

## CHAPTER 2

# SIGNAL EQUIPMENT

Before Signalmen can perform their jobs, they must know the equipment with which they will work and how to operate it. Although equipment may differ in size or vary slightly among ships, signal gear generally is standard throughout the Navy.

In this chapter we discuss the principles of operation; maintenance procedures where applicable; and safety precautions pertaining to signal lights, infrared (IR) equipment, flags, halyards, and optical equipment.

You will not be permitted to use signal equipment until you have been instructed in the operation of it. The necessary permission must come from the communications (or signal) officer or the petty officer in charge of the signal bridge.

You must be able to locate, even under conditions of total darkness, all light switches for electrical visual signal equipment. Usually this is simply a matter of familiarization. On the signal bridge most switches are on or within reach of the equipment. When you first report aboard ship, explore the bridge to see where the signal equipment switch panels are located. Do this before your watch. This practice will prove helpful later when you are scheduled for night watches.

### SIGNAL SEARCHLIGHTS

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**LEARNING OBJECTIVES:** Describe the different types of signaling searchlights. Identify their parts and assemblies and explain their functions.

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Searchlights are placed aboard naval ships for two purposes: illumination and communications. The use of a searchlight in visual communications is called the directional method, because the light has to be pointed at the receiver. Searchlights are classified according to size and source. We discuss the 12-inch searchlights in this chapter. The 12-inch light is either an incandescent or mercury-xenon arc lamp.

Searchlights come under the cognizance of the Naval Sea Systems Command (NAVSEASYS COM), and the ship's engineer officer is responsible for their

repair. That does not, however, relieve the Signalman of the full responsibility for observing the instructions for the proper use and routine maintenance of the searchlights. The life of a searchlight depends upon the care given to it. Preventive maintenance and daily cleaning will keep your searchlight ready for instant use.

Searchlights used in the Navy normally use a shutter to interrupt the light beam and permit signaling. The patterns of light caused by the opening and closing of the shutter are the basis for transmitting messages by Morse code.

### 12-INCH INCANDESCENT SEARCHLIGHT

The 12-inch incandescent searchlight is used primarily for signaling and secondarily for illumination.

Figure 2-1 shows a 12-inch incandescent searchlight, consisting of the mounting bracket, lamp-supporting yoke, and high-power (1,000-watt) incandescent lamp housed in a drum. By use of a brace or extension between the mounting bracket and the yoke, the light can be swung in an arc to clear fixed portions of the ship's structure.

Besides holding the lamp, the drum provides a mounting for the signaling shutters. On top of the drum are vane sights, used to aim the light. The back

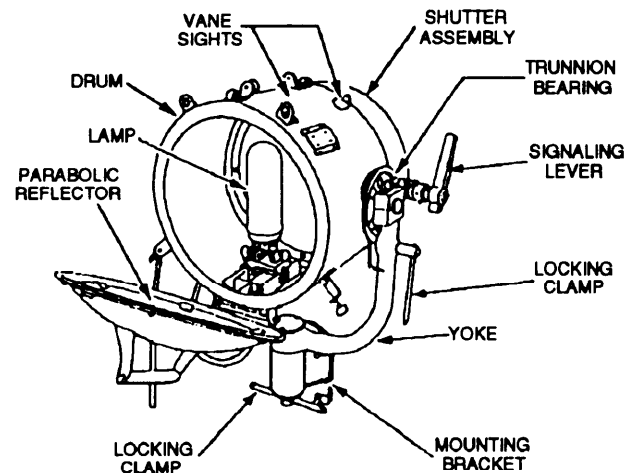


Figure 2-1.—12-inch incandescent searchlight.

door is hinged, allowing access to the drum interior. The parabolic reflector is mounted on the rear door. Signaling levers on both sides of the drum open and close the shutters to permit signaling up to 15 words per minute.

The drum is mounted on the yoke with trunion bearings so that the light can be elevated or depressed. Locking clamps on the yoke secure the light in elevation; locking clamps beneath the mounting bracket lock the light in train.

There is very little to operating this type of light. You can learn in a short time the proper procedure for turning the lamp on and off, positioning it horizontally or vertically, and operating the shutter. Train the searchlight directly on the receiver in daytime, but not at night, for it might blind the receiver and bridge personnel. At night, train the searchlight slightly under or above the receiver.

## **Operation**

A remotely mounted rotary switch controls power to the searchlight. To open the signaling shutters, use pressure on the signaling lever to overcome spring pressure. When you release pressure on the signaling lever, the spring forces the shutters closed. Two leather bumpers cushion the return of the signaling lever, protecting the shutter from damage.

Do not keep the searchlight switched on longer than necessary. When the searchlight is not in use, lock it in the fore-and-aft position.

When the signal bridge is secured, as during overhaul, searchlight lay-up maintenance should be conducted according to the maintenance requirement card (MRC); also, all tests and care and maintenance procedures should be performed before redeployment, to ensure proper operation. During inclement weather, place a protective canvas cover over lights not in use.

## **Maintenance**

Maintain searchlights according to current MRCs. Electrical contacts must be kept clean and bright. Electrical leads should be checked daily and replaced as soon as defects appear. Depending on the amount of time they are used, moving parts such as trunion bearings and stanchion sockets must be lubricated at intervals. Shutter vane hinges and links should be lubricated once a quarter, or more frequently if required. Searchlights should be operated for a few

minutes after lubrication with the door glass and cover removed to allow the lubricant to evaporate.

Screws and bolts should be checked for tightness at regular intervals, particularly following the firing of the ship's guns.

The two shutter stop screws should be adjusted at regular intervals to take up the wear in the leather bumpers. The leather bumper should just touch the stop adjustment when the vanes are closed to prevent twisting.

The reflector should be cleaned quarterly and/or when needed. Refer to your MRC for instructions on cleaning the reflector.

Never paint a bearing surface or the working member of any part of the light. Do not paint bolts, locking nuts, or other parts accessing the interior. Do not paint over nameplates, and keep oiling cups and holes free of paint.

Replacing the lamp and focusing should be done only by qualified Electrician's Mates unless a member of the signal gang is qualified and authorized to do so.

## **12-INCH MERCURY-XENON ARC SEARCHLIGHT**

The mercury-xenon arc searchlight uses a 1,000-watt mercury-xenon lamp. The searchlight is provided with an automatic lamp-starting circuit.

Parts consist of a drum, back dome, signaling shutter, mounting yoke, lamp, focusing device, starter box, and ballast assembly. The automatic starting circuit assembly is attached to the lower part of the drum. A screening hood with various color filters is supplied.

A high-voltage, pulse-type circuit is used. When the searchlight is turned on, the boost transformer supplies 130 volts to the primary coil of the transformer, which in turn provides a series of pulses of approximately 50,000 volts generated by high-frequency discharges through a spark gap.

When the main arc in the lamp is established, the voltage to the primary coil of the transformer drops to 65 volts. This voltage is not high enough to cause the secondary voltage of the transformer to break down the spark gap. Thus, the high-voltage pulse to the lamp automatically ceases.

Five resistors are connected in parallel and are, in turn, connected in series with the lamp. These resistors limit the current at starting and during operation, and supply the correct electrical values to the lamp.

## 12-INCH MODIFIED MERCURY-XENON SEARCHLIGHT

Some of the older mercury-xenon searchlights are 12-inch, incandescent lamp searchlights converted to use a 1,000-watt, compact, mercury-xenon arc lamp (fig. 2-2). The addition of a small amount of mercury to xenon in a gaseous discharge arc lamp produces a much more brilliant light with a great deal of radiation in the green and ultraviolet parts of the spectrum. The increase in light intensity greatly increases the range of the searchlights.

The modifications made to convert the searchlight include the installation of a lamp holder, lamp adjuster assembly, and lamp starter assembly mounted on the searchlight drum.

Other modifications include the following:

1. Providing a 115-volt, 60-Hz ballast unit to be mounted below the deck near the searchlight and connected to it by a flexible cable.
2. Installing the short-arc mercury-xenon lamp.
3. Furnishing the additional onboard repair parts necessitated by the changes. (The electrical components include a ballast, transformers, capacitors, spark gaps, and switch circuits.)

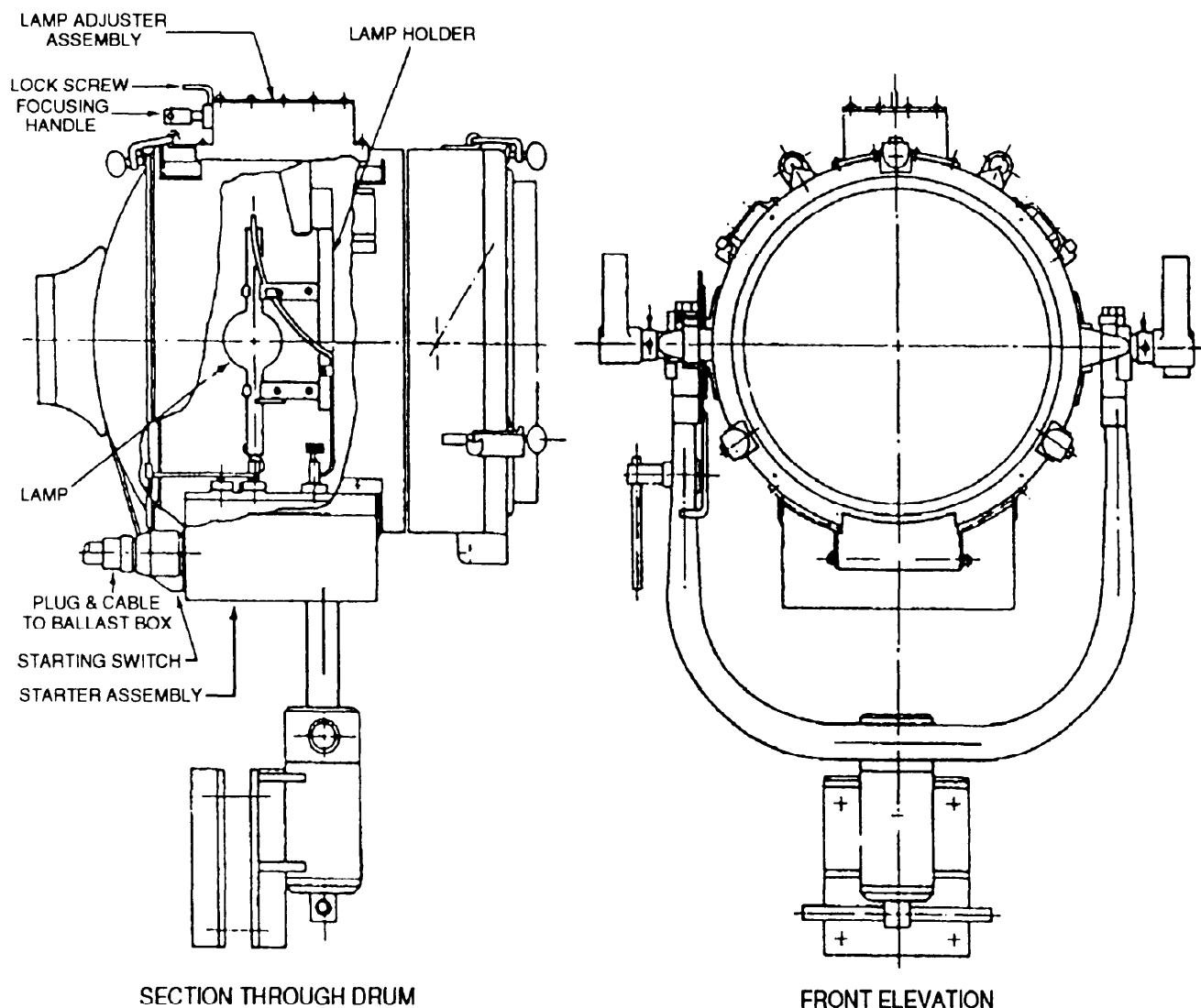


Figure 2-2.—12-inch modified mercury-xenon arc searchlight.

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## Operation

To start the light, close the remote manual switch, then turn the starter counterclockwise on the rear of the starter unit. (See fig. 2-3.) Release the starter switch as soon as the lamp arcs. Be sure the starter switch returns to its previous position; otherwise, the higher current required to start the lamp may damage electrical components.

Initially, the lamp burns only at about 25 percent of designed intensity. It takes 2 to 3 minutes to reach maximum brilliance.

The light should not be elevated or depressed more than 10 degrees for extended periods of time because the life of the lamp is reduced considerably at extreme angles. Operate the shutters the same as you would the incandescent lamp shutters. To turn off the lamp, open the remote manual switch.

## Maintenance

The 12-inch mercury-xenon arc searchlight should be inspected and checked monthly. All screws, especially those of the reflector clamps, focusing mount, and lamp support, should be examined for looseness. All screws and fastenings should be checked after ship's guns have been fired.

Trunion and yoke bearings should be lubricated with grease; see the MRC for the type of grease.

Replacement of the lamp must be performed as explained in the applicable manufacturer's manual, observing all precautions given.

When the return action becomes sluggish, the shutter bearing and links should be lubricated. The lubricant should be used sparingly and should not be allowed to contact the envelope of the mercury-xenon lamp. Should the shutters remain sluggish, replace the shutter springs.

The reflector and glass cover should be cleaned as required by the MRC.

When considered necessary, the cover of the ballast box should be removed and the five resistors examined and tightened in their sockets. Wiring should be checked and terminal screws tightened as required. The packing glands at the cable entrances should be kept secure and watertight.

Focusing is performed by means of a sliding plunger at the rear of the focusing box on top of the searchlight.

Maintenance is basically the same for the manual-starting and automatic-starting, 12-inch, mercury-xenon searchlights. For detailed differences in the construction and operation of these two types, see the applicable manufacturer's manual.

Electrical maintenance should be left to the electricians unless a member of the signal gang is qualified to do it by the engineer officer.

