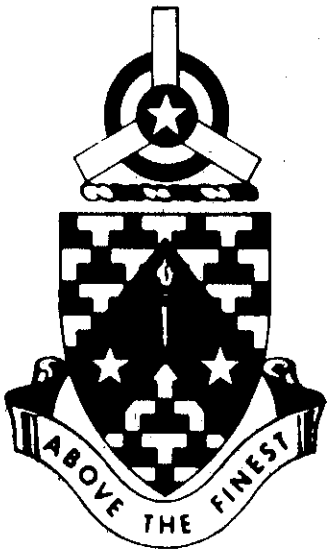
PROGRAMED TEXT

AIRCRAFT HARDWARE

AM-4



APRIL 1969

UNITED STATES ARMY

PRIMARY HELICOPTER SCHOOL

FORT WOLTERS, TEXAS

PROGRAMED TEXT

PROGRAM TEXT

FILE NO: AM-4

PROGRAM TITLE

Aircraft Hardware

POI SCOPE: Discuss the types and functions of aircraft hardware and methods employed to inspect aircraft hardware.

INSTRUCTOR REFERENCES:

Aircraft Allied Subjects, U.S. Army Transportation School
Aircraft Structural Hardware, U.S. Army Transportation School
AF Manual 52-11, Sheet Metal Maintenance

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November 1968

TABLE OF CONTENTS

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PREFACE

This Programed Text has been designed to teach you the nomenclature, function and operational use of various types of helicopter hardware.

Start with Frame 1 and work each frame in succession. Work all odd numbered pages first, then the even numbered pages. Each frame will usually ask you a question. The correct answer is printed on top of the next frame. If you were incorrect, turn back and restudy the information before continuing on the the next frame. When you have finished the text, complete the self-evaluation exercise. Now, begin by studying the performance objectives on page iv.

PERFORMANCE OBJECTIVES

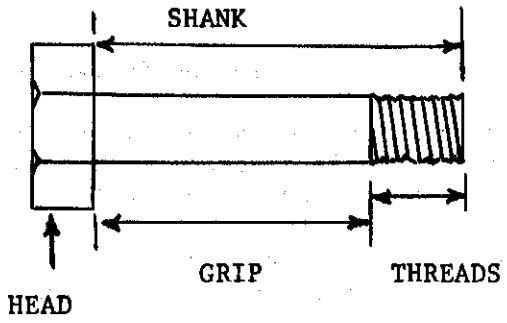
Given illustrations of hardware items used in the construction of a helicopter, you will:

1. Label correctly each item by proper nomenclature.

2. Select from a list of statements, the statement which best describes the function and/or operation of the item as it is used on the helicopter.

3. Examine the illustrations of hardware items and determine if the items would be serviceable or unserviceable if installed on a helicopter.

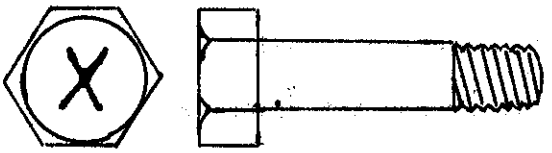
FRAME 1 BOLTS



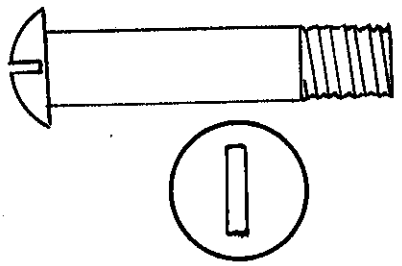
A bolt is a threaded connector having a head, grip, and shank. (See illustration)

There are five basic types of bolts used on Army aircraft.

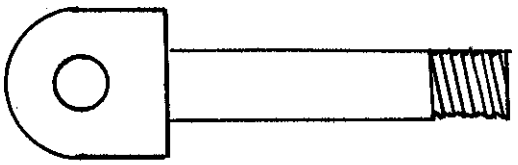
1. Standard hex head bolt - Used in general application, an X is marked on the head of the bolt for identification purposes.



2. Clevis bolt - Used in applications subject to shearing stresses; often used as mechanical pins. The bolt has a slotted head like a screw.



3. Eyebolt - Used to carry external tension loads such as attachment of cables to a turnbuckle.



b. is a teflon bearing

FRAME 10

Teflon, a new type of bearing, is finding increased usage in the Army.

Teflon offers high reliability and is fairly easy to maintain. It requires no lubrication because it is impregnated with a self-lubricant. It is shock resistant and has an extremely low coefficient of friction.

At the present, teflon is widely used in rod end bearings and in the rotor system of late production models of the UH-1C and the Huey Cobra.

Teflon is bonded to either the inner or outer race of a bearing and must be sealed from dirt. Dirt will deteriorate and tear the teflon coating without proper cleaning.

Which of the following listed maintenance measures should be performed frequently to insure long teflon bearing life?

