U.S. Department
of Transportation

**United States
Coast Guard**

AIRMAN HANDBOOK

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Technical Training Center
Elizabeth City, NC 27909-5003

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QUESTIONS ABOUT THIS TEXT SHOULD BE ADDRESSED TO THE AVIATION MAINTENANCE TECHNICIAN SUBJECT MATTER SPECIALIST

References

Selected References

This pamphlet contains original material developed at AVTECHTRACEN, Elizabeth City, NC and excerpts from the following technical publications:

Air Operations Manual, COMDTINST M3710.1 (series)

Applicable Aircraft Computer Maintenance System (ACMS)

Aeronautical Engineering Maintenance Management Manual, COMDTINST M13020.1 (series)

Servicing of Aircraft and Static Grounding, USAF T.O. 00-25-172

Aircraft and Missile Structural Hardware, USAF T.O. 1-1A-8

Use and Care of Hand Tools and Measuring Equipment, USAF T.O. 32-1-101

Quality Control of Fuels and Lubricants, USAF T.O. 42B-1-1

Notice to Students

Introduction

This pamphlet is designed as a non-resident, self-paced study program. The primary purpose of this pamphlet is to provide information required for a proficient, safe standard method of completing the Airman syllabus in preparation for an aviation "A" school.

Important Note

This text has been compiled for TRAINING ONLY. It should NOT be used in place of official directives or publications. The text information is current according to the references listed. You should, however, remember that it is YOUR responsibility to keep current with the latest professional information available.

How to Proceed

To complete this pamphlet:

- Read each assignment (chapter)
- Complete the practice exercises (where applicable)
- Review the feedback (where applicable)
- Complete the end of pamphlet review quiz (where applicable)
- Review the feed back (where applcable)
- If you have any questions, contact your instructor.
- Upon completion of each chapter, see your instructor for On-the -Job-Training (OJT) and syllabus sign-off.

Continued next page

Student Feedback

The last page of this pamphlet is a memorandum which is provided for you to submit your input to the subject matter specialist. As you read each assignment, if you have comments, such as:

- Suggestions for adding or deleting information
- Notations of errors in the text (include page number and your reference material)
- Questions about the text or a self-quiz

Write your comments in sentence form on the memorandum. Tear it out of the pamphlet, fold and tape it as indicated on the form, and mail it through your unit's mail room. The subject matter specialist will review each memorandum received.

Table of Contents

In This Pamphlet

This pamphlet covers the following topics:

Crew Resource Management

Objectives

Study the instructional text, perform the assignment Self-Quiz, and master the following performance objectives. Overall success is determined by performance that is in accordance with the references listed below.

- Given the description of a method of communicating and a list of methods, **SELECT** the described method.
- Given the description of a step in the communication process that must occur to effectively communicate an idea and a list of possible steps, **SELECT** the described step.
- Given a description and a list of barriers to effective communication, **SELECT** the described barrier.
- Given a list, **IDENTIFY** ways that the sender of an idea can help the receiver understand the message.
- Given a list of possibilities, **IDENTIFY** ways that the receiver can verify their understanding of the message being sent.
- Given a list of possible roadblocks, **IDENTIFY** the roadblocks which interfere with or inhibit someone from being assertive.
- Given the description of an assertiveness roadblock tool and a list of possible tools, **SELECT** the described tool.
- Given the description of a clue that warns of lost or diminished situational awareness and a list of possible clues, **IDENTIFY** the described clue.

References

The information contained in this assignment can be found in the following references:

- Crew Resource Management Training Pamphlet: ATC Mobile
- Team Coordination Training, Cutter Operations: RTC Yorktown (prepared by Geis-Alvarado & Associates, Inc. Napa, CA)
- Human Factors Digest No. 2: ICAO Circular 217-AN/132

Communication

Introduction

The ability to communicate effectively is a valuable skill that most people take for granted. In fact, poor communication skills have caused many aircraft accidents. You will rarely find communications directly cited as a causal factor of an accident, but if you examine the elements of the mishap you will usually find some failure of the crew to effectively communicate. When the communication process breaks down between people, interpersonal problems may result. When it breaks down in the aircraft, fatalities may result.

Levels of Communication

Communication can generally be broken into three different levels of effectiveness:

- Poor Communications
- Good Communications
- Effective Communications

Poor Communication

This category includes communications where the message is not even received, as indicated by the resulting confusion.

Good Communication

Communication is good if the receiver correctly understands the message, but does not respond with the desired action.

Effective Communication

Communication is effective only if the sender achieves the intended purpose, i.e., the receiver not only understands, but responds as desired. This may seem to be relatively simple, but in actual practice, communicating effectively can be very difficult. There are two reasons for this:

- The ability to appropriately convey our thoughts and feelings
- To receive and properly interpret the thoughts and feelings of others

These are learned skills that must be continually practiced and refined.

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Effective Communication (Continued)

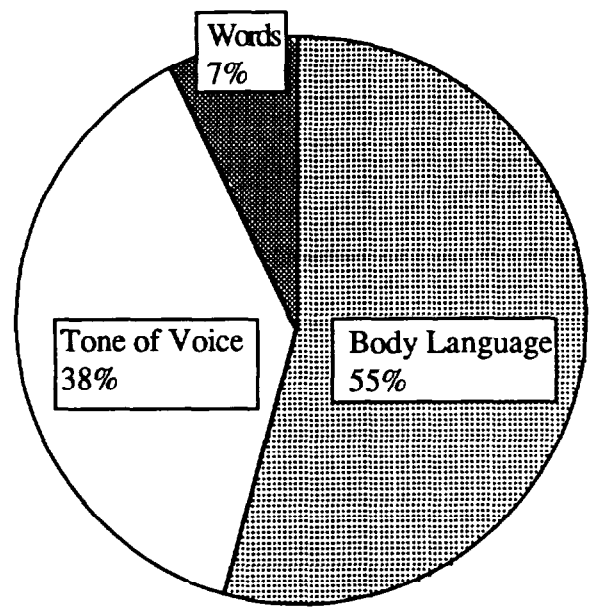
Effective communication is a shared responsibility. Each person must have some awareness of and appreciation for others, and understand why they feel and behave the way they do. Without either of these factors effective communications will not exist.

Exchanging Information

Communication is the process of exchanging information. Information is conveyed by the following three methods:

- Body language
- Tone of voice
- Words

Studies have shown that body language accounts for 55% of the information communicated, tone of voice for 38%, and words for only 7%.



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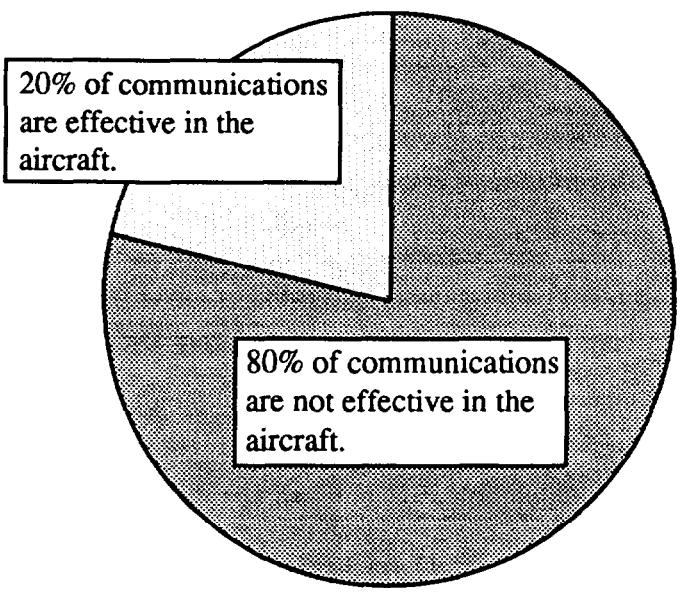
Availability

How many of these methods are available to us in our radio or ICS communications?

- Obviously body language is not used in radio communications and is used very little in Internal Communication System (ICS) communications. Consider that crewmembers often cannot see each other, helicopter crews are wearing helmets and visors and usually cannot take the time to look at the other person even if they can see them. Immediately nearly 55% of our communications effectiveness is gone!

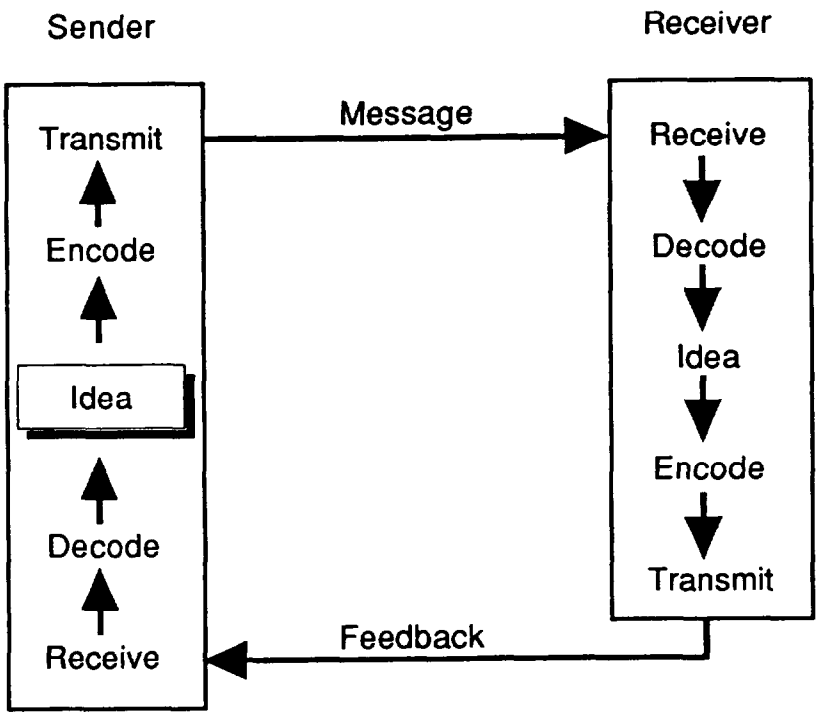
- How much tone actually comes through on radio calls? Not much considering background static, poor communication, and engine noise. Most aviators are taught that a calm, collected voice should be used at all times; especially in emergencies! Probably over half of "tone effectiveness" in radio or ICS communications is lost or purposefully removed. That leaves about 20% effectiveness available for communications.



Communication Process

Introduction

The process of communication has three elements, a person (sender) transmitting information (a message) to another person (receiver). To determine if it has been received accurately, a feedback loop must be added. It is even more difficult to determine if the communication has been effective in achieving the desired results. There are ten steps that must occur for information or an "idea" to be properly transmitted, received, and then acknowledged (see illustration below). The first step is the senders idea, followed by the other nine.



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Sender

Communication is a two-way process that starts with the sender. The sender should be conveying information necessary for mission accomplishment. The sender must be pro-active in making the receiver understand the message. Too often, what is said is not always what is heard. To prevent this from happening, do the following:

- Be clear and concise
  - Clarify the idea you want to get across
  - Clarify the purpose of the statement
  - Try to eliminate emotional overtones
- Consider the environment
  - Remove any rank or interpersonal barriers
  - Establish your credibility
- Address the receivers needs
  - Find a good time for the discussion
  - Avoid overloading the listener with too much information
  - Remember that the sender also needs to listen
- Encourage feedback

Receiver

The receiver needs information to accomplish their task. The effectiveness of the crew often rests on its members ability to listen. Unfortunately most people find listening difficult. Active listening is a process used by the receiver to facilitate communication and enhance performance. It requires the receiver to be active in the communications process. To actively listen the receiver needs to:

- Hear
  - Stop talking and listen
  - Remove distractions
  - Put the speaker at ease and show you want to listen
- Interpret
  - Listen with understanding
  - Listen and respond to feelings
  - Note verbal and nonverbal cues

Continued next page

Communication Process (Continued)

Receiver (Continued)

- Evaluate
  - Suspend premature judgement
  - Ask questions
- Respond
  - Give feedback confirming what you heard
  - Avoid argument and criticism

Communication Feedback

Introduction

For communication to be effective the receiver must provide feedback to the sender. The receiver considers the senders words, tone of voice, and body language when providing feedback.

Definition

Feedback occurs when the receiver acknowledges and/or verifies their understanding of the mesage sent by the sender.

Methods of Providing Feedback

Feedback can be sent to the sender in the following ways:

- Acknowledging
- Parroting
- Paraphrasing

Acknowledging

Acknowledging a message is common courtesy and is usually accomplished by saying "ROGER". This demonstrates that the receiver has heard the message. However, for critical information or complicated ideas, acknowledgment does not ensure that the message is fully understood.

Parroting

Parroting is speaking back verbatim the words of the speaker. It confirms to the speaker that the words transmitted were the words received. It is preferred in verifying receipt of standard commands. However, like acknowledgment, it does not ensure that the receiver understood the message.

Paraphrasing

Paraphrasing is rephrasing in your own words the content of the senders message. It clarifies the message for both sender and receiver. Paraphrasing allows you to check your understanding of the message and gives the sender an opportunity to correct any communication error.

Communication Barriers

Introduction

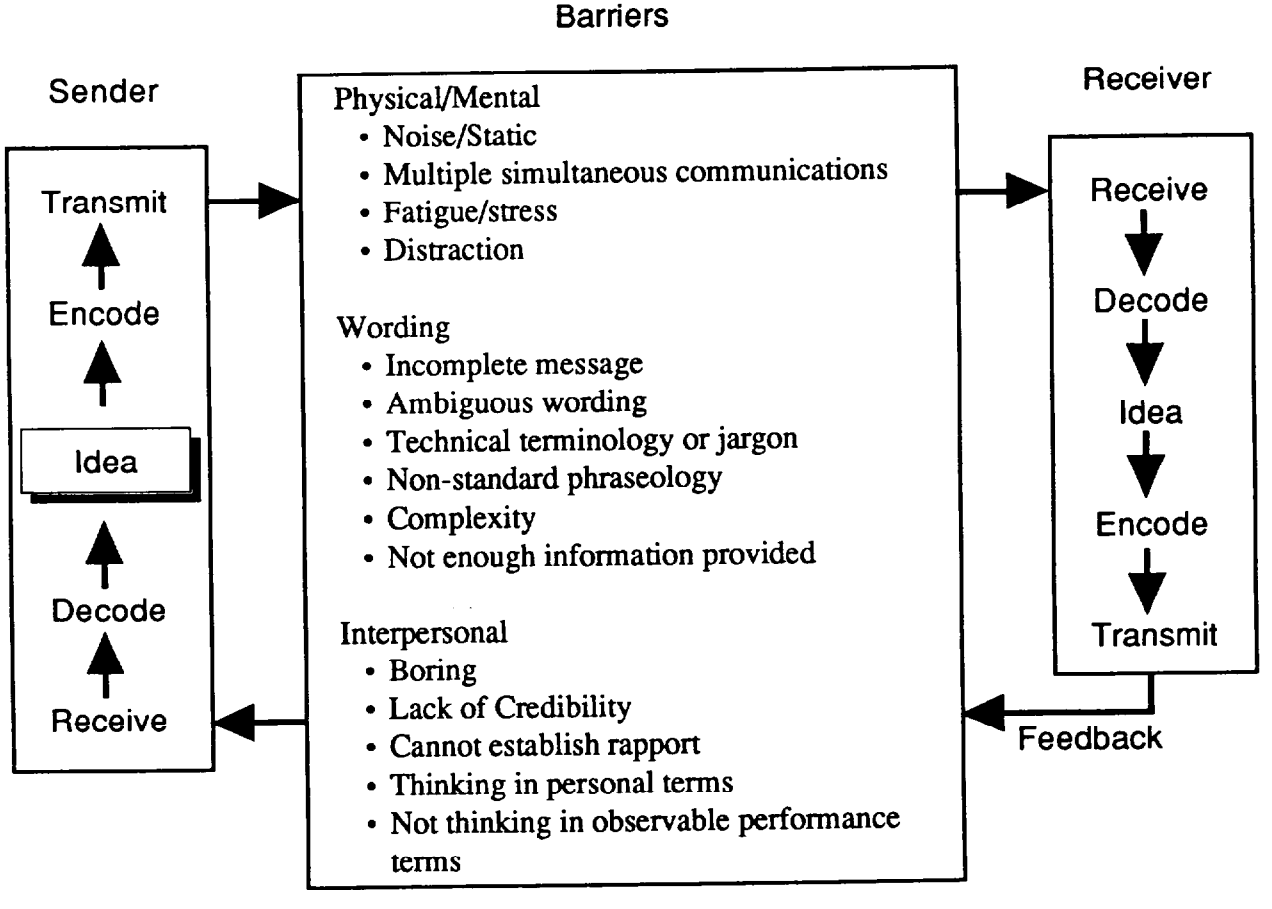
Communication barriers either block, distort, or alter the message being sent. By identifying the barriers and applying countermeasures, crew members can communicate more effectively.

Definition

Barriers are influencing factors which impede or break down the continuous communications loop.

Barriers

The communication loop shown below lists the common barriers to effective communication.



Assertiveness

Introduction

Sometimes it is essential to express your point of view without fear of retribution or reprisals, especially during emergency situations. The effective team leader advocates open communication by team members. In their interactions, effective team members are mutually respectful to each other.

Definition

Assertiveness is the ability of crew members to state and maintain a position that may be counter to the position of others until convinced by the facts, not the authority or personality of another, that their position is wrong.

Assertive People

Assertive people stand comfortably, but firmly, and speak in a steady tone of voice. They recognize boundaries between their ideas and those of others. People responding assertively are aware of their feelings. Tensions are kept in a normal, constructive, and situationally appropriate range. Actions that indicate assertive behavior include:

- Ask task related questions.
- Suggest alternative solutions/courses of action.
- State opinions of decisions/procedures that have been suggested.
- Avoid letting rank differences threaten mission safety or performance (question unreasonable/unsafe request).
- Maintain their position when challenged, until convinced by facts.
- Confront ambiguities and conflicts.
- Ask for assistance when overloaded or having difficulty with a task.

Assertive Words

Assertive words include statements reflecting responsibility for self, "I think," " I feel," "I want," and cooperative words such as, "let's see, how can we resolve this?" "what do you think?" and "what do you see?"

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Assertiveness With Respect

Crew members should respect and support the authority of the aircraft commander while clearly asserting their suggestions or communicating any problems they are aware of. When in doubt....Speak out!

Assertive Statement

The assertive statement contains information and includes messages which enhance team performance and are often critical to mission safety. These messages provide key information about the situation and its risks, the effectiveness of decisions, and observed errors. This information must be clearly and precisely conveyed, and well timed. An assertive statement should contain all of the following elements in the order listed:

Element	Description
1. An opening statement.	The opening statement should get their attention, (Say their name).
2. A specific concern.	State concern using an owned emotion – "I am uncomfortable with...".
3. A problem statement.	State the problem, real or perceived.
4. A solution.	Offer a solution – "I think we should...".
5. A request for feedback.	Obtain agreement – "What do you think?"

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Example of an Assertive Statement

An HH-65A aircrew experienced a landing that the flight mechanic felt was a hard landing. The pilots didn't seem to be concerned about the landing and were discussing the next takeoff. The flight mechanic was concerned enough to press the issue. Below is an example of the flight mechanic's assertive statement.

"Pilot, Flight Mechanic: I don't feel comfortable with that last landing. It felt to me like an extremely hard landing. I think we should taxi back to the ramp and check out the airframe. What do you think?"

The pilot was reluctant at first but the flight mechanic persisted and convinced the pilot to taxi back to the ramp. The inspection revealed several screw heads that had pulled through a cowling. A job well done on the flight mechanic's part!

Assertiveness Roadblocks

Introduction

Sometimes a person who feels the need to be assertive can't or won't because of assertiveness roadblocks.

Definition

Roadblocks are situations or feelings that interfere with or inhibit someone from being assertive.

Roadblocks

Some of the common roadblocks to assertiveness are:

- Norms
- Hidden Agenda
- Odd Man Out
- Excessive Professional Courtesy
- Chain of Errors
- Strength of an Idea
- Hazardous Attitudes

Norms

Norms are unwritten rules that become pressures that act upon a group. For example, if a particular mission has always been completed in four hours or less, then the crew may feel pressured to complete the mission in four hours or less regardless of circumstances.

Hidden Agenda

A hidden agenda is intentionally withholding information about intentions, plans, or mistakes from the rest of the crew. Be assertive enough to admit your own mistakes when it can affect the safety of the flight.

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Assertiveness Roadblocks (Continued)

Odd Man Out

Odd man out occurs when a crew or group tends to ignore input from a particular member. The member could be less experienced, the "new guy", a different race or sex, or a less popular individual. This results in a loss of total crew effectiveness.

Excessive Professional Courtesy

Excessive professional courtesy can result in the hesitancy of a crew member to call attention to deficiency in the performance of others, particularly those crew members who are senior or more experienced. This is also known as the "Halo Effect," the tendency to attribute unwarranted skill or expertise, based on unrelated or faded experience.

Chain of Errors

A chain of errors is a progression of errors often based on faulty decisions possibly influenced by other roadblocks. Crew members need to be assertive early. Often the key is to recognize the chain developing, then a member of the crew can act to change the situation. Sometimes a simple inquiry, "Inquiry Invites Advocacy," can break the chain.

Strength of an Idea

Strength of an idea is the tendency to unconsciously make the available evidence fit a preconceived situation, to see or hear what we want to, and substitute that for reality. It can take as long as fifteen seconds to "break" an idea that has been ingrained, but is incorrect.

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Hazardous Attitudes

Any attitude that places the mission, aircraft, or crew in danger is considered a hazardous attitude. The table below lists some of the more common hazardous attitudes and provides a counteracting response.

Hazardous Attitudes		
Attitude	**Example**	**Counteracting Response**
Copilot Syndrome	"I'm just along for the ride."	"Whatever happens to the rest of the crew also happens to me."
Anti-Authority	"Don't tell me!"	"Follow the rules, they are usually right."
Impulsivity	"Do something - *Quickly*!"	"Not so fast ...Think first."
Invulnerability	"It won't happen to me."	"It could happen to me."
Macho	"I can do anything."	"Taking unnecessary risks is foolish."
Resignation	"What's the use?"	"I'm not helpless. I can make a difference."
Missionitis	"I want to press on."	"I don't have to do this now.

Assertiveness Roadblock Tools

Introduction

Assertiveness roadblocks must be overcome for the sake of the aircraft, mission, and the crew. Listed below are some of the tools which can be used to avoid or get around road blocks.

- Two Challenge Rule
- I'M SAFE
- DECIDE
- The Assertive Statement
- This is Stupid

Two Challenge Rule

The Two Challenge Rule provides for automatic assumption of duties from any crew member who fails to respond to two consecutive challenges. Attempt to overcome the natural tendency to believe the flying pilot knows what they're doing. The two challenge rule may be used as a tool for knowing when to speak up, however concurrence on how it will be used needs to be obtained before it is ever used.

I'M SAFE

I'M SAFE – An acronym used as a self run checklist prior to flight.

- Illness – "Do I have any symptoms?"
- Medication – "Have I been taking prescription or over-the-counter drugs?"
- Stress – "Am I under psychological pressure from work? Do I have money, health or family problems?"
- Alcohol – "Am I within the guidelines established in COMDTINST 3710? Am I still having residual symptoms?"
- Fatigue – "Did I sleep well last night, and am I adequately rested?"
- Eating – "Have I eaten enough of the proper foods and drank fluids?"

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Assertiveness Roadblock Tools (Continued)

DECIDE

DECIDE – An acronym used once a change has been detected to help determine and direct a corrective course of action.

- Detect – Detect the fact a change has occurred which requires attention.
- Estimate – Estimate the significance of the change to the operation.
- Choose – Choose a safe outcome for the operation.
- Identify – Identify options and their risks to control the change.
- Do – Do the best option
- Evaluate – Evaluate the effect of the action on the change and on the progress of the operation.

Assertive Statement

An assertive statement will almost always make the targeted crewmember think about what they are doing and provide feedback. This opens the situation up for discussion and allows all crewmembers to provide input to the decision. Remember, be assertive!

This is Stupid

To be successful, "This is Stupid" entails speaking exactly those words in a forceful manner. Usually this will shock the crew into awareness of the potential risks of the present course of action, and avoid the necessity of going to the final level of Assertiveness, actual conflict.

Crew Incapacitation

Introduction

The aviation community has recognized crew incapacitation as a serious hazard. All crewmembers must be aware of this hazard so that it will be easier to recognize and deal with.

Obvious Incapacitation

Obvious incapacitation usually involves a sudden, total and prolonged loss of function. Among its possible causes are combat casualties, heart disorders, strokes or cerebral hemorrhages, and severe kidney or gall stone attacks. A civil aviation study conducted by the International Civil Aviation Organization (ICAO), revealed that during a seven year period there were seventeen instances of pilot deaths on the flight deck. Five of these led to fatal accidents. This type of incapacitation is not common but when it does occur other crewmembers must act quickly.

Subtle Incapacitation

Subtle incapacitation usually involves partial loss of function. This type of incapacitation occurs more frequently and is very difficult to detect. Among the most common causes are preoccupation with personal problems, reactions to stress and fatigue, and various medical problems. Subtle incapacitation is considered a more significant operational hazard because the affected crew member may look well and appear to be fully conscious. They also may not be aware of the problem or capable of rationally evaluating the problem themselves. Detection is also made more difficult by the common assumption that the individual flying the aircraft has a purpose for everything, even if it appears to be wrong. This is known as "Excessive Professional Courtesy". Subtle crew incapacitation is experienced by all of us at one time or another and has been shown to be a factor in many accidents.

Situational Awareness

Introduction

Human error is the leading cause of aircraft mishaps, but no crew purposely crashes an aircraft! So what allows human error to creep into the picture? The loss of situational awareness is the most frequent answer. Too often, we read that the pilot became task saturated and that loss of situational awareness led to the mishap. Therefore, it is important to recognize the loss of situational awareness.

Definition

Situational Awareness is the ability to identify, process, and comprehend the critical elements of information about what is happening to the team with regards to the mission. More simply, it's knowing what is going on around you.

Continued next page

Loss of Situational Awareness Clues

The loss of situational awareness usually occurs over a period of time and will leave a trail of clues. Be alert for the clues listed in the table below that warn of lost or diminished situational awareness.

Clue	Explanation
Confusion or Gut Feeling	Disorder within the team or a gut feeling that things are not right. The body is able to detect stimulus long before we have consciously put it all together. Trust your feelings!
Looking for Hazards	Aircraft operations require more than just flying the aircraft. The proper assignment and performance of tasks, particularly lookout tasks, is essential to safe aircraft operations.
Improper Procedures	Improper procedures puts the individual or the team in a gray area where no one may be able to predict the outcome with any certainty.
Departure From Regulation	In addition to violating procedures, we are operating in an unknown area where the consequences of our actions cannot be predicted with any degree of certainty.
Failure to Meet Planned Targets	During each evolution, we set goals or targets to meet, such as airspeed, altitude, waypoints, and landing times. When they are not met, we must question why and systematically begin to evaluate our situation.
Unresolved Discrepancies	When two or more pieces of information do not agree, we must continue to search for information until the discrepancy is resolved.
Ambiguity	Ambiguity occurs when information we need is confusing or unclear, we need to fill in the pieces before proceeding.
Fixation or Preoccupation	When someone fixates on one task or becomes preoccupied with work or personal matters, they lose the ability to detect other important information. Early detection of both fixation and preoccupation is essential to safe aircraft operations. The best way to identify these clues is by knowing the behavior of your team members and being alert to change. Preoccupation with personal matters can often lead to subtle changes in behavior.

Lesson Summary

Summary

This lesson has provided information on three basic elements of Crew Resource Management, communication, assertiveness, and situational awareness.

Communication

For a crew to work together communication is essential. Strive for effective communications. Organize messages so they are clear and concise. Consider barriers that might interfere with the message. Select a time when the receiver can listen. Request feedback to ensure the message was understood the way it was intended. Be a good listener, remove distractions, ask questions, and provide feedback.

Assertiveness

Be assertive! Make sure you understand what is going on and why you are doing it. Ask questions until you are satisfied! Be assertive enough to remove yourself from a flight if you don't feel well or if you are preoccupied with professional or personal matters. Be alert for roadblocks and crew incapacitation. Use the following tools to avoid or get around them:

- Two Challenge Rule
- I'M SAFE
- DECIDE
- The Assertive Statement
- This is Stupid

Situational Awareness

Pay attention to what is going on around you. When the mission is complete is no time to become complacent, you still have a flight home. Stay alert! Remember, if you have a feeling something is not right then it probably isn't. Follow procedures and adhere to regulations. Ask questions!

Crew Resource Management Self-Quiz

Questions

Answer the following questions on Crew Resource Management.

1. The three methods of communicating are_____, _____, and _____.

2. To assure the sender that a message has been received accurately the receiver must provide _____.

3. The sender of a message can help the receiver understand it by _____.

   A. addressing the receivers needs
   B. not talking and listen
   C. providing feedback
   D. putting the speaker at ease

4. Which type of feedback confirms to the speaker that the words transmitted were the words received?

   A. Acknowledging
   B. Rogering
   C. Parroting
   D. Paraphrasing

5. Fatigue/stress is an example of what type of barrier to effective communication?

6. The ability of crewmembers to state and maintain a position that may be counter to the position of others, until convinced by the facts, not the authority or personality of another, that their position is wrong is called _____.

Continued next page

Questions (Continued)

7. When making an assertive statement, what is the FIRST thing you should do?

   A. State the problem
   B. Offer a solution
   C. State concern (an owned emotion)
   D. Get their attention (say their name)

8. The tendency to attribute unwarranted skill or expertise, based on unrelated or faded experience is which type of assertiveness roadblock?

   A. Strength of an idea
   B. Excessive professional courtesy (Halo effect)
   C. Norms
   D. Hidden agenda

9. Which assertiveness tool for roadblocks should have concurrence from all concerned on how it will be used before it is used?

   A. DECIDE
   B. The Assertive Statement
   C. Two Challenge Rule
   D. This is Stupid

10. Which loss of situational awareness clue is evident when the body detects stimulus before you have consciously put it all together?

    A. Fixation or preoccupation
    B. Unresolved discrepancies
    C. Ambiguity
    D. Confusion or gut feeling

Crew Resource Management Self-Quiz Feedback

Feedback

Compare your answers to the feedback provided below. If you had trouble with this self-quiz, please review the appropriate section of this reading assignment.

Question	Answer	Reference
1.	body language, tone of voice, words	1-3
2.	feedback	1-5
3.	A	1-6
4.	C	1-8
5.	Physical/mental	1-9
6.	assertiveness	1-10
7.	D	1-11
8.	B	1-14
9.	C	1-16
10.	D	1-20

Aircraft Handling

Introduction

Aircraft towing operations are performed daily at all Coast Guard airstations. If done incorrectly it can cause costly damage to equipment and serious injury to personnel. The use of proper equipment, and the correct number of experienced personnel is important to the safe completion of the towing operation.

Chapter Purpose

This chapter is designed to give you the skills required to perform as a member of an aircraft handling team.

How To Proceed

To begin this chapter:

- Read this chapter
- Complete the practice exercises
- Review the feedback
- Contact your instructor if you have any questions

Objective

Given a list of duties and scenarios, **SELECT** the duties of each member of an aircraft handling team to include wing/tail walker, cockpit brake monitor, and tow tractor driver.