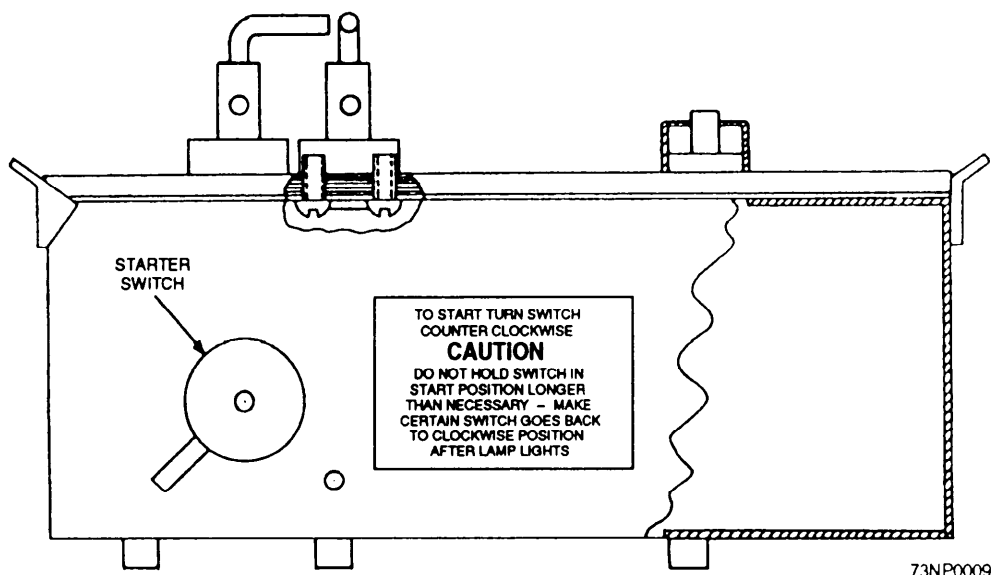


Figure 2-3.—Starter unit for 12-inch mercury-xenon searchlight.

Because the lamp contains gas under pressure, take care when handling it or when cleaning the interior of the drum. The lamp shell is quartz, not glass. Keep it free of oil or grease, and do not handle it without the protective metal case provided. Grease or oil may, at lamp operating temperatures, set up stresses in the quartz and cause the lamp to explode. If the lamp should be soiled in any way, wash it off with alcohol or other grease-free solvent, then dry it carefully with a clean cloth.

Before opening the drum, make sure the power is off. This can be done by turning the remote switch Off and then removing the power cable plug from the starter unit.

When you remove or replace the lamp, wear the face guard and gloves provided. Place the protective metal guard over the lamp; disconnect the lamp leads from the binding post on top of the starter unit; loosen all wing nuts holding the lamp in the lamp adjuster assembly; then remove the lamp.

**CAUTION**

Even when it reaches the end of its useful life, a mercury-xenon lamp is potentially dangerous. Turn it in to the mercury control officer or his/her representative for disposal.

When installing a new lamp, do not touch the quartz with your fingers. Keep the protective case around the lamp until it is in place.

Hold the lamp by the protective cover with the longer of the two leads pointing up, and insert them in the two vee-slots on the lamp supports. Fasten the lamp in place with the clamps and wing nuts; then connect the power leads to the binding post, making sure they do not touch any other metal parts.

For signaling at the greater design ranges, more accuracy in the aim is required. To align the sights with the beam, aim the light at a bulkhead 50 to 100 feet away. Focus the lamp for the narrow beam. Look through the sights; the beam should be in the center.

If the beam is not centered, remove the top cover plate of the lamp adjuster assembly. (See fig. 2-4.) If the beam is high or low, loosen the thumbscrew and turn the vertical adjustment screw to raise or lower the lamp. When you have it adjusted, tighten the thumbscrew. If the beam is off to one side, loosen the four horizontal screws on the transverse sliding plate;

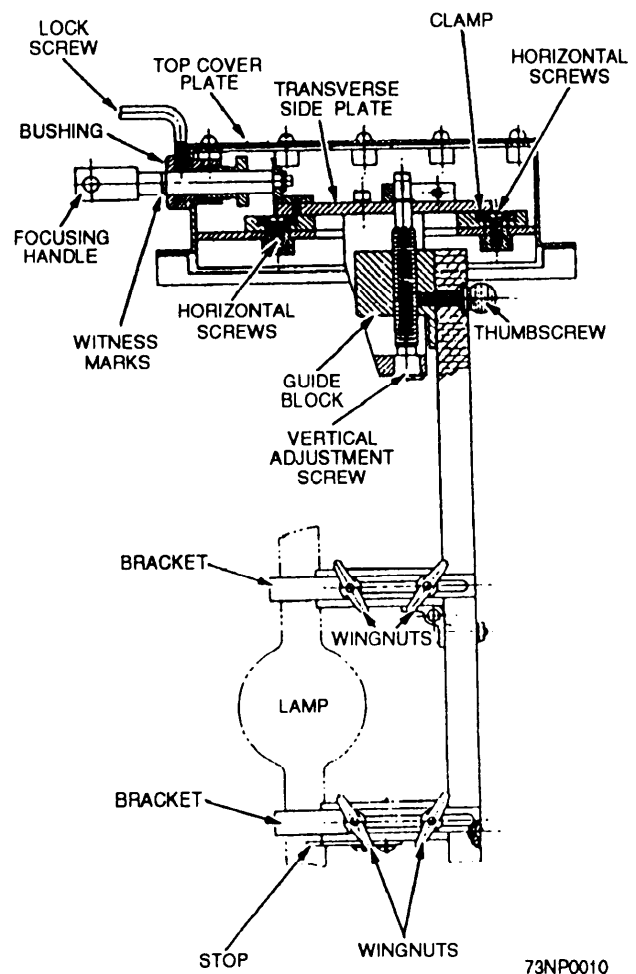


Figure 2-4.—12-inch mercury-xenon lamp adjuster assembly.

slide the plate by hand to center the beam; and retighten the screws.

## MULTIPURPOSE SIGNAL LIGHT

The multipurpose signal light (fig. 2-5) produces a high-intensity beam of light suitable for use as a spotlight or as a blinker for visual communication. The power source is three dry cell batteries or the ship's electrical power via a 120/20-volt transformer mounted in the storage box. The front handle is adjustable to maintain a steady position when signaling, and front and rear sights are provided for holding the beam on target.

Supplied with the light are red, green, and amber lenses, a 15-foot power cord for supplying power from the ship's electrical source to the stowage box, and a 25-foot cord for supplying power from the storage box to the light.

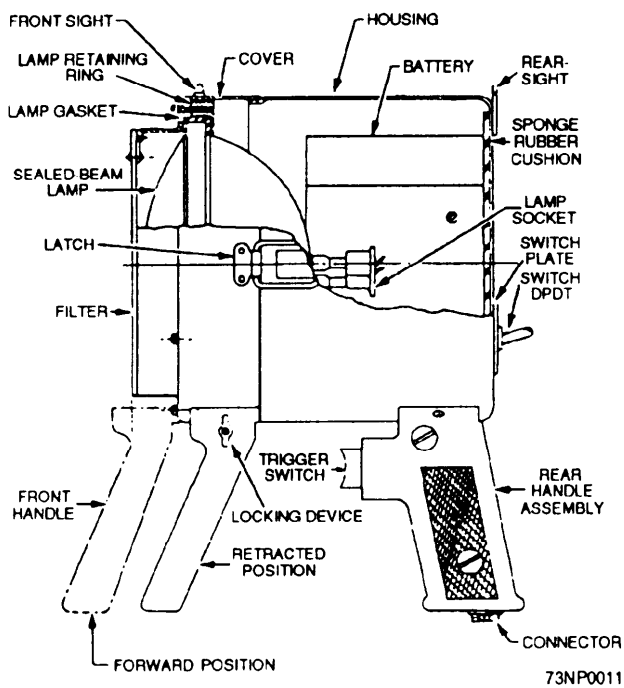


Figure 2-5.—Multipurpose signal light.

For signaling, the light may be held in the hand and operated with the trigger. It has an effective signaling range of 4,000 yards and is designed to send up to 12 words per minute.

### YARDARM BLINKERS SYSTEM

*LEARNING OBJECTIVE:* Explain the function of the yardarm blinkers system.

Yardarm blinkers are 32-point, 360-degree white lights located on the yardarm or on separate supports on the mast. (See fig. 2-6.) The fixtures are spraytight and fitted with screens at their bases to prevent glare or reflection, which could interfere with navigation. The range of the yardarm blinkers is limited and can only be used effectively during hours of darkness.

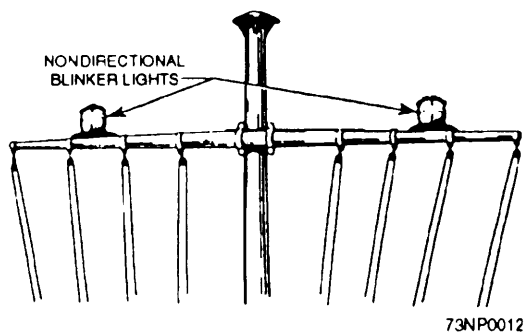


Figure 2-6.—Yardarm blinkers.

Yardarm blinkers permit communication to several units simultaneously. These lights are operated from signal keys located on each side of the signal bridge and in the signal shelter. By selecting the appropriate position on the transmitter control panel, you can operate the beacons as a steady light or as blinkers using the signal key.

Normally, maintenance is the responsibility of the Electrician's Mates. Cleanliness and upkeep of the light exteriors are tasks for Signalmen. This upkeep can be hazardous. Before going aloft, check Man Aloft Procedures covered later in this chapter.

### INFRARED COMMUNICATION EQUIPMENT

*LEARNING OBJECTIVE:* Explain the function of infrared (IR) transmitting sets.

Infrared equipment consists of the AN/SAT 2 IR transmitting set or a searchlight fitted with an H hood. This equipment is popularly known as Nancy gear. Night vision sights (NVSS) make it possible to visually detect the invisible IR rays of the light spectrum. Together this equipment provides a measure of communication security.

Like visible light, IR is limited in range to the horizon, and range is further reduced by adverse weather conditions.

### AN/SAT 2 TRANSMITTING SET

The AN/SAT 2 IR transmitting set (see fig. 2-7) is designed to transmit signals in the IR region of the frequency spectrum; that is, between 0.75 and 1.2 microns. Infrared radiations are invisible, thus providing a secure means for signaling at night under darkened ship conditions. The two IR transmitters (beacons) may be operated as a steady source for point-of-train purposes, or they may be flashed in Morse code for signaling and recognition. The beacons are visible for 360 degrees and can be positioned to transmit fore and aft or port and starboard. For security, the beacons have been designed so they cannot be detected by the unaided eye at distances greater than 400 yards. The beacons are white-light tight; however, they are visible as dim red lights at short distances. The AN/SAT 2 is used mainly for nondirectional communication.

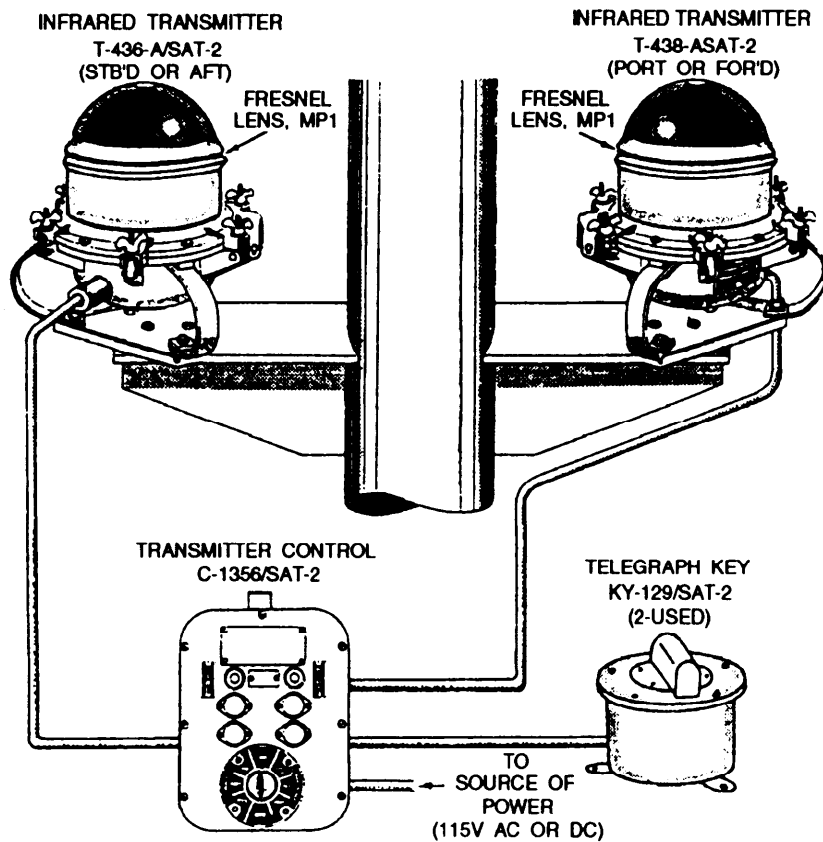


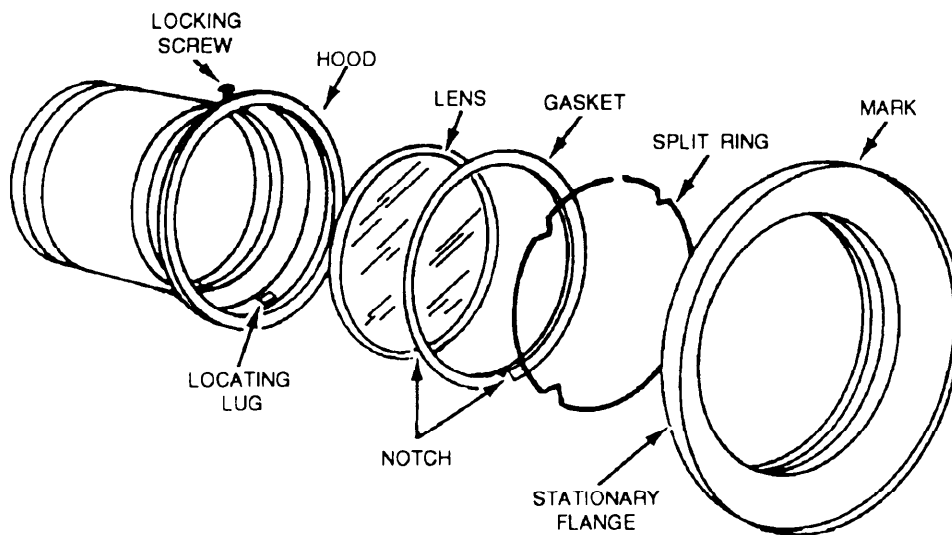
Figure 2-7.—AN/SAT 2 infrared transmitting set.