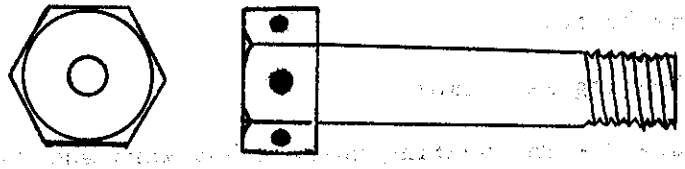
a. Lubricates with light oil daily.

b. Lubricates with grease twice per day.

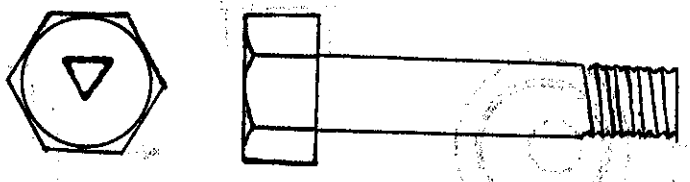
c. Replace bearing seals at every 25 hours of operation.

(d) Wash away the dust and dirt which accumulates around the bearings.

4. Drilled head bolt - Originally designed for use as engine bolts. There are drilled holes in the head for safety wire.



5. Close tolerance bolt - Used where tight fitting bolts are prescribed. In areas where high shear and load reversals are present. It is identified by a triangle on the head.



What type of bolt would be used to secure a component which is exposed to high shear tension loads, vibration and load reversals.

a. Standard hex head bolt

b. Clevis bolt

c. Eyebolt

d. Close tolerance bolt

D. Wash away dust and dirt.

FRAME 11

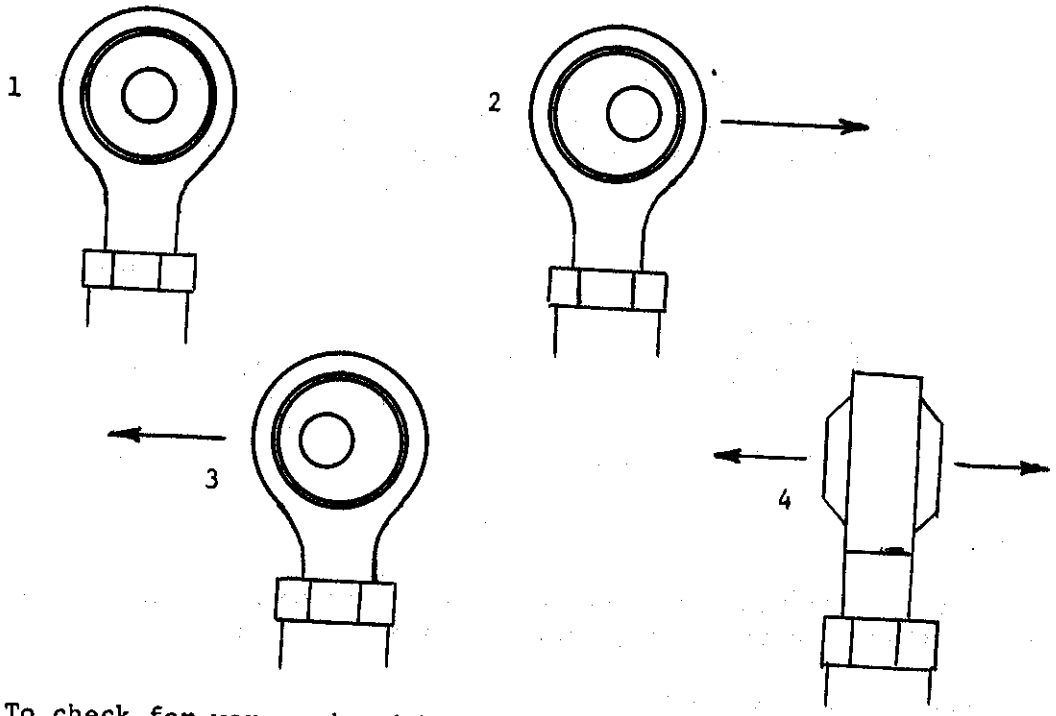
Rod end bearings wear away rapidly when they are exposed to continuous load reversals. Therefore, they should be inspected to insure that they are not too loose.

Note illustrations below.

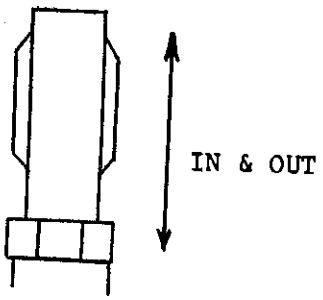
Figure 1 - This bearing is normal

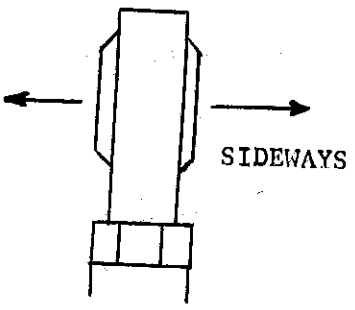
Figure 2 and figure 3 - The bearing surface has worn and the inner part of the bearing is free to move radially inside the outer bearing race.