References

- Aeronautical Engineering Maintenance Management Manual, COMDTINST M13020.1 (series)
- Applicable aircraft publications

Towing Teams

Introduction

The amount of personnel required to tow an aircraft is dependent upon the aircraft type and the area in which the towing will take place.

Personnel

The table below lists the personnel required to tow each individual aircraft.

Position	Aircraft To Be Towed			
	HC-130	HU-25	HH-60	HH-65
Supervisor	1	1	1	1
Vehicle Driver	1	1	1	1
Brakeman	1	1	1	1
Hydraulic Pressure Monitor	1			
Wing Walkers	2	2	2	2
Tail Walkers	1		1	1

Supervisor Responsibilities

The supervisor will:

- Assume total responsibility of towing operation.
- Issue positions of other crewmembers.
- Determine signals to be used during towing operation.
- Ensure towing members can be seen during operation.
- Ensure all problems and obstacles that may be encountered during the towing operation are discussed before it is started.
- Ensure that the locking scissors or locking pins are disconnected/unlocked prior to the towing operation and reconnected/locked after the tow bar is removed from aircraft.

Continued next page

Towing Teams (Continued)

Vehicle Driver Responsibilities

The vehicle driver:

- Shall obey emergency stop signal commands given by any team member, as will be illustrated in the Taxi Signalling chapter.
- Safely operates the tow vehicle.
- Performs pre-operational check of the tow tractor.

Brakeman Responsibilities

The brakeman must:

- Be qualified to operate the brakes on that specific aircraft.
- Observe and operate the aircraft brakes as required by team member's signals as will be illustrated in the Taxi Signalling chapter.

Hydraulic Pressure Monitor Responsibilities

The hydraulic pressure monitor will maintain the hydraulic system pressure for aircraft brakes by actuating the hand pump as needed.

Wing Walker/Tail Walker Responsibilities

The wing walker/tail walker will:

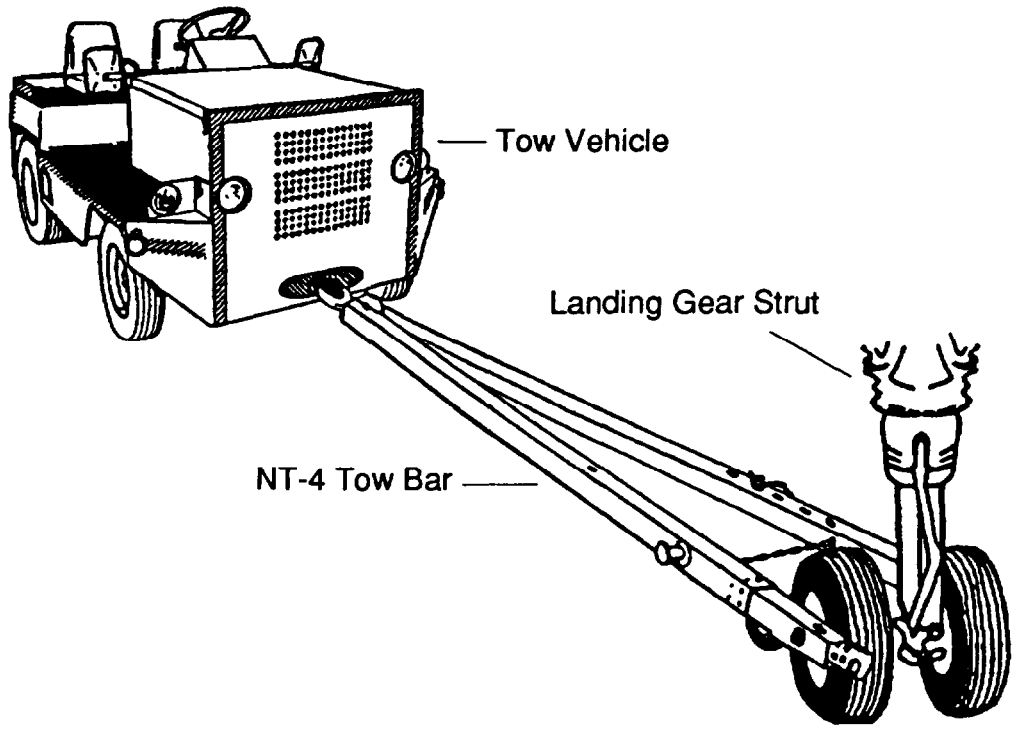
- Observe and ensure that a safe distance is maintained from all obstacles.
- Provide clear/unobstructed signals of movement in tow area as will be illustrated in the Taxi Signalling chapter.

Towing Equipment

Introduction

The aircraft in the Coast Guard vary in size and type, each requiring a specific tow bar and tow vehicle. The example below shows the basic setup using a tow vehicle, tow bar, and a forward landing gear strut.

Towing Setup



Tow Vehicle

The tow vehicle provides the power to move the aircraft around while on the ground without the engines running. Each tow vehicle is rated by the amount of pulling/pushing force it can produce.

The common types are:

- TA-18 rated to 18,000 pounds.
- SM-80F rated to 8,000 pounds.
- TA-75 rated to 7,500 pounds.
- SM-340 rated to 4,000 pounds.

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Tow Vehicle Pre-operational Inspection

The pre-operational inspection is to be performed prior to the first use each day. Accomplishing the inspection ensures safe and trouble free operation of the tow vehicle.

Your instructor should provide you with a checklist to follow, which will cover the following areas:

- All fluids for proper level
- Brakes, lights, and indicating systems
- Fire extinguisher

Continued next page

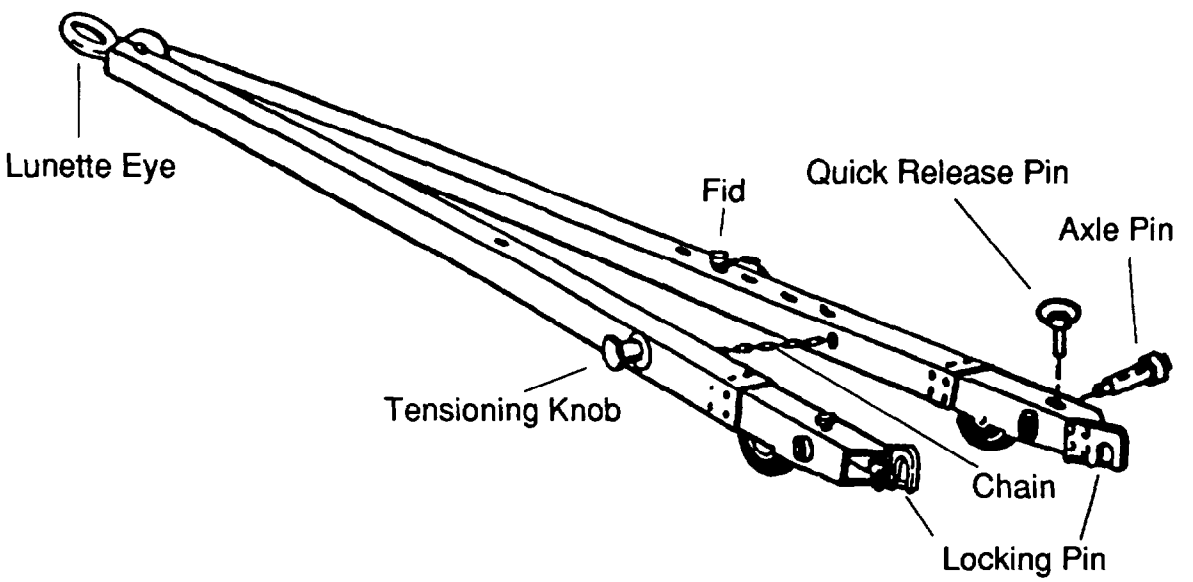
Tow Bar Parts Function Table

The table below shows the parts and function of the NT-4 tow bar.

Part	Function
Lunette Eye	Attachment point for tow vehicle.
Tensioning Knob	Adjusts chain tension.
Fid	Allows for storage of excess chain.
Chain	Pulls tubes together, holds axle pins in the aircraft holes.
Quick Release Pin	Allows axle pin to be removed.
Axle Pins	Fit in landing gear axle holes.
Locking pins	Attaches tow bar to towing rings on landing gear strut.

Diagram

Below is a diagram of an NT-4 tow bar.



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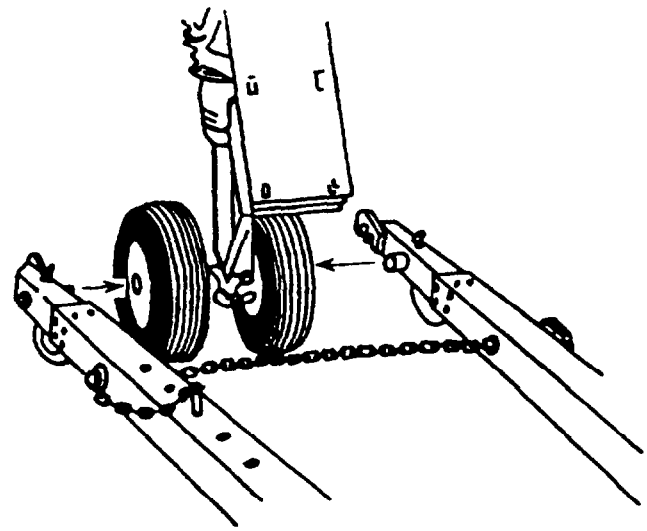
Tow Bar Installation Procedures

Follow the Step/Action table below to install the NT-4 tow bar.

Step	Action
1	Remove fid from hole and place slack in chain.
2	Spread tow bar wide enough to fit on outside of landing gear.
3	Install axle pins into gear axle holes or locking pins on towing rings of aircraft landing gear.
4	Pull slack out of chain and put fid into hole.
5	Turn tension knob to tighten chain.
6	Attach lunette eye to tow vehicle.

Diagram

Below is a diagram of an NT-4 tow bar installation.



Aircraft Chocks

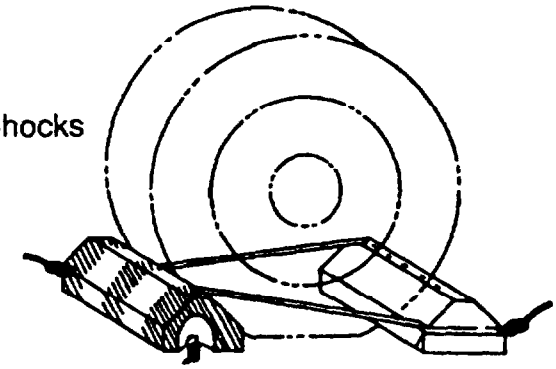
Introduction

Aircraft chocks are designed to prevent the aircraft from rolling while parked on the ramp or aboard ship. The two common types you will see are fixed and adjustable. The chocks are placed in front of and behind the landing gear wheel any time the aircraft is parked. There is another type found at cold weather units called ice chocks. If you happen to be stationed at a cold weather unit, you will be instructed as to the proper use of ice chocks.

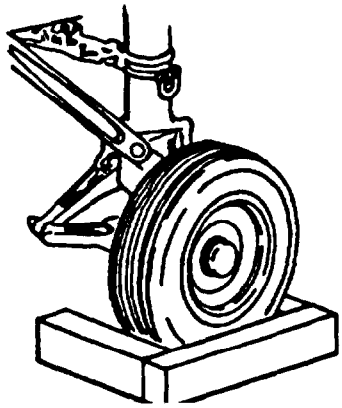
Examples of Aircraft Chocks

Below are some examples of aircraft chocks.

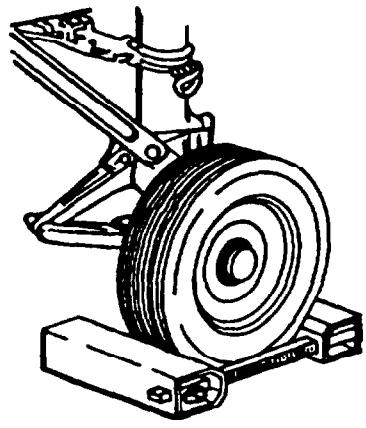
Adjustable Wooden Chocks



Nonadjustable Wooden Chocks



Adjustable metal Chocks

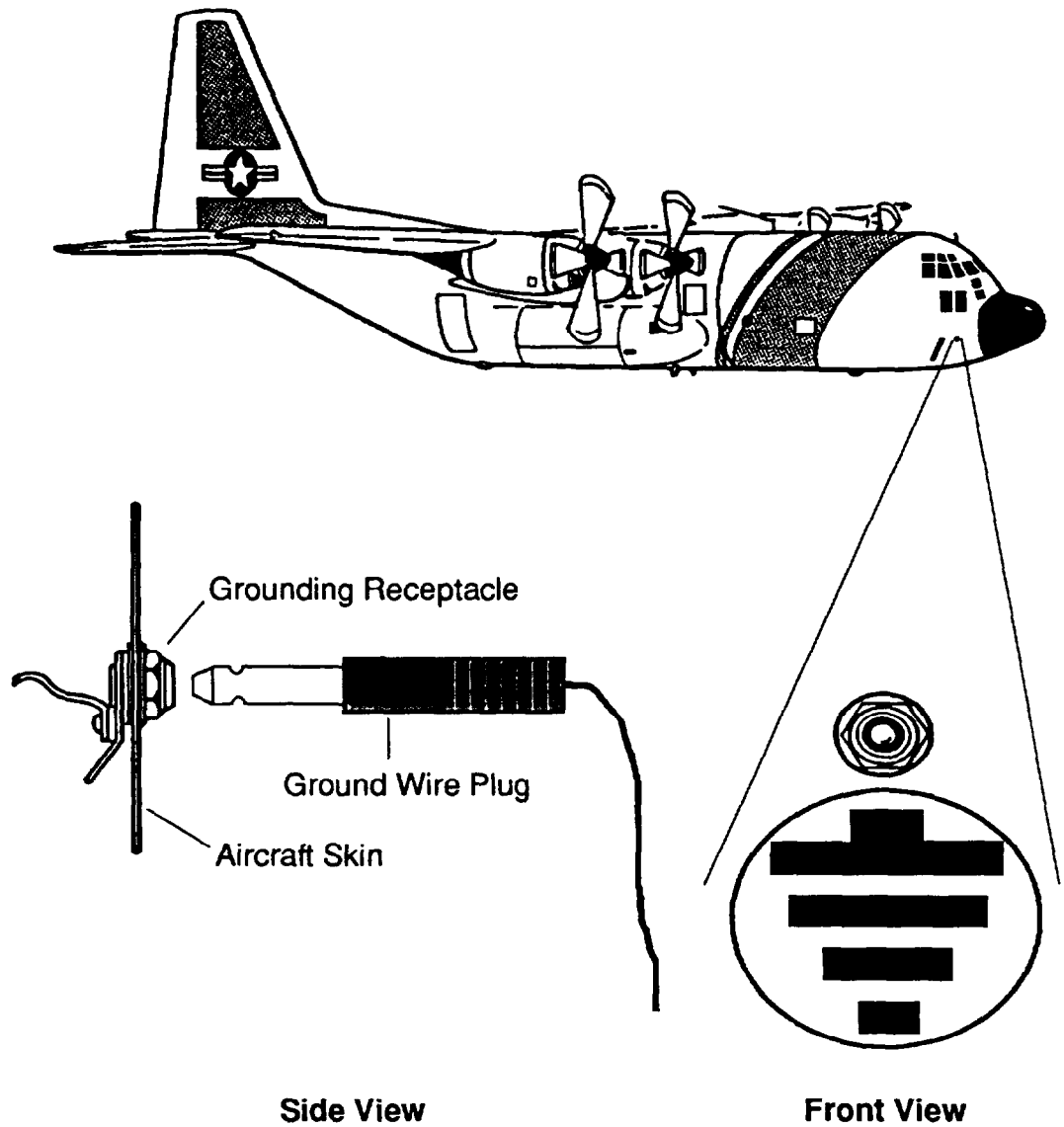


Aircraft Grounding

Introduction

Grounding procedures will minimize the buildup of electricity by allowing the electricity to dissipate into the ground. All aircraft are required to be grounded when parked on the ramp or in the hanger. The ground wire will be connected to the ground first, then plugged into the aircraft.

Grounding Example



Nose Landing Gear Lock Pin

Introduction

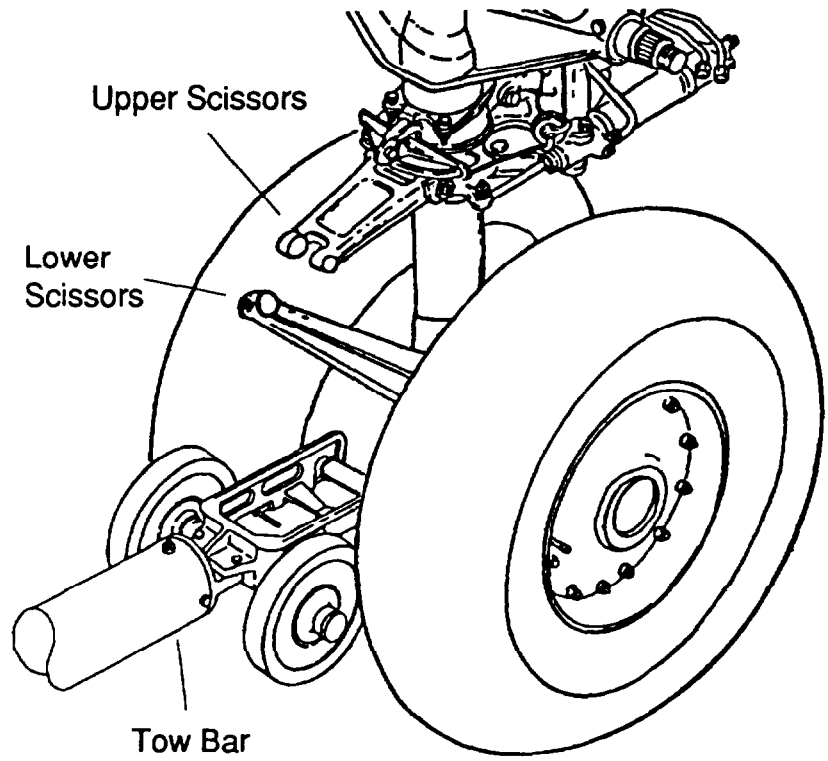
The locking pin is installed to lock the nose wheel on the center line of the aircraft.

Purpose

Removing the pin allows the upper scissors to be disconnected from the lower scissors and allow the nose wheel to turn left and right when being towed. The upper scissors is stationary and the lower scissors rotates left and right with the wheels.

Locking Pin Example

An example of a C-130 with the locking pin removed.



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Towing Safety Precautions

Introduction

The following seven safety precautions are to be observed while engaged in aircraft towing procedures.

Towing Precautions

While towing aircraft ensure that:

- Brakes are charged and working.
- Entrance doors are closed and ladders are retracted.
- Tires and struts are inflated.
- Engines are not running.
- No one walks or rides between tow vehicle and aircraft.
- You do not exceed a towing speed of 5 mph.
- You never carry more passengers than seats available on the tow vehicle.

Aircraft Towing Procedures

Introduction

Towing is accomplished safely everyday, moving aircraft in and out of hangers for maintenance and engine runs. The procedures must be strictly adhered so neither aircraft or personnel are damaged.

Towing Procedures

Follow the general procedures below for towing. The air station you are assigned to may have some additions to these procedures.

Step	Action
1	Ensure aircraft: • Is grounded. • Chocks are installed. • Brake system is charged.
2	Ensure towing team is in position.
3	Remove nose landing gear scissors pin, if equipped.
4	Attach tow bar to aircraft landing gear.
5	Attach tow bar to tow vehicle.
6	Remove grounding wire and chocks.
7	Release aircraft brakes, if not released.
8	Tow aircraft to desired location.

Continued next page

Aircraft Parking Procedures

Follow the procedure below to park the aircraft.

Step	Action
1	Engage aircraft parking brakes.
2	Install chocks and grounding wire.
3	Release aircraft brakeman.
4	Remove tow bar from tow vehicle.
5	Remove tow bar from aircraft.
6	Install nose landing gear scissors pin, if equipped.
7	Place Halon fire extinguisher next to aircraft.

Towing Practice

Introduction

Use the seven safety precautions and procedures presented to you in this chapter to answer the following questions pertaining to the maintenance scenarios. Check your answers using the feedback provided. If you have any questions contact your instructor.

Scenarios/ Questions

1. You have been assigned to tow an HC-130 aircraft from the hanger to the fuel pit. You will fill the brakeman position, what other positions are required, and how many per position.

2. List the responsibilities of each of the following towing team members:

Supervisor: _____

Vehicle driver: _____

Brakeman: _____

Continued next page

Scenarios/ Questions (continued)

Hydraulic Pressure Monitor: _____

_____

_____

Wing Walker/Tail Walker: _____

_____

_____

3. The nose gear locking pin on most aircraft must be removed prior to towing to allow _____

_____

_____

4. When towing aircraft, the minimum speed of the tow vehicle and aircraft is _____.

5. List the violations to the towing safety precautions found in the following scenario.

   AD3 Stephens is supervising the towing of an HC-130 aircraft. The crew consists of a brake rider, two wing walkers, tow vehicle driver, and two extra people on the tow vehicle equipped with one seat, to observe the towing procedure.

_____

_____

_____

_____

_____

_____

Towing Practice Feedback

Introduction

Check your answers against the following answers. If you have any questions, review the lesson and/or contact your instructor.

Answers

1. One supervisor
   One vehicle driver
   Two wing walkers
   One hydraulic pressure monitor
   One tail walker

2. **Supervisor:**

- Assumes total responsibilities of towing operation.
- Issues positions and responsibilities of the other crewmembers.
- Determines signals to be used during towing operations.
- Will have total oversight of all other members of tow team.
- Ensures all problems and obstacles are discussed and resolved before start/restart of towing operation.
- Ensures locking pins are removed/disconnected prior to towing operation, and replaced/reconnected after tow bar removal from aircraft.

Vehicle driver:

- Will obey emergency stop signal command given by any team member.
- Is responsible for safe operation of the tow vehicle.
- Is responsible for pre-operational check of tow vehicle.

Continued next page

Answers (Continued)

Brakeman:

- Must be qualified to operate the brakes on a specific aircraft.
- Must observe and operate the aircraft brakes as required by team members signals.

Hydraulic Pressure Monitor:

- Will maintain hydraulic system pressure for aircraft brakes by actuating hand pump as needed.

Wing Walker/Tail Walker:

- Observe and ensure that a safe distance is maintained from all obstacles.
- Provides clear/unobstructed signals of movement in the area.

3. These must be removed to allow the nose gear to turn left or right during the towing evolution.
4. 5 mph
5. Missing one hydraulic pressure monitor and one tail walker. No seats for the extra two people riding on the tow vehicle.

Chapter Summary

Closing Actions

This chapter has introduced you to the equipment used in towing aircraft:

- Tow vehicles
- Tow bars
- Chocks
- Grounding wires

Your unit may have procedures that differ slightly but almost every air station's aircraft handling procedures are a little different.

Chapter Completion

Now that you have completed this chapter, your instructor will sign off your syllabus as you complete the tasks.

Further Study

For more information and/or study refer to the Aeronautical Engineering Maintenance Management Manual, COMDINST M13020.1.

Aircraft Taxi Signalling

Introduction

All aviation personnel are required to be capable of directing an aircraft by the use of standard taxi signals. Anytime an aircraft is ready to taxi from the flight line, is returning to the flight line, or is taxied in congested areas, the aircraft must be directed by one or more taxi signalmen.

Chapter Purpose

This chapter is designed to provide you with the information required to direct a taxiing aircraft.

How To Proceed

To begin this unit of instruction:

- Read the handout
- If you have any questions, contact your instructor
- Upon completion of this chapter, see your instructor for OJT and syllabus sign-off.

Objective

Given a list of signals and a taxiing aircraft scenario, **SELECT** the correct signal using standard day and night taxi signals.

Reference

Aeronautical Engineering Maintenance Management Manual, COMDINST M13020.1 (series)

Aircraft Taxiing

Description

The area designated for aircraft parking is referred to as the flight line. When an aircraft enters or departs the flight line under its own power, it is taxiing. The two types of aircraft taxiing are ground taxiing and air taxiing.

Ground Taxiing

Ground taxiing is when the aircraft remains on the ground while taxiing. An aircraft must be equipped with wheels to ground taxi.

Air Taxiing

Air taxiing occurs when a helicopter lifts in a hover and remains off the ground while taxiing. Some helicopters must air taxi because they are not equipped with wheels.

Aircraft Taxi Signalling Personnel

Definition

Aircraft taxi signal personnel are assigned to ensure the safe movement of the aircraft when it is taxiing. The two types of jobs assigned to aircraft taxi signal personnel are the taxi signalman and the wingwalker.

Taxi Signalman

The taxi signalman is the person who will be actually directing the pilot on the movement of the aircraft. This will be accomplished by the use of hand signals.

Wingwalker

The wingwalker is assigned to assist the taxi signalman in the safe movement of the aircraft.

Wingwalkers will be used anytime the aircraft must taxi within 25 feet of an obstruction. They walk along the outboard edge of a fixed-wing aircraft's wings and tail or a helicopter's main rotor blade tip path and tail. They will ensure the taxi signalman, by the use of hand signals, that no part of the aircraft comes within 5 feet of the obstruction.

Aircraft Taxi Signalling Equipment

Necessary Equipment

This is the equipment used by aircraft taxi signalling personnel.

Equipment	Function
Goggles	Protects eyes from flying debris.
HGU-25/P Helmet Assembly Note: This item may or may not be mandatory at your air station. Even if this item is not mandatory, it may be available and you may choose to use it. This is especially true when directing or wingwalking an air taxiing or ground taxiing helicopter.	• Protects the skull from flying debris caused by rotor, prop, and jet blast. • Integral aural sound protectors provide hearing protection from aircraft noise.
Taxi Wands	Used to provide taxi signals at night. Note: Taxi wands should be moved slowly and deliberately to avoid strobe light effect.

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Diagram 1

This diagram illustrates the HGU-25/P helmet assembly, aural sound protectors, and goggles used by aircraft taxi signalling personnel.

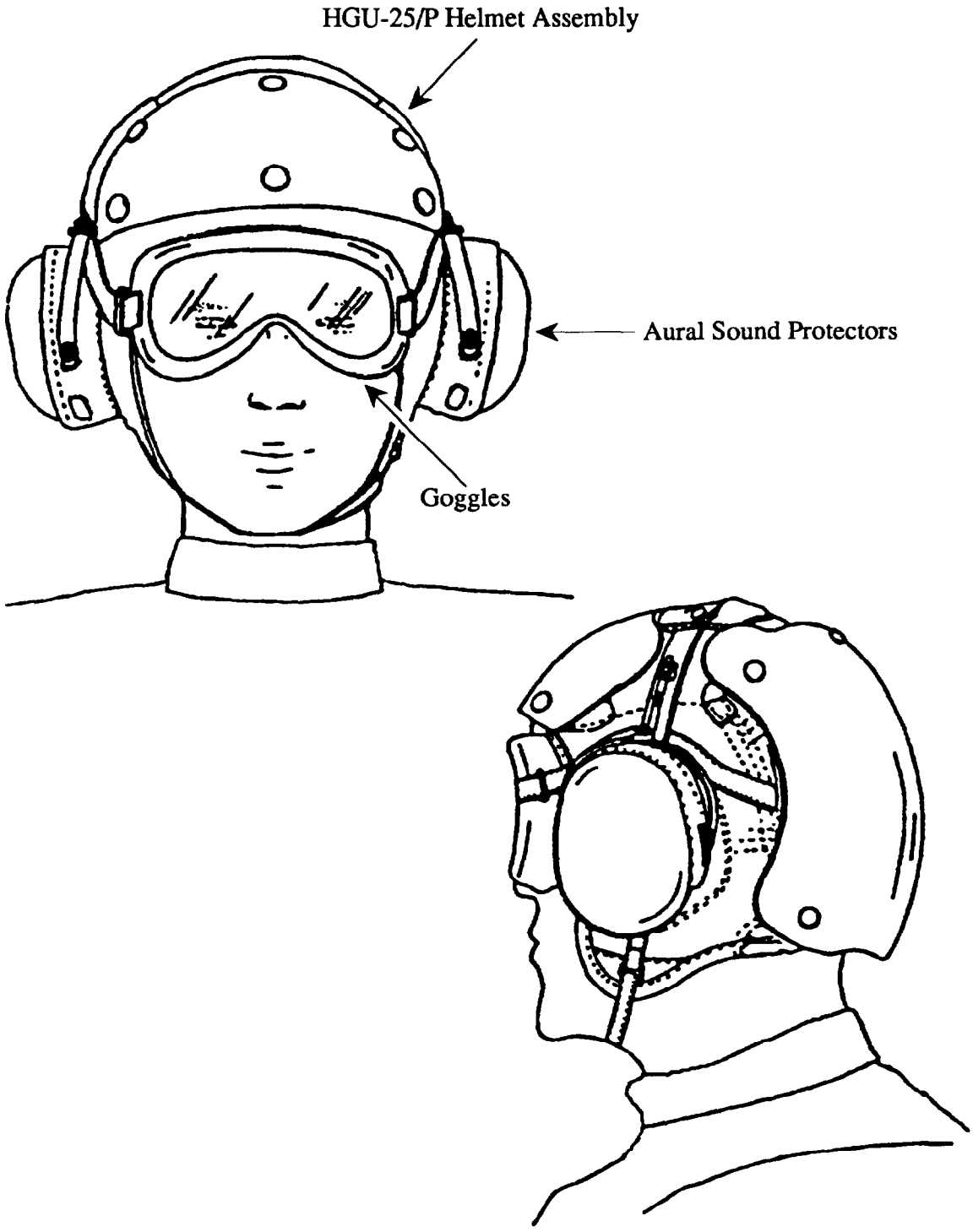

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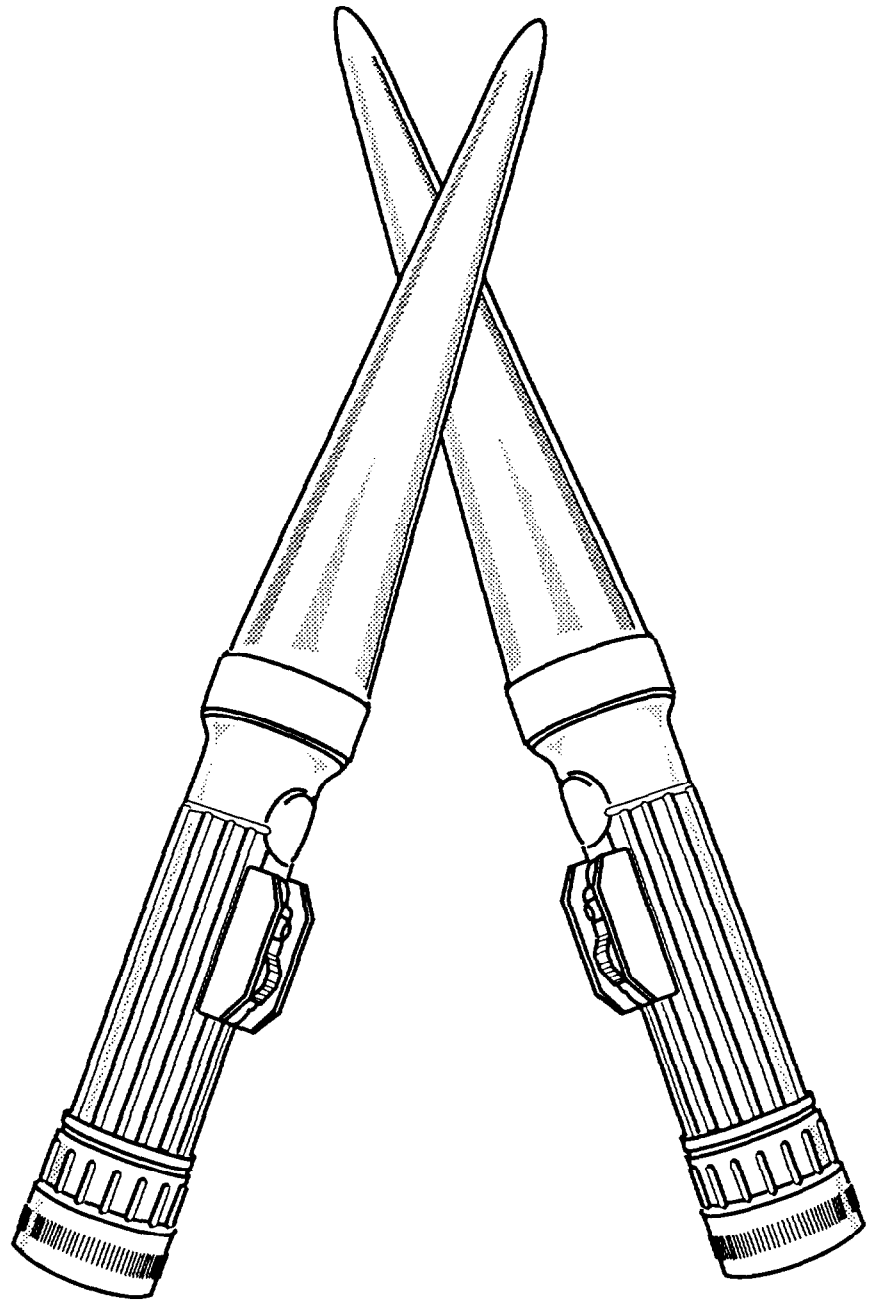
Diagram 2

This diagram illustrates the taxi wands used by the taxi signalman when directing aircraft at night.