The IR transmitting set consists of two IR transmitters (beacons), a transmitter control panel, and two telegraph keys. The beacons may be operated separately or simultaneously by either manual key. Selection of the mode of operation is controlled by the transmitter control panel. The IR transmitter consists of a formed brass housing and a dome-shaped homogeneous tempered glass filter, which encloses a 300-watt, 110-volt, T20 clear bulb incandescent lamp and reflector. The transmitter control consists of a watertight brass housing with a removable front cover, and contains a switch, four fuses, two indicator lights, two terminal boards, and associated wiring. The front panel has a gasket to ensure a watertight fit, and is fastened to the housing by means of eight machine screws. Two locating pins ensure proper alignment of the door and housing. (This control panel is also utilized by the yardarm blinkers; however, this blinker is powered by a separate ship's power supply to ensure the circuit is inoperable during darken ship.) The telegraph key consists of a watertight brass box containing a signaling key, a monitor indicator light, a terminal board, and a capacitor. The watertight housing consists of a formed and welded steel box with a formed steel cover and key guard. The cover is

attached to the housing by means of six machine screws. A locating pin ensures proper alignment. The base of the housing has three mounting lugs. The hinged key guard on the cover protects the key from damage when it is not in use. A hold-down lever permits steady operation of the beacons when placed in the down position.

Due to the constant exposure to the elements, strict compliance with planned maintenance system (PMS) requirements is essential for this equipment. Normally, maintenance is the responsibility of the Electrician's Mates. Cleanliness and upkeep of the light exteriors are tasks for Signalmen. This upkeep can be hazardous. Before going aloft, check Man Aloft Procedures covered later in this chapter.

The most widely used IR transmitting equipment is the standard 12-inch searchlight fitted with a type-H hood containing the special filter lens (fig. 2-8). The lens resembles a sheet of red glass. The light is operated in the same procedure for regular directional communication, but train must be more accurate.



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Figure 2-8.—Searchlight H hood.

## CHEMICAL WARFARE DIRECTIONAL DETECTOR

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**LEARNING OBJECTIVE:** Explain the procedures for the use of the chemical warfare (CW) directional detector, including installation, maintenance, and operations.

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The AN/KAS-1 chemical warfare directional detector system (fig. 2-9) is a passive IR imaging sensor that provides U.S. Navy ships with the capability for detection and identification of chemical warfare (CW) agent attacks. The AN/KAS-1 can be used to detect and identify nerve agent attacks against ships in a task force, against waves of amphibious assault ships/boats proceeding ashore, or against assault forces in the vicinity of the landing area. Chemical warfare agent cloud detection and identification can be accomplished against a sky background for all conditions under which CW attacks may be expected to occur. Detection of CW activity against a land background can be accomplished less effectively.

The inherent characteristics of an IR sensor make the AN/KAS-1 useful in low-visibility/night pilotage and area surveillance. The AN/KAS-1 operator can detect and provide relative bearing to prominent land features (light house, water tower) and buoys. Detection of personnel on the water surface (man overboard) can also be provided by the system.

The AN/KAS-1 consists of a sensor unit, a pivot mount, a power conversion unit (PCU), a carrying/stowage case, a maintenance kit, and an overboard lanyard.

The sensor unit is equipped with the following controls: a field-of-view switch, which enables the operator to use both a wide field of view (WFOV) and a narrow field of view (NFOV); a range/focus knob; a contrast knob; a brightness knob; and a filter wheel switch. The filter wheel switch allows the operator to rotate a wheel positioned in the optical chain of the unit through four positions: filter 1, filter 2, filter 3, and filter out. These filters are used to identify CW nerve agent clouds.

The pivot mount provides the mechanical interface between the sensor unit and the standard bracket and lock assembly. The pivot mount provides a minimum elevation of minus 35 degrees to plus 45 degrees and 360 degrees of azimuth; the number of azimuth rotations is limited only by the length of the interconnecting cable. Handlebars are provided for operator positioning of the sensor unit. The interconnecting cable provides electrical connection/power transfer from the PCU to the sensor unit via a coiled, double-shielded cable.

The PCU (fig. 2-10) provides operating power to the sensor from the ship's 115-Vac, 60-Hz supply. Press-to-test switches/lights are included to verify the presence of input and output voltages. The unit consists of an electronics tray contained in a watertight protective housing.



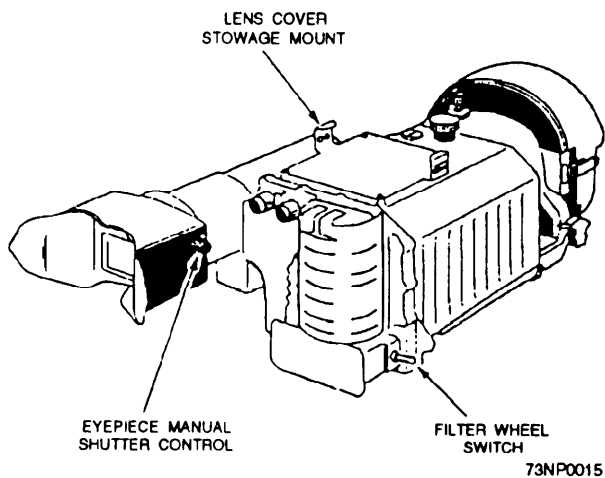
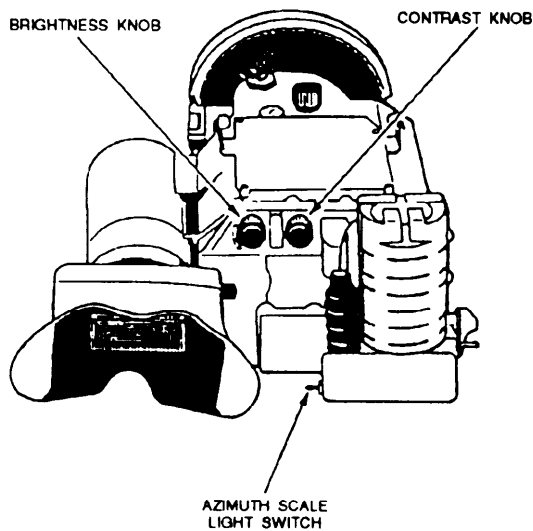
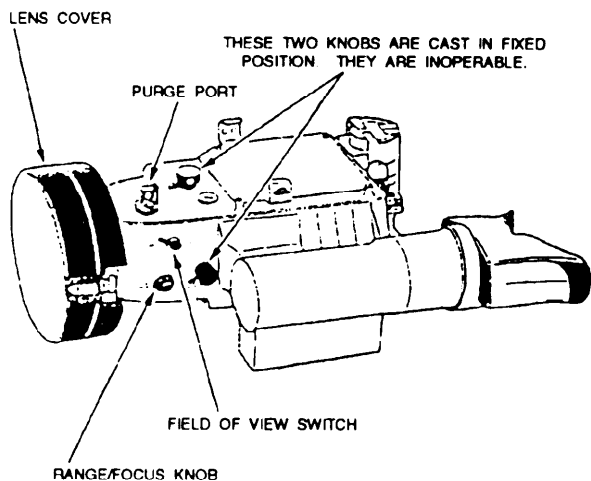


Figure 2-9.—Chemical warfare directional detector.

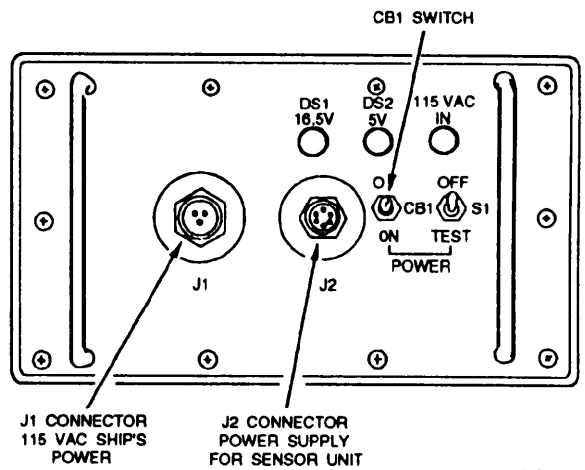


Figure 2-10.—Power conversion unit.

A carrying/storage case is provided for transportation and storage of the AN/KAS-1. Space is also provided in the case for the storage of the sensor unit, pivot mount, interconnecting cables, overboard lanyard, maintenance kit, and foul-weather cover.

A foul-weather cover of waterproof canvas is used for protecting the sensor pivot mount when it is not in use.

A maintenance kit (fig. 2-11) (stowed inside the carrying/storage case) is provided with the ANKAS-1. The kit consists of the following:

1. Spare bulbs and lenses

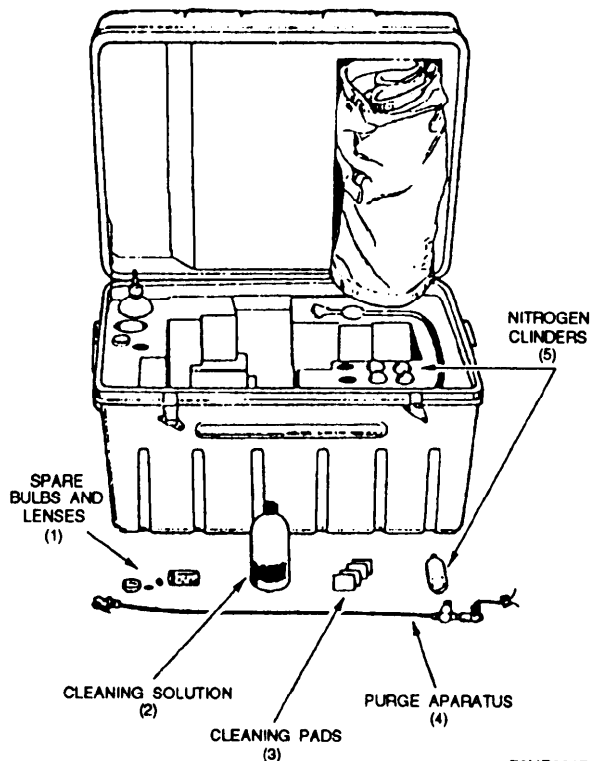


Figure 2-11.—Maintenance kit.

2. Lens-cleaning solution
3. Lens wipers
4. Purge kit regulator/connector assembly
5. Expendable nitrogen gas cartridges (six) to purge the sensor unit of moisture (30-day requirement)

An overboard lanyard (vinyl-covered stainless steel cable) is used to secure the sensor/pivot mount to an eyelet on the PCU unit mounting plate prior to installation or removal. The overboard lanyard and associated safety procedures will prevent accidental over-the-side loss or severe damage (fall to a lower deck) during installation or removal.

## INSTALLATION

Two mounting locations are to be established for each AN/KAS-1 (fig. 2- 12). Each location should be carefully chosen to ensure that it has a wide field of view (the view as wide as possible, and not blocked by other hardware). Care must be taken to avoid interference with other ships' equipment. Locations already selected for the Mk 37 night vision sight (NVS) are usually excellent. When possible, the mounting locations should be high on the ship, such as the signal bridge or pilothouse bridge wings. The locations must be accessible to sound-powered headphones.

The PCU mounting plate installation requires separation distance between the sensor unit and the PCU, and between the PCU and the deck when the PCU is mounted near the AN/KAS-1. These separation distances are necessary to ensure that the power cable will be neither too short nor too long and thereby create entanglement.

## MAINTENANCE

The AN/KAS-1 has been designed for minimum maintenance. Scheduled maintenance procedures will be detailed on the MRC. Corrective maintenance consists of removal and replacement of the sensor/pivot unit or the PCU when a failure occurs. The failure will be handled on a repair-and-return basis and does not require a requisition for replacement.

## TRAINING

Each AN/KAS-1 received will have a complete training package. This training should be incorporated into the Signaller Personnel Qualification Standards (PQS).

## OPTICAL EQUIPMENT

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*LEARNING OBJECTIVES:* Identify optical equipment. List procedures for the operation, maintenance, and handling of optical equipment.

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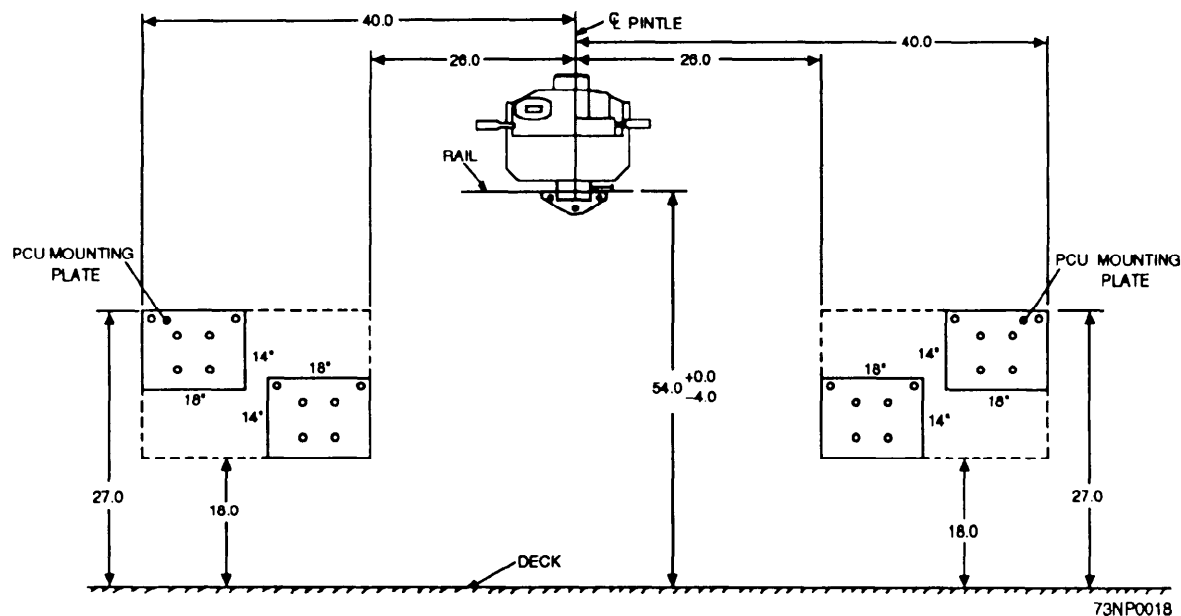


Figure 2-12.—AN/KAS-1 system installation.

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You were born with the finest optical equipment you will ever use—your eyes. But even if you have 20-20 vision, it often is impossible to read flaghoist and other signals accurately with the naked eye. To magnify distant signals, some of the following aids to vision are carried aboard Navy ships.

## SHIP'S BINOCULARS

Ship's binoculars (known as big eyes) have a magnification of 20-power, with an apparent field of view of approximately 70 degrees. The binoculars are mounted on a height-adjustable carriage assembly that is adjustable through 70 degrees elevation ranging from 10 degrees depression to 60 degrees elevation with reference to the horizon, and that can rotate through 360 degrees in azimuth. Ship's binoculars consist of the binocular assembly, carriage assembly, and the pedestal (fig. 2-13).

