. WORK PROCEDURE		
See attached procedure.		
8. TEXT PROCEDURE		
See attached procedure.		
9a. PROCEDURE APPROVAL/DATE		9b. QA APPROVAL/DATE
Crane Officer/1 DEC 83		QA Officer/1 DEC 83
10a. TESTING APPROVAL/DATE		10b. QA APPROVAL/DATE
Crane Officer/1 DEC 83		QA Officer/1 DEC 83
11. WORK AUTHORIZED DATE		
Crane Officer/1 DEC 83		
12. START WORK AUTHORIZATION/DATE		13. START DATE
Duty Officer/1 DEC 83		Duty Officer/1 DEC 83
14a. PROCEDURE		14b. QA INSPECTOR/DATE
Work Center Division Officer/1 DEC 83		QA Inspector/1 DEC 83
15a. TESTING COMPLETE/DATE		15b. QA
Crane Officer/1 DEC 83		QA Inspector/1 DEC 83
16. PACKAGE COMPLETE		
Crane Officer/1 DEC 83		
17. APPROVED BY		
Crane Certifying Officer/1 DEC 83		

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CONTROLLED ASSEMBLY WORK PACKAGE (EXAMPLE)(See [Section 4](#))(Sheet 1 of 7)

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**CONTROLLED ASSEMBLY WORK PACKAGE (CONTINUED)**


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**PROCEDURE - BLOCKS 7 & 8**


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1. **SCOPE (IDENTIFY)**  
Clean, inspect, and lubricate topping hoist motor coupling.

---

2. **EQUIPMENT**  
Starboard Boat and Missile Crane topping hoist motor coupling

---

3. **REFERENCES**  
NAVSEA 0920-LP-111-1010, 57.5-Ton Capacity Boat and Missile Crane

---

4. **PREREQUISITES**  
Boom and block in stow position

---

5. **PRECAUTIONS**
  - a. Avoid prolonged contact with, or inhalation of, cleaning solvents. Avoid use near heat or open flame, and provide adequate ventilation.
  - b. Danger tag the following item:  
Breaker 45-113-5A Starboard B&M Crane Power Supply - OFF

---

6. **STATEMENT:**  
The above precautions have been personally witnessed by me and verified to have been accomplished properly to the requirements of this document.

---

 QA Inspector

 Date
 

---

7. **TOOLS REQUIRED**

3/8-inch drive ratchet	1/2-inch sash brush (1/16 inch through 1/4 inch)
1/2-inch socket	Allen wrench set (1/16 inch through 1/4 inch)
5/8-inch socket	Grease DOD-G-24508 (1/16 inch through 1/4 inch)
Snap ring pliers	Lubrication fitting
5/8-inch open-end wrench	6-inch screw driver
3/4-inch open-end wrench	Grease gun with DOD-G-24508
Clamp-on ammeter 0-500 Amp	Feeler gauge set
Surface pyrometer 0-300 °F	6-inch steel rule
Torque wrench 0-100 ft-lb	Solvent P-D-680, Type II

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8. **PARTS**  
None
- 

9. **WORK PROCEDURE (Block 7)**  
**NOTE:** All parts removed shall be placed in a plastic bag and tagged with their identity for reassembly.
- 

SHEET 2 of 2

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CONTROLLED ASSEMBLY WORK PACKAGE (Continued)(Sheet 2 of 7)

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CONTROLLED ASSEMBLY WORK PACKAGE

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PROCEDURE - BLOCKS 7 & 8  
Continuation Sheet

---

9. WORK PROCEDURE - Continued

Clean, inspect, and lubricate the topping hoist flexible coupling as follows:

1. Remove coupling guard. Bag and tag.

\_\_\_\_\_  
Technician's signature

2. Using the snap ring pliers, remove snap rings and seals from sleeves. Slide back on shaft.

\_\_\_\_\_  
Technician's signature

3. Remove sleeve bolts and lockwashers. Bag and tag. Slide sleeves back on shaft.

\_\_\_\_\_  
Technician's signature

4. Clean hubs, sleeves, seals, and snap rings with a brush and rags dampened with solvent. Dry with rag.

\_\_\_\_\_  
Technician's signature

5. Inspect gear teeth for an uneven wear pattern; look for brightly worn spots, pitting, flaking, and discoloration. Gear teeth should show uniform smooth contact area, indicated by brightly worn spot being equally distributed across each gear tooth face.