Taxi Signalman Position

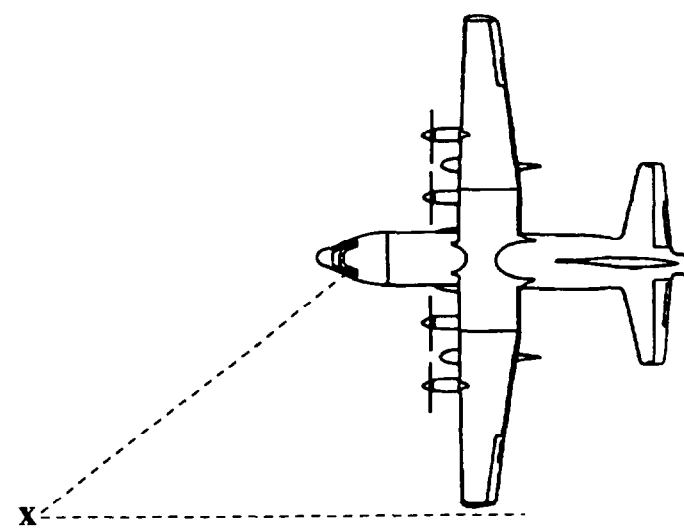
Rule

The taxi signalman has a definite position to maintain when directing aircraft. This position should be ahead of the aircraft and in line with the wingtip on the pilot's side of the aircraft.

The taxi signalman should assume and maintain this position in order to see the pilot at all times. If for any reason eye contact with the pilot is lost, the signalman shall signal the aircraft to stop.

Example 1

The "X" in this drawing illustrates the position of the taxi signalman when directing an HC-130. The dotted line shows that the taxi signalman is ahead of the aircraft, in line with the wingtip on the pilot's side, and can see the pilot.



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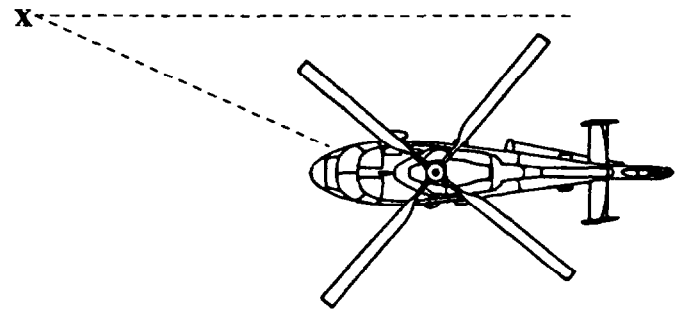
Taxi Signalman Position (Continued)

Example 2

The "X" in this drawing illustrates the proper position of the taxi signalman when directing an HH-65A.

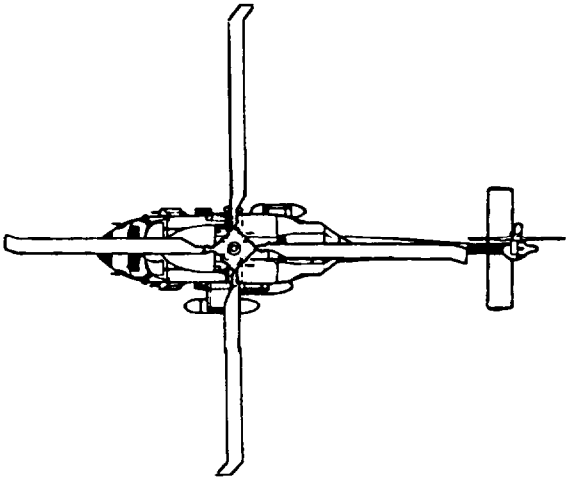


Note: This position is different from the HC-130, the pilot sits on the right side of all rotary-wing aircraft and on the left side of all fixed-wing aircraft.

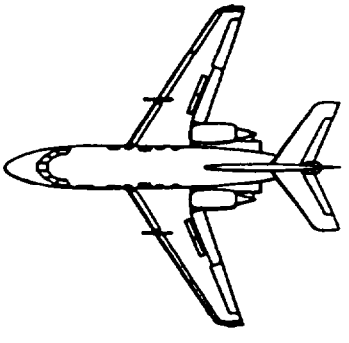
Continued next page

Practice Exercises

1. Label, by placing a "X", where the taxi signalman should be located while directing the HH-60J illustrated below.



2. Label by placing a "X", where the taxi signalman should be located while directing the HU-25A illustrated below.



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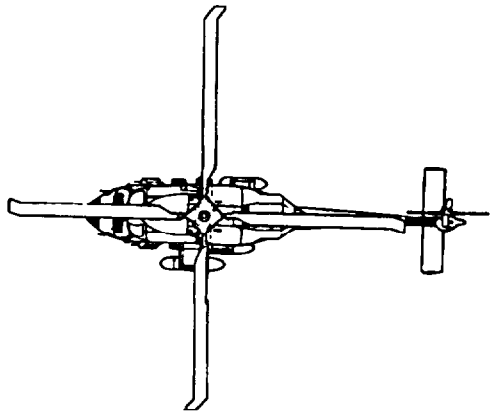
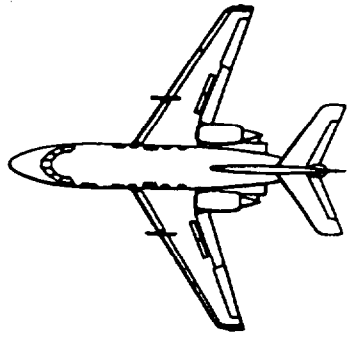
Feedback

1. X



2.



X

Taxi Signalman Safety Precautions

Introduction

The following safety precautions are to be observed while directing a taxiing aircraft.

Safety Precautions

While directing a taxiing aircraft:

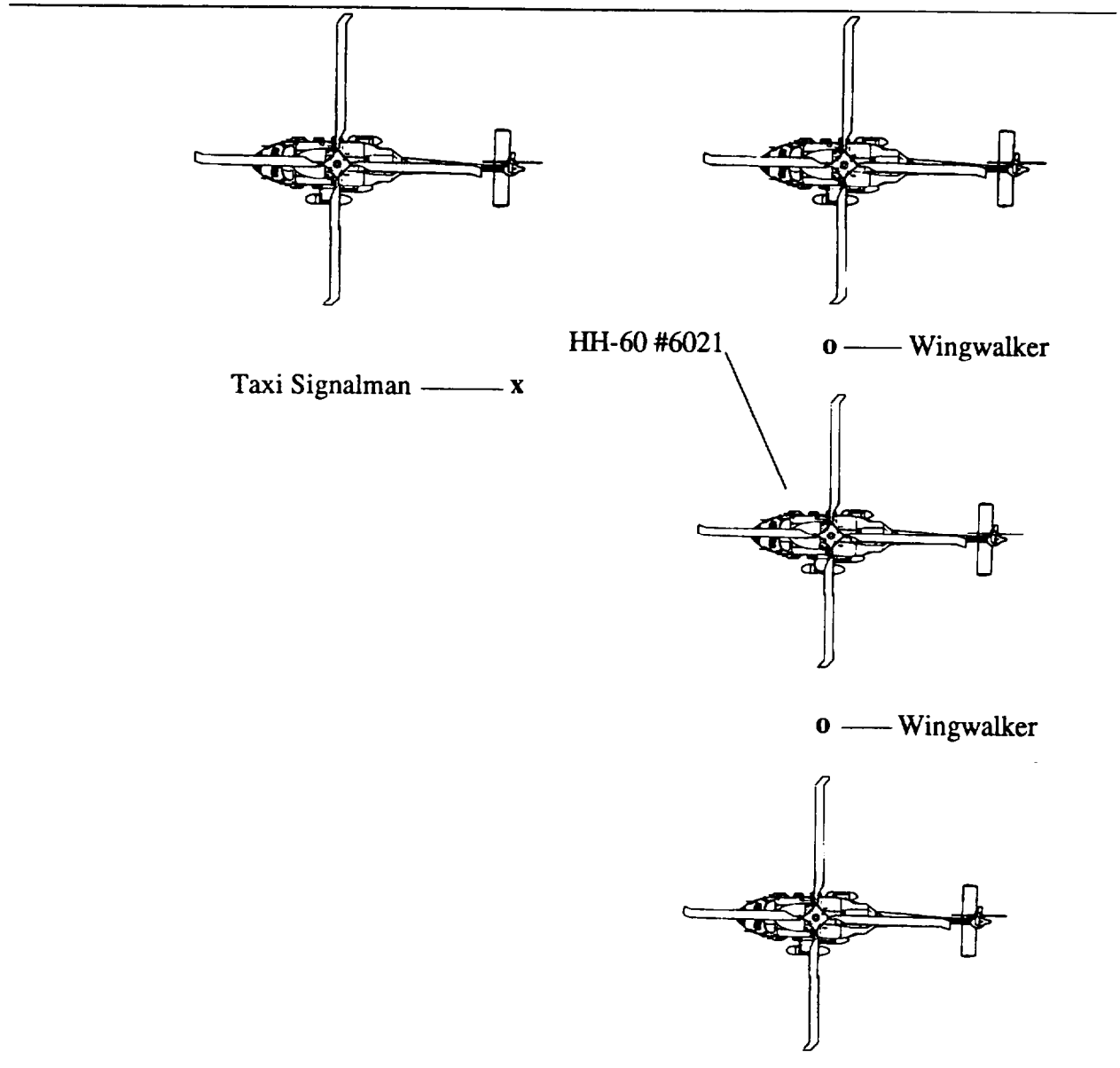
1. If an aircraft must be taxied within 25 feet of an obstruction, a minimum of one wingwalker for each wingtip will be provided. With helicopters, a minimum of one wing walker for each side of the main rotor blade tip path will be provided. Additional wingwalkers should be used, if necessary, to clear the tail or if the taxi signalman cannot maintain visual contact with any of the wingwalkers.

2. Aircraft must not, at anytime, be taxied within 5 feet of obstructions. If the aircraft must pass through an area in which it will come within 5 feet of an obstruction, the aircraft will be secured and moved by a tow tractor.

Continued next page

Example

This drawing illustrates the use of safety precaution #1. HH-60 #6021 is ground taxiing between parked aircraft to taxiway bravo. The wingwalkers will assist the taxi signalman, by the use of hand signals, to maintain the required clearance.



Taxi Signalman Hand Signals for Ground Taxiing Aircraft

Introduction

Standard hand signals have been established so that a taxi signalman may signal pilots to ensure the safe movement of their aircraft while ground taxiing.

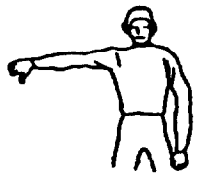
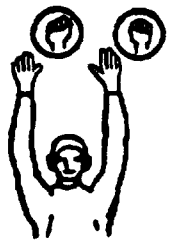
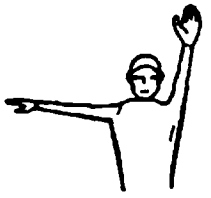
Table

This table shows the signals used by the taxi signalman to direct the pilot of a ground taxiing aircraft.

Signal	Meaning	Description
	**I Have Command** - Identifies to the pilot who the taxi signalman is.	**Day** - Holds one hand open with palm forward, motionless high overhead. **Night** - Holds one hand with wand motionless, high overhead.
	**All Clear** - Used by the . . . • taxi signalman in response to the pilot's signal "Ready to Taxi," to tell the pilot that the aircraft is clear to taxi and • wingwalkers to tell the taxi signalman that the aircraft is clear of obstructions. Note: As the taxi signalman, you should consider the aircraft clear to taxi when taxi signalling personnel are in position and there are no obstructions blocking the movement of the aircraft.	**Day** - Holds fist at shoulder level with thumb extended up. **Night** - Holds wand at shoulder level in "Thumbs Up" position.

Continued next page

Table (Continued)

Signal	Meaning	Description
	**Not Clear** - Used by the . . . • taxi signalman in response to the pilot's signal "Ready to Taxi," to tell the pilot that the aircraft is not clear to taxi and • wingwalkers to tell the taxi signalman that the aircraft will not clear an obstruction.	**Day** - With arm extended at shoulder level, holds fist with thumb extended down. **Night** - With arm extended at shoulder level, holds wand in "Thumbs Down" position.
	**Release Brakes** - Directs the pilot to release the aircraft's brakes.	**Day** - Position arms above head with clenched fists, unclench fists to show open palms towards aircraft with fingers raised. **Night** - Position arms above head with wands crossed, then uncross wands.
	**Hold Brakes** - Directs the pilot to hold the aircraft's brakes on.	**Day** - With arms above head, open palms towards aircraft with fingers raised, then clench fists. **Night** - Position arms above head, then cross wands.
	**Personnel Approaching the Aircraft** - Tells the pilot that personnel want to approach the aircraft. Note: If the aircraft is moving, the stop signal should be given before this signal.	**Day** - Holds left hand vertically overhead, palm towards aircraft. The other hand points to the personnel concerned. **Night** - Same as day signal with addition of wands.

Continued next page

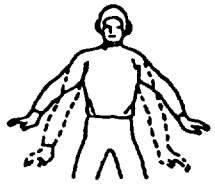
Table (Continued)

Signal	Meaning	Description
	**Move Forward** - Directs the pilot to move the aircraft forward.	**Day** - With hands at head level and palms toward face, make closing motions toward head. **Night** - Same as day signal with addition of wands.
	**Unlock Tail Wheel** - Directs the pilot to unlock the aircraft's tail wheel. Note: The only aircraft in Coast Guard inventory with a locking tail wheel is the HH-60J. This command should be given before directing an HH-60J pilot to make the first left or right turn. This will remind the pilot to unlock the tail wheel before making the turn.	**Day** - Position hands overhead with palms together. Open palms from wrists to form a vertical "V". **Night** - Same as day signal with addition of wands.
	**Lock Tail Wheel** - Directs the pilot to lock the aircraft's tail wheel. Note: This command should be given as the HH-60J is taxiing forward to its final parking spot. The tail wheel must be locked prior to the pilot securing the HH-60J.	**Day** - Position hands overhead with palms forming a vertical "V". Close palms suddenly. **Night** - Same as day signal with addition of wands.
	**Left Turn** - Directs the pilot to turn the aircraft to its left.	**Day** - Make beckoning action with left hand, while pointing in direction of turn with right hand, index finger extended. **Night** - Same as day signal with addition of wands.

Continued next page

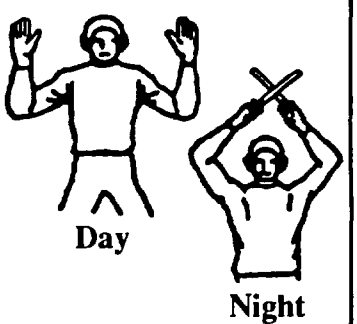
Taxi Signalman Hand Signals for Ground Taxiing Aircraft (Continued)

Table (Continued)

Signal	Meaning	Description
	**Right Turn** - Directs the pilot to turn the aircraft to its right.	**Day** - Makes beckoning action with right hand, while pointing in direction of turn with left hand, index finger extended. **Night** - Same as day signal with addition of wands.
	**Roll Back** - Directs the pilot to move the aircraft backwards.	**Day** - Arms down, palms open facing forward, sweeping backward and forward movement with the arms. **Night** - Same as day signal with addition of wands.
	**Slow Down** - Directs the pilot to slow down the movement of the taxiing aircraft.	**Day** - Raise arms to waist level, palms down. Make a downward patting motion. **Night** - Same as day signal with addition of wands, held horizontally.

Continued next page

Table (Continued)

Signal	Meaning	Description
	**Proceed Under Guidance of Next Director** - Tells the pilot that . . . • there is a change in the taxi signalman or • the aircraft has reached an area in which it is free to taxi without direction from a signalman.	**Day** - Moves both hands at shoulder height, with arms extended, both pointing to the . . . • next taxi signalman when there is a change in the signalman or • direction the helicopter should proceed followed by a hand salute to the pilot when the aircraft is free to taxi without direction from a signalman. **Night** - Same as day signals with addition of wands.
 Day Night	**Stop** - Directs pilot to stop the movement of the aircraft.	**Day** - Raises both hands to eye level, palms facing pilot. **Night** - Holds crossed wands overhead.
	**Emergency Stop** - Directs the pilot to stop the movement of the aircraft immediately.	**Day** - Crosses forearms overhead with fists clenched. **Night** - Crosses wands overhead.

Continued next page

Taxi Signalman Hand Signals for Air Taxiing Helicopters

Introduction

Standard hand signals have been established so that a taxi signalman may signal the pilot of an air-taxiing helicopter to ensure the safe movement of their aircraft.

Table

This table shows the signals used by the taxi signalman to direct the pilot of an air-taxiing helicopter.

Signal	Meaning	Description
	**I Have Command** - Identifies to the pilot who the taxi signalman is.	**Day** - Holds one hand open with palm forward, motionless high overhead. **Night** - Holds one hand with wand motionless, high overhead.
	**All Clear** - Used by the . . . • taxi signalman in response to the pilot's signal "Ready for Takeoff," to tell the pilot that the helicopter is clear for takeoff and • wingwalkers to tell the taxi signalman that the helicopter is clear of obstructions. Note: As the taxi signalman, you should consider the helicopter clear for takeoff when taxi signalling personnel are in position and there are no obstructions blocking the movement of the helicopter.	**Day** - Holds fist at shoulder level with thumb extended up. **Night** - Holds wand at shoulder level in "Thumbs Up" position.

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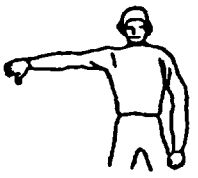
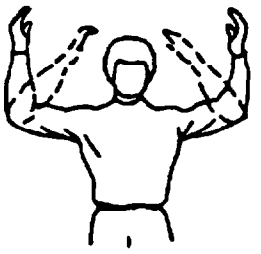
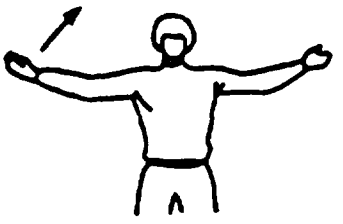
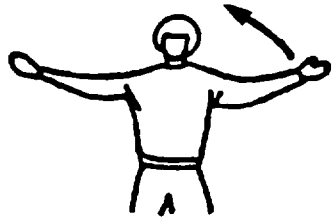
Table (Continued)

Signal	Meaning	Description
	**Not Clear** - Used by the . . . • taxi signalman in response to the pilots signal "Ready for Takeoff," to tell the pilot that the helicopter is not clear to taxi and • wingwalkers to tell the taxi signalman that the helicopter will not clear an obstruction.	**Day** - With arm extended at shoulder level, holds fist with thumb extended down. **Night** - With arm extended at shoulder level, holds wand in "Thumbs Down" position.
	**Hover** - Directs the pilot to lift the helicopter into a hover.	**Day** - Arms extended horizontally sideways, palms downward. **Night** - Same as day signal with addition of wands.
	**Move Forward** - Directs the pilot to move the helicopter forward.	**Day** - With hands at head level and palms toward face, make closing motions toward head. **Night** - Same as day signal with addition of wands.
	**Move Right** - Directs the pilot to move the helicopter to its right.	**Day** - Left arm extended horizontally sideways in direction of movement and other arm swung over the head in same direction in a repeating movement. **Night** - Same as day signal with addition of wands.

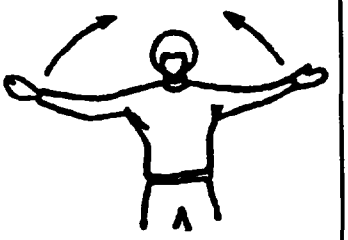
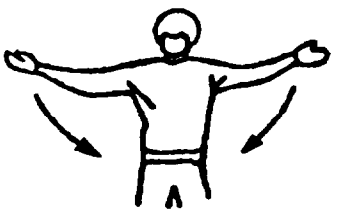
Continued next page

Table (Continued)

Signal	Meaning	Description
	**Move Left** - Directs the pilot to move the helicopter to its left.	**Day** - Right arm extended horizontally sideways in direction of movement and other arm swung over the head in same direction in a repeating movement. **Night** - Same as day signal with addition of wands.
	**Proceed Under Guidance of Next Director** - Tells the pilot that . . . • there is a change in the taxi signalman or • the helicopter has reached an area in which it is free to taxi without direction from a signalman.	**Day** - Moves both hands at shoulder height, with arms extended, both pointing to the . . . • next taxi signalman when there is a change in the signalman or • direction the helicopter should proceed followed by a hand salute to the pilot when the aircraft is free to taxi without direction from a signalman. **Night** - Same as day signals with addition of wands.

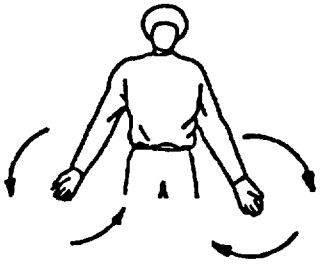
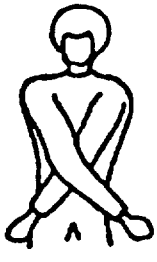
Continued next page

Table (Continued)

Signal	Meaning	Description
	**Move Back** - Directs the pilot to move the helicopter backwards.	**Day** - Arms by sides, palms facing forward, swept forward and upward repeatedly to shoulder height. **Night** - Same as day signal with addition of wands.
	**Move Upward** - Directs the pilot to increase the helicopters altitude.	**Day** - Arms extended horizontally sideways beckoning upwards, with palms turned up. Speed of movement indicates rate of ascent. **Night** - Same as day signal with addition of wands.
	**Move Downward** - Directs the pilot to decrease the helicopters altitude.	**Day** - Arms extended horizontally sideways beckoning downwards, with palms turned down. Speed of movement indicates rate of descent. **Night** - Same as day signal with addition of wands.

Continued next page

Table (Continued)

Signal	Meaning	Description
	**Gear Down** - Directs pilot to lower the helicopter's landing gear.	**Day** - When a helicopter equipped with landing gear approaches with its landing gear retracted, taxi signalman make a circular motion with arms down 45 degrees and ahead 45 degrees. **Night** - Same as day signal with addition of wands.
	**Land** - Directs the pilot to land the helicopter.	**Day** - Arms crossed and extended downwards in front of the body. **Night** - Same as day signal with addition of wands.
	**Waveoff** - Directs the pilot not to land the helicopter. Note: This command is given to a helicopter that is in the process of landing when a situation arises that would make landing unsafe for the helicopter or ground personnel. An example of when this command should be given is if a person or vehicle unknowingly entered the landing area.	**Day** - Cross and uncross arms overhead. **Night** - Same as day signal with addition of wands.

Continued next page

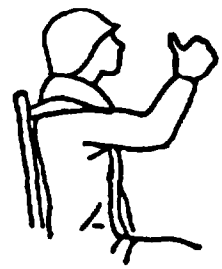
Pilot Taxi Signals

Introduction

Standard hand signals have been established so that a pilot may pass information to the taxi signalman.

Table

This table shows the signals used by the pilot to pass information to the taxi signalman.

Signal	Meaning	Description
	**Ready for Taxi/Takeoff** - Tells the taxi signalman that the aircraft is ready to taxi, or in the case of a helicopter that must air taxi, ready for takeoff.	**Day** - Gives "thumbs up" signal at eye level. **Night** - Gives "up" signal by turning on flashlight or other movable light and moving it up and down.
	**Clear for Personnel to Approach Aircraft** - Tells the taxi signalman that it is clear for personnel to approach the aircraft.	**Day** - Makes a beckoning motion with right hand at eye level. **Night** - No standard night signal has been estalished for this command.

Continued next page

Practice Exercises

1. What does this pilot taxi signal mean?

2. You are directing a ground taxiing aircraft. Personnel desire to approach the aircraft. You give the "Stop" signal and then the "Personnel Approaching the Aircraft" signal. The pilot gives the signal illustrated below. What does this signal mean?

Feedback

1. Ready for Taxi/Takeoff
2. Clear for Personnel to Approach Aircraft

Chapter Summary

Summary

This lesson has given you the information needed to direct a taxiing aircraft.

Chapter Completion

Now that you have completed this chapter, your instructor will sign-off your syllabus as you complete the task.

Further Study

For more information and/or study refer to the following manuals:

- Aeronautical Engineering Maintenance Management Manual, COMDTINST M13020.1 (series)
- Shipboard-Helicopter Air Operations Manual, COMDTINST M3710.2 (series)

Aircraft Fuel Samples

Introduction

This chapter is designed to provide you with the information and skills required to collect and inspect an aircraft fuel sample. Aircraft fuel may become contaminated by water, dirt, sand, or other substances. These contaminants make the fuel unsafe for use. As an aircraft mechanic, you will be required to take aircraft fuel samples to inspect the fuel and determine if it is safe for use in flight.

How to Proceed

To begin this unit of instruction:

- Read this chapter
- Complete the practice exercises
- If you have any questions, contact your instructor

Objective

Given a list of procedures, **SELECT** the correct responses for collecting fuel samples.

References

- Aeronautical Engineering Maintenance Management Manual, COMDTINST M13020.1 (series)
- Servicing of Aircraft and Static Grounding, USAF T.O. 00-25-172
- Quality Control of Fuels and Lubricants, USAF T.O. 42B-1-1
- Applicable aircraft maintenance manuals
- Local maintenance instructions

Aircraft Fuel Tank Sump Drains

Description

All Coast Guard aircraft have fuel tank sump drains. The fuel tank sump drains are valves located within each of the aircraft's fuel tanks in an area referred to as the sump. The fuel tank's sump is the lowest point of the tank. These drain valves can be manually opened so fuel can be drained for the collection of fuel samples.

Operation

The aircraft fuel tank sump drains are opened by using a special sump draining tool applicable to the particular aircraft from which you are taking samples. The majority of sump drain valves can be opened by applying upward pressure with the draining tool. Other types of valves must be rotated while applying upward pressure to open.

Safety Precaution

Do not use excessive force when opening sump drain valves. Some of these valves can be locked open resulting in an uncontrollable leak.

Continued next page

Diagram 1

This diagram illustrates the locations of the right and left main fuel tank sump drain valves on an HH-60J.

