DOCUMENT RESUME

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IDENTIFIERS	Air Force; *Turboprop Engines

ABSTRACT

This instructional package consists of a plan of instruction, glossary, and student handouts and exercises for use in training Air Force personnel to become turboprop propulsion mechanics. Addressed in the individual lessons of the course are the following: common hand tools, hardware, measuring devices, and safety wiring; aircraft and engine fundamentals; maintenance management; engine preservation and storage; safety devices; mechanical hand tools; fuel systems; temperature data systems; engine starter and ignition systems; multimeters; electrical safety; engine repair and testing; technical publications; and propeller rigging and adjustments. The lesson plans included in the plan of instruction include a presentation outline, suggested times for covering individual topics, student materials and audiovisual aids required for the lesson, suggested instructional methods, and instructional guidelines. The student-use portion of the package includes programmed instructional texts, study guides, handouts, and exercises. (MN)

ED265355

TURBOPROP PROPULSION MECHANIC

CHANUTE TECHNICAL TRAINING CENTER
AIR TRAINING COMMAND

CE 043311

PLAN OF INSTRUCTION

(Technical Training)

TURBOPROP PROPULSION MECHANIC

3 April 1984

CHANUTE TECHNICAL TRAINING CENTER

3 April 1984-Effective 3 April 1984 with class 840403

LIST OF CURRENT PAGES

This POI consists of 111 current pages issued as follows:

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DEPARTMENT OF THE AIR FORCE
3330 Technical Training Wing (ATC)
Chanute Air Force Base, Illinois 61868

PLAN OF INSTRUCTION C3ABR42633 000
(PDS Code ZNH)
3 April 1984

FOREWORD

1. PURPOSE: This publication is the plan of instruction (POI) when the pages listed on page A are bound into a single volume. When separated into units of instruction, it becomes the lesson plan/part I. The POI contains the qualitative requirements for course C3ABR42633 000, Turboprop Propulsion Mechanic, in terms of criterion objectives for each unit of instruction and shows planned time, training standard correlation, and support materials and guidance. This POI was developed according to ATCR 52-18.

2. COURSE DESIGN/DESCRIPTION: The instructional design for this course is Group/Lock Step. The course trains airmen to perform duties prescribed in AFR 39-1 for Turboprop Propulsion Mechanic, AFSC 42633. Training includes operation, removal, disassembly, inspection, repair, assembly, test and installation of hydraulically operated propellers, controls and accessories. Operating principles, engine change, adjustments and conditioning of turboprop engines and systems. Disassembly, inspection, repair, and assembly of turboprop engine. Emphasis in ground safety practices; associated ground support equipment; electrical fundamentals; technical publications and familiarization with organizational and intermediate, maintenance forms, maintenance documentation, and man-hour accounting as applicable to engine and propeller maintenance. In addition, military training is provided on commander's calls and physical conditioning.

NOTE: Block training (instructional) sequence may vary so that cross utilization of equipment can be made.

3. TRAINING EQUIPMENT: The number shown in parentheses after equipment listed as Training Equipment under SUPPORT MATERIALS AND GUIDANCE is the planned number of students assigned to each equipment unit.

4. REFERENCES: This POI is based on Specialty Training Standard 426X3, January 1983, and Course Chart C3ABR42633 000, 3 April 1984.

FOR THE COMMANDER

DRUE L. DeBERRY, Lt Colonel, USAF
Commander, 3350 Tech Tng Gp

Supersedes POI C3ABR42633 000, 3 May 1983.
OPR: 3350 Technical Training Group
Prepared by: Normand I. Ross, Chief, TDS
Distribution: Listed on Page A

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Fundamentals

1. COURSE CONTENT	2. TIME
1. Orientation a. School orientation conducted in accordance with CR 50-18, Attachment 3. STS: None Meas: None	3

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-100, Bibliography

Audio Visual Aids
TF 6025A, C-130 Aircraft

Training Methods
Lecture/Discussion (3 hrs)

Instructional Guidance
Conduct orientation in accordance with CR 50-18. Stress management of defense energy resources and materials conservation. Give students a tour of the course and take them up on the engine change trainer to see if any are afraid of heights. Show training film on the C-130 aircraft and have the students fill out student surveys and Hometown News Release.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Fundamentals