Discrepancies noted: \_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
Technician's signature

6. Inspect hubs, sleeve, and snap rings for corrosion.

Discrepancies noted: \_\_\_\_\_

\_\_\_\_\_  
Technician's signature

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**CONTROLLED ASSEMBLY WORK PACKAGE**

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**PROCEDURE - BLOCKS 7 & 8**  
Continuation Sheet

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**9. WORK PROCEDURE - Continued**

**7. Inspect seals for cuts and tears.**

Discrepancies noted: \_\_\_\_\_

\_\_\_\_\_  
Technician's signature

**8. Insert feeler gauge at four positions 90 degrees apart; measure hub gap and angular alignment. Gap should be 1/8 inch for coupling. Gap measurement at four positions should be equal within 0.002 inches.**

GAP                      Maximum Difference \_\_\_\_\_

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

\_\_\_\_\_  
Technician's signature

**9. Place steel rule across hubs at four positions 90 degrees apart. Measure parallel alignment. Steel rule should fit squarely across hubs.**

Discrepancies noted: \_\_\_\_\_

\_\_\_\_\_  
Technician's signature

**10. Pack coupling with grease at 1/4-turn intervals. Force as much grease as possible into gap and hub teeth; eliminate all air pockets.**

\_\_\_\_\_  
Technician's signature

---

SHEET 4 of 7

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CONTROLLED ASSEMBLY WORK PACKAGE (Continued)(Sheet 4 of 7)

**CONTROLLED ASSEMBLY WORK PACKAGE**

**PROCEDURE - BLOCKS 7 & 8**  
**Continuation Sheet**

**9. WORK PROCEDURE - Continued**

- 11. Center sleeve on hubs; reinstall lockwashers and bolts. Torque bolts in 10 foot-pound increments to 35 foot-pounds. Record final torque value for each bolt.

Final Torque.

1. _____	6. _____
2. _____	7. _____
3. _____	8. _____
4. _____	9. _____
5. _____	10. _____

\_\_\_\_\_  
Technician's signature

- 12. Reinstall seals and snap rings.

\_\_\_\_\_  
Technician's signature

- 13. Remove lubrication plugs and install a lubrication fitting in one plug opening. Inject grease through lubrication fitting until new grease appears at opposite plug opening.

\_\_\_\_\_  
Technician's signature

- 14. Remove lubrication fitting and install both lubrication plugs. Remove excess lubricant.

\_\_\_\_\_  
Technician's signature

- 15. Reinstall coupling guard.

\_\_\_\_\_  
Technician's signature

The above procedural steps have been personally witnessed by me and verified to have been accomplished properly to the requirements of this document.

\_\_\_\_\_  
QA Signature

\_\_\_\_\_  
Date

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**CONTROLLED ASSEMBLY WORK PACKAGE**

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**PROCEDURE - BLOCKS 7 & 8**  
**Continuation Sheet**

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**10. TEST PROCEDURES (Block 8)**

Testing will consist of performing a no-load test of the topping hoist and measuring topping hoist motor currents and temperatures during the test.

1. Obtain a qualified crane operator and signalman to perform the no-load test.

_____	_____
Crane Operator	Signalman

2. Obtain a qualified crane electrician to assist in the test.

\_\_\_\_\_

Electrician

3. Remove danger tag from breaker 45-113-5A Starboard B\*M  
Crane Power Supply; restore power.

4. Perform ODCL.

\_\_\_\_\_

Crane Operator

5. Establish communications between the cab and machinery house.

\_\_\_\_\_

Electrician

6. The machinery house personnel shall coordinate with the crane operator in performing the no-load test. The test shall consist of raising and lowering the boom at rated speed for 3 full cycles. The machinery house personnel shall:

- a. Record initial motor temperature before the start of the test.
- b. Record the motor current during each raising and lowering cycle.
- c. Record motor temperature immediately upon completion of the last cycle.