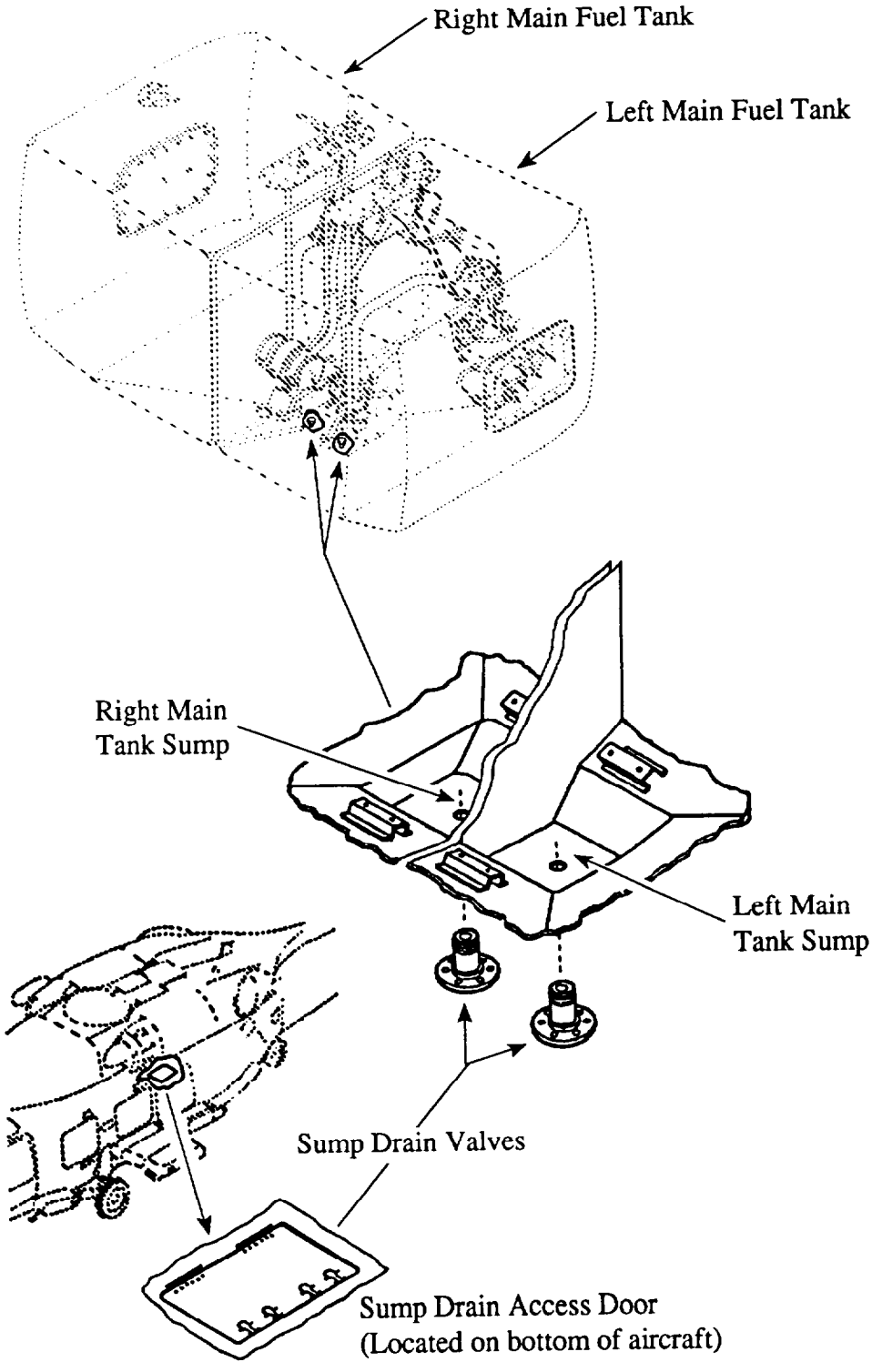


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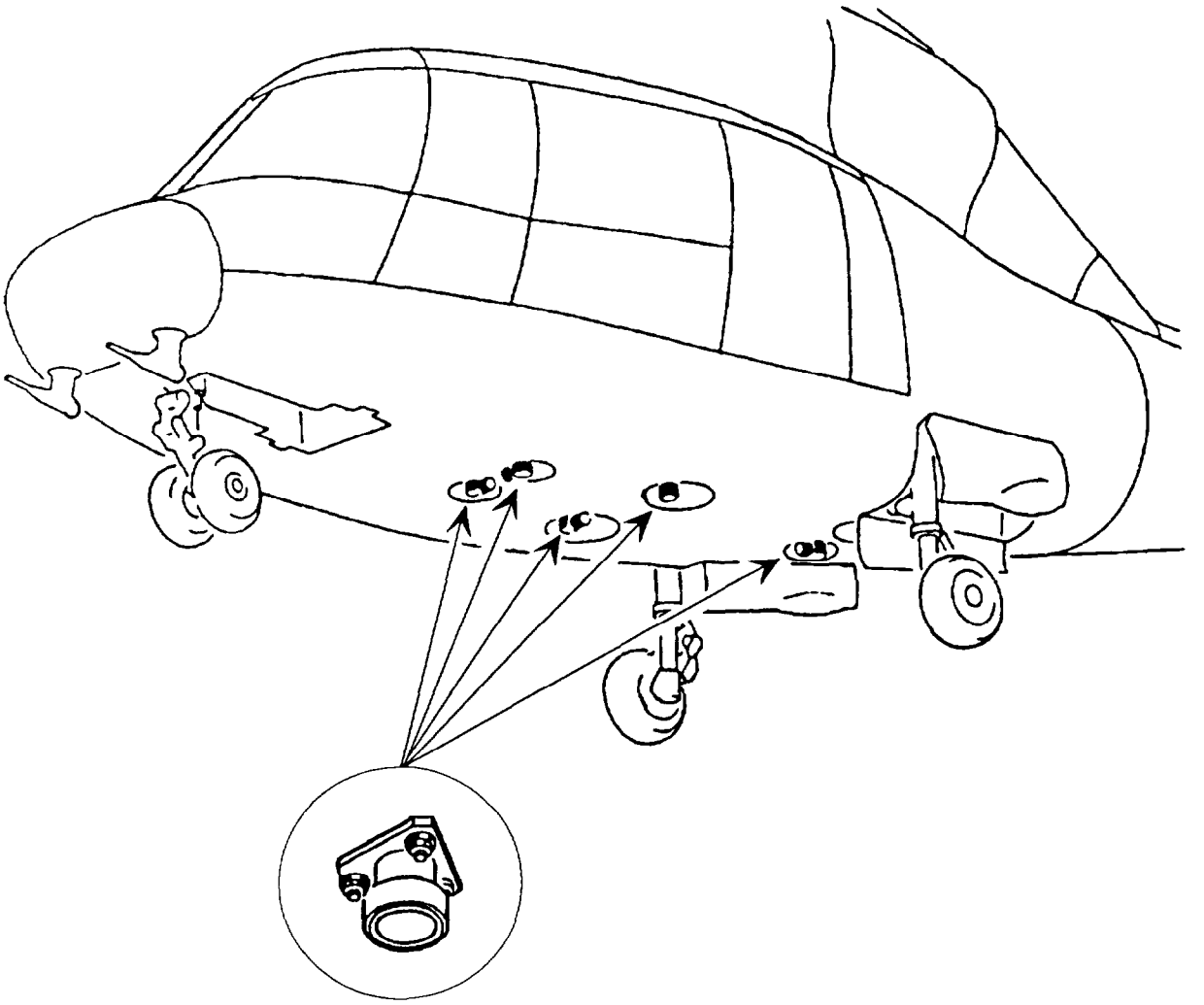
Diagram 2

This diagram illustrates the location of the fuel tank sump drain valves on an HH-65A.



Sump Drain Valve

Aircraft Fuel Sampling Equipment

Necessary Equipment

Always use all of the necessary equipment when taking fuel samples. The table below identifies the equipment you will need, and its function.

Equipment	Function
Goggles or face shield	Protect eyes
Rubber gloves	Protect skin on hands
Metal bucket with ground wires or a rubber bucket	Container for excess fuel
Clear, clean, and dry wide mouth glass jars	Container for the fuel that is to be tested
Sump drain tool	Opens fuel tank sump drain valve

Safety Precautions

The safety precautions for aircraft fuel sampling equipment are:

- Never use a bucket made of plastic or polyethelene due to increased static electricity hazards
- It is mandatory to wear personal protective equipment (rubber gloves, goggles, or face shield) during collection and handling of aircraft fuel samples

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Diagram 1 This diagram illustrates the fuel tank sump drain tool for an HH-65A.

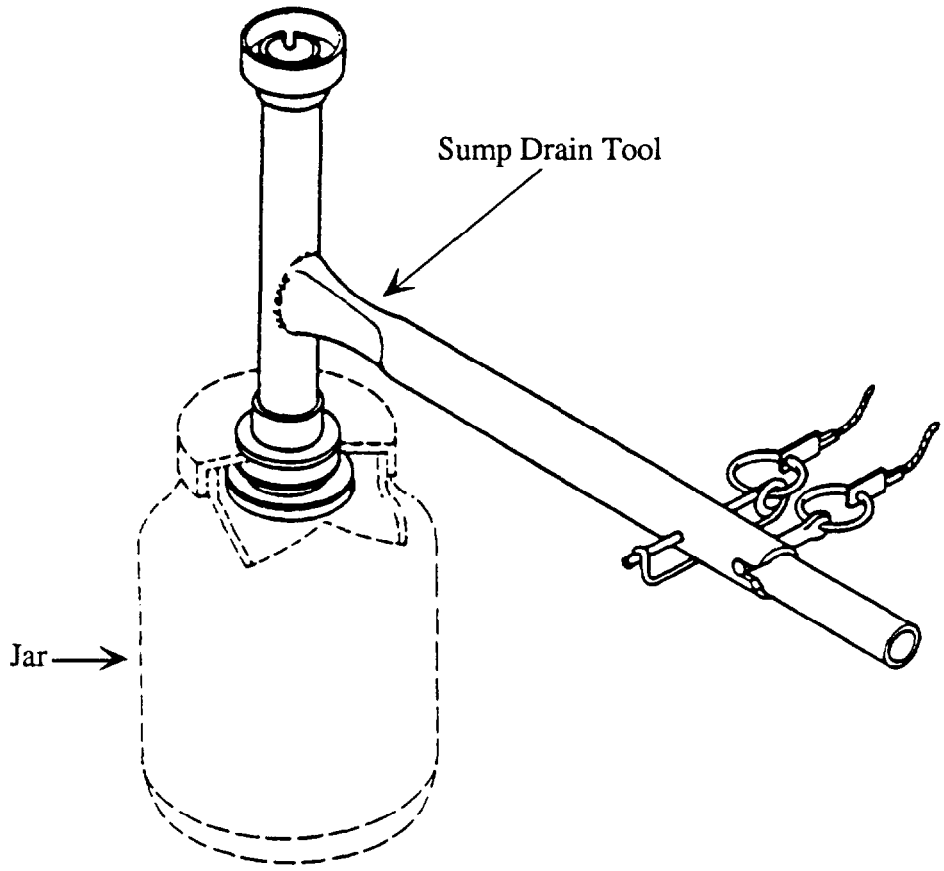

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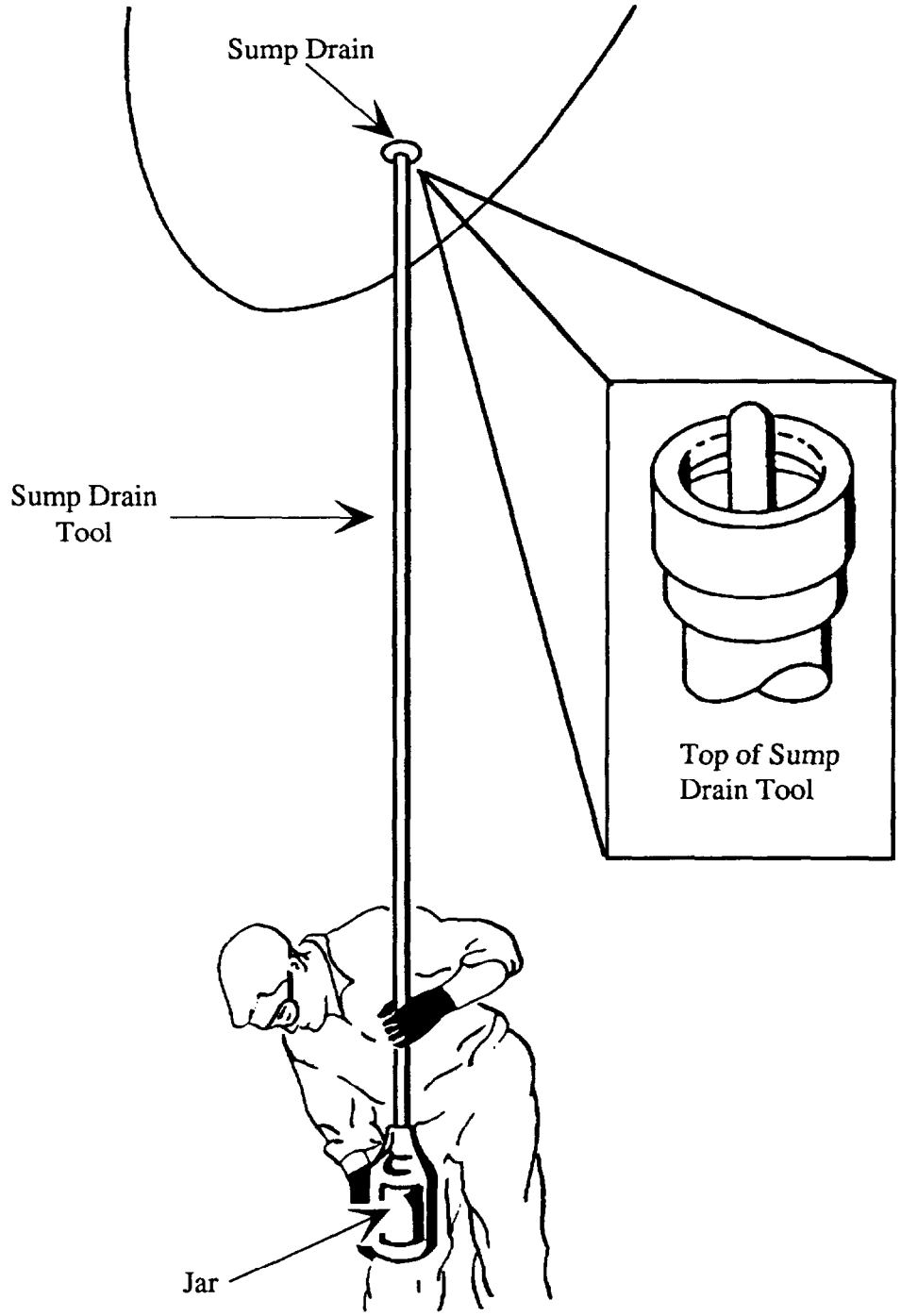
Diagram 2 This diagram illustrates the fuel tank sump drain tool for an HC-130.



Preparation of Aircraft for Fuel Sampling

Introduction

Each air station has an established procedure for preparation of aircraft for fuel sampling. You may see slight differences in these procedures when comparing different air stations. Always follow your established local station procedures when preparing aircraft for fuel sampling.

General Procedure

Complete these steps to prepare an aircraft for fuel sampling.

Step	Action
1	Is aircraft located in hangar or on flight line? • If in hangar, go to step 2. • If on flight line, go to step 3.
2	Tow aircraft from hangar to designated sampling area or aircraft flight line.
3	Ground aircraft if not already accomplished.
4	Place fire bottle near aircraft if not already accomplished.
5	Ensure electrical power is not applied to aircraft.
6	Was the aircraft moved or have the aircraft's engines been operated within the last 30 minutes? • If yes, a 30 minute waiting period will be required before the aircraft is prepared for sampling. This is to allow adequate time for contaminants to settle inside the aircraft's fuel tanks. • If no, the aircraft is prepared for sampling.

Safety Precaution

Aircraft should be spotted in an area in which there will be no smoking or other ignition sources within 50 feet during collection and testing of that aircraft's fuel samples.

Aviation Fuel Spills

Introduction

An aviation fuel spill can occur at any time. Because of this possibility, you must know what to do and act quickly. All air stations have an established procedure for handling fuel spills. You will be given a book of station instructions to read. Your air station's procedures for handling fuel spills will be contained in this book. Remember these procedures and take the time to locate items such as buckets, speedy-dry, eye wash stations, and a shower which may be needed during a fuel spill.

Causes

During aircraft fuel sampling, most small spills occur when buckets or sampling jars are accidently overturned. Large spills occur when sump drain valves get locked open and cannot be closed. In any event, any fuel spill can be extremely dangerous.

Continued next page

Table 1 Use this table to decide what action to take in the event of an aviation fuel spill.

IF the spill is . . .	AND/OR has a dimension of . . .	THEN . . .
not of continuing nature	18 inches or less in area	• sampling may be continued and • upon completion of sampling, stand by aircraft until the spill area is rendered safe or the aircraft departs.
not of continuing nature	not over 10 feet and not over 50 square feet in area	• stop sampling and • post fireguard, up wind from spill area, with a foam-type or Halon-type fire extinguisher until the area is rendered safe.
of continuing nature	over 50 square feet in area	• stop sampling and • immediately report spill to the supervisor in charge, who shall notify the airport or local fire department to render the spill area safe and • all personnel in spill area shall leave at once.

Continued next page

Table 2

Use this table to decide what action to take if aviation fuel is spilled on you.

IF fuel is spilled . . .	THEN . . .
in your eyes	• depart sampling area and • flush eyes with large amounts of water and • seek medical attention.
on your skin in small amounts Example: Fuel spilled on your hand or part of your arm.	• depart sampling area and • wash skin with soap and water.
on your skin in large amounts Example: Upper part of your body doused in fuel.	• depart sampling area and • wash skin with soap and water and • seek medical attention.
on your clothes	• depart sampling area and • remove fuel soaked clothing immediately and • wash skin under clothing with soap and water and • seek medical attention if fuel is present on a large portion of your body.

How to Take Aircraft Fuel Samples

Introduction

Each air station has an established procedure for taking fuel samples applicable to the particular aircraft at that station. You will be trained at this unit to ensure that you are totally familiar with taking fuel samples.

Sample Intervals

All aircraft fuel tank sump drains should be sampled during each daily inspection prior to the aircraft's first flight of the day.

Sump Drain Valves

Each aircraft in the Coast Guard has a different type of fuel tank sump drain valve. Your instructor will provide guidance on the operation and characteristics of the sump drain valves installed on the aircraft at this unit.

Items Completed Before Use

Gathering of fuel sampling equipment and preparation of aircraft for sampling will need to be completed before use of the general procedure outlined on page 13.

Continued next page

General Procedure

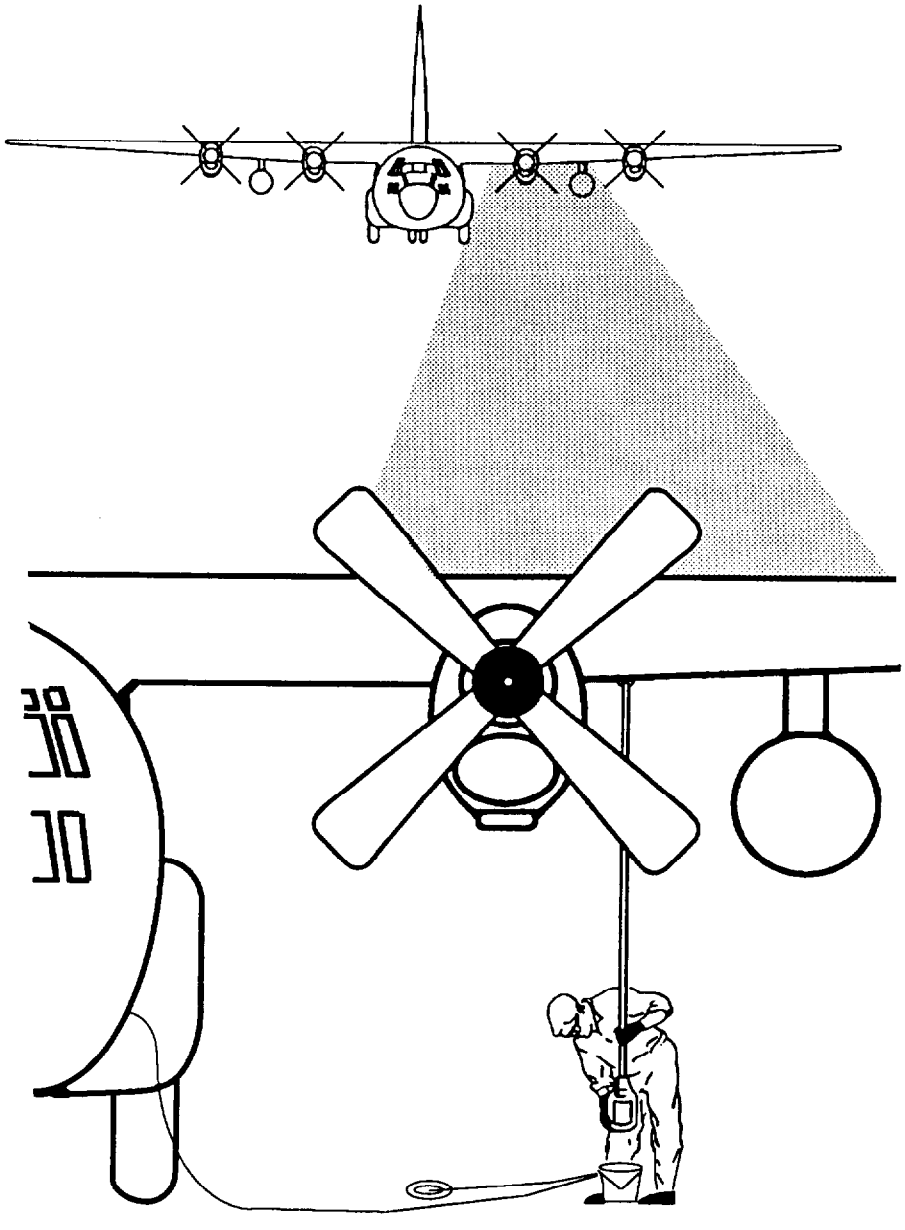
Complete these general steps to take an aircraft fuel sample.

Step	Action
1	Determine if another person has been assigned to assist you. Note: It is mandatory that two people be present when taking aircraft fuel samples.
2	Is the fuel tank sump drain accessible for the tank that is to be sampled? • If yes, go to step 3. • If no, open or remove fuel sump drain cover.
3	Put on personal protective equipment (goggles or faceshield, rubber gloves).
4	Place bucket under fuel tank sump drain.
5	If using a metal bucket, attach one of the ground wires to a grounding post on the ground. Plug the other ground wire into the aircraft's grounding receptacle.
6	Place sample jar under sump drain tool.
7	Insert drain tool into sump drain valve.
8	Drain a minimum of 16 ounces of fuel into sample jar.

Continued next page

Example

This drawing illustrates collection of a fuel sample from the #2 main fuel tank of an HC-130H.



Identifying Particulate Contamination

Definition

Particulate contamination of aircraft fuel is defined as solid contaminants which do not dissolve in the fuel. These solid contaminants are normally referred to as particulates.

Examples

Examples of particulates found in aircraft fuel are:

- Metal particles
- Rust/scale
- Sand/dirt
- Lints/dust
- Slimes/sludges
- Gums/resins/rubber

Identification

Particulate contamination can be visually identified in fuel samples as follows:

- Coarse particles usually visible to the naked eye
- Fine particles generally not visible to the eye unless in sufficient amounts to appear as a haze or cloudiness in the fuel

Identifying Water Contamination

Definition

Water contamination of aircraft fuel is defined as water which is contained in the aircraft's fuel system.

Types of Water Contamination

Water is present to some extent in all aircraft fuel systems. The three types of water contamination are:

- Dissolved water
- Entrained water
- Free water

Identification of Dissolved Water

Dissolved water is present to some degree in all aircraft fuel systems, but is not visible to the naked eye. Because of this, no visual identification of dissolved water can be made.

Identification of Entrained Water

Entrained water can be visually identified in fuel samples by:

- Small droplets of free water suspended in the fuel
- Small amounts not usually visible to the naked eye, but in larger amounts create a milky haze or cloud in fuel

Identification of Free Water

Free water can be visually identified in fuel samples by the presence of visible slugs or large droplets of water.

Warning

Excessive water contamination may cause aircraft fuel filters, strainers, and lines to clog due to freezing of the water at low temperatures.

How to Perform a Clear and Bright Test

Introduction

Acceptable fuel for an aircraft's fuel system must be free from excessive contaminants. For this reason, proper testing of aircraft fuel samples is critical. The fuel must visually appear to be clear and bright. Therefore, visual testing of fuel samples is referred to as a Clear and Bright Test.

Definition

The term clear refers to fuel that is absent of any visible indication of particulate, entrained, or free water contamination. The term bright refers to the shiny appearance of clean, waterless fuel.

Continued next page

Procedure

Complete these steps to perform a Clear and Bright Test.

Step	Action
1	Obtain fuel sample using collection procedure outlined on page 13.
2	Check fuel sample for visible contamination and brightness.
3	Swirl the fuel in the glass jar to form a vortex. Result: The contaminants contained in the fuel are heavy and will collect directly beneath the vortex and form a sediment spot.
4	Does this sediment spot exceed 3/4 inch in diameter? If yes, go to step 5. If no, go to step 8.
5	Take a second sample from the fuel tank in which the contamination exists.
6	Swirl the fuel in the glass jar of the second sample to form a vortex.
7	Does the sediment spot in the second sample exceed 3/4 inch in diameter? If yes, aircraft is unsafe for flight. Report fuel contamination to Quality Assurance. If no, go to step 8.
8	Place all fuel samples in appropriate storage locker.
9	Fill in required entries on CG-4377B.

Continued next page

Example

This is an example of the fuel being swirled in the glass jar to form a vortex.

CG-4377B Fuel Sample Sign-Off

Introduction

In this section we will be referring to the Aviation Administration pamplet that came with this course. These documents will enable you to follow a step-by-step procedure to ensure correct sign-off of the CG-4377B.

When to Use

Use this procedure when satisfactory clear and bright tests have been completed on the aircraft's sampled fuel.

Sign-Off Procedure

If there is a question, contact your instructor to complete the fuel sample sign-off.

Aircraft Fuel Sampling Practice

Introduction

Use the information presented to you in this lesson to answer the following questions pertaining to the maintenance scenarios. Check your answers using the feedback provided on page 4-24 of this handout. If you have any questions contact your instructor.

Scenarios/ Questions

AMT3 Jones is a member of Duty Section 3 at Air Station Clearwater. It is 0630 and Duty Section 3 is responsible for taking fuel samples on the two HH-60J helicopters which are departing at 0830 on training flights. The Watch Captain assigned AMT3 Jones to assemble the equipment the duty section will need to take the fuel samples.

1. What aircraft fuel sampling equipment will AMT3 Jones need to locate? List the equipment.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

Continued next page

Scenarios/ Questions (Continued)

After AMT3 Jones assembles the fuel sampling equipment, the Watch Captain tells him to go down to the galley to pick up box lunches for one of the morning helicopter flights. AMT3 Jones departs for the galley and is gone about 15 minutes. When AMT3 Jones returns, he notices that another member of the duty section, AMT3 Barnes, is taking fuel samples on Helo 6033 in the hangar while the remainder of the duty section is positioning Helo 6034 out on the flight line. Helo 6033 is properly grounded and there is a fire bottle located in the immediate area.

2. In the scenario above, there are two violations of the general procedures found in your handout. List these violations.

   a. _____

   b. _____

The duty section has completed positioning Helo 6034 on the flight line. The Watch Captain tells AMT3 Jones and AMT3 Barnes to go and take fuel samples on Helo 6034.

3. Since Helo 6034 has just been moved, how long should AMT3 Jones and AMT3 Barnes wait before taking fuel samples?

   _____

After taking a fuel sample from Helo 6034, AMT3 Barnes hands the sampling jar to AMT3 Jones to perform a Clear and Bright Test. When AMT3 Jones swirls the fuel in the sampling jar he notices small droplets of water forming beneath the vortex.

4. In the scenario above, what type of contamination is this called?

   _____

_____

Continued next page

Scenarios/ Questions (Continued)

While fuel sampling Helo 6034, AMT3 Barnes locks open the aft main fuel tank sump drain valve. While AMT3 Barnes tries to close the valve, AMT3 Jones contains the fuel by using buckets. Shortly, all of the buckets are full and the fuel is now pouring out on the ground. The spill area continues to grow and now is over 50 square feet. AMT3 Barnes is unable to get the valve closed and his right shirt sleeve and arm have become fuel soaked. Fuel continues to pour out of the sump drain valve onto the ground.

5. In the scenario above, what actions should AMT3 Barnes and AMT3 Jones take? List the actions required.

_____

_____

_____

_____

_____

6. After taking a fuel sample, you notice particles of sand in the sample. What is this type of contamination called?

_____

_____

Aircraft Fuel Sampling Feedback

Introduction

Check your answer against the following answers. If you have any questions, review the chapter and/or contact your instructor.

Answers

1. a. Goggles or face shield
   b. Rubber gloves
   c. Metal bucket with ground wire or a rubber bucket
   d. Clear, clean, and dry wide mouth glass jar
   e. Sump drain tool

2. a. Fuel samples are being taken on Helo 6033 while it is located in the hangar
   b. AMT3 Barnes is taking fuel samples by himself

3. 30 minutes

4. Entrained water

5. AMT3 Barnes and AMT3 Jones should depart the spill area immediately and report the spill to their supervisor, who shall notify the airport or local fire department to render the spill area safe. AMT3 Barnes should also remove his shirt and wash his right arm.

6. Particulate

Chapter Summary

Summary

This chapter has given you the basic procedural information to properly take aircraft fuel samples and to perform Clear and Bright Tests on those samples.

Chapter Completion

Now that you have completed this chapter, your instructor will sign-off your syllabus as you complete the tasks.

Further Study

For more information and/or study refer to these following manuals:

- Aeronautical Engineering Maintenance Management Manual, COMDTINST M13020.1 (series)
- Quality Control of Fuels and Lubricants, USAF T.O. 42B-1-1
- Servicing of Aircraft and Static Grounding, USAF T.O. 00-25-172
- Aircraft Refueling for Shore Activities, NAVAIR 06-5-502

Aircraft Fueling

Introduction

We will discuss the general procedures used when fueling. Your instructor will tell you of any differences in procedure associated with your aircraft.

Chapter Purpose

This Chapter is designed to give you the procedural information for fueling aircraft.

How To Proceed

To begin this chapter:

- Read the handout.
- Complete the practice exercises.
- Check your answers with the feedback provided.
- If you have any questions, first review the chapter, then contact your instructor.

Objective

Given aircraft fueling safety precautions, **SELECT** the correct response for aircraft fueling scenarios.

References

- Aircraft Computerized Maintenance System (ACMS)
- Servicing of Aircraft and Static Grounding, USAF T.O. 00-25-172
- Applicable aircraft maintenance manuals
- General aircraft T.O.'s
- Local maintenance instructions

Fueling

Introduction

Aircraft fueling is accomplished daily at every airstation. There are two basic processes used to accomplish aircraft fueling called:

- Standard Refueling
- Hot Refueling

Standard Refueling

Standard refueling is the most commonly used process at all air stations. It can be accomplished by using either the over the wing, or single point method.

Hot Refueling

Hot refueling is the process used when the aircraft does not shut down all the engines, which allows for a quick turn around time. It is accomplished using the single point refueling method. Hot refueling is potentially dangerous, which is why it is used infrequently in Coast Guard aviation.

Single Point Method

This method is most commonly used on Coast Guard aircraft. The fueling hose is connected to a single fitting and the fuel is distributed to the different fuel tanks through switching valves and fuel lines.

Over the Wing Method

This method is used when the aircraft does not have single point capability, or the single point system is not operational. Each fuel tank in the wing has a fuel cap which is removed and the hose is inserted into the tank to be filled.

Safety Precautions

Introduction

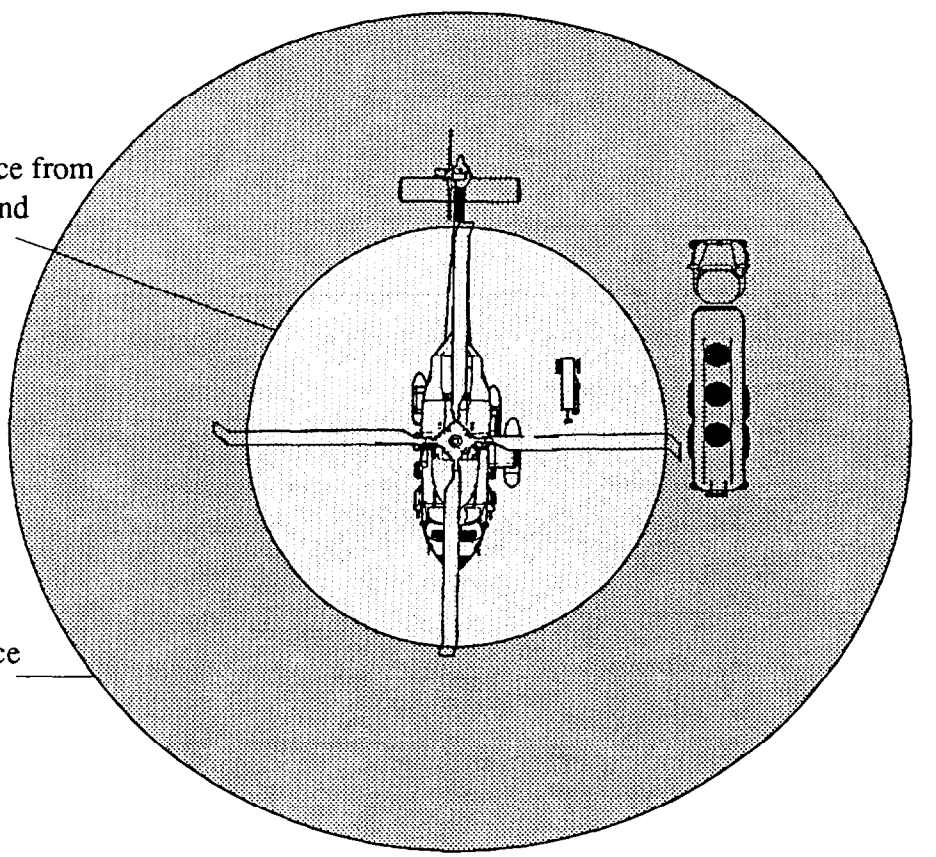
The following safety precautions are to be observed while performing Standard, or Hot refueling procedures.