Figure 4 - The bearing is free to move laterally.



To check for worn rod end bearings you must move the push-pull tube "in and out" and sideways and feel for excessive play between the inner and outer bearing races.





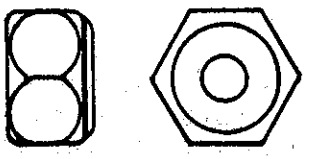
d. close tolerance bolt.

FRAME 2

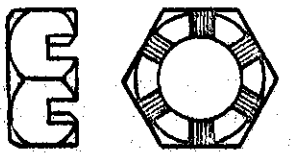
A nut is a device used to secure a threaded bolt in place.

Aircraft nuts can be divided into two general groups: non-self-locking nuts which must be safetied by external locking devices and self-locking nuts which contain the locking feature as an integral part.

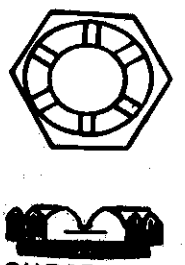
Group 1 - non-self locking nuts:



PLAIN METAL NUT



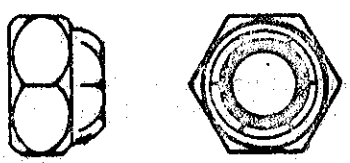
CASTELLATED NUT



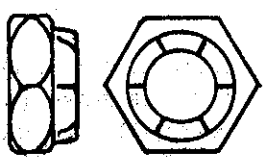
SHEAR NUT

NOTE: The shear nuts are designed for use with devices that are normally exposed to shear loads.

Group 2 - self-locking nuts are:



NUT, SELFLOCKING - FIBRE CENTER



ALL METAL LOCKNUT

NOTE: In most self-locking nuts, the locking action will cause some permanent change in the design of the nut.

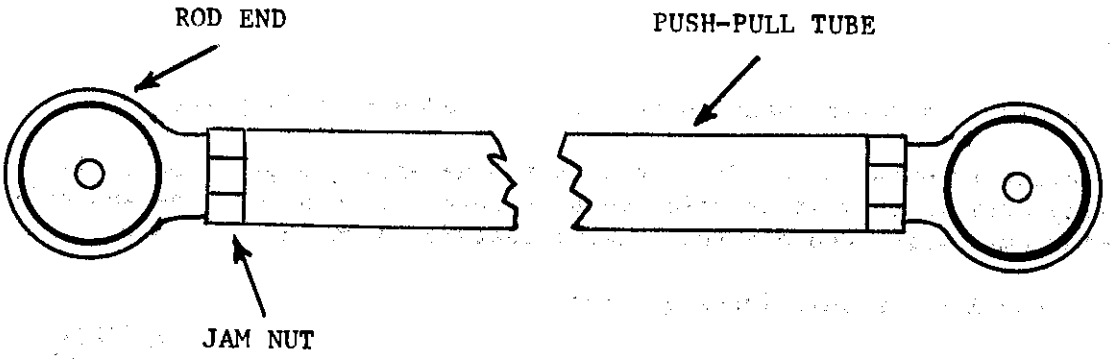
Would it be advisable to reuse self-locking nuts after their initial installation?

a. Yes

b. No

FRAME 12

PUSH-PULL TUBES



Push-Pull tubes are used to transmit the pilot's control responses to the engine and flight controls of the helicopter. **Most** are constructed of aluminum alloy with either a forked or a rod end fitting installed at both ends. The length of the tube will determine the diameter. As the length of the tube increases, the diameter of the tube increases to strengthen the tube proportionately.

To insure the serviceability of a push-pull tube, you must check these areas of importance.

1. Move the push-pull tube to insure that it does not strike any other part of the structure. If it does strike another object, it will restrict its operational range and possibly wear the push-pull tube at the point of contact.

2. Examine the push-pull tube for straightness. A careless person will use the push-pull tubes as a step or handle to climb up on the aircraft and will bend the tube.

3. When the push-pull tube is correctly installed, you should be able to twist it to see if the bearings are free to move.

   If the push-pull tube binds as it is twisted, the binding may indicate one of the following:

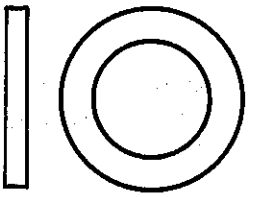
   a. The rod ends are not properly installed. Improperly installed rod ends could cause controls to malfunction.

   b. The bearings in the rod end are corroded or scarred.