The binocular assembly contains the optics required to obtain the desired magnification. Eyeguards are provided to keep stray light from the observer's eye when sighting through the eyepiece.

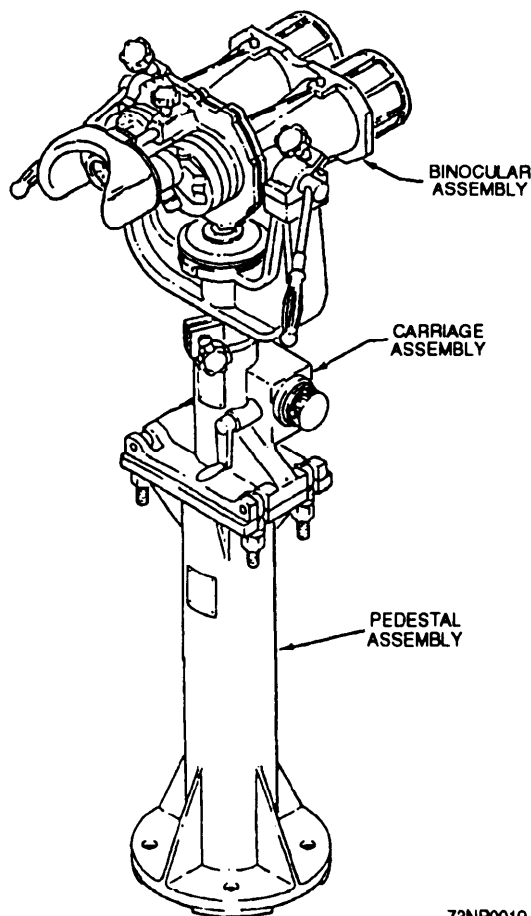


Figure 2-13.—Ship's binoculars.

The focusing knob enables the eyepiece to be individually adjusted. Each focusing knob is provided with a diopter scale, which is graduated from -3 to +1 in 1/2-diopter increments. The interpupillary distance (IPD) of the eyepieces is controlled by an interocular handle, and is adjustable from 56 to 74 millimeters. An INCREASE-DENSITY control is provided to adjust the polarized light filter. Inlet and outlet valves, located on top of the main housing assembly, are provided to evacuate and recharge the binocular assembly with dry nitrogen.

The carriage assembly enables the binocular assembly to be positioned in the proper azimuth and elevation. The carriage assembly contains a 360-degree azimuth scale graduated in 1-degree increments. The binoculars may be locked in any position from minus 10 degrees to plus 60 degrees by the elevation or azimuth knobs. The carriage also contains a handcrank that allows vertical adjustment of the binocular assembly through a range of 8 inches.

The pedestal assembly is used to mount the binoculars to the deck

## Operation

Perform the following procedures to operate the ship's binoculars (fig. 2-14):

1. Using the elevation handle, crank the binocular assembly to the desired height.
2. Loosen the headrest assembly knob and adjust the headrest to obtain proper relief and to center your eyes before the eyepieces. Tighten in position.
3. Adjust the interocular adjust knob until the same field is visible in both eyepieces.
4. Loosen the azimuth carriage and binocular elevation lock knobs; using the control handles, maneuver the binoculars in either azimuth or elevation so that the rear sight and front pin are trained on the object.
5. Rotate the variable-density control knob to remove the density filter from the optical path.
6. Individually move an eyepiece to the extreme plus diopter setting. Place your eyes into position and slowly move the eyepiece in until the image of the target is clearly defined. If the eyepiece is allowed to go past sharp definition, do not refocus; start over. Memorize your diopter scale readings. These readings can be used to make future focusing adjustments.

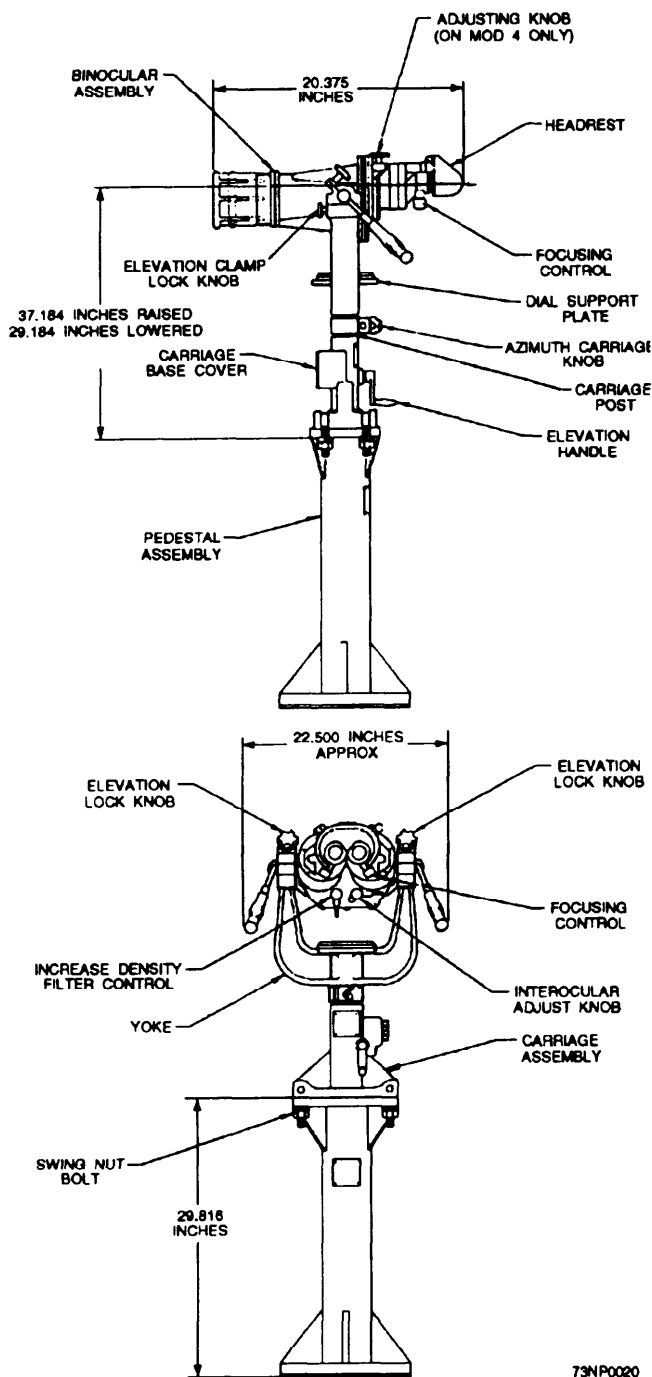


Figure 2-14.—Ship's binoculars arrangement and operating controls.

7. Rotate the variable-density control knob to control light and glare from the target field. Full clockwise rotation of the knob brings the polarizing filter, aligned for maximum light transmission, into the light paths. Gradual counterclockwise turns reduce light transmission to the minimum.

8. To lock the binocular assembly in the desired position, tighten the azimuth carriage and carriage assembly elevation lock knobs. A slight amount of friction may be introduced by leaving the elevation lock knobs slightly loose.

When the binocular is not in use, lower the carriage to its lowest position, secure all locks, and install the canvas cover over the binocular assembly.

### Maintenance

Maintenance should be performed according to the MRC. Scheduled maintenance includes routine inspection, cleaning, lubrication, and adjustments that can be made without removing the binoculars from the ship.

### CAUTION

The optical parts sealed within the body of binoculars may be seriously damaged by contamination if the body seal is broken. Any repair or adjustment requiring opening the body should be made by the appropriate facility.

Ship binoculars should be inspected daily to make sure they are in good working order both optically and mechanically. This includes checking the locking mechanisms, elevation, and rotation; external surfaces; rubber components for deterioration; and all controls to ensure a snug fit between their respective shafts and preformed packing.

The objective and eyepiece lenses are to be cleaned using appropriate cleaning material according to the MRC. However, unnecessary cleaning should be avoided. Wipe the metal parts of the binoculars with fresh water and detergent to prevent accumulation of salt and dirt.

When lubricating, remove the old lubricant and residue. Apply new lubricant sparingly as required. The angular elevation clamp, round boss, and lock pin should be lubricated at each removal or replacement. Remove the access cover to lubricate the gear

assembly. Take care to keep lubricant from the friction disc and the locking surfaces. Lubricate the yoke assembly by removing the binocular and removing the three screws and lift dial support; then lift the yoke from the carriage post and lightly coat the interior bearing surface of the yoke.

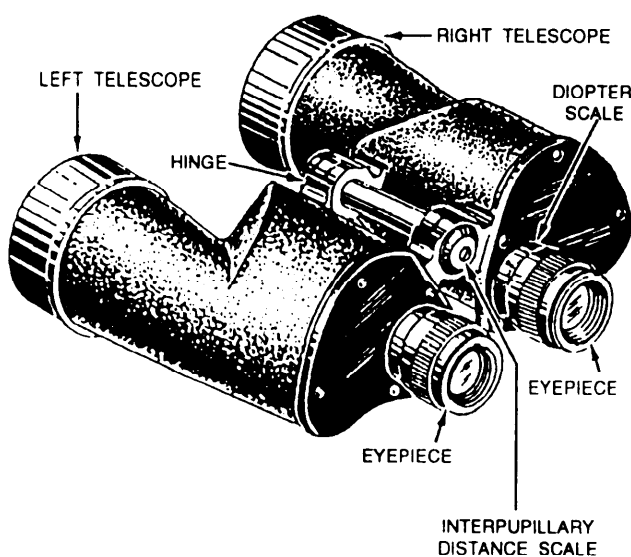
### CAUTION

Two persons should be used to lift either the binocular or yoke assembly.

## BINOCULARS

Binoculars (fig. 2-15) are the most commonly used of all optical equipment. Although normally only 7-power, they give a wide range of vision and are best suited for searching over a wide area or for following moving targets. They require the use of both eyes and, because both eyes do not always have the same vision, it is better to adjust the focus for each lens individually. Proper focus is essential. If the focus is off, eyestrain is increased greatly, and you will not get maximum efficiency from your optics.

To obtain the proper focus for each eye, turn both binocular scales to the +4 setting. Hold the binoculars firmly against your eyebrows. To get the focus for your left eye (only one eye can be focused at a time), cup the right hand over the right lens, cutting all light to that eye. Be sure to keep both eyes open, however, because closing one eye will give an incorrect focus. Train the binocular on a small well-defined object.



73NP0021

Figure 2-15.—7 × 50 binoculars.

Slowly turn the eyepiece from the +4 setting until the object stands out in sharp detail.

The reading on the scale gives you the correct focus for your left eye. Now do the same for your right eye. The chances are the setting will be different. Repeat this step several times to make sure the focuses are correct.

Once you get the glasses focused properly, remember your settings so you can focus your binoculars on a very dark night. The correct night focus usually is a -1 setting from your day focus for each eye.

The other adjustment for binoculars is the IPD adjustment. All Navy binoculars have the IPD scale on the hinges between the barrels. Find out what your IPD is and remember it. It may already be in your health record. If not, have a medical officer measure you for it. When you have set your correct IPD scale, you will see a complete circle, never overlapping circles. At night, if you have the wrong IPD setting, you will cut out a lot of light that should be going to your eyes.

Take a look through a pair of binoculars not adjusted for your eyes, then look through a pair that is adjusted properly. Notice the difference. If possible, always use the same binoculars.

Most glasses are treated scientifically to reduce glare, but there are times when the direct rays of the sun are so strong that it is almost impossible to distinguish shapes and colors. To overcome this handicap, glasses usually have colored lens filters that can be inserted over the regular lenses, reducing glare considerably.

## CARE OF OPTICS

Optical instruments require great skill and precision in their manufacture. They are both delicate and expensive. As with all precision equipment, careless handling can render them out of adjustment or useless. All maintenance should be accomplished according to current MRCs.

Your optics have many enemies. The major ones are dust, heat, light, and moisture. A severe shock, such as falling to the deck, may cause breakage either of lenses and prisms or mechanical parts. A sharp shock invariably causes the prisms and reticles to become misaligned.

Prevent dust from getting on the lenses as much as possible. Always leave the optics in their cases, or covered, when not in use. When dust gathers on the lenses, clean them only with lens paper, and make sure that your supply of lens paper is kept clean. Don't clean a lens when it doesn't need it. Repeatedly cleaning a lens, no matter how skillfully you do it, eventually damages the lens. Strong sunlight discolors the cement, and excessive heat often softens cemented lenses and filters and may allow them to separate. Moisture in any form, whether salt spray or the perspiration from your hand, causes film and chemical deterioration of the optical glass.

To have a useful piece of optical equipment when you need it, follow these few simple rules:

- Handle your optical equipment carefully. Don't let it bang against another object.
- When the optical equipment is not in use, keep it stowed in its proper place.
- Keep it dry and out of the weather.
- Keep it clean; use only appropriate material to clean it.
- Don't hang optical devices over the side, and when you are using binoculars, always keep them on a strap around your neck.
- Don't attempt to repair optical equipment. Send it to a repair ship or tender where Opticalmen have the proper equipment to make repairs.

### NIGHT VISION DEVICES

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*LEARNING OBJECTIVE:* Explain procedures for operating, maintaining, and cleaning night vision devices.

---

Night vision devices belong to a family of precision instruments that use electronic optics for observation, surveillance, and navigation. Night vision sights (NVSs) can be used in conjunction with the IR equipment discussed previously in this chapter.

Night vision devices are used to scan an area accurately and to detect enemy movement, to observe friendly forces, or to accomplish various other tasks associated with night devices.

Normally, night vision devices will be operated on ships from the signal bridge and bridge level. As a Signaller, you will be required to maintain and operate night vision equipment.

This section will acquaint you with the principles of operation, maintenance, and safety precautions for night vision devices.

### MK 37 NIGHT VISION SIGHT

The Mk 37 Mod 1 and Mod 3 NVS (fig. 2-16) are passive sights that emit no visible or IR light. An image intensifier tube is used to amplify received light, thus enhancing or allowing vision under nighttime or similar conditions of low illumination. The primary function of the Mk 37 NVS is long-range observation, such as enemy surveillance and target detection.