1. COURSE CONTENT	2. TIME
2. Shop and Flight Line Safety	5
a. Without references, identify 2 out of 3 principles pertaining to accident prevention. STS: 3a Meas: PC	(.25)
b. Without references, identify 2 out of 3 facts concerning health hazards. STS: 3b Meas: PC	(.5
c. Without references, identify 2 out of 3 principles relating to protection of health. STS: 3b Meas: PC	(.25)
d. Without references, identify 2 out of 3 facts about shop safety practices. STS: 3c Meas: PC	(.5)
e. Without references, identify 2 out of 3 facts about flight line safety practices. STS: 3c Meas: PC	(.5)
f. Without references, identify 2 out of 3 facts relating to the foreign object damage prevention program. STS: 3d Meas: PC	(.5)
g. Without references, identify 2 out of 3 facts about the use of portable fire extinguishers. STS: 3e Meas: PC	(1.5)
h. Without references, identify facts about hazard reporting with no errors allowed. STS: 3f Meas: PC	(.5)
i. Without references, identify facts about mishap reporting with no errors allowed. STS: 3g Meas: PC	(.5)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-102A, Inspection and Operation of Portable Fire Extinguishers
C3ABR42633-WS-102, Shop and Flight Line Safety

Audio Visual Aids
35mm Slides: Accident Prevention Program

Training Methods
Lecture/Discussion (5 hrs)

Instructional Guidance
Discuss principles of accident prevention, health hazards, protection of health, shop and flight line safety practices, foreign object damage and use of portable fire extinguishers. This will take you up to objective 2g step (1)(d)3 on day 1 lesson plan. Have the students complete appropriate question in WS-102 before administering the PCs 12a thru 12f. During the first part of day 2, finish discussing portable fire extinguishers and hazard/mishap reporting. Have student complete questions in WS-102 prior to administering the PCs 12g thru 12i.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Fundamentals

1. COURSE CONTENT	2. TIME
3. Study Skills a. Without references, identify facts pertaining to how to study. STS: None Meas: None	2

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
ATC PT 52-11, Study Skills

Training Methods
Supervised Project (SP) (2 hrs)

Instructional Guidance
The students will complete PT 52-11, study skills, with their answers on a separate sheet of paper. This assignment will take them approximately 2 hours to complete and will be checked for completeness. This objective, 3a, is not measurable.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Fundamentals

1. COURSE CONTENT	2. TIME
4. Aircraft and Engine Fundamentals	12.5
a. Without references, identify 2 out of 3 facts about aircraft designators. STS: 4a Meas: PC	(1.5)
b. Without references, identify 2 out of 3 facts relating to engine designators. STS: 4a Meas: PC	(1.5)
c. Without references, identify 2 out of 3 facts pertaining to engine operation. STS: 11a Meas: PC	(3)
d. Without references, identify 2 out of 3 facts about the constructional features of each of the following engine sections:	
(1) Reduction gearbox. STS: 11b(1) Meas: PC	(1)
(2) Torquemeter assembly. STS: 11b(2) Meas: PC	(1)
(3) Compressor section. STS: 11b(3) Meas: PC	(1)
(4) Combustion section. STS: 11b(4) Meas: PC	(1)
(5) Turbine section. STS: 11b(5) Meas: PC	(1.5)
(6) Accessory section. STS: 11b(6) Meas: PC	(1)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-104, Glossary
C3ABR42633-SG-104, Aircraft and Engine Fundamentals
C3ABR42633-WB-104, Jet Engine Theory
C3ABR42633-WB-104A, T56 Engine Cases and Parts
C3ABR42633-WB-104B, Engine Major Sections and Parts

Audio Visual Aids
Allison Engine Chart
TF 1-5364, An Introduction to Jet Engines
NSC 42-22, Aircraft and Engine Designators

Training Equipment
T56 Engine (12)

Training Methods
Lecture/Discussion (12.5 hrs)

Instructional Guidance
First discuss aircraft and engine designators using 35mm slides (Aircraft and Engine Designators). Administer PCs 14a and 14b. Next start discussing engine operation during the last part of the morning. Finish the lesson on engine operation in first two hours of day 3. Have trainees do WB-104 then administer PC 14c. Then discuss T56 engine constructional features, from the reduction gearbox to combustion section. Have students complete applicable sections of WB-104A and administer PCs 14d(1) thru 14d(4). On day 4 finish the lesson on constructional features on the turbine and accessory drive sections during the first 2.5 hours of the day. Have trainees finish WB-104A and administer PCs 14d(5) and 14d(6).