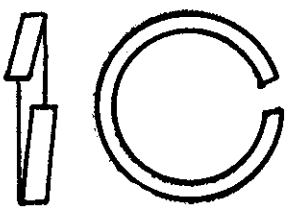
b. No

FRAME 3

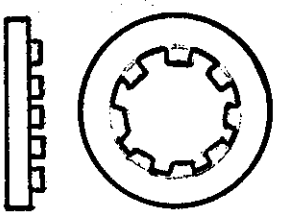
WASHERS



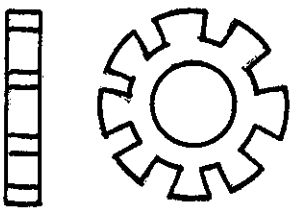
FLAT WASHER



SPLIT WASHER



INTERNAL STAR



EXTERNAL STAR

The four types of washers most commonly used on aircraft are the flat washer, split lock washer, internal star lock washer, and the external star lock washer.

The flat washer may be used in any situation to prevent the nut from damaging or scaring the surface of the object to which the bolt is attached.

The lock washer serves to hold the nut in place on the bolt.

To hold a nut in place, you should use a:

a. Flat washer

b. Lock washer

c. Either of the above

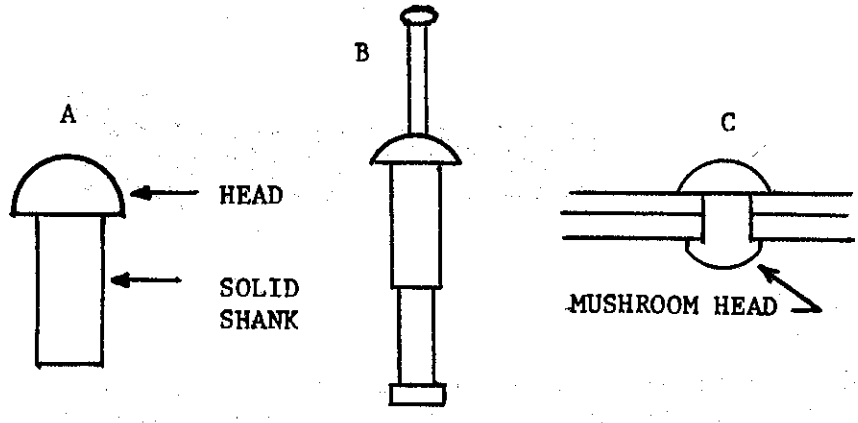
FRAME 12 cont.

4. Insure that the jam nut on each end of the push-pull tube is tight. Loose jam nuts will cause the rod end to move in, or out, of adjustment.

Insure that the rod end has been screwed into the push-pull tube with a sufficient amount of threads engaged.

b. Lock washer

FRAME 4



A rivet is a metal pin used for holding together two or more sheets, plates or pieces of material. When the rivet is manufactured, a head is formed on one end of the body shank.

Riveting consists of drilling holes in the pieces of metal or other material, to be joined together, inserting the shank of the rivet through the holes, and "mushrooming" the shank to form a second head. (See Sketch C above)

Riveted joints require a group of rivets to insure satisfactory strength to the joint. The strength of the joint depends on the sum of all the rivets in the group. If one or more rivets is missing, the strength of the joint is affected.

Rivets are divided into two main groups: The solid shank rivet (A) and the special or cherry rivet (B).

The standard solid shank rivets shown above are commonly used to fasten together the aircraft skin. Where one side of the structure is inaccessable, special (or cherry) rivets are used.

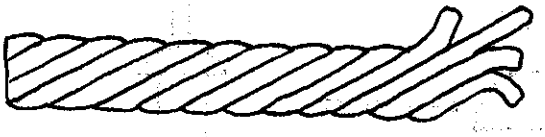
If one rivet in a series is damaged, will it affect the overall strength of the remaining rivets?

a. True

b. False

FRAME 13

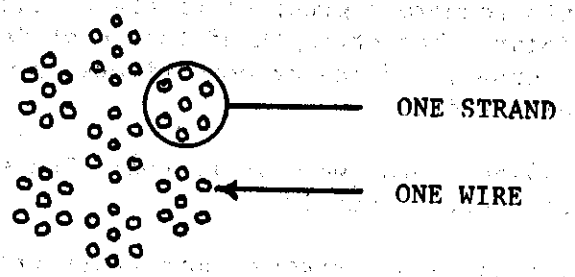
CABLES



A cable is a group of wires, or a group of strands of wires, twisted together into a strong wire rope. They are used to manipulate and regulate flight controls, engine accessories, utility system equipment and various other helicopter systems.

The cables most commonly used in aircraft controls are fabricated from extra flexible, preformed, and corrosion-resistant steel in diameters of 1/16 to 3/8 inch.