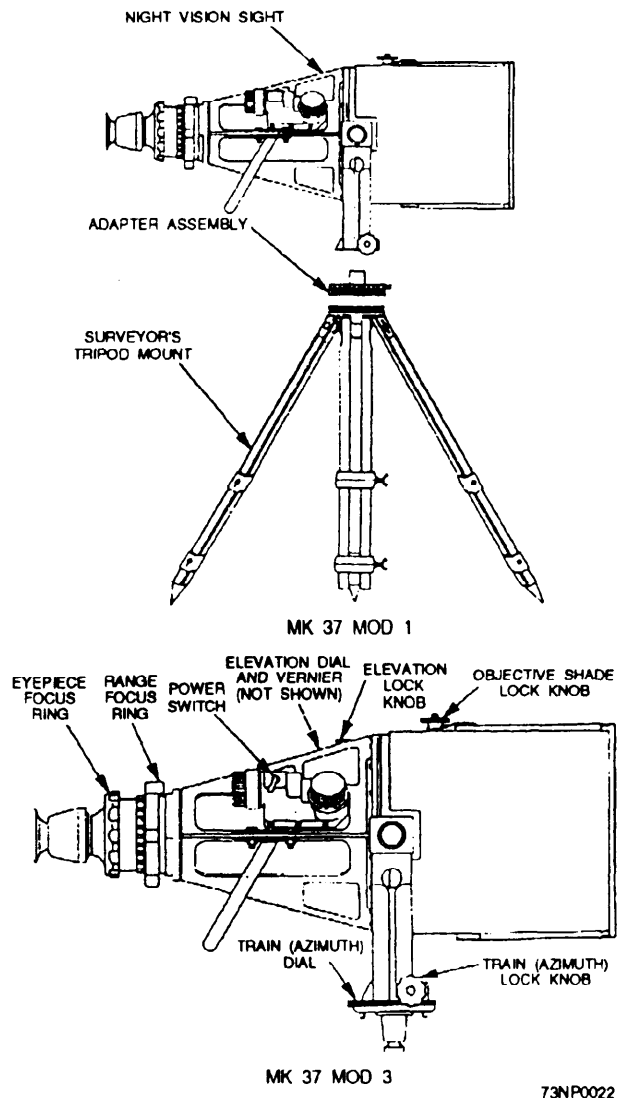


Figure 2-16.—Mk 37 Mod 1 and Mod 3 night vision sights.

The two models of the Mk 37 NVS differ basically by the type of mount used. Mod 1 is mounted on a tripod, and Mod 3 is bracket-mounted on the ship's signal bridge railing. The tripod mount supplied with the Mod 1 consists of three adjustable legs with a tripod adapter on top to secure the sight to the mount. The bracket mount for the Mod 3 is approximately 6 inches by 4 inches by 3.5 inches and is used when installing the sight at a suitable viewing location. The bracket mount is capable of positioning the Mk 37 Mod 3 through 360 degrees in train and from -28 degrees to +44 degrees in elevation.

The Mk 37 consists of three functional sections: objective lens, image intensification tube, and eyepiece.

The objective lens assembly consists of lens elements and mirrors, which function optically together and focus the image. The assembly is purged and sealed in an atmosphere of dry nitrogen to prevent lens fogging.

The image intensification tube consists of three stages of fiber optics, each with a photocathode and phosphor screen amplifying and transferring the image to the next stage. The adjustment for the intensifier is set at installation to prevent damage to the intensifier tube and must not be disturbed.

The eyepiece assembly consists of glass elements that function to magnify and focus the image on the eye of the operator. The Mk 37 NVS has seven glass elements in each eyepiece. The eyepiece assembly is purged and sealed in an atmosphere of dry nitrogen to prevent fogging. The Mk 37 NVS is supplied with a monocular eyepiece; attached to the eyepiece is a rubber eyeshield, which protects the eyes and aids in security by covering the areas around the eye. Light leaks are thereby prevented. In addition to the monocular eyepiece lens, the Mk 37 NVS is supplied with a binocular eyepiece lens. This lens allows the observer to use both eyes, thereby reducing eye fatigue. The binocular eyepiece allows a small amount of backglow from the image tube to illuminate the operator but is acceptable for most surface-ship applications.

A power converter is supplied with the NVS for convenience in use aboard ship or whenever 115-Vac, 60-Hz power is available. The power converter consists of the converter unit and cord assembly. It is sealed in a plastic cylindrical case in a threaded metal cap and is not repairable. The input connector of the converter is on the cap end, and the output spring contact is on the other end. The converter unit screws into the battery case of the NVS after the battery has

been removed. The 20-foot cord has a converter plug on one end and a standard shipboard 115-Vac, 60Hz power plug on the other. If the entire cord is not required to reach the power source, roll up the excess to avoid creating a walking hazard. A BA 1100/U 6.8-volt disposable mercury battery is also supplied with the NVS. The battery has a 72-hour continuous-use life-span and a 2-year shelf life. The battery is placed in the main housing with the positive end first. The positive end is easily identified, even in the dark, by its slightly raised center.

## Operation

Before operating the Mk 37 NVS, the operator needs knowledge and skill in the installation and setting up of the equipment. Actions required prior to installation are as follows:

1. Relieve air pressure inside the carrying case by pressing the core of the relief valve, located near the carrying handle, before releasing the latches.
2. Cut wire seals by all case latches.
3. Release all case latches and remove the cover.
4. Inventory and inspect the contents to ensure they are ready for installation.

Installation of the NVS consists of mounting the sight on the appropriate operational location and installing the power converter or battery. Locate the NVS at two positions, one port and one starboard. Ensure 360-degree rotation and that the location provides ample clearance for operation of the sight in all positions of train and elevation without interference.

The setup consists of removing the NVS from the storage case. Secure the pintle in the bracket and locking assembly. If the sight is to be battery operated, insert the battery and replace the battery cap. If the power converter is to be used, store the battery cap in the case and insert the power converter in the battery housing; rotate it clockwise until it is secure. Connect the cord between the converter and a 115-Vac, 60-Hz power source. The sight is now ready for operation.

### CAUTION

- Do not leave the battery in the equipment during storage, or corrosive damage may result.
- Do not remove the cover in daylight.

The following steps are required to place the MK 37 NVS in operation:

1. Place the power switch in the ON position.
2. Press your eye against the monocular lens eyeshield flap and view the image, or view the image with both eyes through the binocular eyepiece.
3. Adjust the diopter ring to create a sharp reticle image.
4. Adjust the focus ring for a clear image of the object desired.

### AN/PVS-8

The AN/PVS-8 (fig. 2-17) is a portable, shipboard-mounted, battery-operated NVS used for long-range surveillance. The unit uses the mounting system common to the Mk 37 NVS. An eye shield is used to prevent the visible light emitted from the eyepiece from being externally visible on the operator's face. Power is provided by two 1.5V AA batteries with a life of 60 hours. Magnification of the unit is 6.2X with a 4.7-degree field of view. As with other NVSs, an internal image intensifier tube amplifies available light such as moonlight, starlight, and skyglow, so the scene becomes visible to the operator. An automatic brightness control is provided to automatically maintain the viewed scene illumination contrast during periods of changing light level conditions. The manual gain control (tube brightness) will not function when the automatic brightness control is in operation. The image

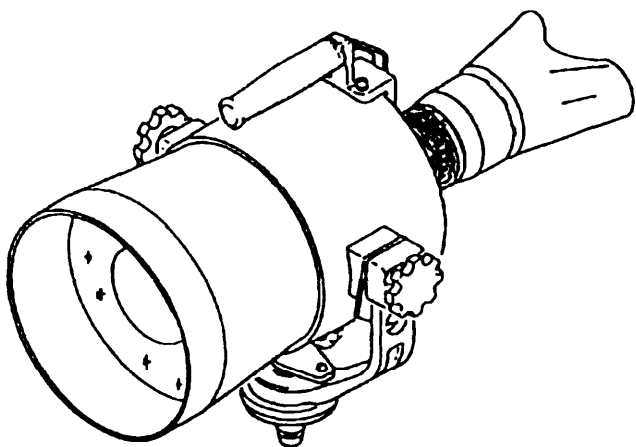


Figure 2-17.—AN/PVS-8 long range night vision sight.

intensifier tube also has protection from high-intensity, short-duration flashes of light.

### OPERATION

Setup and operation of the AN/PVS-8 is similar to the Mk 37; actions required prior to installation are as follows:

1. Relieve air pressure inside the carrying case by pressing the core of the relief valve, before releasing the latches.
2. Release all case latches and remove the cover.
3. Inventory and inspect the contents to ensure they are ready for installation.

Setup of the NVS consists of mounting the sight on the appropriate operational location and installing the batteries. Remove the NVS from the storage case. Secure the pintle in the bracket and locking assembly. Rotate the TUBE BRIGHTNESS control switch fully counterclockwise to the OFF position. Insert the batteries and replace the battery cap. The sight is now ready for operation.

#### CAUTION

- Do not leave the batteries in the equipment during storage, or corrosive damage may result.
- Do not remove the cover in daylight.

The following steps are required to place the AN/PVS in operation:

1. Rotate the TUBE BRIGHTNESS control clockwise to turn on the NVS.
2. Press your face against the eyeguard and view the image.
3. Adjust the TUBE BRIGHTNESS control to the setting that provides good target to background contrast.
4. Adjust the range focus ring for a clear image of the object desired.

Now that you have the sights operational, you must learn scanning procedures. A well-trained operator will see more than an inexperienced one. Targets that are readily identifiable by a trained observer will invariably escape detection by the



untrained eye. You must learn to scan through practice. Detailed information to help develop scanning skills is given in *Basic Military Requirements*.

## Maintenance

To make sure the sights are always ready for operation, organizational maintenance personnel must perform a systematic inspection to discover and correct defects before they result in equipment failure. Scheduled maintenance is to be performed as described on current MRCs. If any part is defective or missing, other than those authorized for replacement or repair, requisition a replacement sight according to normal supply procedures.

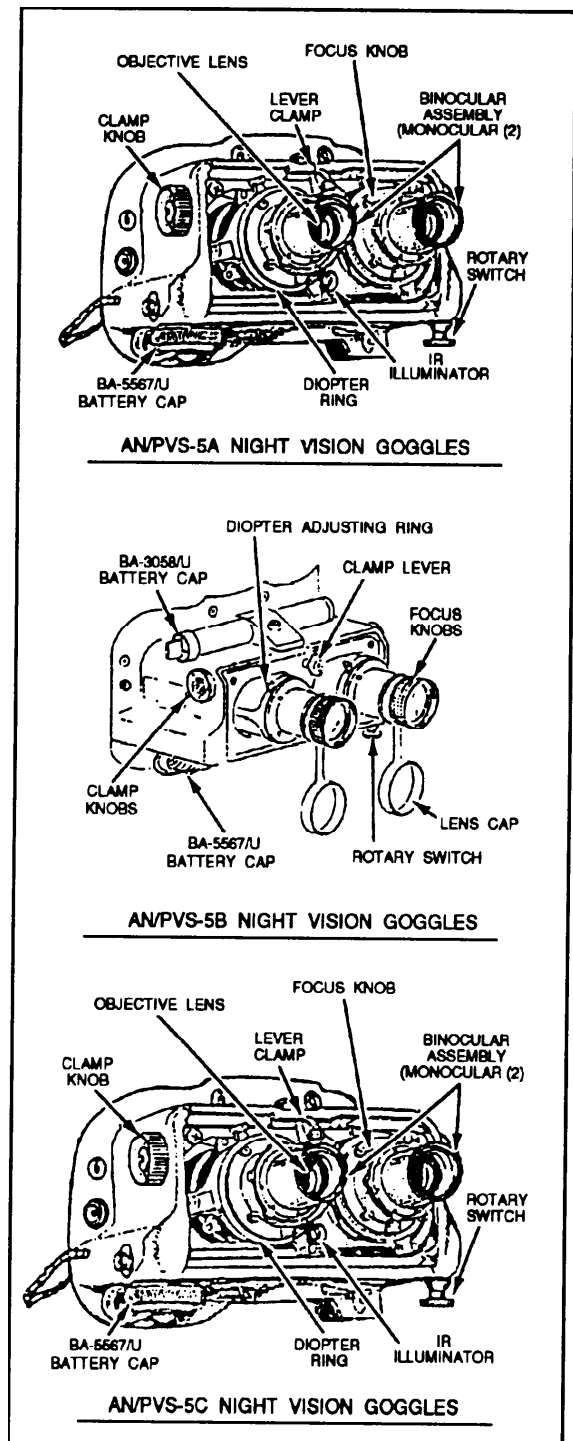
## NIGHT VISION GOGGLES

Night vision goggles, AN/PVS 5A, 5B, and 5C (fig. 2-18) provide improved night vision, using available light from the night sky. An auxiliary IR light source provides illumination for close-up work when ambient light is low. The goggles enable the user to observe from the air, as well as perform normal ground tasks such as reading, walking, and driving.

The goggles are binoculars consisting of two identical monocular eyepieces mounted on an adjustable frame and may be moved sideways. Each monocular assembly consists of three primary subassemblies: objective lens assembly, image intensifier, and eyepiece lens assembly. The goggles are mounted in a cushioned face assembly, which is strapped on to the user. The goggles are approximately 5 inches high, 7 inches wide, 6 inches deep, and weigh 32 ounces without carrying case.

The mechanical function of the goggles is to accommodate differences in the physical characteristics of individual users. This is done by adjusting the IPD, diopter setting, focus, and eye relief.

The two monocular assemblies are mounted in the frame and may be moved laterally to coincide with individual user's IPD. Lateral movement is performed by loosening the lever clamp, which releases tension from the guide assembly and permits each monocular eyepiece to slide on flanges of the tube housing. Each monocular eyepiece is moved manually to the desired IPD, and the lever clamp is tightened.



73NP0024

Figure 2-18.—AN/PVS 5A, 5B, and 5C night vision goggles.

To adjust the diopter setting, adjust each eyepiece by rotating the diopter adjust ring, which moves the eyepiece assembly nearer to or further from the user's

eye. Each eyepiece is adjustable through a range of +2 to -6.

Each objective lens assembly is focused by rotating the focus knob. The objective lens is screwed into the mounting collar and the knob is attached to the lens and held in place by the focus knob retainer. Rotating the focus knob positions the objective lens for viewing at desired ranges.

The eye relief adjustment allows the binocular assembly to be moved within the frame for eye relief and comfort. Clamp knobs, located on either side, can be loosened by turning the knobs counterclockwise and manually moving the frame to reposition the binocular assembly with reference to the user's eyes. The assembly is tightened into place by turning the clamp knob clockwise.

## Operation

The principles of operation are the same for the AN/PVS 5A, 5B, and 5C. The operating phase of night vision goggles consists of pre-operation, test operation, and post-operation instructions.