_____	_____
Crane Operator	Electrician

SHEET 6 of 7

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CONTROLLED ASSEMBLY WORK PACKAGE (Continued)(Sheet 6 of 7)



## APPENDIX E.

### CRANE COMPONENT CERTIFICATION ENVELOPE

#### 589-E.1

The crane certification envelope is a listing of the load bearing members, load controlling members, safety features, and travel drive systems of the crane. All equipment and crane components essential to safe and reliable load handling are contained within a certification envelope. Crane certification depends upon the continued satisfactory condition of equipment within the certification envelope. When a material deficiency exists within the certification envelope, the deficient item shall be repaired or replaced, and the crane recertified, or a departure-from-specification submitted and approved for continued operation. Components contained within this certification envelope for shipboard cranes are identified in this appendix. If necessary, slight modifications may be made to the certification envelope to accommodate minor design differences within the various crane types. Where changes are made, they should be forwarded to the Naval Ship Systems Engineering Station (NAVSEA Philadelphia) (Code 9731) for concurrence.

589-E.1.1 The component certification envelope in this appendix is considered to contain minimum requirements and should not be construed as limiting the authority of Commanding Officers to add items or components to the list. The component certification envelope was derived from the following crane component categories:

- a. Load Bearing Members. Those components which transmit the weight of a suspended load to supporting structure.
- b. Load Controlling Members. Those components, or systems installed to permit the motion of a suspended load.
- c. Safety Features. Those items installed to prevent possible damage to equipment personnel as a result of crane operation.
- d. Rotation and Travel Drive Systems. Crane components or systems necessary to cause the crane to rotate or to travel from one location to another.

589-E.1.2 If the component certification envelope is not appropriate to a specific shipboard crane because of the particular crane design or uniqueness of the installation, NAVSEA Philadelphia (Code 9731) should be informed by letter, identifying the appropriate technical manual. NAVSEA Philadelphia will provide the ship with a certification envelope according to the above principles.

#### 589-E.2 MAJOR DEFICIENCIES

589-E.2.1 Major deficiencies in the crane certification envelope are those defects which affect the ability to safely and reliably handle loads up to the rated capacity of the crane. Examples of major deficiencies are: deteriorated wire rope, defective brakes, hydraulic pump or motor failure, electric drive motor failure, inoperative limit switches and inoperative interlocks. Major deficiencies which cannot be resolved should be the subject of a departure-from-specification request. See [Table 589-4-2](#) for approval authority.

#### 589-E.3 MINOR DEFICIENCIES

589-E.3.1 Minor deficiencies in the crane certification envelope are defects which affect the capability of the crane to perform according to design specifications, but otherwise do not directly impact safe load handling.

Examples of minor deficiencies are: inability to operate at rated speed, limited travel or topping capability, out-of-calibration instruments, inoperative travel warning device, and overdue maintenance actions. While identifying minor deficiencies, exercise judgment to ensure that the minor deficiency is not merely a symptom of an underlying major deficiency (affecting safety). Minor deficiencies which cannot be resolved should be the subject of a departure-from-specification request according to paragraph [589-6.3.3](#).

#### **589-E.4 COMPONENT LISTING**

589-E.4.1 Several components listed in this appendix are unique to certain designs and may not be found on all cranes. For purposes of defining the component certification envelope, disregard components that do not apply.

589-E.4.2 Some load controlling components also have load bearing functions. For example, electric hoist motors on electromechanical cranes are load bearing when the brake is released and the hoist is in operation, but have no load bearing function when the brake is set and the motor is deenergized. For purposes of the crane component certification envelope, these members have been defined as load controlling where their primary function is load controlling.

##### **a. Load Bearing Members:**

###### **1. Rotating Crane Structural Components:**

- (a) Boom
- (b) Pedestal or kingpost
- (c) Boom hinge assembly
- (d) Mast
- (e) Counterweights

###### **2. Nonrotating Crane Structural Components:**

- (a) Bridge girders
- (b) Bridge end trucks
- (c) Trolley frame

###### **3. General Structural Components:**

- (a) Gantry legs
- (b) Wheel truck assemblies
- (c) Rails and rail foundations

###### **4. Mechanical (Hoist) Components:**

- (a) Load block and hook assembly
- (b) Wire rope
- (c) Sheaves
- (d) Hoist drum
- (e) Gearing
- (f) Holding brakes
- (g) Couplings
- (h) Bearings
- (i) Shafts
- (j) Machinery foundations and bolts

## b. Load Controlling Members:

## 1. Hydraulic Cranes:

- (a) Hydraulic power units: (1) Electric motor (2) Pump(s).
  - (1) Hydraulic motor(s)
  - (2) Cylinders
  - (3) Electric motor
  - (4) Actuators
  - (5) Solenoid valves
  - (6) Pump(s)

## 2. Electric Cranes:

- (a) Electric motors
- (b) Motor speed controllers
- (c) Motor speed control components