A cable is classified by the number of strands and wires it contains. For example, a 7 X 7 cable has 7 strands of 7 wires each. (See illustration below)



Check to see that there is sufficient tension on the cable. Loose cables may drag or hang on other structural members and cause poor control responses. Check to see that no strands are broken and, in areas where the cable passes through a pulley or fairlead, check for wear.

The three main things you are looking for when checking a cable for serviceability are: **a.** slack **b.** broken and **c.** contact.

a. True

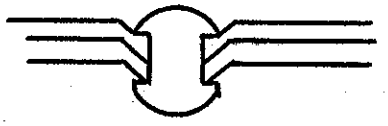
FRAME 5

In order for rivets to be useful they must be properly installed.

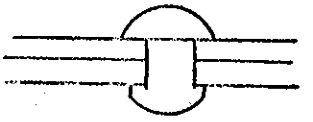
When checking structures joined by rivets, insure that the rivets are tight and no cracks are present around the rivet head or that no dents or deep scratches exist around the rivet.

Which of the following rivet installation is acceptable?

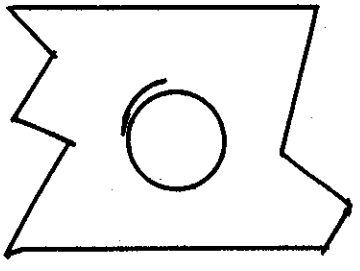
A



B



C



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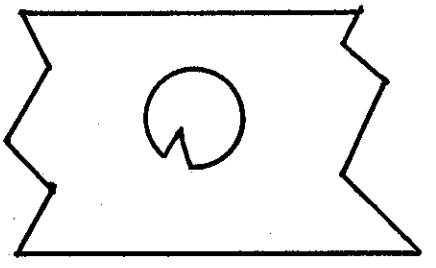


ANSWER: a. cable tension b. broken wire c. wear

FRAME 14

Aluminum alloy and corrosion resistant steel tubing is used for fuel, oil, instrument, hydraulic, and vent lines. Aluminum alloy tubing is used mostly because of its lighter weight, ease of forming, and resistance to corrosion and fatigue. Tubing material can be identified by visual inspection or by the aluminum alloy designation stamped on the surface.

Corrosion resistant steel tubing is used in high pressure hydraulic systems where the pressure is in the 3000 PSI range.

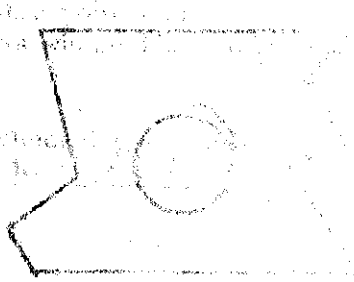
Aluminum alloy tubing is used for general purpose lines of low fluid pressure.

1. What type of tubing would you expect to find in a hydraulic line of low pressure?

ANSWER aluminum

2. What type of tubing is found in a high pressure hydraulic system?

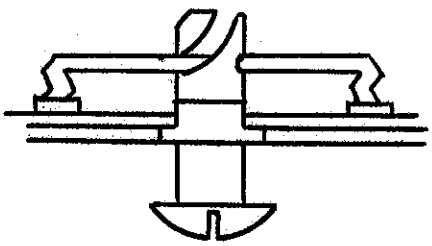
ANSWER steel



ANSWER: B (is correct)

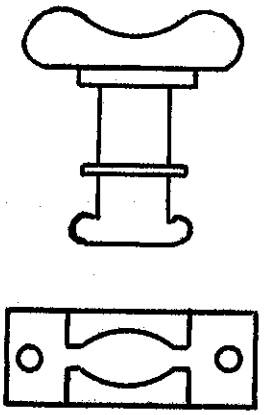
FRAME 6

FASTENERS



DZUS

CAMLOC



AIRLOC

Fasteners are used in aircraft construction to facilitate quick removal of covers, plates, cowling and fairlings. The type fasteners used are the Dzus, Camlock, and Airlock.

The Dzus fastener is comprised of the collar, stud assembly and cross spring.

The camloc fastener consists of three parts: the collar, the spring, and the stud assembly.

The airlock fastener consists of two parts: the spring receptable and the stud assembly.

Which type of fastener utilizes the cross spring?

a. Camloc
b. Dzus
c. Airlock

ANSWER: 1. aluminum alloy 2. steel

FRAME 15

Flexible hoses are also used in aircraft for instrument, hydraulics, and vent lines.

Flexible hoses come in two types: low-medium pressure, and high pressure.

The low-medium pressure hose has a rubber center covered with a braided fabric and is used mainly for vent lines or low pressure installations.

The high pressure hose is constructed of a rubber core with a braided wire cover over that inner core.

Which type of flexible hose has a rubber center covered with a braided fabric?