Pre-operation instructions:

1. Release the air pressure as instructed on the side of the storage case.
2. Release the latches and open the storage case and remove the goggles. Inspect the goggles for damage.
3. Ensure the rotary switch is in the OFF position.
4. Use only one battery compartment at a time. Insert battery/batteries (AN/PVS 5A uses only one lithium battery; the AN/PVS 5B and 5C use either one lithium battery or two alkaline batteries in one compartment) and replace the cap.
5. Snap the headstrap to the face mask, making sure all straps are extended to their maximum lengths. Place the head strap on your head, grasp the straps with both hands and slowly pull until the face mask cushion touches your face. Continue pulling until the goggles feel snug. Perform the same step for the vertical head strap.
6. Remove the objective and eyepiece lens caps. If demisting shields are used, snap them over the eyepiece lens. Be careful not to smudge the eyepiece lens or demisting shield.

7. Loosen the lever clamp and adjust the monoculars for proper distance between your eyes. Tighten the clamps.

8. Loosen the clamp knob and adjust the binocular assembly until the eyepieces are located a comfortable distance from your eyes with proper tilt. Tighten both clamps.

Instructions for test operation:

1. Position the rotary switch to the ON position.
2. Loosen the lever clamp and adjust the goggles for proper spacing between the monocular eyepieces. Retighten the clamp.
3. Loosen both clamp knobs and adjust the goggles for proper tilt and eye relief. Retighten the clamp knobs.
4. On the AN/PVS 5A and 5B, turn the focus knob fully counterclockwise on each objective lens for distant viewing. Adjust for the clearest view. The focus knob may be turned fully clockwise to adjust for a minimum focus of 10 inches. On the AN/PVS 5C goggles, the focus function is part of the objective lens assembly. To focus the goggles for the sharpest view, grasp the outside of each objective lens assembly and turn it to obtain the sharpest image.

5. Adjust each diopter ring until the image is sharp (the diopter ring adjusts the diopter for each individual user and does not require movement after initially set).

6. Pull and turn the rotary switch for IR operation (optional test). Return the switch to ON for normal operation. The rotary switch turns the goggles and IR illuminator on and off. Be sure it is turned to OFF when the goggles are not in use.

Post-operation instruction:

1. Remove the demisting shields, if installed, by grasping them and pulling them off the eyepiece lenses. Return them to their case.
2. Replace the objective and the eyepiece lens cap.
3. Ensure the rotary switch is in its OFF position. Remove the battery (or batteries) from the battery compartment(s) and return it to its case. Replace the battery caps.
4. Inspect the face mask cushion for tears, cracks, or missing snaps; also inspect the goggles for missing parts.
5. Clean the goggles, carrying case, and shipping case as necessary with fresh water. Ensure both cases and liner are dry prior to storing the goggles in them.

6. Loosen the clamp knobs and the lever clamp.

7. Store the goggles, batteries, and accessories in the cases, making sure they are properly positioned to close, and then latch the carrying case.

8. Store the carrying case in the storage case if the goggles are to be placed in prolonged storage. Latch the storage case.

### AN/PVS-11 Pocketscope

The pocketscope (fig. 2-19) is a hand-held, submersible NVS equipped with either a 1X or 3X magnification lens used for short-range observation in either passive or active mode. The power source is two 1.5V AA batteries with a life of 40 hours. This NVS is provided with an IR source for close-up viewing. It can illuminate a man-size target at 15 meters in active mode. The unit also has an optional adapter for a 35mm camera or closed circuit television.

### OPERATION

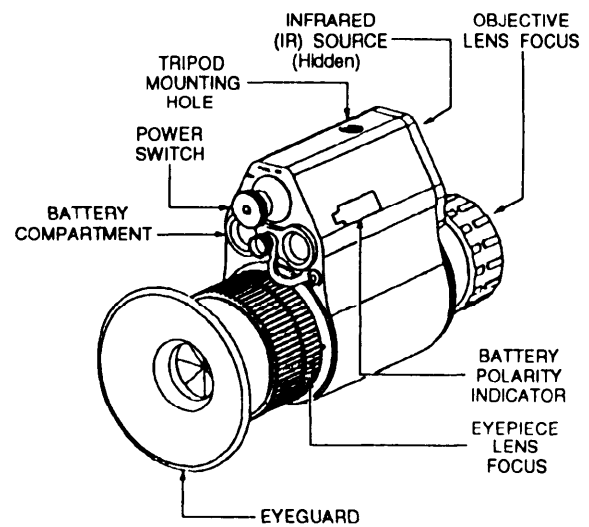
This NVS is similar in operation to other NVSs used by the Navy. The same precautions should be exercised with it as with the others. For passive operation, set the OFF-ON-PULL IR switch to on and observe that a green glow is visible in the eyepiece. Adjust the eyepiece and objective lens for proper focus. The pocketscope is ready for passive night vision operation. For IR illuminator mode (active), pull out the OFF-ON-PULL IR switch and rotate it to the PULL-IR position. Observe that the area in the immediate front of the pocketscope is illuminated.

#### CAUTION

The IR source is a light that is invisible to the unaided eye. However, the light from the illuminator can be detected by opposing forces using NVSs.

### Maintenance

Routine maintenance for night vision goggles and the pocketscope is basically the same as for the Mk 37 and AN/PVS-8. Scheduled maintenance is to be performed as described on current MRCs to discover and correct any defects before they result in operational failure. If any part is defective or missing, other than the parts authorized for replacement or repair at the organization level, requisition



73NP0025

Figure 2-19.—AN/PVS-11A pocketscope.

replacement units. Review the technical manual before performing any maintenance on night vision devices.

### GENERAL SAFETY PRECAUTIONS

Night vision devices are precision electro-optical instruments and must be handled carefully at all times.

The image intensifier assembly phosphor screen contains toxic material. If an assembly becomes broken, be extremely careful to avoid inhalation of the phosphor screen material, and do NOT allow it to come in contact with the mouth or open skin wounds. If the phosphor screen material comes into contact with the skin, wash immediately with soap and water. If phosphor screen material is swallowed or inhaled, induce vomiting and seek medical help.

The batteries used in NVSs require special handling to avoid possible physical harm or equipment damage. Return all used or damaged batteries to the property disposal officer. The following are the batteries used in NVS:

1. BA 1567/U battery.
2. Alkaline Battery BA 3058/U.
3. Lithium Battery BA 5567/U. This battery contains sulfur dioxide gas under pressure. Do not heat, puncture, disassemble, or otherwise tamper with the battery. Turn off the equipment if the battery compartment becomes too hot; wait until batteries have cooled before removing them. Batteries have a safety vent to prevent explosion. When they are venting gas, you will smell gas, your eyes may become irritated, or

you may hear the sound of gas escaping. When safety vents have operated, batteries must still be handled with care.

Do not remove any covers during daylight. During nighttime operation do not leave sights pointed at a bright light for extended periods of time, because the image intensifier tube may be permanently damaged.

Before using any NVSs, you must review the technical manual.

## FLAGS AND HALYARDS

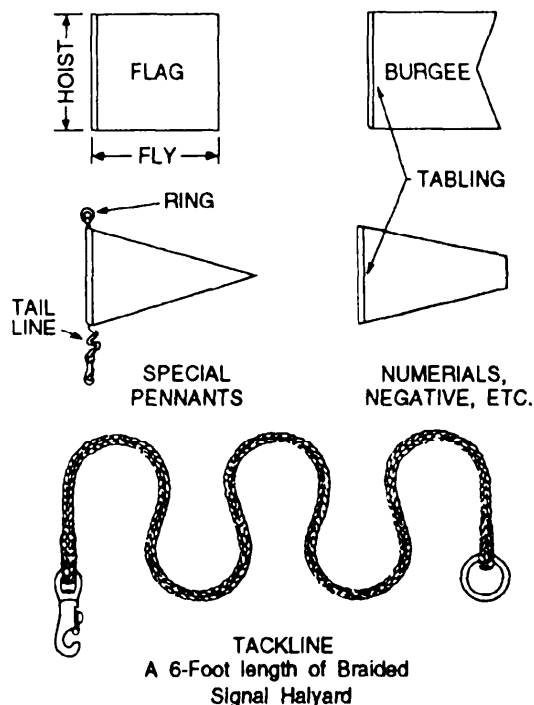
**LEARNING OBJECTIVE:** Identify the procedures for the proper care and repair of flags, for going aloft, and for splicing and reeving halyards.

Working with flags is an integral part of the Signalman's job. Flags are used to send messages and tactical signals during daylight, to identify a ship's nationality, and, on occasion, to indicate the seniority of an officer or civil official on board. Individual flags are discussed in other chapters. This section is confined to describing flags and halyards in general.

Bunting, the cloth of which flags are made, is available in cotton, wool, and nylon. Because cotton costs less, it is usually used in simply designed flags and pennants. Cotton bunting is not as durable as wool and will not stand as much weathering, but it is often less expensive to wear out two cotton flags than one woolen flag. Flags and pennants that are in almost constant use, however, usually are made of wool or nylon. Wool is also used in flags of complicated design when the original cost of material is less important than the labor involved.

## FLAG NOMENCLATURE

The parts of flags and pennants are shown in figure 2-20. The fly is the horizontal length of the flag, the hoist is the vertical width. Tabling is a reinforced border of light duck, stitched to the edge of the flag at the hoist. A length of line leads through the tabling, at the top of which a ring is spliced. The other end of the line, extending several inches below the tabling, is the tail line. A snap hook is attached to it. The tail line serves as a spacer between flags, and the snap and ring are used to secure flags to each other in a hoist.

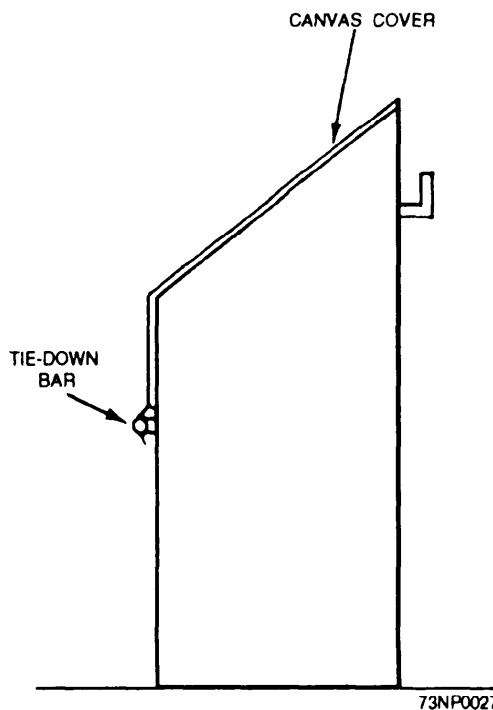


73NP0026

Figure 2-20.—Parts of flags and pennants.

## CARE OF FLAGS

Wind and moisture cause flags to deteriorate rapidly. Unless stowed promptly and handled carefully, flags quickly become dirty. The flagbag (fig. 2-21) is designed to provide proper stowage for the



73NP0027

Figure 2-21.—Flagbag.

flags and rapid access to them. It also keeps them clean and, with the canvas cover in place during inclement weather, dry. Flags should be washed in the ship's laundry periodically. Only mild soap and warm water (not hot) should be used for cleaning flags. Grease spots can be removed with dry-cleaning solvents.

Damp or wet flags are mildew prone. When flags are wet, dry them as soon as possible by hoisting them on the signal halyards. This should not be done when under way or when in high winds. Air bunting is an excellent way to dry flags. This can be done on request from the senior officer present.

## REPAIR OF FLAGS

Although ships carry spare sets of flags, Signalman strikers or third class petty officers may be assigned to repair bunting. If a bunting space is available, it will contain a sewing machine, bunting, thread, tapes, and tabling material. If a bunting repair space is not available, repairs may be done by using a sewing machine located in the deck spaces. When repairing flags, never mix materials. Wool and cotton shrink differently, and combinations invariably become misshapen after the first wetting. For correct dimensions, refer to NTP 13, *Flags, Pennants and Customs*.

## HALYARDS

Signal halyards are made of either nylon or natural color braided cotton line. The braided cotton line is no longer used aboard ship, because it could not hold up under the effects of ships' high speeds, stack temperatures, and gases. Ashore, however, cotton halyards are still used. Double-braided 1 1/8-inch nylon rope is required by the Board of Inspection and Survey (INSURV). Double-braided 1 1/2-inch nylon rope is permitted alternately with twisted rope for dressing lines. The twisted nylon and double-braided nylon rope withstand the heat and gases much better than braided cotton line.

Halyard blocks are single, roller-bushed sheave blocks. They are attached by means of sister hooks to U-bolts welded to the yardarms. Those attached to stays and mastheads may be of other construction, adapted to the construction of the stay or masthead.

## CARE OF HALYARDS

When reeving halyards through signal halyard blocks, always reeve forward to aft. Rings and snaps on halyards are put on with a halyard eye splice.

Splicing double-braided nylon rope is explained and illustrated in the following section.

At night and during inclement weather, ease off the halyards to prevent unnecessary strain caused by shrinkage. At other times, however, keep halyards clear and taut to give the signal bridge a sharp appearance. Periodically check the condition of the halyards. Replace them before they become too worn.

## SPLICING DOUBLE-BRAIDED LINE

When double-braided nylon line is being spliced, the end must be worked into the center, and special tools are needed for the job. For line 3 inches in circumference or smaller, a fid and pusher are used. For line larger than 3 inches in circumference, only a wire fid is used. Steps 1, 2, and 3 in figure 2-22 show how to secure the fid to the line. Stamped on each fid is a number indicating the size of line for which the fid was made. Fids also serve as rulers to measure with while splicing is being done. The wire fid lengths in figure 2-23 are in 1/2 and 1/3 scale. Friction or masking tape and a soft lead pencil, crayon, or preferably, a wax marking pencil are needed. Sharp-pointed shears also are handy.

The splice described here, and the line on which it is used, were developed by the Samson Cordage Works of Boston, Massachusetts.