## 3. Control Braking

## 4. Controls (pendant or cab-controlled):

- (a) Master control switches or levers
- (b) Master control float switches
- (c) Crane control pushbuttons
- (d) Limit bypass switches
- (e) EMERGENCY RUN pushbuttons

## 5. Electrical Power:

- (a) Ship electrical distribution:
  - (1) Circuit breakers or fuses
  - (2) Isolation transformers
  - (3) Rectifiers
- (b) Diesel generator
- (c) Electrical protection:
  - (1) Overcurrent devices
  - (2) Undervoltage devices
  - (3) Loss-of-power cutout switch
- (d) Crane electrification:
  - (1) Slip ring
  - (2) Cable reel

## c. Safety Features:

- 1. Hoist upper limit switch/stop
- 2. Boom limit switch/stop
- 3. Emergency stop/power off
- 4. Travel warning device
- 5. Machinery guards
- 6. Loss-of-power protection

## d. Rotation - Travel Drive Systems:

1. Rotation assembly:
  - (a) Drive motors
  - (b) Gearing
  - (c) Shafts
  - (d) Couplings
  - (e) Brakes
  - (f) Rotation limit switches
  - (g) Bumpers and stops
2. Travel assembly:
  - (a) Drive motors
  - (b) Drive shafts
  - (c) Couplings
  - (d) Gearing
  - (e) Brakes
  - (f) Travel limit switches
  - (g) Bumpers and stops

## APPENDIX F.

## CRANE CERTIFICATION AUDIT PLAN (SECTION 6)

## 589-F.1

The attributes contained in the sample Crane Certification Audit Plan (Figure 589-F-1) were developed from an overall review of specific requirements, but do not reflect all requirements. The questions on the sample form have been worded so that negative answers will indicate specification violations. When discovered, a deficiency or lack of compliance should be identified in the appropriate remarks block of the Crane Certification Audit Plan and recorded on a Crane Certification Audit Discrepancy Identification form (Figure 589-F-2).

CRANE CERTIFICATION AUDIT PLAN			
ATTRIBUTE	SAT	UNSAT	REMARKS
<b>A. PERSONNEL</b>			
1. Have crane crews been organized to meet minimum manning requirements?			
Reference: paragraph 589-3.2			
2. Are personnel responsibilities for training and qualification of crane crew members designated in writing by the Commanding Officer?			
Reference: paragraph 589-3.3.1			
3. Has a formal training program been established?			
Reference: paragraph 589-3.3.2			
4. Do crane crew members meet minimum physical requirements?			
Reference: paragraph 589-3.3.3			
5. Are qualification, testing, record keeping, and other special requirements being met?			
Reference: paragraphs 589-3.3.4 through 589-3.3.11			

Figure 589-F-1. CRANE CERTIFICATION AUDIT PLAN (Sheet 1 of 7)

<b>CRANE CERTIFICATION AUDIT PLAN</b>			
<b>ATTRIBUTE</b>	<b>SAT</b>	<b>UNSAT</b>	<b>REMARKS</b>
6. Are watchstanding proficiency requirements being met?  Reference: paragraph 589-3.3.10			
7. Are proper communications in effect, including hardhat colors and signals?  Reference: paragraph 589-3.4.1			

Figure 589-F-1. CRANE CERTIFICATION AUDIT PLAN (Sheet 2 of 7)

<b>CRANE CERTIFICATION AUDIT PLAN – Continued</b>			
<b>ATTRIBUTE</b>	<b>SAT</b>	<b>UNSAT</b>	<b>REMARKS</b>
<b>B. OPERATIONS</b>			
1. Are proper precautions being observed?			
Reference: paragraphs 589–3.5.4.2 and 589–3.5.4.3			
2. Is an adequate and effective ODCL performed daily when the crane is in use?			
Reference: paragraph 589–3.5.3			
3. Are minimum operating guidelines being observed?			
Reference: paragraphs 589–3.1.1 through 589–3.5.9			
4. Are rigging procedures proper?			
Reference: paragraphs 589–3.6 through 589–3.7.6.4			
5. Are special procedures in effect for CRITICAL lifts?			
Reference: paragraphs 589–3.7 through 589–3.7.6.4			

Figure 589-F-1. CRANE CERTIFICATION AUDIT PLAN (Sheet 3 of 7)