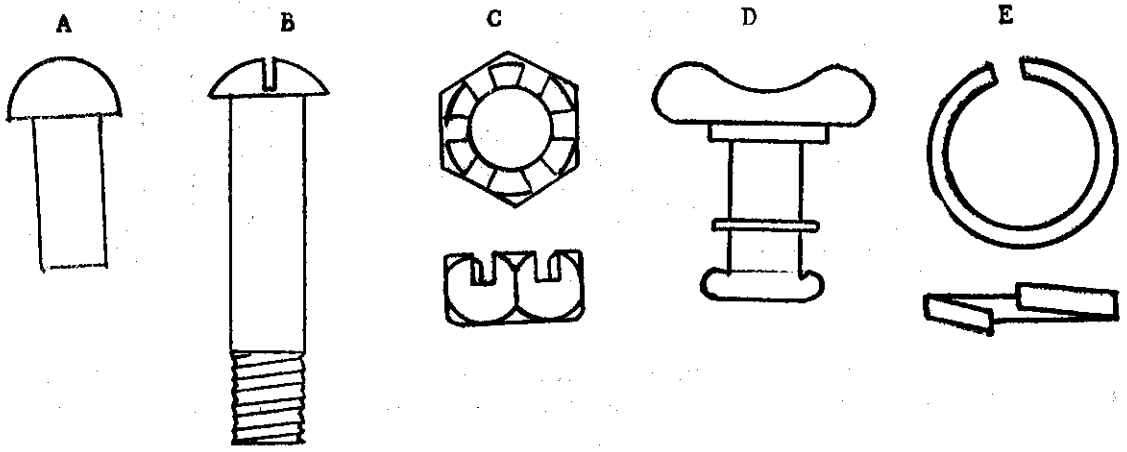
a. Low-medium pressure hoses

(b.) High pressure hoses

b. Dzus

FRAME 7

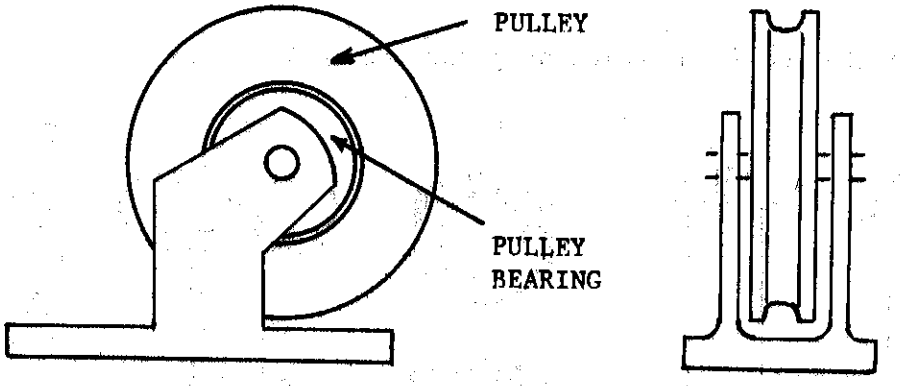
Identify the items below by proper nomenclature.



A. rivet
B. clevis bolt
C. castellated nut
D. air lock fastener
E. split ring lock washer

ANSWER: a. low-medium pressure hose

FRAME 16



Pulleys are used in the cable control systems to guide the control cable and as anchor points in small changes of direction of the cable.

The location and intended use of the pulley will determine its size.

Pulleys are checked for:

1. Cracks
2. Even wear
3. Freedom of operation

What are the main purposes of a pulley in a cable control system?

a. Act as guide

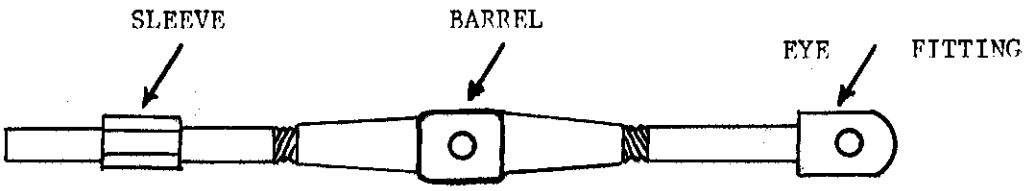
b. Change direction

(c) Both of the above

d. None of the above

ANSWER: a. rivet b. clevis bolt c. castellated nut d. Airloc fastener
e. split washer

FRAME 8. TURNBUCKLES



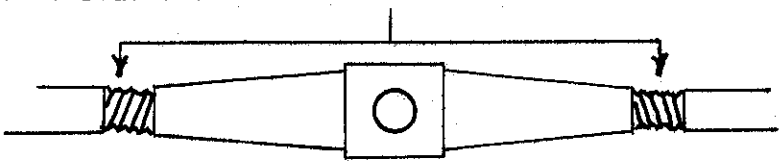
Turnbuckles are devices used in control systems to adjust cables and rods for proper length and tautness.