Fueling Equipment Precautions

During fueling procedures:

- Never approach an aircraft by driving directly toward it.
- Keep minimum distance from fuel truck to aircraft vents at 25 ft.
- Park fuel truck parallel to the aircraft, and with the operator's side adjacent to the aircraft.
- No open flame within 50 ft.
- Electric cart will be 50 ft from fueling equipment.
- Do not operate radar within 300 ft of fueling operations.

Minimum Distances



Fueling Precautions

During fueling procedure:

- Always wear goggles and/or face shield.
- Ensure one 150 pound fire extinguisher is in close proximity to the fueling operations.
- Discontinue fueling if lightning is within 3 miles.

Fuel Load

Introduction

Prior to fueling the aircraft you must know how much fuel (fuel load) to put on the aircraft and to which tanks it will be distributed. The amount of fuel and where it is distributed is critical, due to its effect on weight and balance. Fuel load information is obtained from the maintenance management section at the air station. There are two types of fuel loads:

- Standard fuel load
- Special fuel load

Standard Fuel Load

A standard fuel load is:

- Set by maintenance management section for the air station.
- Used when fueling aircraft on routine missions.
- The amount of fuel in pounds and gallons, and into which tanks it will be distributed.

Special Fuel Load

A special fuel load is:

- Passed to maintenance management by the pilot indicating the amount of fuel in pounds and gallons and into which tanks it will be distributed.
- More or less fuel than the standard fuel load.
- Dictated by the mission requirements to prevent exceeding the weight limits of the aircraft.

Grounding Procedures For Fueling

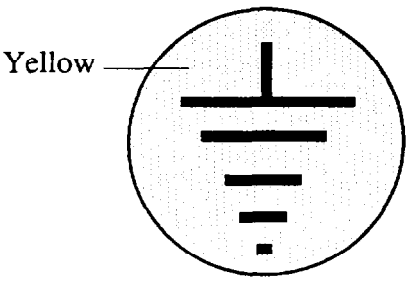
Introduction

Prior to commencing fueling procedures you will have to prepare the aircraft and fueling equipment. The basic preparation will include:

- grounding aircraft
- grounding fueling equipment
- meeting power requirements

Grounding Receptacle Symbol

Grounding receptacle symbols are color coded black and yellow and are placed at all grounding locations. The following is an example of a grounding symbol.



Grounding Procedures

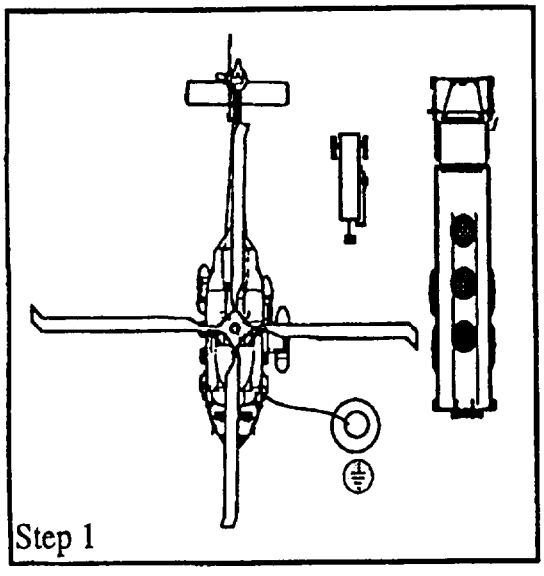
Fuel traveling through the refueling hoses and falling into the fuel tank generates static electricity which, if not controlled, could cause an explosion. Performing the following grounding procedures will minimize the buildup of static electricity by providing a path that allows the static electricity to dissipate into the ground and not through you or the aircraft.

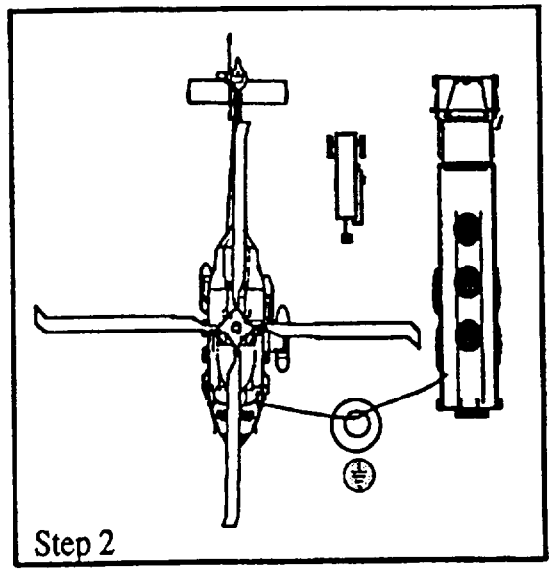
Step	Action
1	Connect grounding wire to the ground, then to aircraft.
2	Connect ground wire from fueling equipment to ground. Use same grounding point as aircraft as possible.
3	Connect ground wire from fueling equipment to aircraft.
4	Connect ground wire on the fueling nozzle to aircraft.

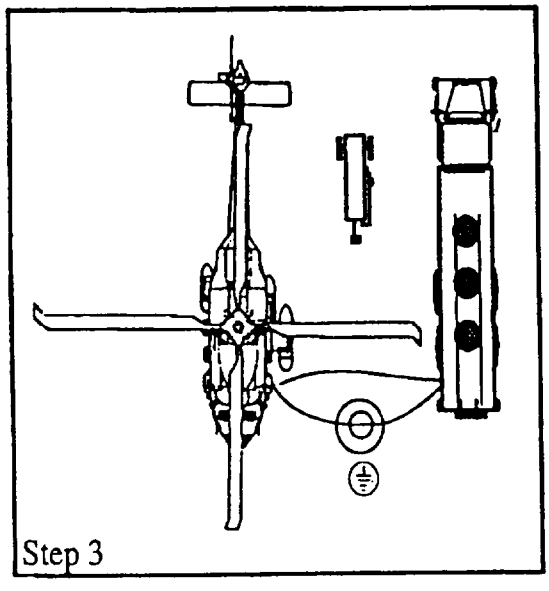
Grounding Procedures For Fueling (Continued)

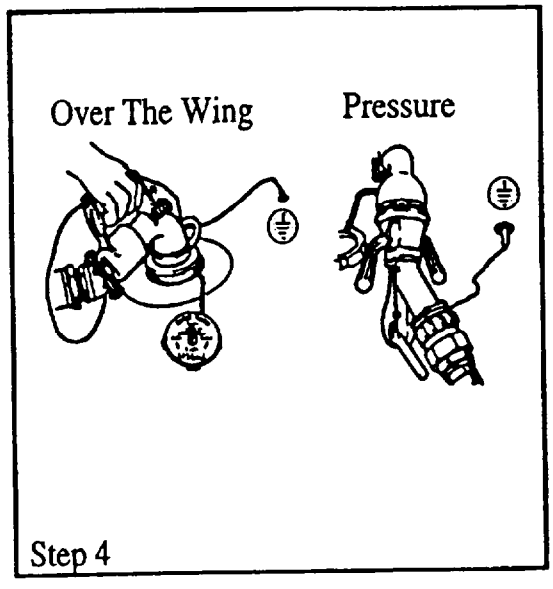
Illustration of Grounding Sequence

The illustrations below show in proper sequence, the grounding procedure used.









Applying External Power For Fueling

External Power

The type of aircraft you will be fueling and whether you will be using the hot refueling or standard refueling procedures will determine whether or not a mobile electrical power cart is used.

Types of Power Carts

Two types of mobile electrical power carts are used at most airstations are:

- Hobart
- Essex

Power Cart Capabilities

Mobile electrical power carts provide both AC and DC power to enable you to:

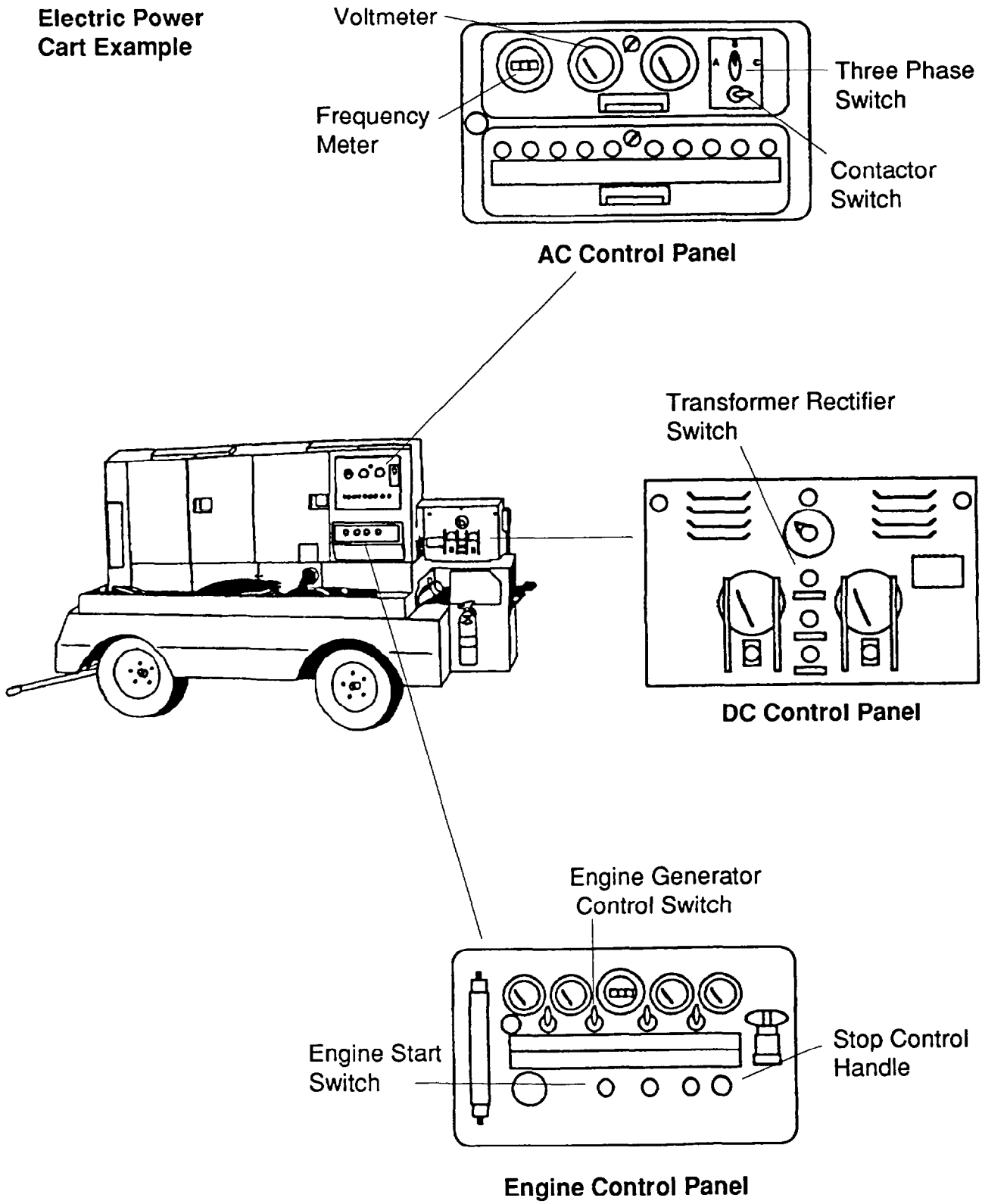
- Switch tanks during pressure fueling.
- Check the high level shut-off switches.
- Take a reading of the fuel load.

Mobile Electrical Power Cart Use

The following mobile electrical power cart component identification example and operational procedure chart will familiarize you with the basic procedures for operation. When you have completed this chapter, your instructor will demonstrate the use and operation of the mobile electrical power cart.

Continued next page

Electric Power Cart Example



Continued next page

Applying AC and DC Power

This is the procedure for applying external power.

Step	Action
1	Perform pre-start inspection of power cart by checking: • Fuel, oil, and radiator components for leaks and proper fluid levels. • Electrical system, check for burnt wires and terminals, and loose connections. • Condition of tires for wear and inflation. • Operation of footbrake or handbrake. • AC and DC electrical system for output voltage and frequency
2	Position power cart a cord's length away from aircraft.
3	Ensure aircraft power is off.
4	Plug AC or DC power cord into aircraft. Do not plug or unplug cord with power applied.
5	Start and idle engine for 5 minutes.

Continued next page

Applying AC and DC Power (Continued)

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>6</td><td>Hold engine generator control switch to build up voltage position momentarily.</td></tr>
<tr><td>7</td><td>Rotate the three phase switch to all three positions to ensure frequency (cycles) 400 and volt meter should read 115 VAC for all three phases.</td></tr>
<tr><td>8</td><td><table><tr><th>If you require</th><th>Then</th></tr><tr><td>AC Power</td><td>Go to Step 9</td></tr><tr><td>DC Power</td><td>Go to Step 10</td></tr></table></td></tr>
<tr><td>9</td><td>Place contactor switch in the closed position. Green light will illuminate. Go to Step 11.</td></tr>
<tr><td>10</td><td>Place transformer rectifier switch in the on position.</td></tr>
<tr><td>11</td><td>Place aircraft external power switch in the on position.</td></tr>
</table>

Securing External Power After Fueling

Securing External Power

When you no longer need external power you must secure (shut down) the mobile electrical power cart. The table below lists the procedure to secure external power at the aircraft.

Step	Action
1	Secure aircraft external power switch.
2	Secure transformer rectifier and/or AC Contactor switch.
3	Place generator control switch in the idle position for 3 minutes.
4	Pull stop control handle out until engine comes to a complete stop.
5	Remove and stow power cables (never remove or install power cables with power on).

Aircraft Fueling Procedures

Introduction

Certain procedures must be used to prevent contamination and/or damage to equipment. Your unit's procedures may vary slightly depending on the type of aircraft you are fueling and the fueling equipment used.

Refueling Procedures

Follow the procedures below to fuel the aircraft.

Step	Action
1	Obtain fuel load information from maintenance management section.
2	Locate and position fueling equipment (fuel truck or fuel cart) next to aircraft.
3	Ensure aircraft wheels are loosely chocked.
4	Place 150 pound fire bottle in close proximity to aircraft.
5	Clear aircraft of all workstands and equipment.
6	Connect required equipment (internal communications system if needed, and/or electrical power cart).
7	Follow grounding procedures.
8	Service fuel tanks, as required.
9	Remove grounds in the opposite order of installation.
10	Return all servicing equipment.
11	Sign off appropriate paper work.

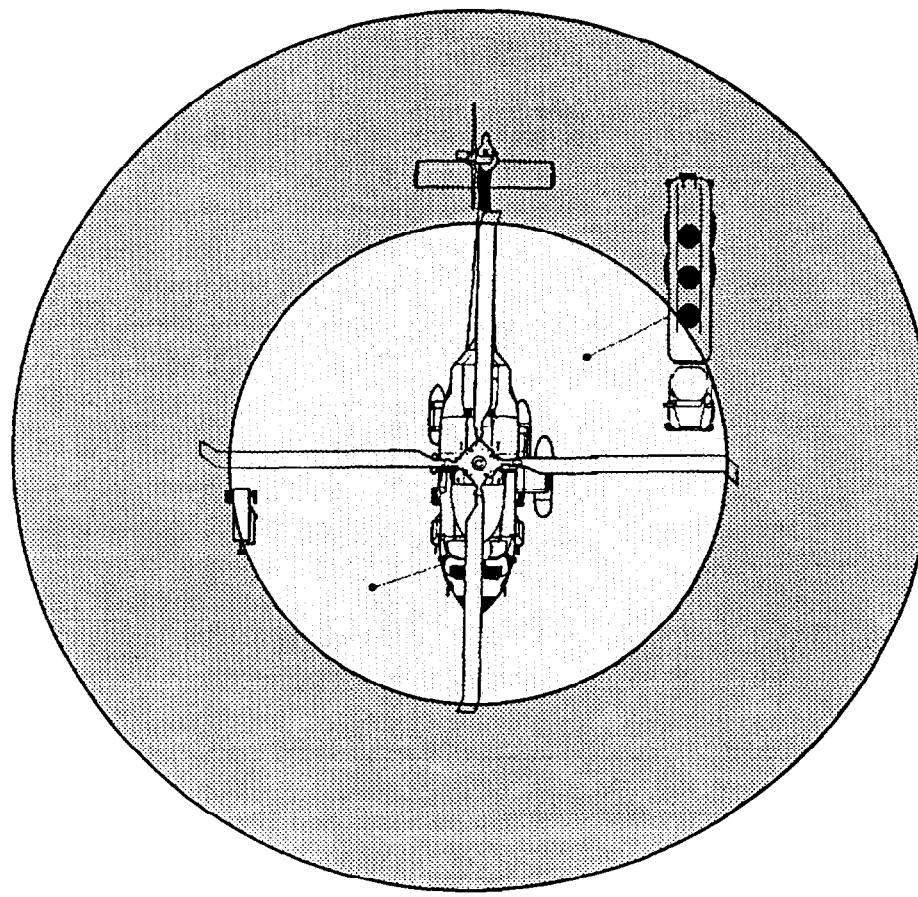
Aircraft Fueling Practice

Introduction

Using the eight safety precautions presented to you in this chapter, answer the following questions. Check your answers using the feedback provided. If you have any questions, review the chapter and contact your instructor.

Scenarios/ Questions

List the four violations contained in this illustration.



a. _____

b. _____

c. _____

d. _____

Continued next page

Scenarios/ Questions (Continued)

2. During aircraft refueling, a power cart would be used to:

   a. _____

   _____

   b. _____

   _____

   c. _____

   _____

3. The fuel truck has arrived at the aircraft and P.O. Smith is preparing the aircraft for fueling. List in order, the steps that he must follow to ground the equipment.

   a. _____

   _____

   b. _____

   _____

   c. _____

   _____

   d. _____

   _____

4. If an electrical storm is within ____ miles, refueling must be stopped.

   _____

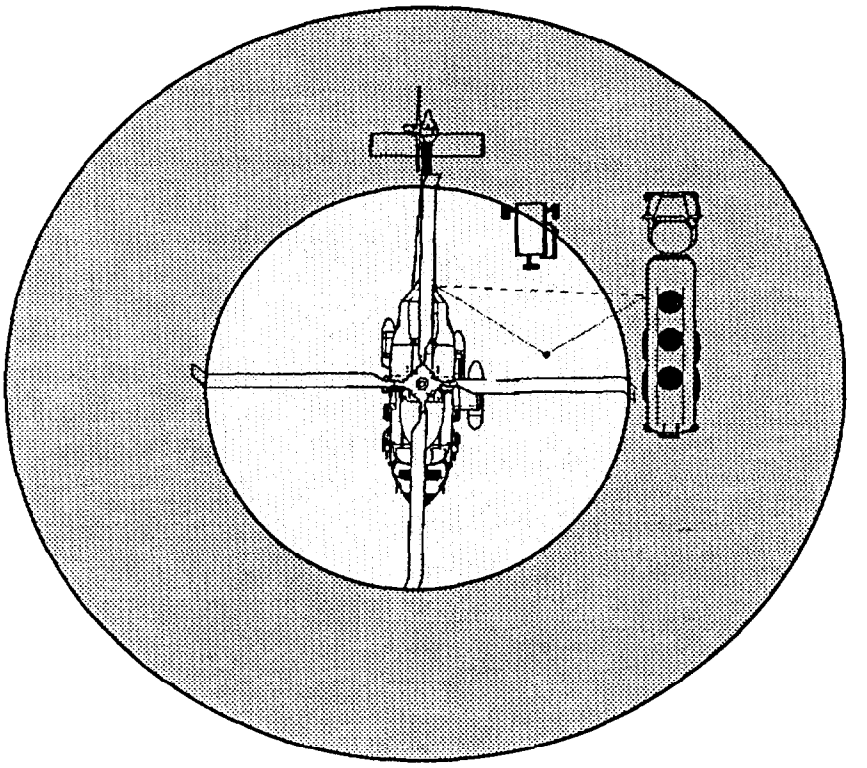
Aircraft Fueling Practice Feedback

Introduction

Check your answers against the following feedback. If you have any questions, review the chapter and/or contact your instructor.

Answers

1.



a. Minimum distance from fuel truck to aircraft is 25 ft.

b. Park fuel truck with operator's side adjacent to the aircraft.

c. Fire extinguisher is not in close proximity to the fueling operation.

d. Grounding triangle is not complied with.

Continued next page

Answers (Continued)

2.

a. Switch tanks during pressure refueling.

b. Allow the high level shut-off switches to be activated.

c. Take a reading of the fuel load.

3.

a. Connect grounding wire to ground then to aircraft.

b. Connect ground wire from furling equipment (fuel truck, fuel cart) to ground (same grounding point as aircraft, if possible).

c. Connect ground wire from fueling equipment (fuel truck, fuel cart) to aircraft.

d. Ground fuel nozzle to aircraft, prior to opening fill cap.

4.

a. 3 miles

Chapter Summary

Summary

This chapter has given you the basic procedural information to enable you to fuel Coast Guard aircraft. You will be introduced to the specifics of your aircraft's fueling procedure at the unit. If you have any questions about the information contained in this chapter, contact your instructor.

Chapter Completion

Now that you have completed this chapter, your instructor will sign-off your syllabus as you complete the tasks.

Further Study

For more information and/or study, refer to Servicing of Aircraft and Static Grounding, USAF T.O. 00-25-172 and specific aircraft maintenance manuals.

Aircraft Corrosion

Introduction

Many of the discrepancies found on aircraft components and structures result from corrosion damage. As a mechanic or technician, you will be responsible for inspecting and preventing corrosion damage. This chapter is designed to familiarize you with the procedures for the inspection and prevention of corrosion on Coast Guard aircraft.

Chapter Purpose

This chapter is designed to provide you with the information required to complete a corrosion inspection and wash an aircraft.

How to Proceed

To begin this unit of instruction:

- Read the handout.
- If you have any questions, contact your instructor.
- Upon completion of this chapter, see your instructor for OJT and syllabus sign-off.

Objective

Gain knowledge of washing aircraft, performing corrosion inspections, and applying corrosion preventative compounds to aid in the completion of the airman syllabus.

References

- Aeronautical Engineering Maintenance Management Manual, COMDTINST M13020.1 (series)
- Aircraft Weapons Systems Cleaning and Corrosion Control, NAVAIR 01-1A-509

Corrosion Introduction

Definition

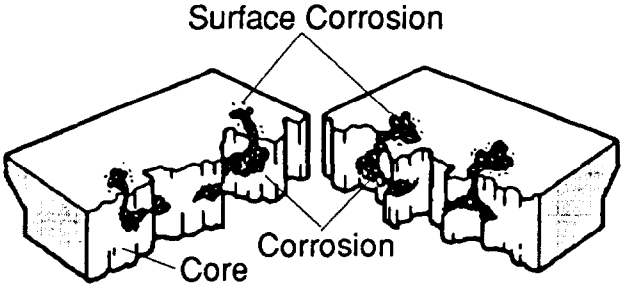
Corrosion is the deterioration of metal as it reacts to the environment. Simply stated, the metal attempts to return to its natural state when combining with oxygen.

Cause of Corrosion

Corrosion is caused by an electrochemical attack on the metal surface. In the electrochemical attack, metals of different electrical potentials are involved. When one metal contains positively charged atoms and the other metal contains negatively charged atoms, a potential for corrosion exists. Corrosion will not occur, however, unless an electrical contact is made between these metals. An electrical contact between metals can be made by any foreign material such as water, grease, and gases. These foreign materials are referred to as electrolytes. Once the contact is made, electrons will flow from the positively charged metal (anode) to the negatively charged metal (cathode), resulting in the destruction of the positively charged metal. Consequently, all preventive measures in corrosion control are designed primarily to avoid the establishment of this electrical contact.

Place of Origin for Corrosion

Generally, corrosion begins on the surface of metals. If allowed to progress, corrosion will eventually work into the core of the metal.



Preventive Maintenance

Definition

Preventive maintenance is the constant cycle of cleaning, inspecting, and preserving that is required to prevent corrosion. Preventive maintenance also involves corrosion removal, surface treatment, sealing, and painting, all of which are beyond the scope of this lesson.

Preventive Maintenance Program

The two most important factors in preventing corrosion, and the only ones which can be controlled by field personnel, are the removal of the electrical contact (electrolyte) and the application of protective coatings. An effective preventive maintenance program for corrosion will address these two factors. Listed below are some of the actions used in corrosion control.

- Clean aircraft on a regular basis.
- Wipe all exposed unpainted surfaces on a regular basis.
- Keep low-point drains open.
- Inspect aircraft for corrosion.
- Apply preservation compounds.

Since the extent of corrosion depends on the length of time electrolytes are in contact with metals, corrosion can be minimized by following a preventive maintenance program.

Aircraft Cleaning

Purpose

The first step in performing preventive maintenance is cleaning. Cleaning is necessary to remove the accumulation of soils, salt, exhaust deposits, and other materials to allow for a thorough inspection. Depending upon the maintenance requirement, the entire aircraft may require washing, or just spot cleaning in a specific area.

Cleaning Agents

When cleaning an aircraft, use only the proper cleaning agent. The recommended type of cleaner, including precautions and instructions, may be found in the Aircraft Weapons Systems Cleaning and Corrosion Control Manual, NAVAIR 01-1A-509.

Washing Equipment

The choice of washing equipment depends on several factors, such as the amount of cleaning that is required, the aircraft type, the location of the cleaning activity, and the availability of facilities such as air pressure, water, and electricity.

Below is a list of common equipment used in aircraft washing.

- Aircraft washing kit (#251) has a swivel applicator head with a surface for attaching cleaning pads and sponges. A handle is fitted to the applicator head to allow for cleaning in hard to reach areas.
- Hoses and spray nozzles
- Brushes and sponges
- Protective gear such as rubber gloves, goggles, and aprons should be used to protect skin, eyes, and clothing from certain cleaning agents.

Washing Preparation

Prior to washing, certain areas of the aircraft need to be protected from various cleaning agents; materials such as rubber, plastic, and composites may be damaged. The application of masking tape and barrier paper to these areas usually provides ample protection.

Secure all obvious openings and access panels to prevent the entry of cleaning agents and water.

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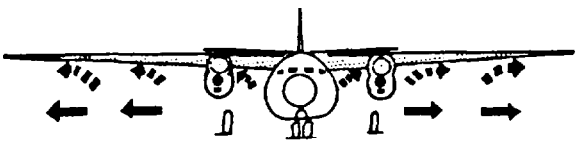
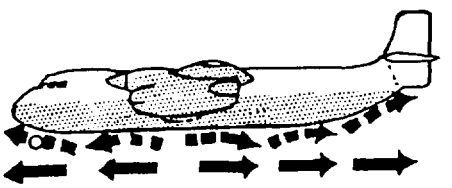
Aircraft Washing Procedure

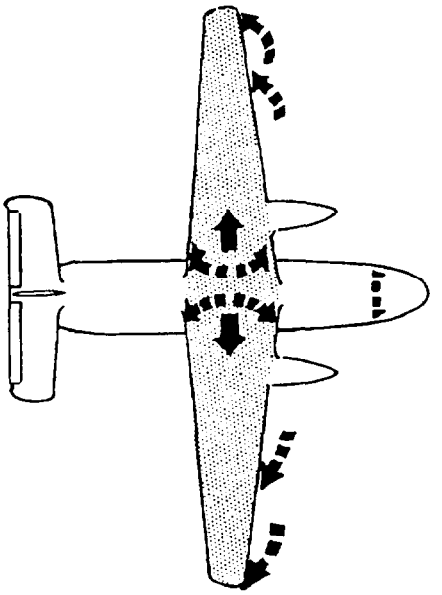
Use the following steps to wash the exterior surfaces of an aircraft.



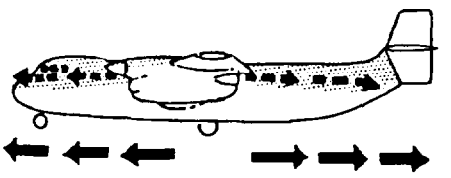
Step 1
Wash underside of wing spraying from center section to wing tips.



Step 2
Wash undersurface of fuselage and tail sections from landing gear toward both ends of aircraft.



Step 3
Wash the upper side of wings and center section of fuselage.



Step 4
Spray remaining parts of the upper side of fuselage and tail sections, moving from center to ends.

Corrosion Inspection

Purpose

Inspections are needed to assure the detection, prevention, and removal of corrosion. Without proper and systematic inspections, corrosion will seriously damage the aircraft and its equipment.

Inspection Tools

Visual inspection is the method most widely used to detect corrosion. To perform a visual inspection, the following tools are used:

- Flashlight
- Inspection mirror
- Magnifying glass (10X)
- Plastic scraper

Inspection Areas

Certain areas of the aircraft are more prone to corrosion than others. This may be because of the location, configuration, shape, or materials used in the area. During a corrosion inspection, these areas should receive special attention. Below is a list of areas commonly prone to corrosion.

- Exhaust trail areas
- Battery compartments and vent openings
- Lavatories and galleys
- Bilge areas
- Wheel wells and landing gear
- Water entrapment areas
- Hinges

Continued next page

Evidence of Corrosion

As corrosion begins to attack the outer surface of a metal, surface deposits are formed. When performing a corrosion inspection, it is important to detect these deposits. The chart below shows common metal alloys used on aircraft and the appearance of corrosion deposits on them.

Alloy	Appearance of Corrosion Deposit
Magnesium	White, powdery, snow-like mounds, or white spots on surface when dry. Paste-like appearance when wet.
Steel	Reddish-brown oxide (rust).
Aluminum	White-to-gray powder when dry. Paste-like appearance when wet.
Cadmium (used as a protective plating)	From white, powdery deposit to brown or black mottling of the surface.
Stainless steel	Rough surface; sometimes a red, brown, or black stain.
Nickel based alloys (Inconel, monel)	Green, powdery deposit.
Copper based alloys (brass, bronze)	Blue or blue-green, powdery deposit.

When corrosion occurs beneath a paint coating, the surface of the paint will often be blistered, lifted, or discolored.

Continued next page

Inspection Procedure

Use the following steps to perform a corrosion inspection.

Step	Action
1	**Clean** inspection area thoroughly.
2	**Inspect** area with magnifying glass, inspection mirror, and flashlight.
3	**Examine** edges of skin panels, fasteners, and corrosion-prone areas.
4	**Dislodge** blisters, bubbles, or other irregularities in paint coating with plastic scraper. **NOTE** If paint coating is not easily dislodged and corrosion is not suspected, the irregularity is probably confined to the paint coating itself, and no further action is required.
5	**Document** corrosion on appropriate paperwork.

Documentation

Documentation of corrosion must include the description and location of the corrosion. This is important so that qualified personnel can locate the corrosion at a later time and perform the necessary actions to remove it.

Most corrosion can be documented on a maintenance discrepancy report. However, extensive corrosion or corrosion in a critical area may need to be documented on the CG-4377 part III for immediate action.

Continued next page

Documentation (Continued)

Below is an example of a maintenance discrepancy report used to document corrosion found during an inspection.