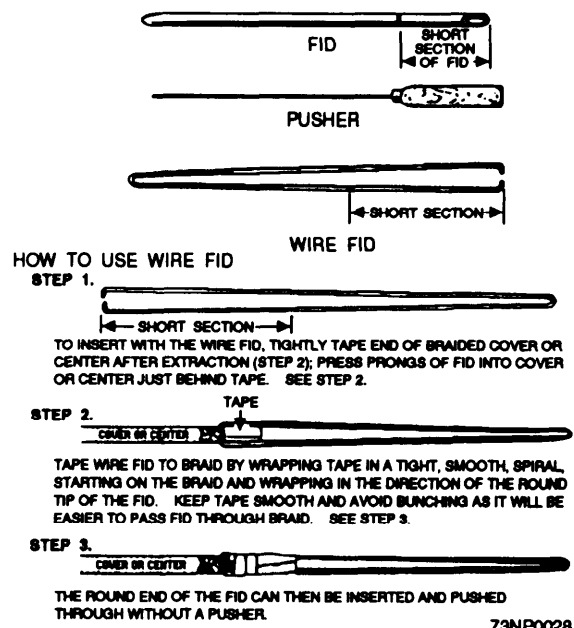
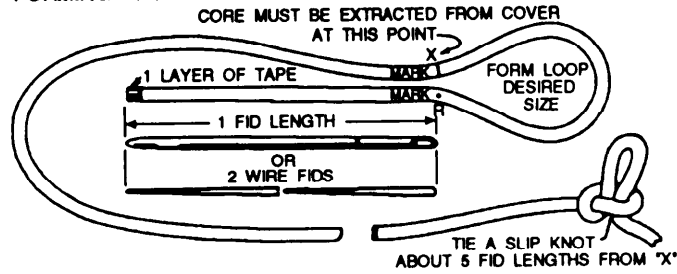
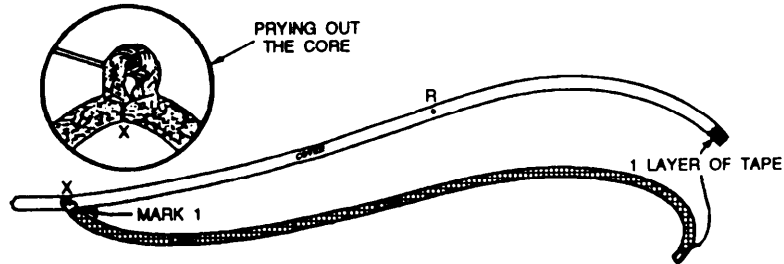


Figure 2-22.—Fids used for splicing double-braided line.

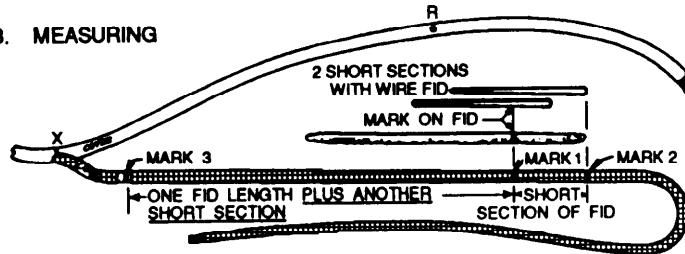
STEP 1. FORMING THE LOOP



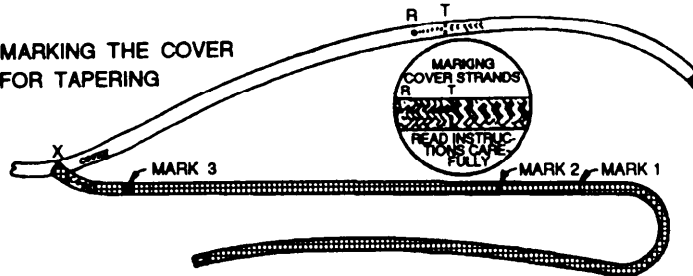
STEP 2. EXTRACTING THE CORE



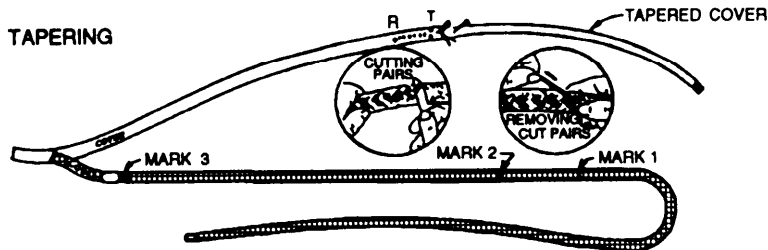
STEP 3. MEASURING



STEP 4. MARKING THE COVER FOR TAPERING



STEP 5. TAPERING



73NP0029

Figure 2-23.—Measuring and taping.

### Standard Eye Splice in New Double-Braided Line

The standard eye splice can be performed on new line only. It retains up to 90 percent of the average new line strength. Until you become

familiar with splicing this material, follow each step in detail. Figure 2-22 shows the fids and pushers used for splicing; steps 1 through 3 explain how to secure the wire fid to the line that is to be spliced. Figure 2-23 shows how to mark the line and extract the core.

1. Tape the end to be spliced with one thin layer of tape. Then, measure one tubular fid length (two wire fid lengths, because the wire fid is 1/2 size) from the end of the line and mark. (This is point *R* (reference), step 1 of fig. 2-24.) From *R*, form a loop the size of the eye desired and mark. (This is point *X*, where you extract the core from inside the cover.)

2. Tie a tight slipknot approximately five fid lengths from *X*. This must be done to keep the core and cover from becoming uneven. Bend the line sharply at *X*. With the pusher or any sharp tool, such as a ice pick, awl, or marlinespike, spread the cover strands to expose the core (step 2 of fig. 2-24). First pry, then pull the core completely out of the cover from *X* to the taped end of the core. DO NOT pull cover strands away from the line when you are spreading the cover, as this will distort the line unnecessarily. To assure correct positioning of mark 1, do the following: holding the exposed core, slide the cover as far back toward the tightly tied slipknot as you can. Then, firmly smooth the cover back from the slipknot toward the taped end. Smooth again until all cover slack is removed. Then, mark the core where it comes out of the cover. (This is mark 1.)

3. Again slide the cover toward the slipknot to expose more core. From mark 1, measure along the core toward *X* a distance equal to the short section of tubular fid (two short sections with wire fid) and make two heavy marks. (This is mark 2.) From mark 2, measure in the same direction one fid length plus another short section of the fid (with wire fid, double measurements) and make three heavy marks. (This is mark 3, step 3 of fig. 2-24.)

4. Note the nature of the cover braid—it is made up of strands, either one or two (pair). Notice that half the pairs revolve to the right around the rope and half revolve to the left. Beginning at *R* and working toward the taped end of the cover, count eight consecutive strands (single or pairs) that revolve to the right (or left). Mark the eighth strand. (This is mark *T*, step 4 of fig. 2-24.) Make mark *T* go completely around the cover. Starting at *T* and working around the taped cover end, count and mark every fifth right and left strand (single or paired) until you have progressed down to the end of the taped cover.

5. Insert the fid into the core at mark 2. Slide it through and out at mark 3. (Step 5 of fig. 2-24.) Add extra tape to the tapered covered end, then jam it tightly into the hollow end of the fid (see insert). Hold the core lightly at mark 3; place the pusher point into the taped end; push the fid and cover through from mark 2 and out at mark 3. With the wire fid, first press prongs into

the cover, then tape over. Then after the fid is on, milk the braid over the fid while pulling the fid through from mark 2 to mark 3. Take the fid off the cover. Continue pulling the cover tail through the core until mark *R* on the cover emerges from mark 3 (see step 6 of fig. 2-24). Then remove the tape from the end of the taped cover.

6. Make sure the tape is removed from the cover end. Start with the last marked pair of cover strands toward the end; cut and pull them out completely (see step 7 of fig. 2-24). Cut and remove the next marked strands and continue with each right and left mark strand until you reach point *T*; do NOT cut beyond this point. The result should be a gradual taper ending in a point. Very carefully pull the cover back through the core until point *T* emerges from mark 2 of the core (see step 8 of fig. 2-24). From point *X* on the cover, measure approximately one-half fid length toward the slipknot on the line and mark this point *Z* (see step 9 of fig. 2-24).

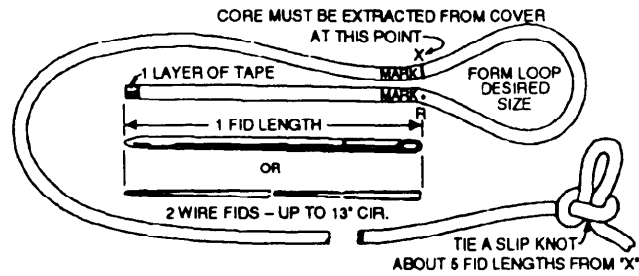
7. You are now ready to put the core back into the cover from *T* to *Z*. Insert your fid at *T* (step 9 of fig. 2-24). jam the taped core end tightly into the end of the fid. With the pusher, push the fid and core through the cover "tunnel," past point *X*, to, and through the cover at point *Z*. When using the wire fid, attach the fid to the tapered core. After the fid is on, milk the braid over the fid while pulling through from *T* to *Z*. When pushing the fid past *X* to *Z*, make sure the fid does not catch any internal core strands.

#### NOTE

Depending on eye size, the fid may not be long enough to reach from *T* to *Z* in one pass. If not, bring the fid out through the cover, pull the core through, and reinsert the fid into the same hole it came out of. Do this as many times as needed to reach point *Z*.

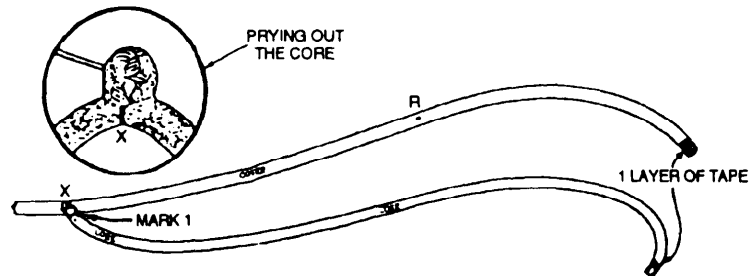
8. Alternately pull on the core tail at *Z*, then pull the tapered cover at mark 3. The crossover should be tightened until the crossover is equal to the diameter of the line. Remove all the slack from the eye area by smoothing the cover from point *T* toward *X*. Mark where the core tail emerges through the cover at point *X* (see step 10 of fig. 2-24). Pull the core tail out until the mark just made on the core is exposed at *Z*. The diameter of the core must now be reduced by cutting and removing one strand of each group around the complete circumference. Measure one-third fid length from the first reduction cut toward the end and make a mark. Cut

STEP 1.

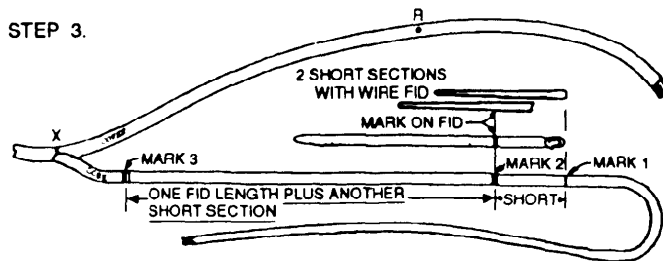


ON ROPE OVER 1" DIAMETER, IT IS OFTEN EASIER TO PASS A SPIKE OR SIMILAR OBJECT THROUGH THE ROPE INSTEAD OF TYING A SLIPKNOT.

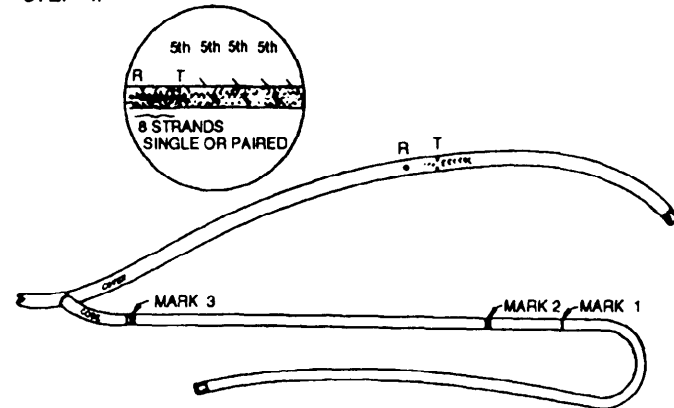
STEP 2.



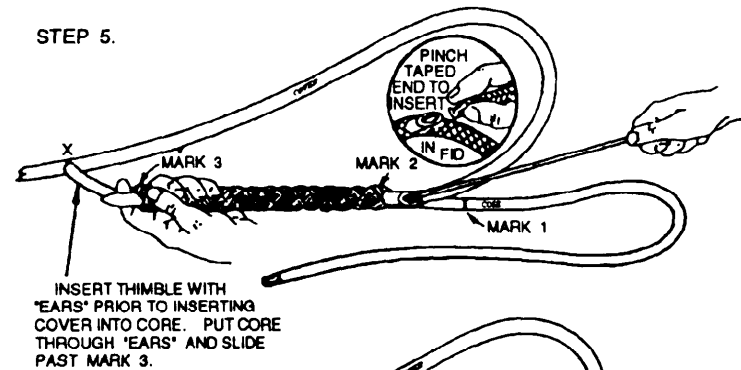
STEP 3.



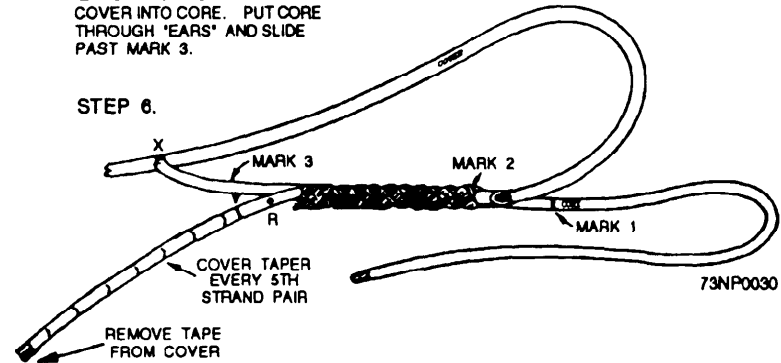
STEP 4.



STEP 5.