A turnbuckle assembly consists of a barrel and two connecting fittings, either forked, eye-shaped, or sleeve. The barrel is fitted with left and right-hand threads at opposite ends. Turning of the barrel will cause both fittings to move in or out simultaneously.

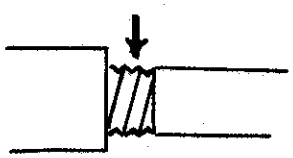
When the turnbuckle is used to connect and tighten rods, a forked or eye fitting may be used. When it is used to connect and tighten cables, a threaded sleeve screws into the barrel and the cable is attached to the sleeve. See illustration above.

The turnbuckle is checked to insure that:

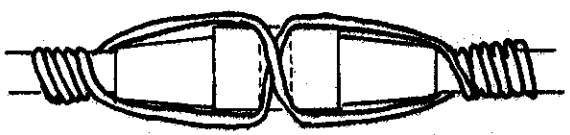
1. Both threaded terminals are screwed into the barrel an equal distance.



2. No more than three threads on the terminal are exposed.



3. The turnbuckle and terminals are safety wired.

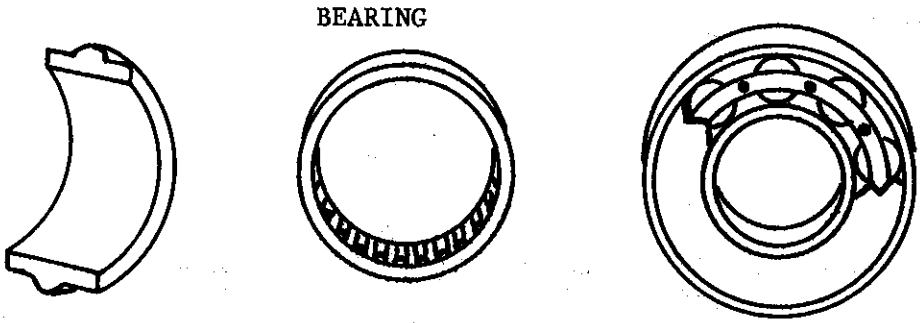


Where are turnbuckles most commonly found?

a. On structural members.
b. On tie down equipment.
c. On control systems.
d. On seat belts.

ANSWER: c. both of the above

FRAME 17

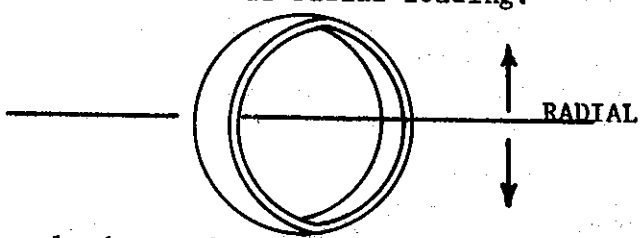


Bearings are used in various components of the helicopter.

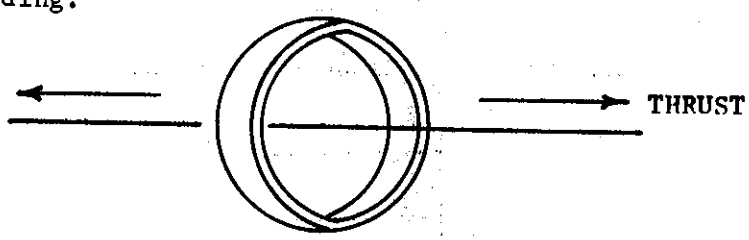
The three general types of bearings used in the components are plain, roller, or ball bearing. The ball and roller bearings are generally used in preference to plain bearings.

Bearings are exposed to radial and thrust loads.

When a shaft turns, it produces centrifugal force. This force acts at 90° from the shaft and is known as radial loading.



When the force or load on a bearing is parallel to the shaft, it is known as thrust loading.



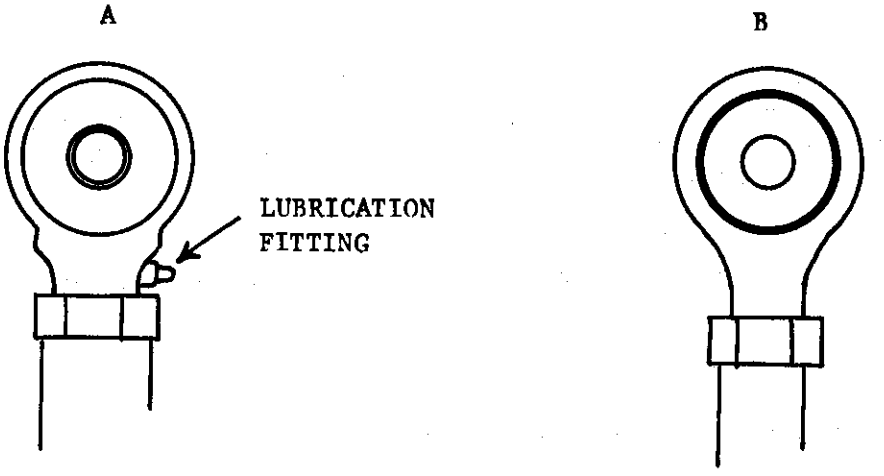
Plain bearings supporting rotating parts are generally subjected to radial loads only. However, some have been designed to take thrust loads.