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Fundamentals

1. COURSE CONTENT	2. TIME
5. Maintenance Management	6
a. Without references, identify facts pertaining to the functions of the Deputy Commander for Maintenance without error. STS: 7a Meas: PC	(.5)
b. Without references, identify 2 out of 3 facts pertaining to the responsibilities of the Deputy Commander for Maintenance. STS: 7a Meas: PC	(.75)
c. Without references, identify 2 out of 3 facts about the functions of the management units that make up the Deputy Commander for Maintenance staff. STS: 7b Meas: PC	(1)
d. Without references, identify 2 out of 3 facts relating to processing material. STS: 7d Meas: PC	(.75)
e. Without references, identify 2 out of 3 facts relating to controlling material. STS: 7d Meas: PC	(.75)
f. Without references, identify 2 out of 3 facts relating to cross utilization training without error. STS: 7e Meas: PC	(.5)
g. Without references, identify 2 out of 3 principles about the maintenance system. STS: 8a Meas: PC	(1)
h. Without references, identify 2 out of 3 facts pertaining to maintenance data collection. STS: 7c Meas: PC	(.75)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-PT-105, Maintenance Management

Training Methods
Supervised Project (SP) (6 hrs)

Instructional Guidance
This assignment (Maintenance Management, PT-105) will take the trainees approximately 6 hours to complete. Trainees will be given PCs 15a thru 15h at the end of each two objectives for the sections of PT-105 they have completed.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Fundamentals

1. COURSE CONTENT	2. TIME
6. Technical Publications and Forms	10.5
a. Without references, identify facts about the use of AF manuals, without error. STS: 4c Meas: PC	(.25)
b. Without references, identify facts about the use of AF regulations, without error STS: 4c Meas: PC	(.25)
c. Without references, identify 2 out of 3 principles about the TO system. STS: 4a Meas: PC	(4)
d. Without references, identify the purpose of TCTOs, without error. STS: 4d Meas: PC	(.25)
e. Without references, identify 2 out of 3 facts about the types of TCTOs. STS: 4d Meas: PC	(.75)
f. Given the aircraft work unit code manual, TO 00-20-2-2, document maintenance actions with no more than 7 errors on Form 349 and 6 errors on Form 350. STS: 4b, 8c Meas: PC	(5)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-106, Air Force Technical Order (AFTO) System
C3ABR42633-WB-106, Air Force Technical Order (AFTO) System
C3ABR42633-WB-106A, Aircraft Maintenance Concept
TO 00-20-2-2
TO 1C-130A-06, Aircraft Work Unit Code Manual
TO 1C-130B-2-4, Maintenance Instructions
TO 1C-130B-1, Flight Manual
TO 2J-T56-24
TO 2J-T56-26

Audio Visual Aids
TF 5890, Right The First Time
Training Charts, AFTO Forms 349, 350, and 781A

Training Methods
Discussion/Demonstration (10.5 hrs)

Instructional Guidance
The rest of day 4 will be spent on discussing the use of AF manuals, AF regulations, and principles of the AFTO system. Give PCs 16a and 16b. In first hour of day 5 finish the AFTO system and give PC 16c. Then discuss the purpose of TCTOs and types of TCTOs. Give trainees PCs 16d and 16e. Next discuss how to use the -06 work unit code manual and have trainees finish WB-106A. Discuss how to use TO 00-20-2-2 and demonstrate how to complete AFTO Forms 349 and 350. Finish instruction of AFTO forms in first hour of day 6. Give trainees PC 16f.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Fundamentals

1. COURSE CONTENT	2. TIME
7. Engin. stem Locations	19
a. Using TOs 1C-130B-2-4 and 1C-130B-1, identify 2 out of 3 facts about the arrangement of the starter system. STS: 11c(1) Meas: PC	(3)
b. Using TOs 1C-130B-2-4 and 2J-T56-24, identify 2 out of 3 facts about the arrangement of the ignition system. STS: 11c(2) Meas: PC	(4)
c. Using TOs 1C-130B-2-4 and 2J-T56-24, identify 2 out of 3 facts about the arrangement of the oil system. STS: 11c(3) Meas: PC	(2.5)
d. Using TOs 1C-130B-2-4 and 2J-T56-24, identify 2 out of 3 facts relating to the arrangement of the fuel system. STS: 11c(4) Meas: PC	(2.5)
e. Using TOs 1C-130B-2-4 and 2J-T56-24, identify 2 out of 3 facts relating to the arrangement of the bleed air system. STS: 11c(5) Meas: PC	(1)
f. Using TOs 1C-130B-2-4 and 2J-T56-24, identify 2 out of 3 facts relating to the arrangement of the anti-icing system. STS: 11c(6) Meas: PC	(1)
g. Using TO 1C-130B-1, identify 2 out of 3 facts relating to the arrangement of the fire warning system. STS: 11c(7) Meas: PC	(1)
h. Using TO 1C-130B-1, identify 2 out of 3 facts relating to the arrangement of the overheat warning system. STS: 11c(8) Meas: PC	(1)
i. Using TO 1C-130B-2-4, identify 2 out of 3 facts relating to the arrangement of the negative torque signal system. STS: 11c(11) Meas: PC	(1)
j. Using TOs 1C-130B-1, 1C-130B-2-4, and 2J-T56-24, identify 2 out of 3 fac relating to the arrangement of the engine indicating system. STS: 11c(12) Meas: PC	(1)
k. Using TOs 1C-130B-1 and 1C-130B-2-4, identify 2 out of 3 facts about the arrangement of the temperature datum system. STS: 11c(9) Meas: PC	(1)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
TO 1C-130B-1, Flight Manual
TO 1C-130B-2-4, Maintenance Instructions - Power Plant
TO 2J-T56-24, Illustrated Parts Breakdown - T56-A-7 Engine