MAINTENANCE DISCREPANCY REPORT

FOR OPERATING ACTIVITY USE
DO NOT MAIL TO TAMSCO

AIRCRAFT MODEL	A/C NUMBER	OPERATING ACTIVITY
HH-60J	6034	CGAS Elizabeth City

DESCRIPTION	ACTION TAKEN	CORRECTED BY AD3 JOY
REPORTED BY AD3 Joy / DATE 5 Oct 93	Cleaned area, inspected for further damage, none noted; applied MIL-C-85054 I.A.W. NAVAIR 01-1A-509	CMS CODE (IF APPLICABLE) N/A [X] / MPC SUBMITTED? YES [ ] NO [X]
Found bare metal, top aft, left sponson, three inches in diameter.		MPC NUMBER
		DATE 05 Oct 93 / QA INSPECTOR

DESCRIPTION	ACTION TAKEN	CORRECTED BY AM3 Bass
REPORTED BY AE2 Rock / DATE 10 Oct 93	Removed battery compartment door; removed corrosion and sealed area with MIL-C-16173 I.A.W. NAVAIR 01-1A-509, re-installed door.	CMS CODE (IF APPLICABLE) 240150 N/A [ ] / MPC SUBMITTED? YES [X] NO [ ]
Corrosion found left side battery compartment door, corrosion extends underneath door.		MPC NUMBER 086.0
		DATE 12 Oct 93 / QA INSPECTOR gem

DESCRIPTION	ACTION TAKEN	CORRECTED BY
REPORTED BY / DATE		CMS CODE (IF APPLICABLE) N/A [ ] / MPC SUBMITTED? YES [ ] NO [ ]
		MPC NUMBER
		DATE / QA INSPECTOR

DESCRIPTION	ACTION TAKEN	CORRECTED BY
REPORTED BY / DATE		CMS CODE (IF APPLICABLE) N/A [ ] / MPC SUBMITTED? YES [ ] NO [ ]
		MPC NUMBER
		DATE / QA INSPECTOR

DESCRIPTION	ACTION TAKEN	CORRECTED BY
REPORTED BY / DATE		CMS CODE (IF APPLICABLE) N/A [ ] / MPC SUBMITTED? YES [ ] NO [ ]
		MPC NUMBER
		DATE / QA INSPECTOR

REVIEWED BY : ADCS Stanley King
(MAINTENANCE SUPERVISOR)

Corrosion Preventative Compound

Definition

A corrosion preventive compound is a type of cleaner/lubricant/ preservative which provides metals with a suitable resistance to contaminants such as dirt, water, and gaseous exhaust.

Usage of Corrosion Preventative Compounds

Areas which are corrosion prone or have unprotected metal should be routinely protected by an application of a corrosion preventative compound until a more permanent treatment, such as paint or sealant, can be applied.

Types of Corrosion Preventative Compounds

The following table shows some types of corrosion preventative compounds used on Coast Guard aircraft. Many of these compounds are able to remove water (known as water displacing) or other electrolytes from a metal surface. Some compounds provide lubrication in addition to corrosion protection.

Type	Purpose
MIL-C-81309 Type II	General use, provides short term protection (1 month), easily removed.
MIL-C-81309 Type III	Avionics equipment, short-term protection.
MIL-C-85054 (Amlguard)	Use as protective coating until painting is practical.
MIL-L-63460	Cleaner/lubricant/preservative for sliding parts.
VV-L-800	Lubricating oil.
MIL-C-16173	A non-water displacing film used in areas where large amounts of water collect. Provides long-term protection.

Continued next page

Corrosion Preventative Compound (Continued)

Application of Corrosion Preventative Compounds

Corrosion preventative compounds range in appearance and consistency from thick, black paste, which is applied with a brush, to light oils and aerosol sprays. The thicker compounds provide better protection, but are difficult to remove. The thinner compounds provide some lubrication and do not crack, chip, or peel. However, these compounds must be removed and replaced regularly to provide continuing protection. The most common type of corrosion preventative compound used in this lesson will be the aerosol spray type.

Aerosol spray application is very effective in protecting large areas. To apply the compound, hold the aerosol can approximately six to eight inches from the area to be covered and spray in a sweeping motion.

Safety Precautions

Use a respirator for protection from harmful, toxic vapors when applying corrosion preventative compounds in confined areas for prolonged periods of time.

Avoid prolonged skin contact with corrosion preventative compounds, for they are toxic to the skin.

Wear chemical-proof or splash-proof goggles.

Avoid using corrosion preventative compounds with oxygen equipment, lines, and fittings. Most compounds are not compatible with oxygen.

Review

Questions

1. What is the definition of corrosion?

2. List three actions that help control corrosion in an ongoing preventative maintenance program.

3. List, in order, the four steps for washing aircraft.

4. List the steps for a corrosion inspection.

5. List the safety precautions to be followed when applying corrosion preventative compounds.

Aircraft Fuel Sampling Feedback

Introduction

Check your answer against the following answers. If you have any questions, review the chapter and/or contact your instructor.

Answers

1. the deterioration of metal as it reacts to the environment.

2. any three of these five:

   - clean aircraft on a regular basis
   - wipe all exposed unpainted surfaces on a regular basis
   - keep low-point drains open
   - inspect aircraft for corrosion
   - apply preservation compounds

3. - Wash underside of each wing spraying from center section to wing tips.
   - Wash undersurface of fuselage and tail sections from landing gear toward both ends of aircraft.
   - Wash the uper side of wings and center section of fuselage.
   - Spray remaining parts of the upper side of fuselage and tail sections, moving form center to ends.

4. - clean
   - inspect
   - examine
   - dislodge
   - document

   see page 6-8 for more details of each step

5. - Use a respirator for protection from harmful, toxic vapors when applying corrosion preventative compounds in confined areas for prolonged periods of time.
   - Avoid prolonged skin contact with corrosion preventative compoounds, for they are toxic to the skin.
   - Wear chemical-proof goggles.
   - Avoid using corrosion preventative compounds with oxygen equipment, lines, and fittings. Most compounds are not compatible with oxygen.

Chapter Summary

Chapter Completion

Now that you have completed this chapter, your instructor will sign-off your syllabus as you complete the tasks.

Further Information

For more detailed information, refer to Aircraft Weapons Systems Cleaning and Corrosion Control, NAVAIR 01-1A-509.

Aircraft Jacking

Introduction

Many maintenance activities require jacking the aircraft as part of the job. As an aircraft mechanic you will be required to serve as a member of a jacking team. This handout will introduce you to the different types of jacks, their operation, safety precautions to be observed, and how to raise and lower and aircraft properly.

Chapter Purpose

This chapter is designed to provide you with the information required to jack an aircraft.

How to proceed

To begin this unit of instruction:

- Read the handout
- If you have any questions, contact your instructor
- Upon completion of this chapter, see your instructor for OJT and syllabus sign-off.

Objective

Given a list of positions and scenarios, **SELECT** a response as a member of an aircraft jacking team.

References

- Aviation Computerized Maintenance System (ACMS)
- Applicable aircraft maintenance manuals

Equipment

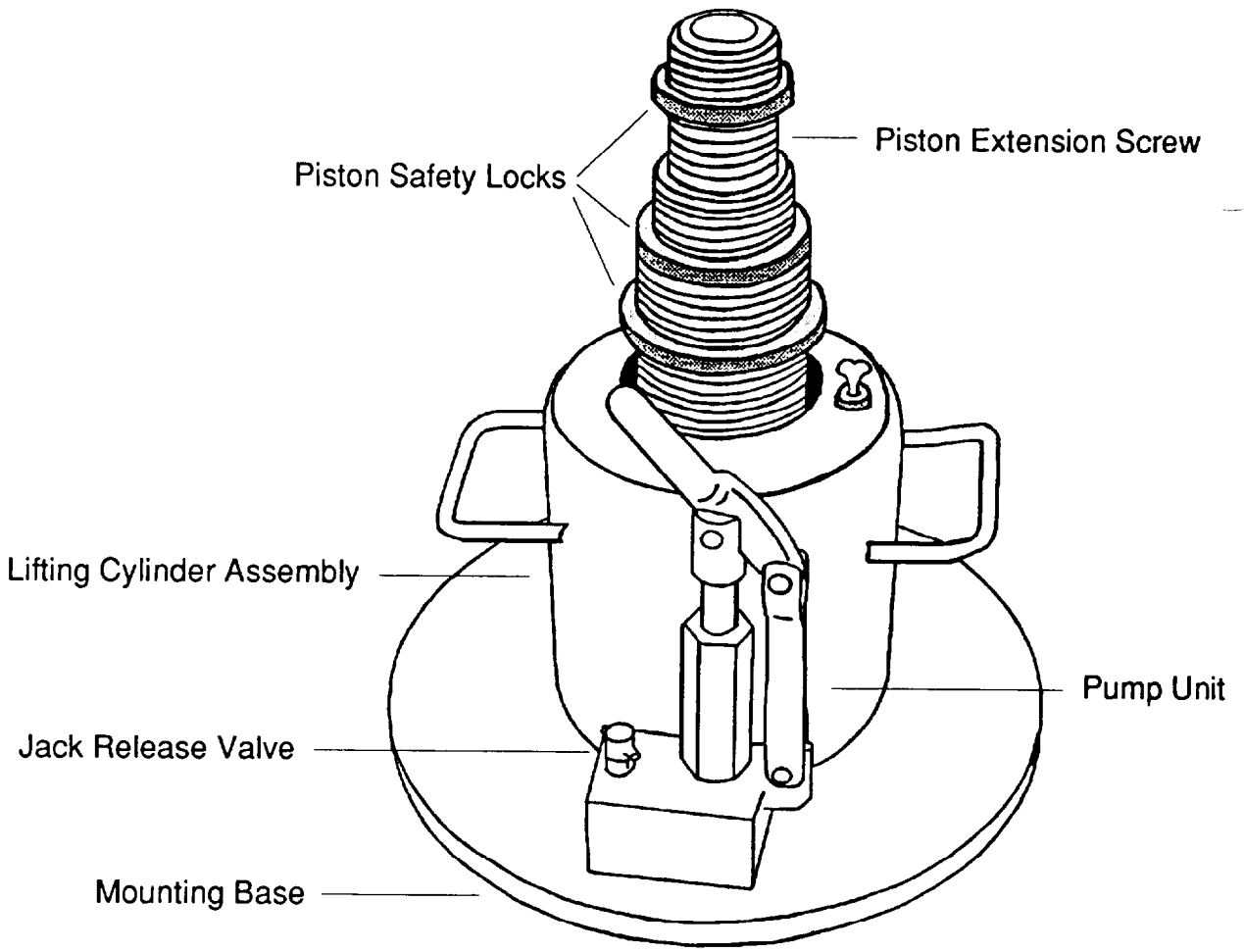
Single Base Jack

Generally, there are only two types of jacks that are used for aircraft jacking. They are classified as either single base or tripod.

The single base jack is designed to jack one axle at a time. It is portable, compact, self-contained, and hydraulically operated. It consists of six main parts:

- Lifting cylinder assembly
- Mounting base
- Hydraulic pump unit
- Piston Safety Locks
- Jack Release Valve
- Piston Extension Screw

The height of the single base jack can be raised or lowered by adjusting the piston extension screw of the lifting cylinder assembly. This adjustment allows the jack to be positioned under the aircraft.



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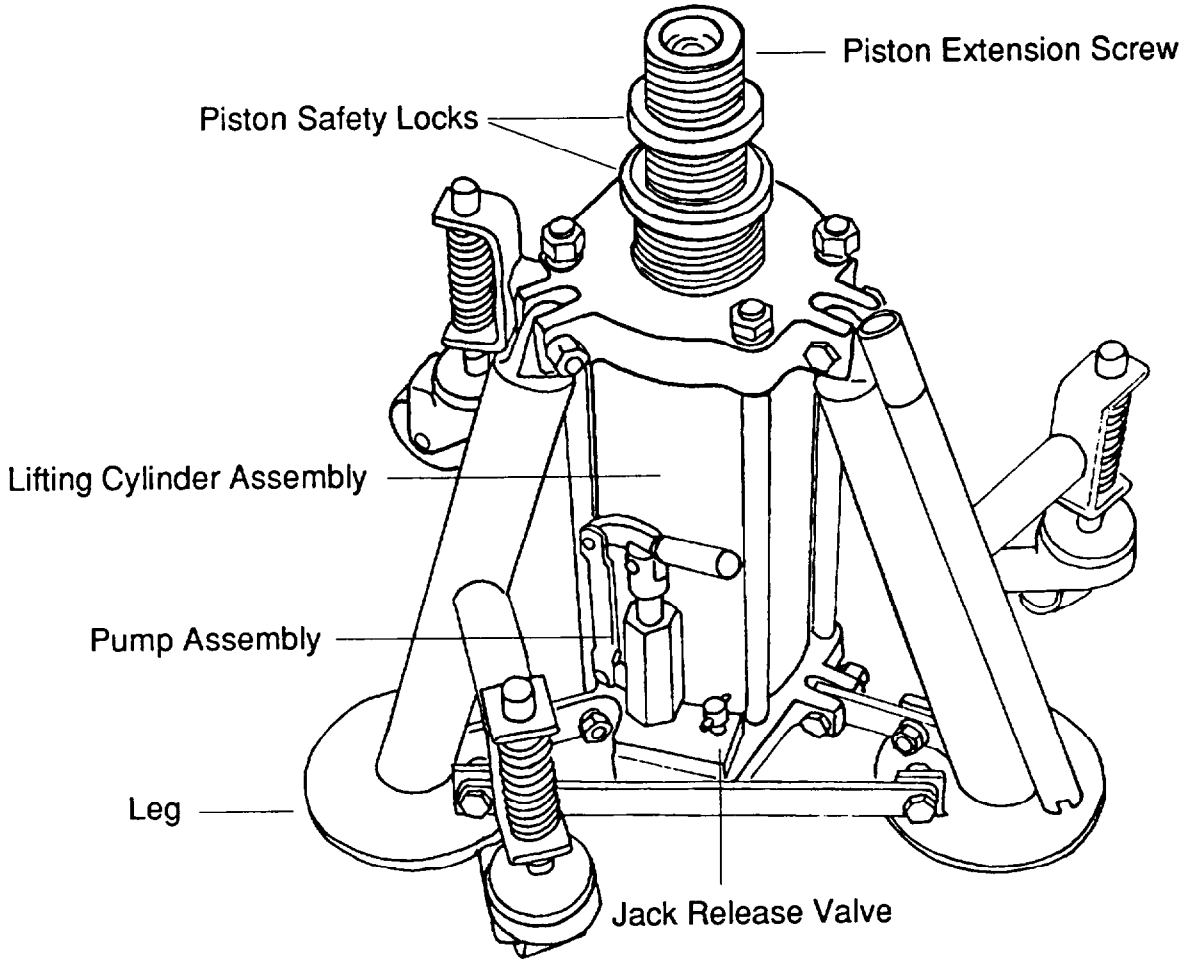
Tripod Jack

Tripod jacks are used when the entire aircraft is to be lifted off the ground. They are mobile, self-contained, and hydraulically operated. They consist of six main parts:

- Lifting cylinder assembly
- Three tubular steel legs
- Hydraulic pump unit
- Piston Safety Locks
- Jack Release Valve
- Piston Extension Screw

The height of the tripod jack can be raised or lowered by adjusting the piston extension screw of the lifting cylinder assembly to position the jack under the aircraft jacking adapter.



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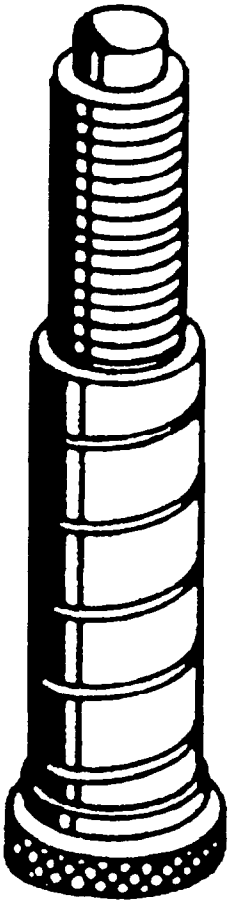
Equipment (Continued)

Piston Safety Lock

All aircraft jacks used in the Coast Guard are equipped with a piston safety lock. This lock (also called a ring or collar) is threaded to the jack piston and prevents the jack from collapsing in the event of a sudden loss of hydraulic fluid or inadvertent lowering. This safety device mechanically locks the piston in place.

Operation

When turning the piston safety lock during a jacking operation, no more that two threads should be exposed between the lock and the jack body.

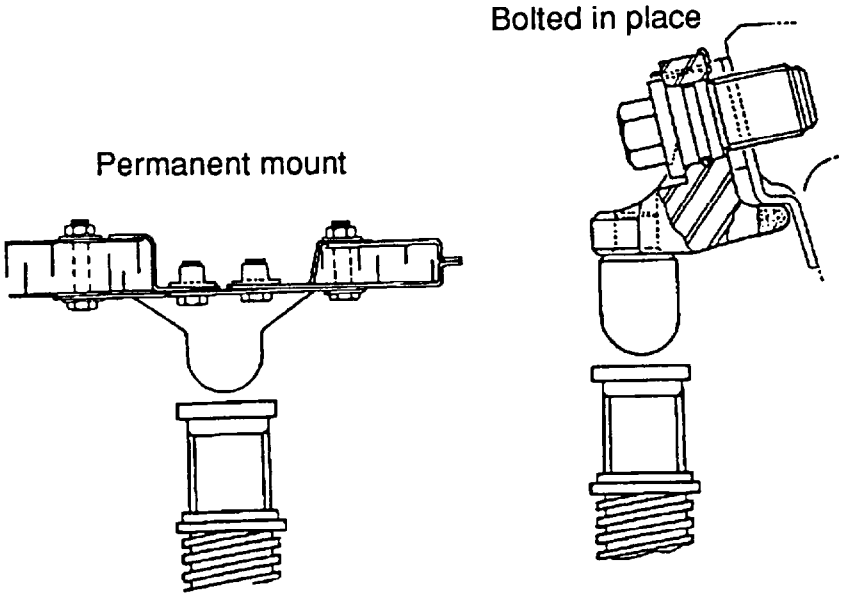


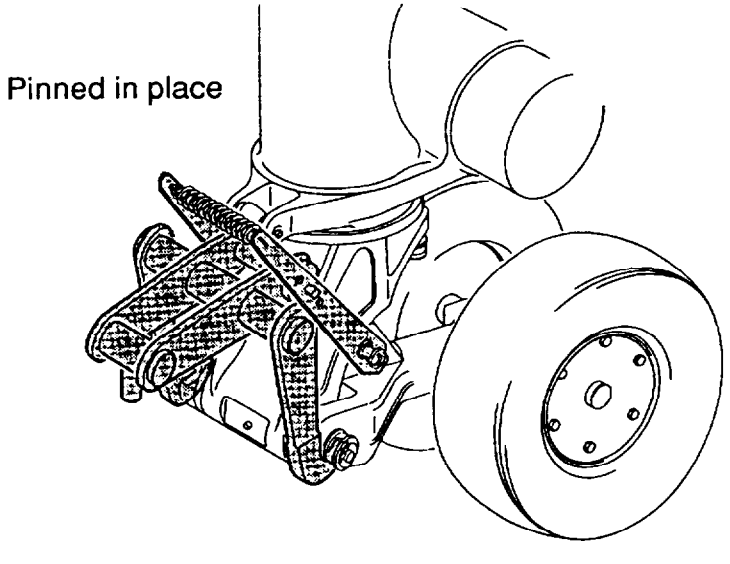
Piston Safety Lock

Continued next page

Jacking Adapter

Jacking adapters (jack pads) are used as a mating surface between the jack and the aircraft. Each aircraft has its own type of jack adapters which must fit perfectly. Adapters may be permanently mounted to an aircraft or attached before jacking by such means as bolting or pinning into place.





Review

Question

1. You have replaced a main landing actuator on an aircraft and, according to the maintenance procedure card, the complete landing gear system must be operated to ensure it works properly. Which type jack will you use?

_____

Answer

Answer on page 3.

Question

2. The wheel bearings on the right main landing gear of the HH-65 need to be lubed. Which type jack will you use?

_____

Answer

Answer on page 2.

Safety

Principles

In all aircraft maintenance activities, safety must be an important consideration. This is especially true in aircraft jacking operations since extensive damage to aircraft and serious injuries to personnel can result if procedures and precautions are not followed. Listed below are six general safety principles that should be observed for a jacking operation IAW the Aeronautical Engineering Maintenance Management Manual, COMDTINST M13020.1 (series) and applicable directives.

- Jacking of an aircraft **shall not** be performed outdoors if wind velocity exceeds 15 mph.
- **Do not** lift more weight than the jack is rated for. Jack rating may be stenciled on the jack or listed on an identification placard attached to the jack.
- **Do not** remain on aircraft while being raised or lowered unless required by maintenance instruction.
- **Do not** climb on a jacked aircraft unless required by maintenance instruction.
- Aircraft **shall only** be raised as high as necessary to perform the task.
- **Do not** extend the piston screw beyond limits as specified in the jack technical manual.

Review

Question

1. What are the six safety principles that are to be observed for a jacking operation?

Answers

Answers on page 7.

Jack Inspection

Procedures

Prior to use, the operator will inspect an aircraft jack according to the following procedure:

Step	Inspection Point	Action
1	Bolted Connections	Tighten securely.
2	Hose Connections	Check for leaks and tighten securely.
3	Piston and Extension	Check for cleanliness and presence of corrosion.
4	Piston Safety Lock	Check for free rotation.
	CAUTION *If leaks are found, do not use! Jack failure could occur. Inform ground support equipment supervisor of discrepancies.*	
5	Pump Assembly	Check for leaks.
6	Cylinder Assembly	Check for leaks.

Review

Questions

1. When inspecting the piston and extension of the jack, what do you check for?

_____

2. A small leak has been found on the pump assembly of the jack. What should you do?

_____

Answers

Answers on page 9.

Responsibilities

Jacking Supervisor

The jacking supervisor is the leader of a jacking team. As a result of this position, the jacking supervisor is responsible for the following:

- Ensuring that the jacking operation is performed safely; in a clear, well marked area.
- Contacting operations to verify wind velocity when jacking outdoors.
- Ensuring prescribed jacking procedures are being followed in accordance with the applicable maintenance instructions.
- Familiarizing jack team members with procedures.
- Establishing a clear method of communication among jacking team members.
- Ensuring operators work in a coordinated team effort.
- Ensuring climbing on aircraft is kept to a minimum.

Jack Operator

The jack operator is to work under supervisor direction, except when jacking one axle. This is generally because jacking one axle is a one person job. The jack operator has the following responsibilities in a jacking operation.

- Perform supervisor responsibilities when jacking one axle.
- Ensure equipment is functioning properly.
- Remain attentive and observant to jacking supervisor.
- Notify jacking supervisor of any safety concern or hazard.

Review

Questions

1. When jacking a complete aircraft, who has the responsibility of ensuring prescribed procedures are being followed?

2. Who ensures jacking equipment is functioning properly?

3. When would a jack operator be responsible for supervisor duties?

Answers

Answers on page 11.

Jacking Procedures

Introduction

Since jacking methods vary for different types of aircraft, only general jacking procedures will be presented in this lesson. When jacking one axle, a supervisor is usually not required. The operator will perform all steps.

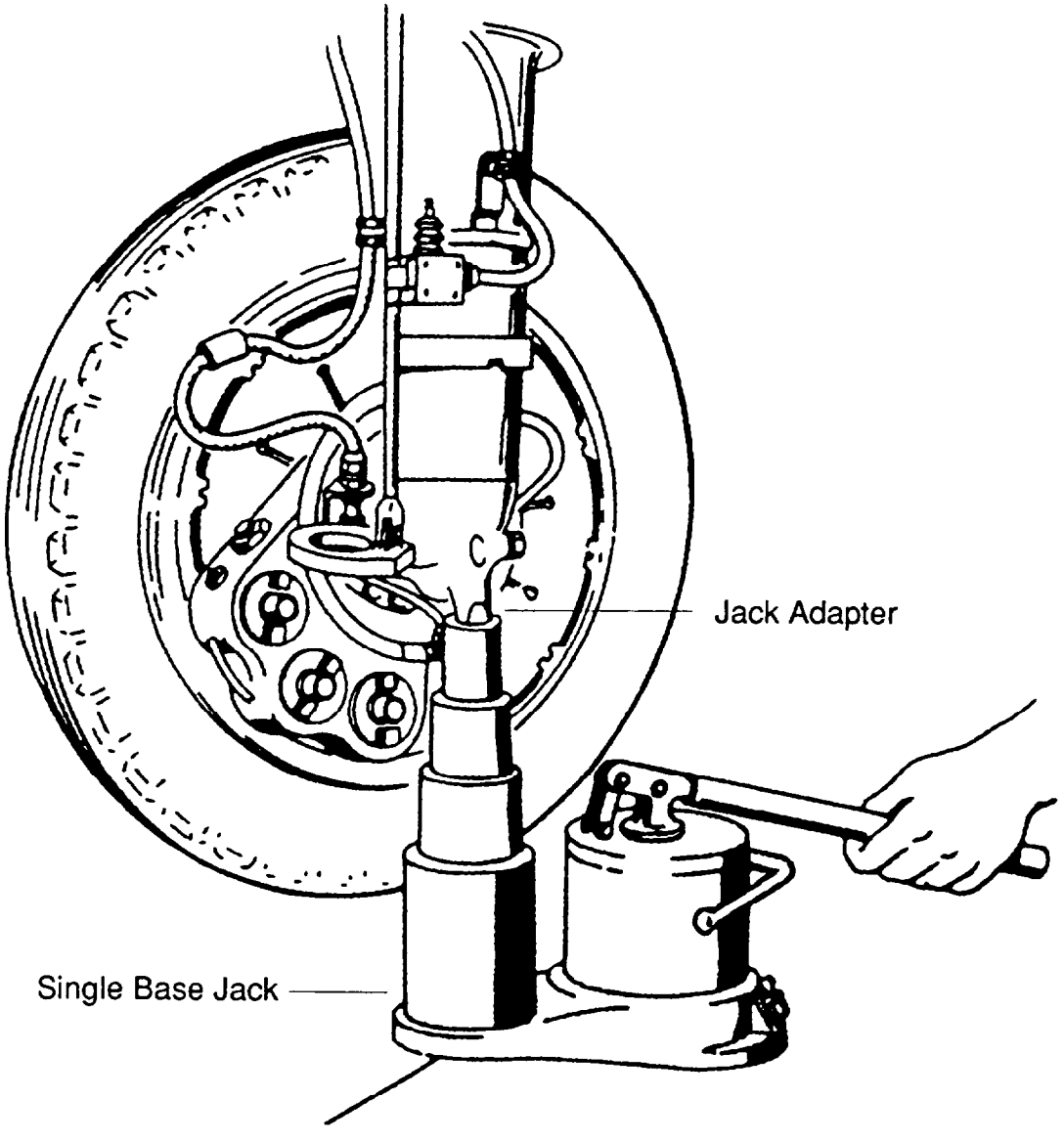
Lifting One Axle

Follow the steps in this table to lift one axle.

Step	Action
1	**Review** the applicable maintenance instructions for specific jacking procedures.
2	**Visually inspect** jacking area to ensure it is level.
3	**Clear** workstands, equipment, and personnel.
4	**Mark** jacking area with signs and barrier.
5	**Select** and **Inspect** jack for condition and function.
6	**Install** jacking adapter if not permanently attached.
7	**Chock** wheel not being jacked.
8	**Lock** tail wheel (if equipped).
9	**Center** jack under jacking point.
10	**Close** jack release valve.
11	**Extend** jack until it contacts jacking adapter.
12	**Perform** alignment check of jack.
13	**Jack** the axle, see figure on next page. **The piston safety lock should be turned downward as the piston is raised.**

Continued next page

Lifting One Axle



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Lowering One Axle

Follow the steps in this table to lower one axle.

Step	Action
1	**Clear** workstands, equipment, and personnel.
2	**Pump** up jack slightly to release piston lock nut.
3	Slowly **open** the pump release valve. **The piston safety lock should be turned upward at about the same rate as the piston is descending.**
4	**Lower** the wheel to the ground.
5	**Remove** jack as soon as jack clears the aircraft.
6	**Remove** jacking adapter.
7	**Stow** jacking equipment.

Continued next page

Lifting Complete Aircraft

Follow the steps in this table to lift the complete aircraft.

☐ Supervisor ☐ Operator

Step	Action
1	**Review** the applicable maintenance instructions.
2	**Visually inspect** jacking area to ensure it is level.
3	**Clear** workstands, equipment, and personnel.
4	**Mark** jacking area with signs and barrier.
5	**Select** and **Inspect** jacks for condition and function.
6	**Station** an operator at each jacking position.
7	**Install** jacking adapter if not permanently attached.
8	**Center** the tripod jack under the jacking point.
9	**Inspect** legs of the jacks to ensure that they do not interfere with the operations to be performed. **Place two legs parallel with the aircraft.**
10	**Close** the jack release valve.
11	**Stand** in front of aircraft and direct jacking operation.
12	**Seat** jacks under supervisor direction.
13	**Perform** an alignment check of the jacks.
14	**Jack** aircraft simultaneously under supervisor direction to keep aircraft level, see figure on next page. **The piston safety lock should be turned downward as the piston is raised.**
15	**Remove** chocks when wheels clear the deck.
16	**Snug** piston lock nuts against the jack body.

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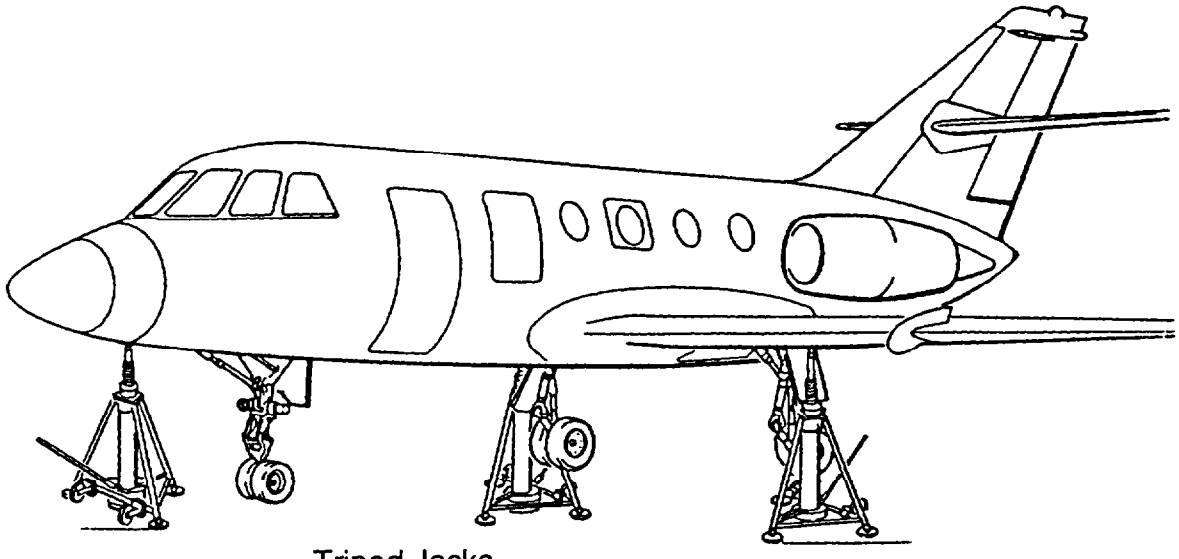
Lifting Complete Aircraft



Tripod Jacks

Continued next page

Lowering Complete Aircraft

Follow the steps in this table to lower the complete aircraft.