Ball bearings are designed to take radial or thrust loads or any combination thereof.

Roller bearings are made in many types and shapes. Plain and tapered are the most common types. Plain roller bearings are used for radial loads only. Tapered roller bearings will withstand both radial and thrust loads.

c. on control systems

FRAME 9 ROD END BEARINGS



Rod end bearings are commonly used in conjunction with flight or engine controls.

This type of bearing is used to reduce friction on connecting parts and for smoother operation of the controls.

Two distinct types of rod end bearings are:

1. Ball, roller, or needle bearings which require periodic inspection for cleaning and lubrication. A above

2. Fiber bearing made of Teflon material which require no lubrication, but do require periodic cleaning. B above

Which of the rod end bearings shown above is made of fiber material?

A.

(B.)

STOP. TURN TO FRAME 10 PAGE 2

FRAME 18

CLAMPS

Clamps are used to secure flexible hoses, tubing, and wiring. There are many different types of clamps, but the main things to check on all clamps are:

1. tightness
2. to see that the clamp is not chafing whatever it is holding.
3. that there are enough clamps to keep whatever they are holding from vibrating.

If a clamp was used to secure tubing exposed to vibrations, you should insure that:

(a) The clamp is tight.

b. The rubber cushion is present.

c. The clamp is loose.

ANSWER: a. clamp is tight

SELF EVALUATION EXERCISE
ON
AIRCRAFT HARDWARE

(Select the best answer)

1. Push-pull tubes are used to transmit control forces from the cockpit to various flight & engine controls and are also used as support for the crew members to stand-on while inspecting the aircraft

   a. True

   b. False

2. To check the rod end bearings of a push-pull tube on pre-flight inspections you would check for:

   a. Side play

   b. End play

   c. Radial movement

   d. All of the above

3. If one jam nut is loose on a push-pull tube assembly, the aircraft is still safe to fly because the other jam nut will prevent the push-pull tube from twisting in or out of adjustment.

   a. True

   b. False

4. Turnbuckles must have more than three threads showing outside of the barrel.

   a. True

   b. False

5. A turnbuckle has one end threaded with a right-hand thread and the other end is threaded with a left-hand thread.

   a. True

   b. False

6. To lubricate Teflon bearings, you should

   a. wash with water then apply grease.

   b. use air gun to blow away dirt, then apply grease.

   c. purge bearing with fresh grease.

   d. none of the above.

7. Bearings are inspected to insure that they

   a. operate smoothly.

   b. are installed correctly.

   c. do not have excessive play.

   d. are clean and properly lubricated.

   e. all of the above.

8. Select from the list below, the type of bolt that is used when a component, which it secures, is exposed to high shear and load reversals.

   a. Clevis bolt

   b. Close tolerence bolt.

   c. Eye bolt

   d. Standard hex bolt

9. Where one side of the structure is inaccessable _____rivits are used.

   a. solid shank

   b. cherry

10. If one rivet in a series of rivets is cracked, the aircraft is still flyable, however it should be repaired as soon as possible because the bad rivet will weaken the sum strength of the riveted joint.

a. True

b. False

11. Aircraft fasteners are generally of three types. Dzus fasteners, Airloc fasteners and Camloc fasteners. Which of these three fasteners is constructed with a cross spring, collar, and stud assembly.

a. Dzus

b. Airloc

c. Camloc

12. Castellated shear nuts are normally used in locations where <u>they</u> will be exposed to shear loads.

a. True

b. False

13. A castellated nut is a non-self-locking nut that requires a locking device.

a. True

b. False

14. How many times can you use a fiber self-locking nut?

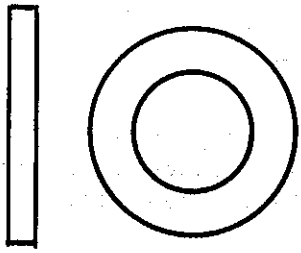
a. 1

b. 4

c. 8

d. 12

15. What type of ~~wahser~~ washer is in the illustration below?



a. Taper pin washer

b. External star

c. Flat washer

d. Split washer

16. What is used to change a cable's direction of travel?

a. bearing

b. Turnbuckle

c. Pulley

d. Fairlead

INTENTIONALLY LEFT BLANK

ANSWERS TO SELF EVALUATION EXERCISE

1. b
2. d
3. b
4. b
5. a
6. d
7. e
8. b
9. b
10. a
11. a
12. b
13. a
14. a
15. c
16. c

L3080 Army–Ft. Sill, Okla.