<b>CRANE CERTIFICATION AUDIT PLAN – Continued</b>			
<b>ATTRIBUTE</b>	<b>SAT</b>	<b>UNSAT</b>	<b>REMARKS</b>
<b>C. MATERIAL AND MAINTENANCE</b>			
1. Are mandatory safety features installed? If not, has an alteration request been submitted?  Reference: paragraph 589–4.2.1			
2. Is an adequate Planned Maintenance System (PMS) program in effect? Is it properly administered?  Reference: paragraph 589–4.3.2			
3. Are specific component test requirements used, and are they properly documented?  Reference: paragraph 589–4.4.1.1			
4. When Controlled Assembly procedures are used, are the procedures sufficiently detailed and properly documented?  Reference: paragraphs 589–4.5 through 589–4.5.9			
5. For electrohydraulic cranes, has a Hydraulic System Test procedure been prepared and approved? Is the procedure in use?  Reference: paragraph 589–4.6			

Figure 589-F-1. CRANE CERTIFICATION AUDIT PLAN (Sheet 4 of 7)

<b>CRANE CERTIFICATION AUDIT PLAN – Continued</b>			
<b>ATTRIBUTE</b>	<b>SAT</b>	<b>UNSAT</b>	<b>REMARKS</b>
<b>D. TEST AND INSPECTION</b>			
1. Are current and satisfactory records available to document annual component inspections; no-load tests, and static, dynamic, and rated load tests?			
Reference: paragraphs 589–5.1 through 589–5.5.5			
2. Are test and inspection results properly recorded and tagged?			
Reference: paragraphs 589–5.1 through 589–5.5.5			
3. Are initial hook throat openings and wire rope installation dates recorded and available?			
Reference: paragraph 589–5.2.8.2			
4. Are test results compared with baseline data for evidence of crane degradation? Has wire rope service life been exceeded, or do hook throat openings exceed 5 percent increase after static load test or 15 percent over life?			
Reference: paragraphs 589–5.5 through 589–5.6.5			

Figure 589-F-1. CRANE CERTIFICATION AUDIT PLAN (Sheet 5 of 7)

<b>CRANE CERTIFICATION AUDIT PLAN – Continued</b>			
<b>ATTRIBUTE</b>	<b>SAT</b>	<b>UNSAT</b>	<b>REMARKS</b>
<b>E. CERTIFICATION</b>			
1. Have the Crane Officer, Test Directors, and Crane Certifying Officer been designated in writing by the Commanding Officer?			
Reference: paragraphs 589–6.2.1 through 589–6.2.4			
2. Has initial certification been established for each assigned crane?			
Reference: paragraph 589–6.3.1			
3. Are departures–from–specification procedures properly performed following decertifying events?			
Reference: paragraph 589–6.3.3			
4. Are cranes properly recertified following decertifying events?			
Reference: paragraph 589–6.3.4			

Figure 589-F-1. CRANE CERTIFICATION AUDIT PLAN (Sheet 6 of 7)

<b>CRANE CERTIFICATION AUDIT PLAN – Continued</b>			
<b>ATTRIBUTE</b>	<b>SAT</b>	<b>UNSAT</b>	<b>REMARKS</b>
5. Is the component certification envelope consistent with each assigned crane type?  Reference: paragraph 589–6.4.1			
6. Are periodic audits being performed?  Reference: paragraph 589–6.5.1			
7. Are crane certification records being adequately maintained?  Reference: paragraph 589–6.6			
8. Is a crane certification file maintained for each assigned crane?  Reference: paragraph 589–6.6			

Figure 589-F-1. CRANE CERTIFICATION AUDIT PLAN (Sheet 7 of 7)

<b>CRANE CERTIFICATION AUDIT DISCREPANCY IDENTIFICATION</b>	
<b>IMMEDIATE CORRECTIVE ACTION REQUIRED:    Yes    No</b>	
ITEM	
AREA	
AUDITOR	
DISCUSSED WITH	
FINDING	
RECOMMENDATION	
CORRECTIVE ACTION (to be completed by Crane Officer)	
CONCURRENCE WITH CORRECTIVE ACTION _____ Crane Certifying Officer	

Sheet \_\_ of \_\_

Figure 589-F-2. CRANE CERTIFICATION AUDIT DISCREPANCY IDENTIFICATION

**APPENDIX G.****TECHNICAL MANUAL DEFICIENCY/EVALUATION REPORT(TMDER)****NOTE**

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

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