☐ Supervisor ☐ Operator

Step	Action
1	**Clear** workstands, equipment and personnel.
2	**Station** an operator at each jacking station.
3	**Stand** in front of aircraft and direct operation.
4	**Pump** up jacks slightly under supervisor direction to release the piston lock nut.
5	**Open** pump release valve under supervisor direction. **The piston safety lock should be turned upward at about the same rate as the piston is descending.**
6	**Lower** aircraft simultaneously under supervisor direction to keep the aircraft level.
7	**Install** chocks when aircraft on ground.
8	**Remove** jacks as soon as they clear the aircraft.
9	**Remove** jacking adapters.
10	**Stow** jacking equipment.

Chapter Summary

Chapter Completion

Now that you have completed this chapter, your instructor will sign off your syllabus as you complete the task.

Further Study

For more information and/or study refer to the following sources:

- Aircraft ACMS MPC for jacking
- Applicable aircraft manual
- Aeronautical Engineering MaintenanceManagement Manual, COMDTINST M13020.1 (series)

Aviation Handtools and General Aircraft Hardware

Introduction

Upon completion of this self paced unit of instruction, you will have an understanding of aviation hand tools, common aircraft hardware, standard aviation tool control policies, and established shop and aircraft safety procedures.

Objectives

- From memory, **COMPLETE** statements that describe the proper use, and safety precautions to be observed, when using tools and measuring equipment applicable to rating.
- Given statements describing tools and their uses, **MATCH** those statements to the nomenclature of each tool.
- From memory, **COMPLETE** statements describing procedures for locating and using torque values, and the care, and use of torque wrenches.
- Given an illustration of aircraft nuts, bolts, washers, Camloc fasteners, Dzus fasteners, and pip-pins, **LABEL** aircraft hardware.
- Given statements explaining the application of aviation hardware, **MATCH** statements to the item nomenclature.

References

- Aeronautical Engineering Maintenance Management Manual, M13020.1 (series)
- Aircraft and Missile Structural Hardware, USAF T.O. 1-1A-8
- Use and Care of Hand Tools and Measuring Equipment, USAF T.O. 32-1-101

General Safety Practices

Introduction

As an aircraft maintenance technician, you will use a variety of hand and power tools. This portion of the handout will provide you with information on safety precautions to be observed when using them.

Machine Safety

Machines in the shop should be located to provide sufficient space for the operator to handle materials and perform the required job operations without interference.

Machines shall be secured to floors, bases, or stands. When machinery and powered transmission equipment are not guarded as part of the design, mechanical guards such as enclosures or barricades will be temporarily or permanently installed to eliminate the possibility of injury.

General Hand Tool Safety

The following hand tool safety practices will be adhered to during your aviation career.

- Tools shall be used only for the purpose for which they were designed.
- Tools having mushroomed heads, defective handles, worn parts, or other defects that will impair their strength or render them unsafe shall be removed from service.
- Suitable storage space such as bins, drawers, racks, or cabinets, shall be provided for hand tools when not in use.
- Tools shall not be left on ladders, scaffolds, work stands, or any other work space when not in use.
- Throwing tools from one location to another, from one mechanic to another, or dropping them to lower levels, will not be permitted.
- Sharp edged or pointed tools will not be carried in pockets.
- Hand tools and wiping cloths will be immediately removed from work spaces of an aircraft upon completion of maintenance.

General Safety Practices (Continued)

Hammers

1. Insure hammer handles have a tight fit with the head.
2. Always strike squarely with the full face.
3. Keep the faces smooth and free of damage.

Mallets

1. Insure the handle has a tight fit with the head.
2. Always strike squarely with the full face.
3. Keep the faces smooth and free of damage.
4. Insure mushroomed portion of mallet heads are ground off as soon as they form to prevent injuries from flying debris.

Screwdrivers

1. Standard screwdrivers must fit 75% of the screw slot.
2. Phillips and Torque Set screwdrivers must fit 100% of the recess
3. Never hold the part in your hand while operating a screwdriver. Always secure parts in a vise or rest on a work bench, should the part or screwdriver slip, injury to your hand could result.
4. Never use screwdrivers as chisels or pry bars.
5. Do not use to check electrical circuits, this will cause arcing and damage to the screwdriver.
6. Never carry screwdrivers in any of your pockets.
7. Never get any part of your body in front of the screwdriver tip. This will prevent injury to yourself should it slip off of the work.

Pliers

1. Do not make pliers work beyond their capacity, needle nose pliers are especially prone to breaking.
2. Do not use pliers to turn nuts, bolts, screws, or fittings, damage to these items will result.

Punches

1. Center punches should never be struck with enough force to damage the metal.
2. Center punches should never be used to remove an object from a hole, the point will spread the metal and bind in the hole.
3. Hold punch at 90 degree angles to the surface, when the punch is struck it will not slip.
4. Grind mushroomed portions of the head as soon as it forms to prevent injuries from flying chips of metal.

General Safety Practices (Continued)

Wrenches

1. Never use a wrench as a hammer.
2. Insure the wrench fits snugly on the bolt or nut, loose fits will cause damage by rounding the head of the bolt or nut.
3. When using an adjustable wrench always pull toward the adjustable jaw.
4. Pull on a wrench, do not push.
5. Do not increase leverage of a wrench by placing a pipe over the handle. Increased leverage may damage the wrench or the work.

Torque Wrenches

1. Before each use, check for signs of damage. If damage is found, test for accuracy or turn it in for replacement or repair.
2. Check that the calibration date has not expired before each use.
3. After use of the adjustable setting torque wrench, set the scale back to zero to prevent damage to the internal spring.

Chisels

1. Grind mushroomed portions of the head as soon as it forms to prevent injuries from flying chips of metal.

Files

1. Always use a handle on the tang end to prevent injuries.
2. Choose the correct file for the job.
3. Clean files using a card file or a pick.
4. Never use files for prying or pounding.

Safety Glasses

Whenever you are using tools for pounding, prying, scraping, drilling or cutting, safety glasses will be worn. Under no circumstances will any job be started until proper eye protection is worn.

Foreign Object Debris (FOD)

Tools, or foreign object debris (FOD), accidently left in aircraft, could cause extensive equipment damage, an aircraft crash, and possible loss of life. For this reason it is of utmost importance that tool control procedures be strictly adhered to.

Tool Control

At an air station, tools are normally kept in tools boxes which have spaces provided for each tool. If a tool is missing, it can quickly be identified and a thorough search for that tool can begin. If a tool cannot be immediately found, it will be necessary to ground the aircraft upon which the tool was being used for maintenance. A missing tool that is not quickly found, could result in the suspension of all flight operations until the tool is accounted for.

Electric Power Tools

Personnel who use electric power tools will be responsible for observing safe operating standards associated with electricity and electrical power tools. **Electric power tools will not be used near flammable or explosive type materials unless they are approved as being explosion proof.** Excessive stretching, scraping, kinking, driving mechanized or portable equipment over power cords as well as exposure to grease and oil will cause premature failures and should be avoided.

Pneumatic Tools

Pneumatic tools shall be kept in good operating condition and thoroughly inspected at regular intervals. Air hoses on the floor shall be protected against damage from motorized equipment by building a runway over the hose. Air hoses shall not be laid over ladders, steps, scaffolding, or walkways in such a manner as to create a trip hazard. **Before connecting compressor air supply lines to pneumatic tools, operators will make certain the main operating valves are turned off. The use of compressed air for blowing dirt from hands, face, clothing, or machinery is prohibited.**

Color Coding

The purpose of color coding, is to inform personnel of the type of hazard that exists in an area in which they may be working. Color coding is also used to easily, and rapidly, identify emergency equipment in the event that it is needed.

Red

Areas that contain fire extinguishers and fire fighting equipment are colored red. Red is also used to identify emergency stop bars and buttons on machinery, electrical circuit breakers, and switches used for emergency shut-down of equipment or electrical service.

Yellow

Yellow is used for paint striking, stumbling, and falling hazards. Where suitable, alternating bands of black and yellow shall be used. For example: low overhead hazards, guard railings, edges of platforms, and pits. Drums and storage tanks containing flammable liquids and gasoline powered equipment are also painted yellow.

Orange

This is the standard color for hazards which cut, crush, burn or shock. It shall be applied on or near dangerous parts such as gears, shears, planers, brakes, rolling or crushing devices, forming devices, punch presses, and riveting machines. The inside of electrical panels, switch box doors, and covers are painted orange.

Blue

Blue is used for the outside of switch and fuse boxes, control panels, off and on control boxes on machinery. For example: arc welding gear, control boxes of hoists, winches, and cranes.

Green

First aid and medical cabinets, stretcher boxes, cabinets for gas masks, safety showers, and all signs relating to first aid are painted green.

Self Test

COMPLETE the following statements:

1. Machines shall be _____ to floors, bases, or stands.

2. Tools shall be used _____ for the purpose for which they were designed.

3. Electric power tools will not be used near _____ or _____ type materials unless they are approved as being explosion proof.

4. Before connecting compressor air supply lines to pneumatic tools, operators will make certain that main operating valves are _____ _____.

5. Whenever you are using tools for pounding, prying, scraping, drilling or cutting, _____ must be worn.

6. Fire fighting equipment, electrical circuit breakers, emergency electrical shut-down switches are color coded _____.

7. Striking, stumbling, and falling hazards are painted _____.

8. The color for hazards which cut, crush, burn, or shock, is _____.

9. Electrical equipment is color coded _____.

10. First aid and medical equipment are painted _____.

Feedback

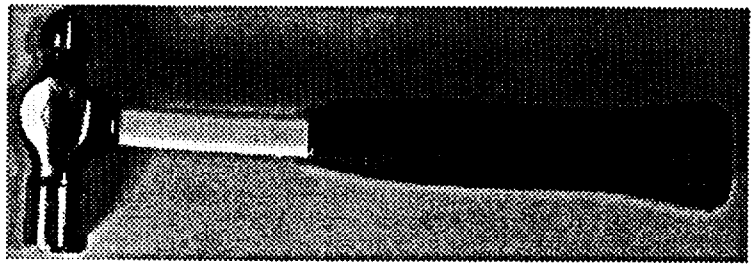
1. secured
2. only
3. flammable, explosive
4. turned off
5. goggles
6. red
7. yellow
8. orange
9. blue
10. green

If any of your answers were incorrect, determine why, and correct them. If you have no questions, continue with the next portion of the handout.

Hammers & Mallets

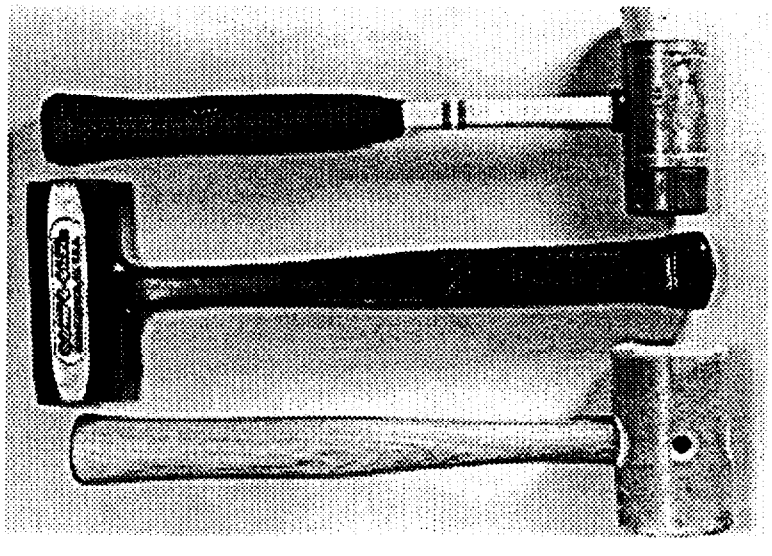
Ball Peen Hammer

The ball peen hammer, is a general purpose machinist's hammer. It is the most common type of hard faced hammer found in the aviation field. Hammers are sized by the weight of the head. The head of the ball peen hammer has two parts, the face and the peen. The face is used for general purpose work. The peen of the hammer has a smaller surface and is used in areas that are too small for the face to enter. The head is made of forged steel. Before using any hammer, ensure that the head is secure on the handle. A loose head could slip off and cause injury to personnel or damage to equipment.



Soft Faced Hammers (mallets)

Soft faced hammers are used when there is a danger of damaging the surface of the work. The heads of these hammers are made with various types of soft materials such as lead, plastic, brass, and tightly rolled rawhide.



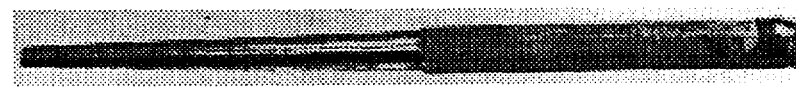
Punches

Center Punch

The center punch is used to make indentations in metal before drilling. These indentations help to prevent the drill from wandering when starting to drill a hole.

Aligning Punch

An aligning punch can be used to line up the holes of mating parts. This punch is usually about a foot in length and has a gradual taper extending from the point back.



Starting Punch

The starting punch can be used for freeing pins which may be frozen in their holes. It is designed to withstand heavy blows from a hammer.

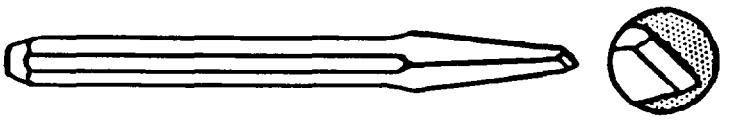
Pin Punch

The pin punch can be used as a follow up tool to the starting punch. A pin that has been broken loose can be driven the rest of the way out of the hole by the use of this punch. Always use the largest pin punch that will fit into the hole. Never use the pin punch to break a pin loose. The thin shank of this punch could flex and possibly break when subjected to heavy blows from a hammer.

Chisels

Chisels are made of tough, high carbon, steel. The tip is formed, hardened, and tempered. Chisels are classified according to the shape of their point and are sized according to the width of their cutting edge. There are many different chisels in use in aviation, but the one most often used in the shop is the cold chisel. This type of chisel is designed to be held in the hand and struck by a hammer. It is used to split nuts, chip casting, and cut thin sections of sheet metal.

When using a chisel, always select a chisel large enough for the job. Select a hammer that matches the chisel. The larger the chisel, the heavier the hammer needs to be. A large chisel will absorb the blows of a small hammer, and will do very little cutting. Keep your eyes on the edge of the chisel and not on the head. Always swing the hammer in the same plane as the chisel.

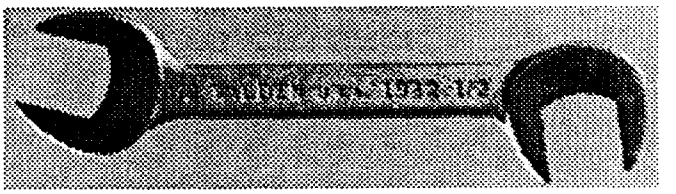


Wrenches

Wrenches are tools used to exert a twisting, or turning force on a nut, bolt head, stud, or pipe. They are manufactured of various types of steel and come in many sizes, shapes, and types. Wrenches are sized according to the size of the opening between the jaws of the wrench. This section of the handout will cover the types of wrenches commonly used in aviation.

Open-End Wrench

The open-end wrench is a solid, non-adjustable wrench with an opening at one or both ends. The jaws are generally set at a 15° angle to the body, which allows for use in tight areas where turning the wrench over will give more swing.



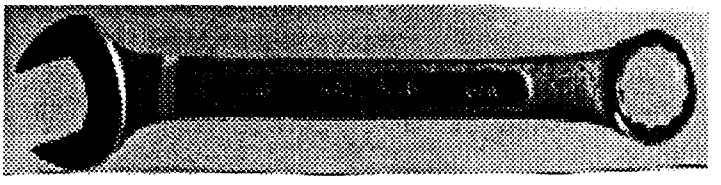
Box-End Wrench

The box-end wrench completely surrounds the bolt head or nut. The box-end wrench is thin-walled and offset 15° to the handle. This allows for its use in hard to get at places. Inside the wrench head, there will be 6, 8, 12, or 16 points. The number of points determines the strength of the wrench head.

a. 6-8 points-heavy duty
b. 12 points-medium duty
c. 16 points-light duty

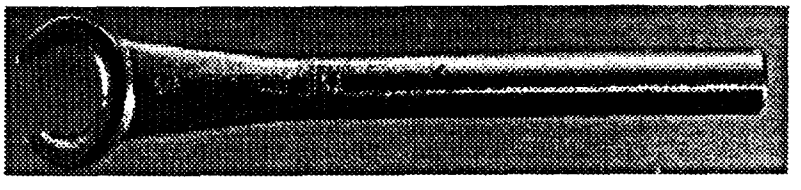
Combination Wrench

The combination wrench is the box-end and open-end wrench combined into one. With the combination wrench, you can break loose the nut, or bolt, and finish loosening it with the open end.



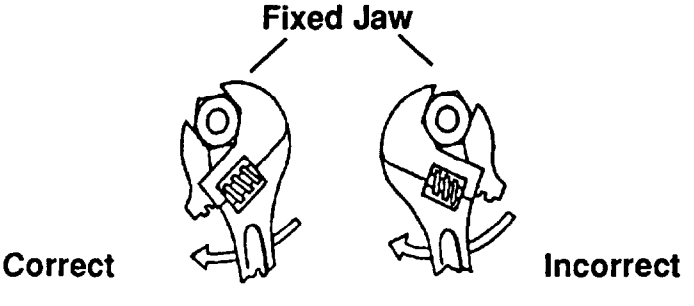
Tubing Wrench

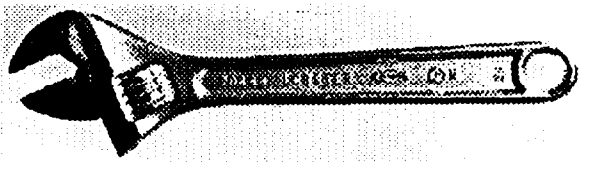
The tubing wrench is similar to the box-end with one exception. The end of the wrench has a section of it removed to facilitate fitting it over tubing and placing it on the tubing nut.



Adjustable Wrench (Crescent)

The adjustable wrench is a smooth jawed, open-end, wrench. The lower jaw is adjusted by a worm screw feature. The adjustable wrench is not designed to be used in place of the solid open-end wrench. Nor is it designed to be used on extremely hard to turn items. Always place the wrench on the nut or bolt so that the force will be applied to the stationary jaw as illustrated below. Pull the wrench rather than push it.





Hex Wrench (Allen)

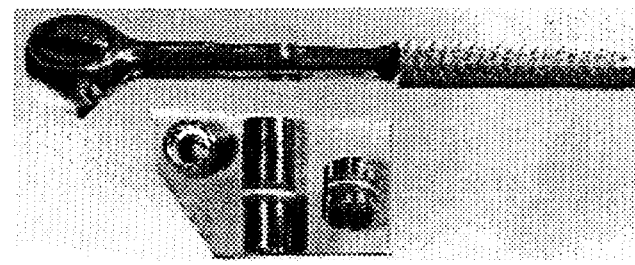
The hex or allen wrench, is a six-sided wrench made from a hexagonal, L-shaped bar of tool steel. It is used on screws or bolts which have a hexagonal recess within their heads. When using allen wrenches, always use the correct size wrench to prevent rounding of the head of the screw.

Strap Wrench

The strap wrench consists of a steel handle with a length of nylon strap connected to the handle. It is used to tighten or loosen round fittings or fittings that do not have heads that other wrenches would fit over. This tool will be used in a later unit of training. Therefore we will not describe the procedure for using it in this portion of the handout.

Socket Wrench with Ratchet Drive

A socket is a wrench shaped cylinder, with a square opening cut into one end and the other end having a 6, 8, or 12 point opening similar to that of the box-end wrench. Sockets come in sets. The size of the square hole determines the size of the drive. The drive sizes available are 1/4, 3/8, 1/2, and 3/4 inch. The size of the individual sockets is determined by the size of the spline end opening. Sockets are manufactured as either deep well or shallow well.

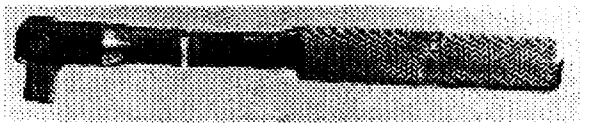


The socket wrench with ratchet drive allows you to tighten, or loosen, a nut or bolt without removing the socket from the bolt head or nut. The head of the ratchet has a reversing lever which enables you to change the direction of pull of the wrench.

Wrenches (Continued)

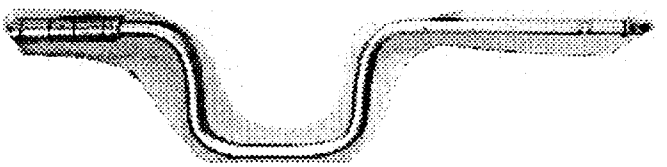
Hinged Offset Handle

The hinged offset handle is designed to be used with a socket. The head of the handle swivels at right angles to the handle. This tool is very convenient in tight places when you need to tighten, or loosen, a nut or bolt.



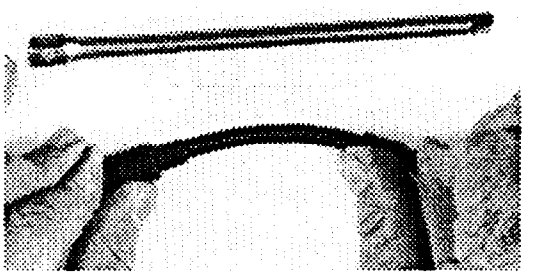
Speed Handle

The speed handle is used to quickly install, or remove, nuts, bolts or screws. The speed handle is not designed to break nuts loose or for final torque.



Extensions

Extensions are used to extend the handle of the wrench above any obstruction that may prevent turning the wrench. Extensions are available in a variety of lengths. There are also flexible extensions available.



Screwdrivers

Screwdrivers

A screwdriver is a tool designed only for installing, and removing, screws. There are three main parts to a screwdriver.

a. Handle

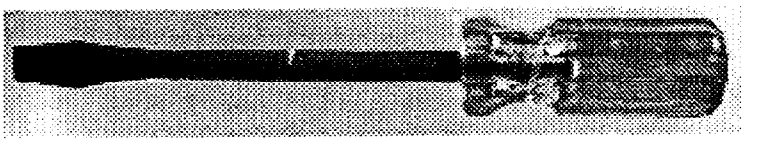
b. Shank

c. Blade

Screwdrivers are designed to withstand a considerable twisting force. Usually the tips of screwdrivers are hardened. Some screwdrivers have square shanks, which allow the use of a wrench in situations where a greater amount of torque is needed.

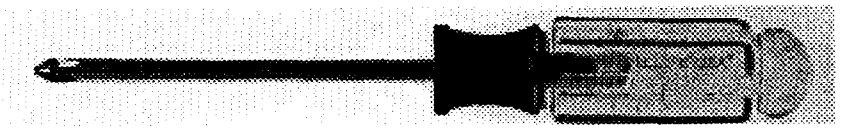
Standard Screwdriver

The standard screwdriver is used on screws that have a straight slot in their heads.



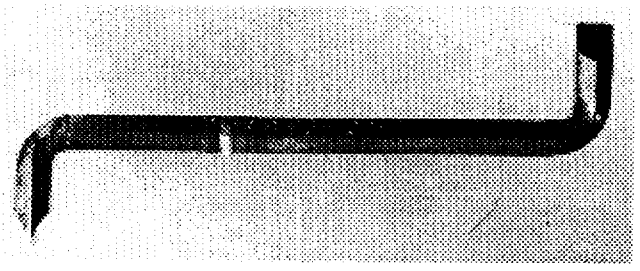
Phillips

The phillips screwdriver is the most common type of recessed head screwdriver. The screwdriver has a blunt end with four flukes formed at 30° angles to the shaft. The tip must fill 100% of the screw recess to prevent damaging the recess in the screw or the blade of the screwdriver.



Off-Set

An offset screwdriver is constructed with one blade forged in line with the shank and the other blade at a right angle to the shank. Both blades are formed 90 degrees to the shank handle. This screwdriver is used when there is not enough room for the use of a standard screwdriver. The blades of the offset screwdriver come in both standard and phillips style.



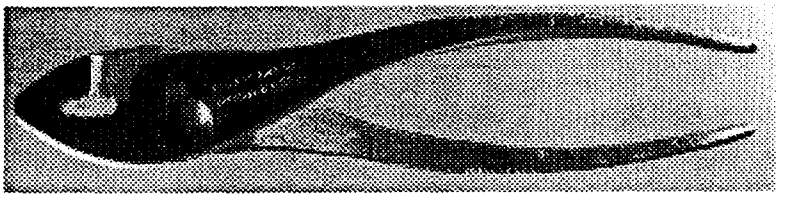
Pliers

Pliers

Pliers are manufactured in various styles and sizes to perform many different operations. The size of pliers is determined by their overall length. Pliers should never be used in place of a wrench.

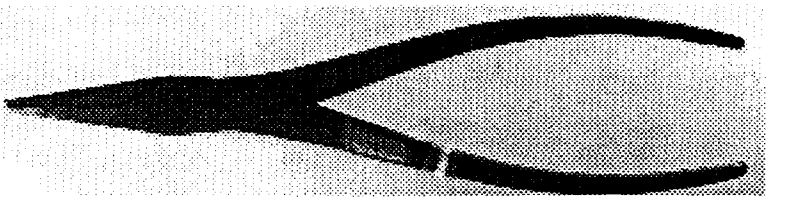
Slip Joint Pliers

Slip joint pliers have straight, serrated jaws, and a pivot to which the jaws are attached. This attachment point allows for the jaws to be set in one of two positions. With the two positions available you can grasp large, or small, objects.



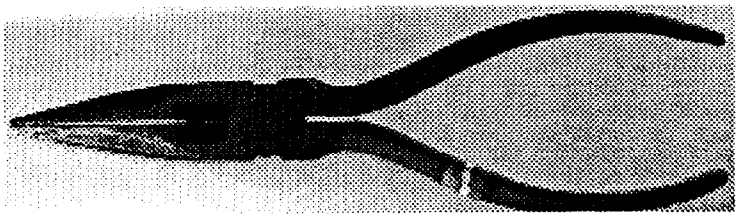
Duck Bill Pliers

Duck bill pliers have long, wide jaws, and slender handles. These pliers are ideal for use in safety wiring and work involving cotter pins.



Needle Nose Pliers

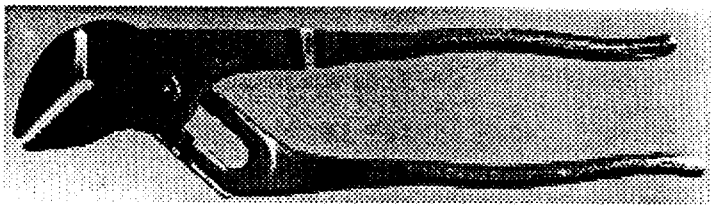
Needle nose pliers are used in the same manner as duck bill pliers, but have jaws that are long and tapered to a point. There is a side cutter in the jaws which will cut small diameter wire.



Pliers (Continued)

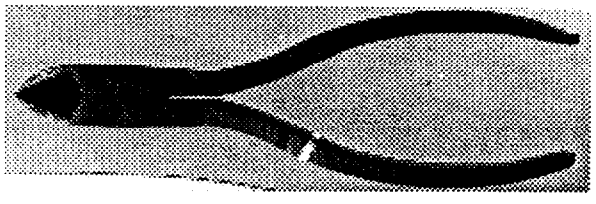
Channel Lock Pliers

Channel lock pliers have jaws which can be adjusted in seven different positions. This allows use of the pliers for gripping many different size items. The handles on these pliers are extra long. These handles enable the user to achieve a much tighter grip on the object being held.



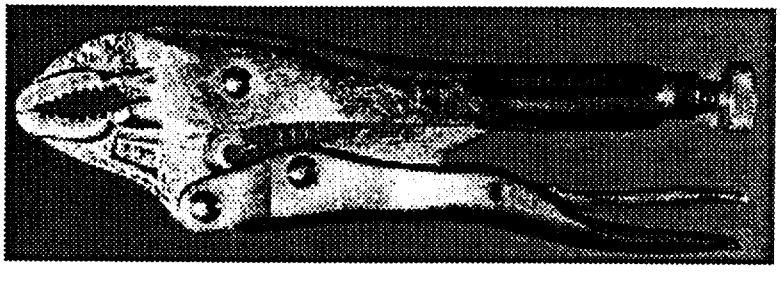
Diagonal Cutting Pliers (dikes)

Diagonal cutting pliers are used for cutting small wire such as safety wire or cotter pins.



Vise Grip Pliers

Vise grip pliers can be used to hold objects regardless of their shape. There is a screw adjustment in one of the handles which makes them adjustable to a variety of sizes. These pliers have an advantage over other types of pliers in that you can clamp them in place, leaving your hands free to work. Do not use these pliers on nuts, bolts, tube fittings, or items that must be reused since the serrations in the jaws will damage the item being worked on.

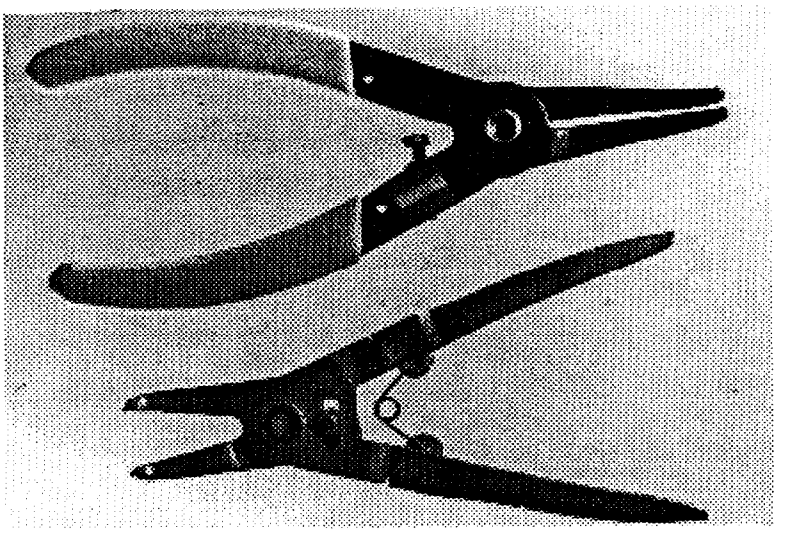


Retaining Ring Pliers (snap ring pliers)

There are two types of retaining ring pliers for removal and installation of retaining rings.

a. Inside-compresses retaining ring.
b. Outside-expands retaining ring.

Do not use these pliers for anything other than for what they are designed. The tips are delicate and will bend, or break easily.



Files

A file consists of five different parts:

a. **TANG** - Retains the handle
b. **HEEL** - This portion of the file is smooth and contains no teeth. It is the part that is in between the tang and teeth.
c. **FACE** - This portion of the file contains the teeth and does the actual cutting.
d. **EDGE** - Some file edges contain teeth. If the edge does not contain teeth, it is known as a safe edge.
e. **POINT** - The tip of the file.

The length of a file is measured from the point to the heel. There are a variety of lengths available.

Files are graded according to the degree of fineness of their cuts and whether they have single, or double, cut teeth. The following text will describe the different types of files used in aviation.