Audio Visual Aids
Allison Engine Chart

Training Equipment
T56 Engine (12)
Engine System Parts (12)

Training Methods
Discussion/Demonstration (19 hrs)

Multiple Instructor Requirements
Supervision and Equipment (2)

Instructional Guidance
On day 6 discuss how to use TOs 1C-130B-2-4 and 1C-130B-1 to include arrangement of the starter system. Have trainees finish the appropriate section of WB-107A, then give them PC 17a. Next discuss how to use TO 2J-T56-24 and include TO 1C-130B-2-4 in discussing the arrangement of the ignition system. Finish discussing the ignition system in the first 2 hours of day 7. Have trainees finish the appropriate section in WB-107A and administer PC 17b. Next discuss the oil system using TO 1C-130B-2-4. Have trainees finish the appropriate section in WB-107A and administer PC 17c. The last 1.5 hours of day 7 will be discussing the fuel system. On day 8, finish the fuel system and have trainees finish appropriate section of WB-107A then administer PC 17d. The rest of day 8 and the first 2 hours of day 9 will be spent discussing bleed air system, anti-icing system, fire warning system, overheat warning system, NTS system, indicating system, and temperature datum system. Have trainees finish appropriate sections of WB-107A and administer PCs 17e thru 17k.

MIR: Two instructors required for 6 hours during demonstration.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Fundamentals

1. COURSE CONTENT	2. TIME
8. Supply Responsibility	4
a. Without references, identify 2 out of 3 facts about the maintenance supply concept. STS: 5a Meas: PC	(.75)
b. Without references, identify 2 out of 3 facts about the use of tags. STS: 5b Meas: PC	(.75)
c. Without references, identify 2 out of 3 facts about the use of issue slips. STS: 5b Meas: PC	(.5)
d. Without references, identify 2 out of 3 facts about the use of turn-in slips. STS: 5b Meas: PC	(.5)
e. Without references, identify 2 out of 3 facts about property accountability. STS: 5c Meas: PC	(.75)
f. Without references, identify 2 out of 3 facts about supply responsibility. STS: 5c Meas: PC	(.75)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-PT-108, AF Supply Discipline
C3ABR42633-WB-108, AF Supply Discipline

Training Methods
Supervised Project (SP) (4 hrs)

Instructional Guidance
SP assignment will be to read and answer questions in PT-108 and WB-108 (AF Supply Discipline). This assignment will take the students approximately 4 hours to complete. Inform the students this is measurable material and they will be evaluated on it. The instructor will check for completeness. NOTE: Progress checks 8a, b, c, d, e, and f will be given upon completion of each three (3) objectives.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Fundamentals

1. COURSE CONTENT	2. TIME
9. Engine Preservation and Storage	2
a. Using TO 1C-130B-2-4, identify 2 out of 3 procedures relating to engine removal from shipping containers. STS: 15a(1) Meas: PC	(.5)
b. Using TO 1C-130B-2-4, identify 2 out of 3 procedures relating to installing engines in shipping containers. STS: 15a(2) Meas: PC	(.5)
c. Using TO 1C-130B-2-4, identify 2 out of 3 procedures concerning preservation of engines. STS: 15b(1) Meas: PC	(.5)
d. Using TO 1C-130B-2-4, identify 2 out of 3 procedures concerning depreserving engines. STS: 15b(2) Meas: PC	(.5)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-PT-109, Engine Preservation and Storage
C3ABR42633-WB-109, Engine Preservation and Storage
TO 1C-130B-2-4