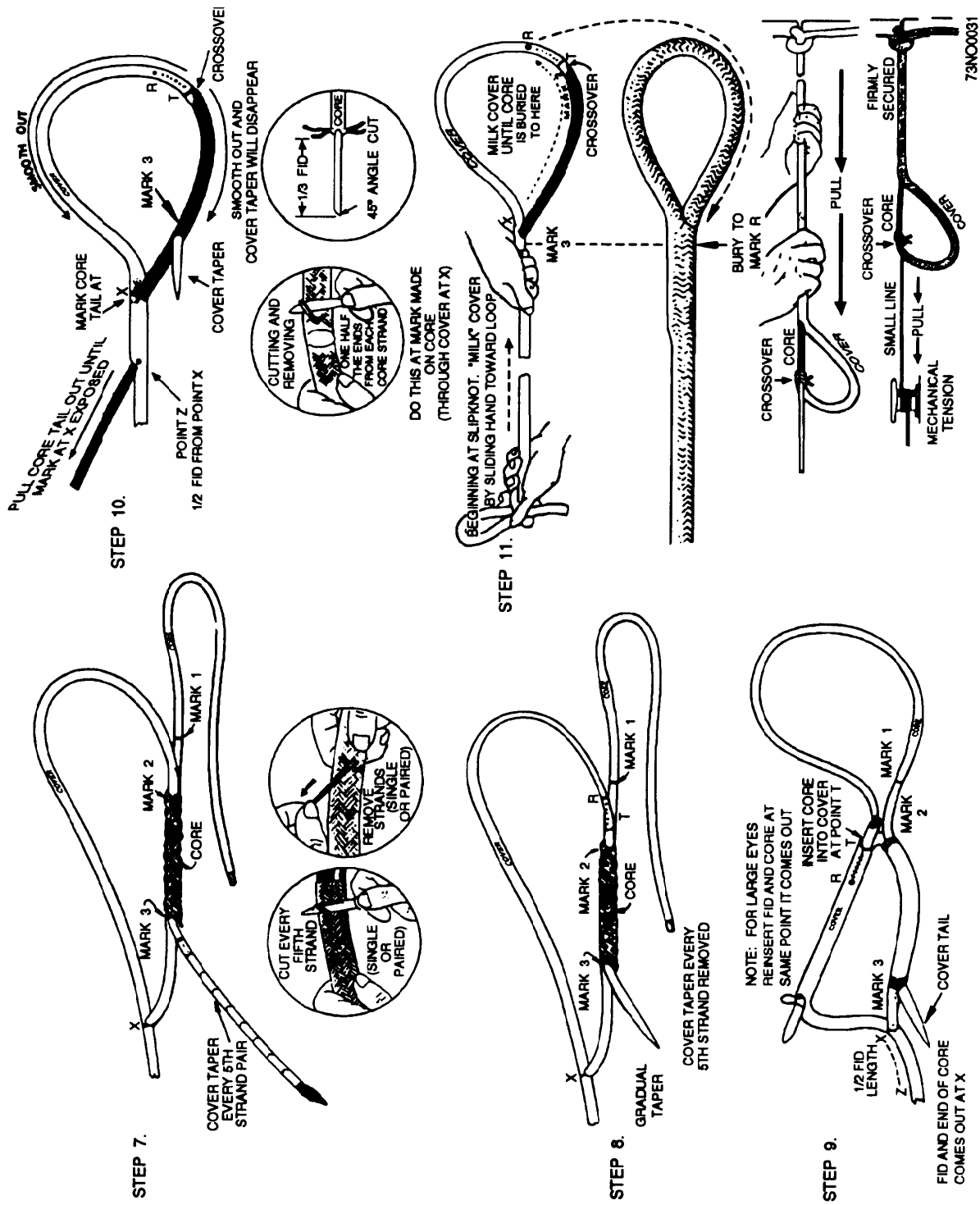
STEP 6.



73NP0030

Figure 2-24.—Completing the double-braided eye splice (page 1 of 2).





73NO0031

Figure 2-24.—Completing the double-braided eye splice (page 2 Of 2).

off the remaining tail at this point. Make the cut on a 45-degree angle to prevent a blunt end (see the insert of step 10). With one hand, hold the crossover part (mark *T*). Smooth the cover section of the eye out firmly and completely from the crossover toward mark *X*. The reduced-volume core tail should disappear into the cover at 2. Smooth out the core section from the crossover toward mark 3, and the cover taper will disappear into the core. Hold the rope at the slipknot, and with your other hand milk the cover toward the splice, gently at first, then more firmly (see step 11 of fig. 2-24). The cover will slide over mark 3, mark 2, the crossover, *T*, and *R*. (It may be necessary to occasionally smooth out the eye during milking to prevent the reduced-volume tail from catching in the throat of the splice.)

If bunching occurs at the crossover, preventing full burying, smooth the cover from *T* to *X*. Grasp the crossover at *T* with one hand, and then firmly smooth the cover slack (female side of eye) with the other hand towards the throat (*X*). Repeat as necessary until bunching disappears. Continue milking until all of the cover slack between the knot and the throat of the eye has been removed.

#### NOTE

Before burying the cover under the crossover, you should do the following:

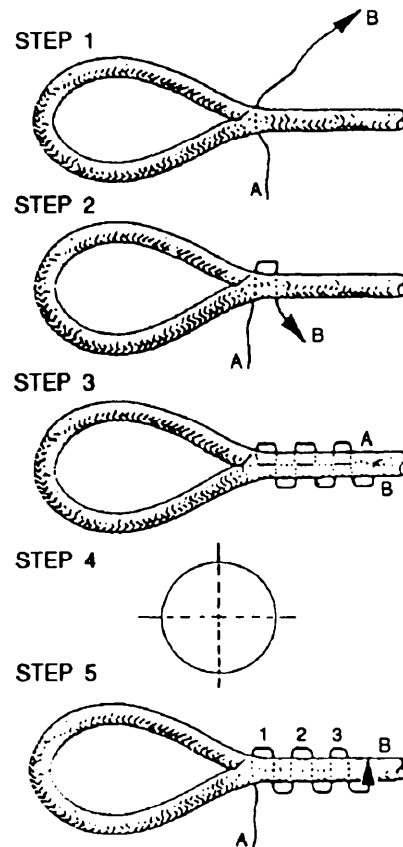
- Anchor the loop of the slipknot to a stationary object before starting to bury the cover. You can then use both hands and the weight of your body to more easily bury the cover over the core and crossover.
- Holding the crossover tightly, milk all excess cover from *R* to *X*.

Flex and loosen the line at the crossover point during the final burying process. Hammering the cover at point *X* will help loosen the strands.

With larger ropes, it is helpful to securely anchor the slipknot; attach a small line to the braided core at the crossover; and mechanically apply tension with either a block and tackle, capstan, come-a-long, or power winch. Tension will reduce the diameter of the core and crossover for easier burying.

9. Prior to whipping (see fig. 2-25), it is to your advantage to stitch-lock the splice to prevent no-load opening. You will need approximately one fid length of nylon or polyester whipping twine. The twine should be about the same size as the strands of line you are stitching. Strands cut from the line may be used. To begin the lock stitch, pass the twine (*A*) through the line as shown in step 1, figure 2-25. Reinsert the twine as in step 2, figure 2-25. (Ensure that all stitching is just snug. **DO NOT TIGHTEN.**) Continue until you have four complete stitches. After you have four stitches, turn the line 90 degrees and pass the remaining end (*B*) through the line perpendicular to the original stitches to make four more stitches. The line should now look like step 4, figure 2-25. Now take ends *A* and *B*, tie a square knot, and bury the ends in between the cover and the core. You may now whip the line or leave it.

You will become more proficient at splicing line each time you do it. Remember to follow each step the manufacturer has laid down in the splicing manual. This must be done for safety reasons. The splices described and the methods for accomplishing them have been tried and proven. They leave no margin for shortcuts.



73NP0032

Figure 2-25.—Making the lock stitch.

## Eye Splice

To make an eye splice with manila or synthetic ropes, untwist the strands in the end of your line as you think necessary, and splice them into the standing part of the line by tucking the unlaidd strands from the end into the standing part.

Learn to estimate the length of line you need to unlay for your complete splice so you will not finish short or waste a lot of line by cutting it off. An original round of tucks plus three more complete rounds are enough for an ordinary eye splice.

With large lines you must whip the ends of the strands before you start; otherwise, they will unravel and become troublesome. Large lines also must be seized at the point where the unlaying stops, or you will have trouble working them. With any line up to about 2 inches, you can open the strands in the standing part with your fingers. The fid must be used for larger lines.

Your first round of tucks must be taken in proper order to avoid getting fouled up. Separate the strands in the end and hold them as indicated in view 1 in figure 2-26. Always tuck the middle strand (facing

you) first. Be sure to keep the right-hand strand, shown in view 2 of figure 2-26, on the side of the line that is toward you. Tuck that one next, over the strand you just tucked the other one under, and under the strand just below it, shown in view 3 of figure 2-26.

Now turn the whole thing over. In view 4 of figure 2-26 you can see that you now have only one strand from the end left untucked, and only one strand in the standing part that does not already have a strand under it. Do not forget to tuck the last strand from outboard toward you.

The first round of tucks is the key to making perfect eye splices; the rest is easy. Simply tuck each strand from the end over the strand of the standing part that it is now above, and under the next strand below that one, until you tuck each strand twice more beside the original tuck. Three tucks to each strand in all is enough for natural fiber rope. Four or five are needed for synthetic fiber, especially the more slippery nylon.

## Going Aloft

Signalmen must be familiar with the procedures for going aloft, if for conducting maintenance, removing Irish pennants, or rigging for full dress ship. Whatever the reason, permission to go aloft must be

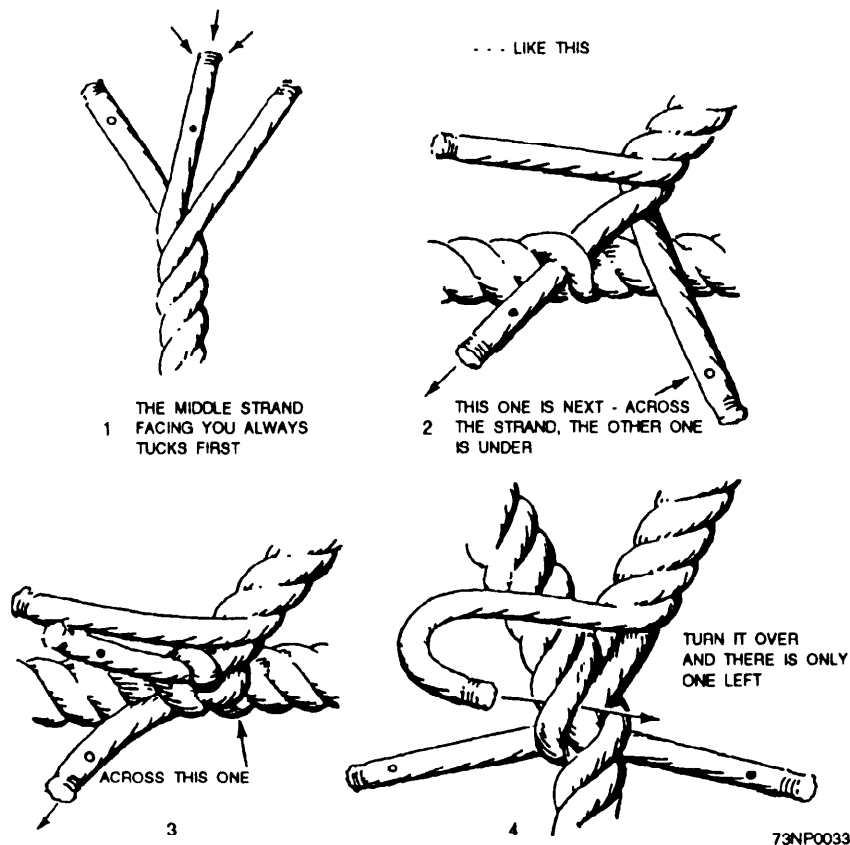


Figure 2-26.—Making an eye splice.

granted by the officer of the deck in port or the commanding officer when under way. Guidance for requesting permission should be included in the signal bridge standing orders.

OPNAVINST 5100.19, *Navy Occupational Safety and Health (NAVOSH) Program Manual*, contains instructions and general precautions for going aloft.

## **MAINTENANCE AND MATERIAL MANAGEMENT (3-M) SYSTEM**

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*LEARNING OBJECTIVE:* Explain the purpose of the 3-M system, the *Hazardous Material Users Guide* and material safety data sheets (MSDS).

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Although this chapter points out that Electrician's Mates generally are responsible for electrical repairs of signal equipment, signal bridge personnel do perform routine upkeep and maintenance functions on assigned equipment. Periodic checks and adjustments must be made, for example, and there are stipulated times when equipment should be lubricated for best performance.

To achieve maximum efficiency in the use of material, as well as manpower, the Navy implemented the 3-M system. The basic purpose of the systems is to provide for managing maintenance and maintenance support in a manner that will ensure maximum equipment operational readiness. The 3-M system standardizes preventive maintenance requirements, procedures, and reports on a fleetwide basis.

OPNAVINST 4790.4, *Maintenance and Material Management (3-M) Manual*, is the basic source of information on the 3-M system.

## **HAZARDOUS MATERIAL USERS GUIDE**

The *Hazardous Material Users Guide* was developed to provide Navy personnel, particularly the deckplate sailor, with safety data for hazardous materials commonly used on ships. The Users Guide is written to avoid the need for technical jargon, chemical symbols, or coded information frequently found in material safety data sheets (MSDS).

The Users Guide gives control measures, safety precautions, health hazards, and spill control and disposal guidelines for each of 20 hazardous material

groups (for instance, adhesives, cleaners, greases, paints, and solvents).

The Control Measures section identifies and prescribes personal protective equipment (PPE) that is appropriate for the chemical hazards in a particular group.

The Safety Precautions section gives safety guidance for using and storing hazardous materials in the group.

The Health Hazards section points out common signs and effects of overexposure to the hazardous materials and provides “what to do” instructions to the hazardous materials user.

The Spill Control section provides information for responding to a spill.

The Disposal Guidelines section gives acceptable methods for disposing of materials within the group.

Materials not included in the Users Guide are items such as ammunition, explosives, propellants, medical/pharmaceutical supplies, and radioactive materials.

## **Material Safety Data Sheets**

MSDSs are technical bulletins containing information about materials, such as composition, chemical and physical characteristics, health and safety hazards, and precautions for safe handling and use. MSDSs should be readily available for every item of hazardous material aboard ship.

When performing maintenance and working with hazardous materials, use of the Users Guide and MSDSs is mandatory. Guidelines contained therein are vitally important and **MUST NOT** be ignored. The information will help reduce the risk of injury and long-term health effects.

## **SUMMARY**

In this chapter you were informed of some of the equipment you will come in contact with during your daily routine aboard the signal bridge. This equipment ranges from the 12-inch searchlight to the Mk 37 NVS. You were informed how to operate and maintain this equipment. You were also informed about the care and maintenance of flags, pennants, and halyard line. As you know by now, knowing how to operate signal bridge equipment is a valuable part of being a Signalman. Learn your equipment well!