Single Cut Files

Single cut files have rows of teeth cut parallel to each other. These teeth are set at an angle of 65° to the centerline of the file. Single cut files are used for sharpening tools and finish filing.

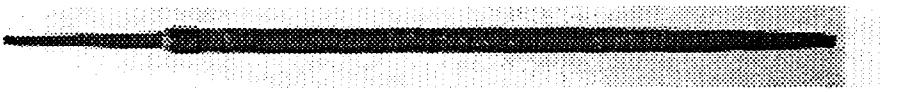
Double Cut File

Double cut files have rows of teeth that are crisscrossed. The teeth are diamond shaped and cut much faster than the single cut file. This file is used for rough work.

Files (Continued)

Square File

The square file is tapered on all four sides. It is used to shape or enlarge rectangular shaped holes.



Triangular File

The triangular file is tapered on all three sides. It is used to shape internal angles, and clear out corners. Some triangular files are used to sharpen saw teeth.

Round File (rat tail)

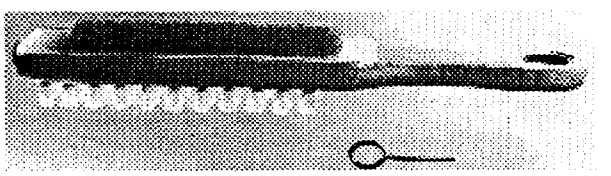
Round files may be tapered or straight. They are used to shape or enlarge round openings.

Half-Round File

This file is the most commonly used general purpose file. The rounded side is used on curved surfaces, and the flat side on flat surfaces.

File Card (file cleaner)

The file card has a stiff bristle brush on one side and a wire bristle brush on the other side. It also has a metal pick installed in the handle. To clean a file, brush the file with a pulling motion, holding the file card parallel to the rows of teeth. The metal pick can be used to free metal particles that the brush will not remove.



Procedures For Use of Files

1. A new file must be broken in on brass, bronze, or smooth cast iron.

2. Never use a file unless the handle is installed. To install the handle, insert the tang into the hole of the wooden handle. Tap the handle against a solid surface to seat it firmly.

3. When storing files, hang them on a rack or store them in drawers with wooden partitions. If you keep your files in a tool box, wrap them with rags to protect the file teeth and your other tools.

4. Never use a file for prying or pounding.

Hand Tools Practice Exercise

Self Test

1. **MATCH** the correct tool nomenclature to the statement that best describes its use.

a. ball-peen hammer
b. soft-faced hammer
c. punch
d. chisel
e. open-end wrench
f. box-end wrench
g. strap wrench
h. hydraulic tubing wrench
i. adjustable wrench
j. allen wrench
k. socket
l. ratchet
m. hinged offset handle
n. file
o. file card
p. speed handle
q. extension
r. standard screwdriver
s. philips screwdriver
t. offset screwdriver
u. slip joint pliers
v. duck bill pliers
w. needle nose pliers
x. channel lock pliers
z. diagonal cutting pliers
aa. vise grip pliers
bb. retaining ring pliers

(1) _____ A tool designed to be struck with a hammer for use in removing parts, pins, aligning mating parts, and making indentations in metal.

(2) _____ A wrench shaped cylinder with a square opening in one end and the other end having an opening similar to that of a box-end wrench.

(3) _____ Designed to be used with a socket. The head swivels at right angles to the handle.

(4) _____ General purpose machinist's hammer.

(5) _____ A tool designed to be struck by a hammer used for cutting thin sections of metal, splitting nuts, and chipping casting.

(6) _____ A solid non-adjustable wrench with an opening at one or both ends.

(7) _____ Used to remove or install screws that have a straight slot in their heads.

Continued next page

Self Test (continued)

(8) _____ Pliers having long, pointed jaws, with a side cutter that can be used to cut small diameter wire.

(9) _____ This tool can be used to sharpen tools and shape metal.

(10) _____ A hammer used when there is a danger of damaging the surface of the work.

(11) _____ Pliers with a screw adjustment in one of the handles and can be clamped in place allowing use of both hands.

(12) _____ Attaches to the drive end of a socket and is used to tighten, or loosen, a nut, or bolt, without removing the socket from the bolt head or nut.

(13) _____ This screwdriver has a blunt end and four flukes formed at 30 degree angles to the longitudinal axis of the shank.

(14) _____ The end of this wrench completely surrounds the head of the nut or bolt.

(15) _____ Designed to quickly remove or install nuts, bolts, or screws. It is not intended to be used to break nuts loose or for final torque.

(16) _____ Used to extend the handle of the wrench above any obstruction that may prevent turning of the wrench.

(17) _____ These pliers are used for cutting small wire and cotter pins.

(18) _____ This screwdriver has a blade on each end of the shank, formed at 90 degree angles, and is used in confined spaces where the use of other screwdrivers is not possible.

(19) _____ These pliers have straight serrated jaws, and a pivot to which the jaws are attached. The jaws can be set in two positions which allow grasping large or small objects.

(20) _____ These pliers have long wide jaws, and slender handles, and are ideal for use in safety wiring and work with cotter pins.

Continued next page

Self Test (continued)

(21) _____ A wrench, with a nylon strap attached to its handle, for use on round fittings or fittings where the use of other wrenches is not possible.

(22) _____ The end of this wrench has a section of the wrench removed.

(23) _____ This wrench is a smooth jawed open-end wrench with an adjustable feature.

(24) _____ Pliers with seven adjustable positions for use in gripping many different sized objects.

(25) _____ Used to remove or install screws or bolts having hexagonal recesses within their heads.

(26) _____ This tool is used for cleaning files.

(27) _____ Used to install or remove snap rings.

Self Test Answers

1. c
2. k
3. m
4. a
5. d
6. e
7. r
8. w
9. n
10. b
11. aa
12. l
13. s
14. f
15. p
16. q
17. z
18. t
19. u
20. v
21. g
22. h
23. i
24. x
25. j
26. o
27. bb

If any of your answers were incorrect, determine why, and correct them. If you have no questions, continue with the next portion of the handout.

Torque Wrenches

The high speeds and performance of aircraft cause tremendous loads to be imposed on the airframes and structural parts. It is important that each nut, bolt, and screw carry its full share of the load. In order for a fastener to do its job properly, it must be tightened, or *torqued*, to a value that is high enough to keep parts from shifting, yet not so tight as to cause failure or damage. As an aircraft repair technician you will often be required to use a torque wrench to measure the proper tightening of threaded fasteners. For example: nuts, bolts, and screws.

Torque is defined as a twisting or turning force. The formula for determining torque is T = F x A.

T = torque

F = force applied

A = length of wrench

Example: 50 pounds of force applied to a wrench 12 inches long.

T = F x A

T = 50 lbs. x 12 in.

T = 600 inch pounds

Torque Measurement

Torque is usually measured in inch-ounces, inch-pounds, or foot-pounds. The inch-ounce measurement is most often used on **small** screws in aircraft instruments and electronic equipment. The inch-pound measurement is the most commonly used unit because most fasteners fall into the **medium-size** category. When **large** bolts or nuts are torqued, foot-pound units will be specified. Different torque wrenches are available for each of these measurements.

NOTE

Always select the proper size and capacity torque wrench. The working range should not be within the lower 20% of the capacity of the torque wrench.

Example: A torque wrench of which the lowest torque value is 10 and the highest is 200, is considered to have a capacity of 200. The lower 20% of this capacity would be 0-40 (20% of 200). Normal use of this

Continued next page

Torque Measurement (continued)

wrench must be limited to values of 40 to 200. The reason for this practice is that a torque wrench has no accuracy requirement for the lower 20% of its capacity.

Often you will find that the torque to be applied to a particular nut or bolt is given in one unit of measurement and the only available torque wrench is calibrated in a different unit of measurement. This will require conversion from one unit of measurement to another in order to apply the proper torque. It is possible to convert from one unit of measure to another by either multiplication or division. There are 12 inches in a foot and 16 ounces in a pound. When converting from larger units to smaller units, you must multiply. If you are converting from smaller units to larger units, you must divide.

Torque Conversion

For conversion from one unit of measure to another, use the following formulas:

foot-pounds x 12 = inch pounds

inch-pounds ÷ 12 = foot pounds

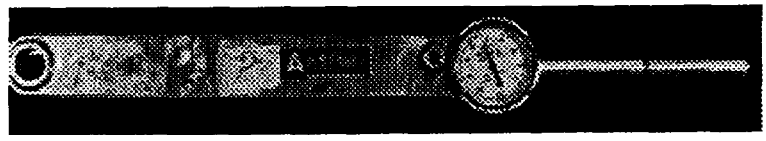
inch-pounds x 16 = inch ounces

inch-ounces ÷ 16 = inch pounds

Let's say that you need to torque a nut to 5 foot-pounds. The only torque wrench you have readily available, measures in inch-pounds, on a scale from 0 to 200. Use the formula for converting foot pounds to inch-pounds. 5 x 12 = 60 inch pounds. Now you can use the inch-pound torque wrench to achieve a torque value of 5 foot-pounds by torquing the nut to 60 inch pounds.

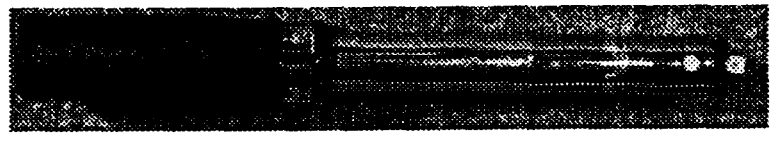
Dial Indicating Torque Wrench

This torque wrench is made up of a handle, bar, dial, and head. The pointer in the scale of the dial indicates the amount of torque being applied. This type of torque wrench is limited to applications where the dial can be seen. The dial face is rotated until the needle is over the zero. The handle is pulled in a clockwise direction until the indicator reads the desired torque.



Micrometer Setting Torque Wrench

This type of torque wrench has to be manually set to the desired torque. This is accomplished by rotating the handle until the desired scale markings of the handle line up with the scale markings of the sleeve. When the torque is reached, a sharp impulse or break-away is felt by the operator. Because of its small head, this type of torque wrench is especially useful in applications where it's difficult to read a dial face, or in tight locations.

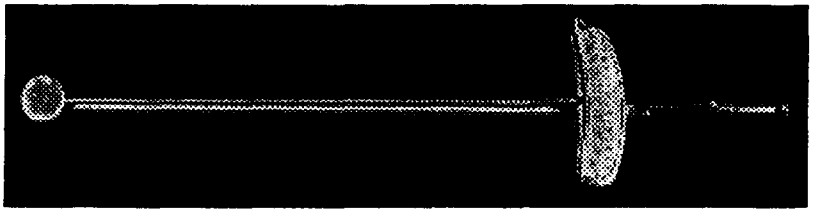


Preset Torque Wrench

This type of torque wrench is manufactured at a predetermined torque value. It is not adjustable. It is similar to the micrometer setting torque wrench in that a sharp impulse is felt when the torque setting is reached.

Deflecting Beam Torque Wrench

This wrench is made up of a shaft, beam, handle, scale, and pointer. When a torque is applied to this wrench, the shaft bends but the pointer does not. This results in a pointing indication on the scale.



Torque Screwdriver

The torque screwdriver is used to torque screws. The torque screwdriver, operates in the same manner as the micrometer setting torque wrench. The torque screwdriver will be used in Parachute Maintenance to torque the parachute connector link screws.

Attachments

The effective length of a torque wrench is measured from the center of the handle to the center of the square drive, as explained below.

Attachments which extend, or shorten, the effective length of the torque wrench are classified as lineal adapters. When an adapter changes the effective length of a torque wrench, it will change the actual torque reading applied to the nut or bolt head. The formula shown below is used to compute the torque when the use of a lineal adapter has changed the effective length of a torque wrench.

TW (indicated torque) = {TA (desired torque) x L (length of wrench)}

{L (length of wrench) + A (length of adapter)}

NOTE

Sometimes an extension will have to be used with a torque wrench. Conversion factors for torquing with an extension can be found in USAF T.O. 1-1A-8. **An extension 90° from the head of the torque wrench will allow the torque value to remain the same.**

Continued next page

Attachments (Continued)

The only components that can be used with a torque wrench are lineal adapters and coaxial attachments.

Coaxial attachments do not change the effective length of the torque wrench. The reading on the torque indicating scale will be correct when using any coaxial attachment.

Use of Torque Wrenches

a. Torque wrenches are precision tools and must be handled carefully.

b. Always apply torque to the nut unless otherwise specified.

c. Tighten a series of nuts, or bolt heads, at a uniformly increasing rate. Final torque should not be applied during the first draw down.

d. When tightening a series of nuts, or bolt heads, tighten in a diametrically opposed pattern.

e. Replace nuts or bolts if they are over torqued.

f. Never lubricate threads unless it is specified.

g. **Do not memorize torque values.** They can normally be found in the maintenance instruction on the job being performed. If they cannot be found, refer to the standard torque chart located in the maintenance manual.

h. Always check the torque wrench for accuracy before using it. There are provisions at each air station for mechanical testing of accuracy of torque wrenches. Consult the quality assurance office of the engineering department for torque wrench recalibration.

i. If the wrench is dropped it must be rechecked and/or recalibrated immediately.

j. Always check the calibration date on the torque wrench before using it. If it has not been calibrated within the past 60 days, do not use it.

Continued next page

Use of Torque Wrenches (Continued)

k. After storage of the micrometer setting torque wrench or after shipment, actuate the handle through a few release cycles. This actuation permits the internal mechanism to redistribute a film of lubricant throughout the working parts.

l. Keep the wrench clean and free of all dirt and grease.

m. Always return the wrench to its stowage box, or kit, when finished with it.

n. Always visually inspect the torque wrench for damage before using. If damages such as a bent pointer, cracked or broken glass (dial type), or signs of rough handling are found, the wrench must be repaired and tested for accuracy before its next use.

o. After use of the micrometer setting torque wrench, set the scale to zero before returning it the storage box to prevent damage to the internal spring.

Special Aviation Hand Tools Practice Exercise

Self Test

COMPLETE the following statements describing procedures for locating and using torque values, and the care and use of torque wrenches.

1. Torque is defined as a _____ or _____ force.

2. The working range of a torque wrench should not be within the lower _____ percent of its working capacity.

3. Do not _____ torque values.

4. Torque values can be found in the _____ _____ located in the maintenance manual.

5. Torque wrenches are precision tools and must be handled _____.

6. Always _____ the torque wrench for accuracy before using it.

7. If a torque wrench is _____, it must be rechecked and/ or recalibrated immediately.

8. If a torque wrench has not been calibrated within the past _____ days, do not use it.

9. After using a micrometer setting torque wrench, set the scale to _____ before returning it to its storage container.

Special Aviation Hand Tools Practice Exercise (Continued)

Answers

1. Twisting or turning
2. 20
3. memorize
4. standard torque chart
5. carefully
6. check
7. dropped
8. 60
9. zero

If any of your answers were incorrect, determine why and correct them. If you have no questions concerning torque wrenches, you may proceed with the next portion of the handout.

Aircraft Hardware

Introduction

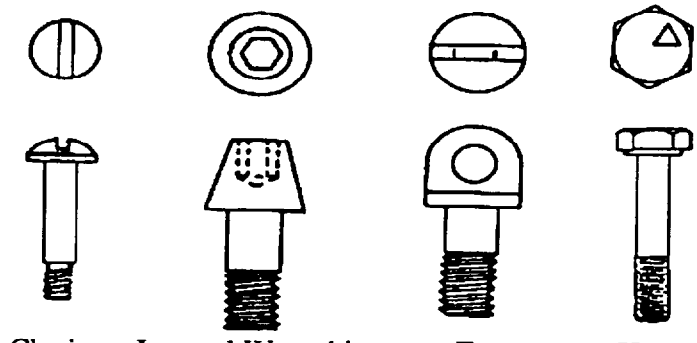
There are many nuts, bolts, screws, rivets, washers, cotter pins, and snap rings on an aircraft. These, and other similar items, are classified as aircraft hardware.

The importance of aircraft hardware is often overlooked because of its small size. However, the safe and efficient, operation of any aircraft is greatly dependent upon the correct selection, and use, of aircraft hardware. In this lesson, you will learn some of the classifications and types of hardware and how they are used.

Bolts

Bolt Types

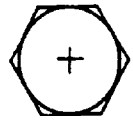
Of the many types of bolts, the four most common are hex-head, eyebolt, clevis, and internal wrenching. An internal-wrenching bolt has a recessed head to receive the internal (Allen) wrench. The hex-head bolt is an all-purpose bolt used for general applications. The eyebolt is a special purpose bolt used where external tension loads are to be applied. The clevis bolt is used only for shear loads. These four types of bolts are illustrated below.



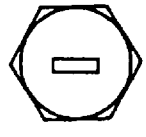
Clevis Internal Wrenching Eye Hex-Head

Bolt Identification Symbols

Symbols stamped on the head of a bolt indicate the material from which the bolt is made and/or the use for which the bolt is intended. There are many different symbols used on bolts. Since this is a basic lesson, we will look at only three of these symbols. The symbol on the bolt shown below, indicates that it is made from steel.



The next symbol is for a corrosion resistant steel bolt.



A close tolerance bolt is identified by a triangle on the head.

Remember, there are many symbols and combinations of symbols, we have looked at only three of them.

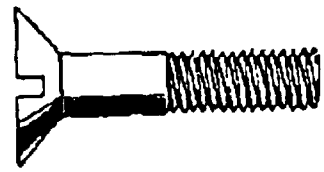
Screws

Machine Screw

Machine screws are used for general-purpose work. Normally these screws have threads running their full length.

Structural Screw

Structural screws do not have threads running the full length. They are normally used for the assembly of primary structural units of an aircraft.



Self-tapping Screw

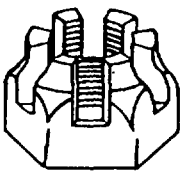
Self-tapping screws cut their own threads they are often used in soft metals or other soft materials. Self-tapping screws may have a pointed, or a flat tip with a slot cut into it.

Nuts

As with bolts and screws, there are many different types of nuts. Each one has a different use. Basically, there are two major classifications of nuts. These are **self-locking** and **nonself-locking.** The difference between the two is that a nonself-locking nut must be safetied by an external device, such as a cotter pin or lock-wire. The self-locking nut has a built-in locking device, such as an elastic or metal insert.

Non-Self-Locking Nuts

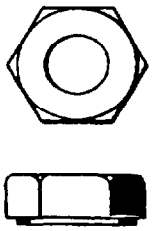
Castle and castellated shear nuts have slots that provide for cotter pin installations. The castle nut is fairly rugged and can withstand large tensional loads. The castellated shear nut is thinner than the castle nut and is not used where tension is applied.



Castle nut

Castellated shear nut

The plain hex nut has limited use in aviation because of the high vibration characteristics of aircraft. Plain hex nuts are safetied with lock washers or jam nuts.



Plain hex nut

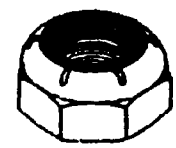
The last type of nonself-locking nut we will cover is the wing nut. A wing nut is used where the desired tightness can be obtained with the fingers and the assembly is frequently removed. Wing nuts may be safetied by lockwire, jam nuts, or lockwashers.

Wing nut

Self-locking Nuts

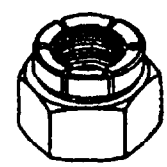
Unlike nonself-locking nuts, self locking nuts contain a locking feature as part of the nut. The two types of self-locking nuts we will cover are the nonmetallic insert (elastic stop nut) and the all-metal (flexloc).

The nonmetallic insert nut is commonly referred to as an elastic stop nut. It incorporates a fiber or nylon insert of a smaller diameter than the thread size of the nut. The screw, or bolt, cuts threads into the insert. Self-locking nuts with a fiber insert should only be used in low-temperature areas. The drawing below shows a non-metallic insert nut. The shaded area represents the fiber insert.



Non-metallic Insert Nut

The all-metal, or Flexloc, nut is a self-locking nut designed for use in high-temperature areas, such as exhaust systems. Normally, the self-locking feature is a saw-cut top and pinched-in threads. These features exert a squeezing pressure on the screw or bolt thereby preventing the nut from loosening.



All-metal (Flexloc) nut

Turnlock Fasteners

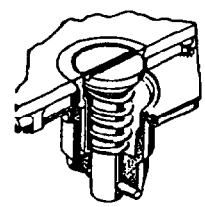
Turnlock Fasteners

Each time an aircraft returns from a flight, some of the access panels must be removed for inspection and servicing. As screws would require a great amount of time for removal, turnlock fasteners are used on these panels. Turnlock fasteners provide the advantage of quick, and easy, removal of these panels.

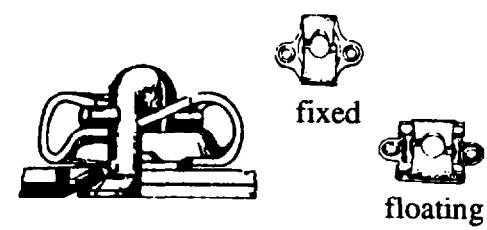
A turnlock fastener has a head similar to a screw. There are three types of turnlock fasteners in use in aviation. These are the **Camloc**, **Airloc**, and **Dzus** fasteners. Approximately one-half turn clockwise is required to secure all three turnlock fasteners.

Camloc & Airloc Fasteners

The illustrations below, show the Camloc and the Airloc fasteners. Notice that they are very similar. Each type has a stud, and on the end of the stud is a cross pin. A receptacle is located on the airframe and the stud assembly is located on the access panel. The difference between these two fasteners is the receptacle for the pin.



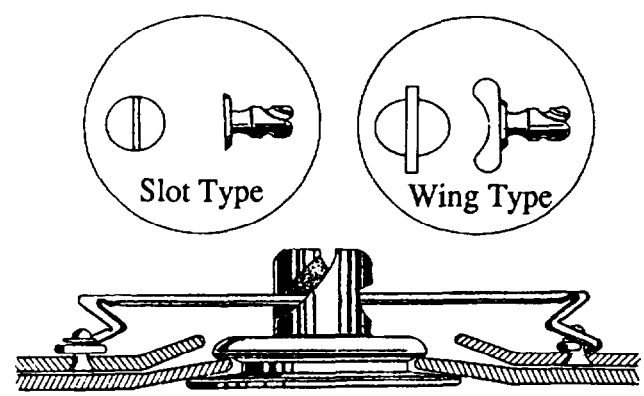
Camloc fastener



Airloc fastener & receptacles

Dzus Fastener

The Dzus fastener does not have a cross pin on the stud. Instead, the stud is slotted. Locking is accomplished by the slots engaging with a spring located on the airframe.



Dzus fastener

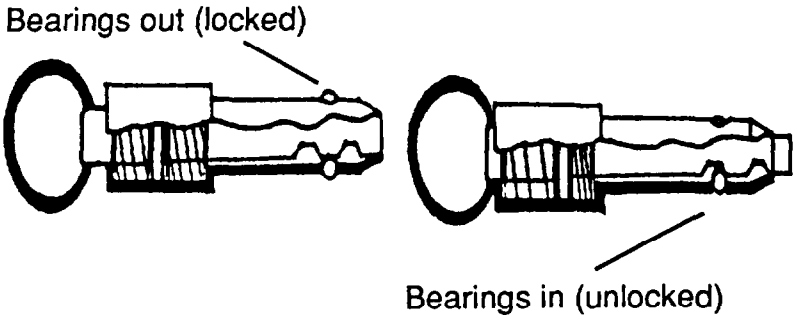
Pip-Pins

Pip-Pins

Pip-Pins are used where rapid removal or replacement of equipment is desired. An example of the use of pins is to hold troop seats in place.

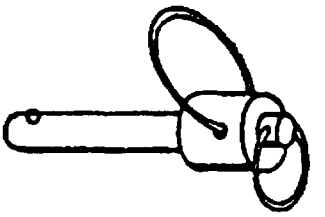
There are two types of pip-pins; single action and double action. On both types, there are two ball bearings mounted on the shaft of the pip. By actuating the release mechanism, the ball bearings drop inward allowing the insertion or removal of the pip-pin.

The below illustration demonstrates the operation of the pip-pin bearing locking mechanism.



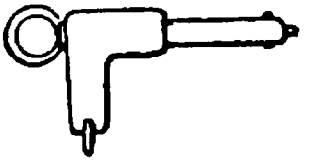
Double Action Pip-Pin

On the double action pip-pin, either pushing or pulling on the release mechanism will allow the ball bearings to drop inward.



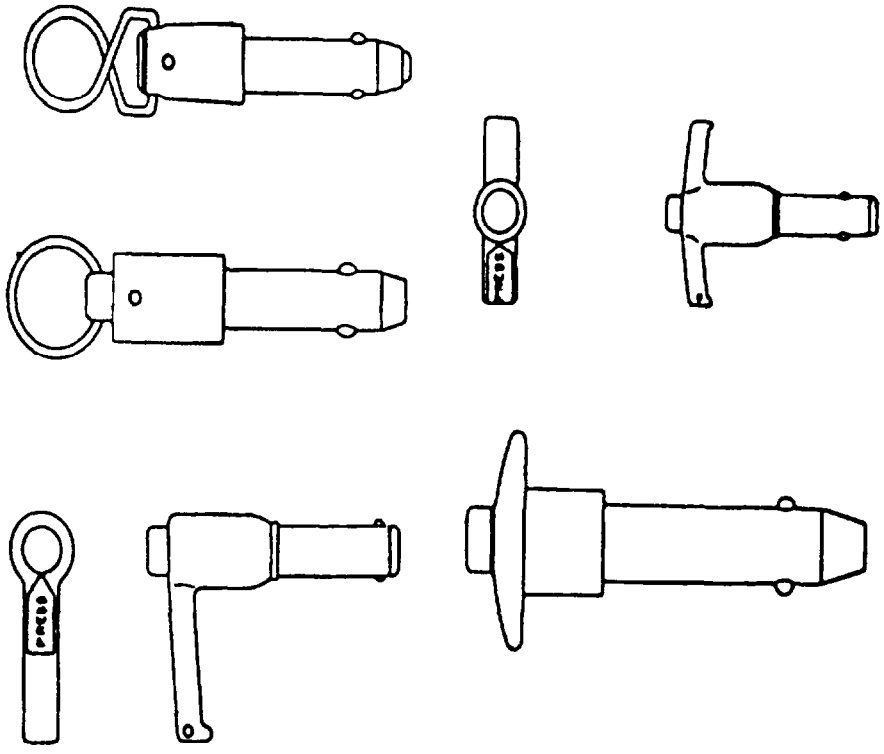
Single Action Pip-Pin

On the single action pip-pin, the release mechanism must be pushed in. It will not release by pulling.



Various Pip-Pins

Illustrated below are some of the various pip-pins you may use in your aviation career.



Self Test

1. Below is a list of fastener nomenclature and a list of statements that describe the use and application of each. **MATCH** the nomenclature to the statement that describes its use and application by placing the letter in the space provided.

a. Hex-head bolt	i. Castle nut
b. Clevis bolt	j. Plain hex nut
c. Internal-wrenching bolt	k. Wing nut
d. Eyebolt	l. Non-metallic insert nut
e. Machine screw	m. Flexloc nut
f. Structural screw	n. Camloc & Airloc fastener
g. Self-tapping screw	o. Dzus fastener
h. Castellated shear nut	p. Pip-pin

(1) _____ Is used where the desired tightness can be obtained by the fingers and the assembly is frequently removed.

(2) _____ This fastener has a slotted stud and locks by engaging with a spring located on the airframe.

(3) _____ A screw used for general purpose work usually having threads running the full length of the screw.

(4) _____ This bolt is an all-purpose bolt used for general applications.

(5) _____ This all-metal nut is a self-locking nut designed for use in high-temperature applications.

(6) _____ Cuts its own threads in the material it is being used on.

(7) _____ This nut has limited use and is safetied by use of a washer or jam nut.

(8) _____ This fastener has a stud, and on the end of the stud is a cross pin.

(9) _____ A special purpose bolt used where external tension loads are to be applied.

(10) _____ A rugged nut which can withstand large tension loads.

Continued next page

Self Test (Continued)

(11) _____ This bolt is used as a shear bolt.

(12) _____ This nut incorporates a fiber or nylon insert.

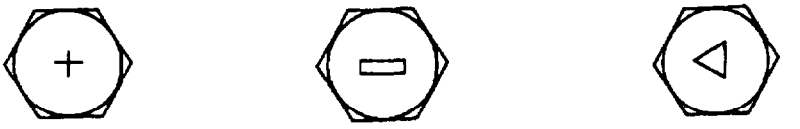
(13) _____ A screw normally used for the assembly of primary structural units of an aircraft.

(14) _____ A nut which is thin and is not used where tension is required.

(15) _____ This bolt has a recessed head to receive the allen wrench.

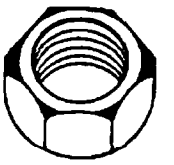
(16) _____ Used where rapid removal or replacement of equipment is desired.

2. **IDENTIFY** the following bolt symbols.



a._____ b._____ c._____

3. **IDENTIFY** the following aircraft hardware.



a. _____ b. _____

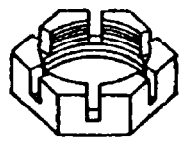
c. _____ d. _____

Continued next page

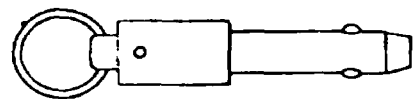
Self Test (Continued)

e. _____

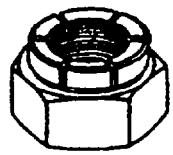
f. _____



g. _____

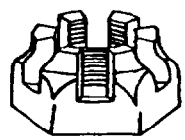


h. _____



i. _____

j. _____



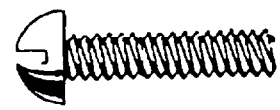
k. _____

l. _____

m. _____

n. _____

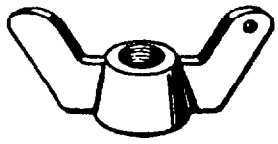
o. _____



p. _____

Continued next page

Self Test (Continued)



q. _____

_____

Aircraft Hardware Practice Exercise (Continued)

Answers

1. (1) k
   (2) o
   (3) e
   (4) a
   (5) m
   (6) g
   (7) j
   (8) n
   (9) d
   (10) i
   (11) b
   (12) l
   (13) f
   (14) h
   (15) c
   (16) p

2. a. Steel Bolt
   b. Corrosion resistant bolt
   c. Close Tolerance

3. a. Clevis
   b. Plain Hex nut
   c. Airloc fastener
   d. Hex-head bolt
   e. Eyebolt
   f. Self-tapping screw
   g. Castellated shear nut
   h. Pip-pin
   i. Flexloc nut
   j. Dzus fastener
   k. Castle nut
   l. Structural screw
   m. Internal-wrenching bolt
   n. Non-metallic insert nut
   o. Camloc Fastener
   p. Machine screw
   q. Wing nut

If any of your answers were incorrect, determine why, and correct them.

UNITED STATES COAST GUARD
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SUBJ: _____

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1. The materials for the course you requested are listed below. If any item listed is not enclosed in this package, report that fact to your Educational Services Officer (ESO).

2. This course is for information only. You will not receive an End-of-Course Test (EOCT) and you will not receive credit for the course.

COMPONENT	NUMBER	QTY
Airman Syllabus	A600S1	1
Airman Handbook	A60001	1
Aviation Administration E-4	A1AA03	1