Training Methods
Supervised Project (SP) (2 hrs)

Instructional Guidance
This assignment will take the student approximately 2 hours to complete. Have students complete PT-109 and use TO 1C-130B-2-4 to complete workbook. NOTE: Progress checks 9a, b, c, and d will be given upon completion of all objectives.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Fundamentals

1. COURSE CONTENT	2. TIME
NOTE: Safety - Stress all safety precautions relating to the use of tools, hardware, and safety wire (unit 10).	
• Cover safety wire with hand prior to cutting it.	
• Do not pull the wire towards you, it might slip off of the pliers and cause injury to your face.	
• Remove all jewelry.	
• Select the right tool for the job.	
• Bend pigtails down and under to avoid injury to yourself and others.	
10. Tools and Maintenance Materials	20
a. Using handout and the identification and lockwiring trainers and handtools, remove and install three nuts and bolts. Two out of the three nuts and bolts must be removed and installed correctly with no more than one error allowed. STS: 9a, 10a Meas: PC	(5)
b. Using a handout, trainer and torque wrenches, torque 3 nuts/bolts, 2 of the 3 must be torqued correctly with no more than 1 error allowed. STS: 9b Meas: PC	(4)
c. Using a handout, tools, safetying devices, and trainer, safety wire 3 bolts together with no more than 2 errors allowed. STS: 9a, 10b Meas: PC	(7)
d. Given a workbook, identify 5 of 6 micrometer readings in Section I and 3 of 6 in Section II. STS: 9b, 9c Meas: PC	(4)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-110A, Hardware
C3ABR42633-HO-110B, Torque Wrenches
C3ABR42633-HO-110C, Lockwiring
C3ABR42633-PT-110, Mechanic's Handtools
C3ABR42633-SG-110, Introduction to Common Handtools, Hardware, Measuring Devices, and Safety Wiring
C3ABR42633-WB-110, Torque Wrenches
C3ABR42633-WB-110A, Safety Devices
C3ABR42633-WB-110B, Aircraft and Engine Hardware
TO 2J-T56-26

Audio Visual Aids
TFA 496a, Torquing Equipment and Usage-Breakaway Handles
35mm Slides, Tools, Hardware, Safety Devices, Torque Wrenches and Micrometers

Training Equipment
Trainer, 17653, Identification and Lockwiring (1)
Handtools and Special Tools (1)

Training Methods
Discussion/Demonstration (9 hrs)
Performance (11 hrs)

Multiple Instructor Requirements
Supervision, Equipment (2)

Instructional Guidance
The first hour of objective 10a will be sent discussing the types and uses of hardware using the 35mm slides. Discuss the different types of handtools and the next four hours will be spent in lab where students will be evaluated removing and installing three nuts and bolts by instructor using PC 110a.

The next hour will be spent discussing torque wrenches using 35mm slides. The students will then spend the next three hours in the lab torquing three nuts in bolts while being evaluated by the instructor using PC 110b.

The next hour will be spent discussing safety wiring procedures, using 35mm slides. The students will then spend the next six hours in the lab safetying three bolts together while being evaluated by instructor using PC 110c.

The next hour will be spent discussing micrometers using 35mm slides. The students will then spend the next three hours in lab reading micrometers while being evaluated by the instructor using PC 110d.

MIR: Two instructors will be required during 16 hours of performance and demonstration.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Fundamentals

1. COURSE CONTENT	2. TIME
11. Career Field Progression a. Without references, identify 2 out of 3 principles relating to career field progression. STS: 1 Meas: PC	2

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-PT-111, Career Field Progression
C3ABR42633-WB-111, Career Field Progression

Training Methods
Supervised Project (SP) (2 hrs)

Instructional Guidance
Have students read PT-111 and answer WB-111. This assignment will take the student approximately 2 hours to complete. The instructor will check for completeness. NOTE: Give progress check 11a upon completion of the objective.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Fundamentals

1. COURSE CONTENT	2. TIME
12. Security	2
a. Without references, identify 2 out of 3 facts about OPSEC vulnerabilities. STS: 2 Meas: PC	

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-112, Operations Security
C3ABR42633-WB-112, Security

Training Methods
Supervised Project (SP) (2 hrs)

Instructional Guidance
Have students read and answer questions in SG-112 and complete WB-112 during SP time. This assignment will take approximately 2 hours to complete. Give progress check 12a upon completion of the objective.

13.	Military Training	4
	a. Physical Conditioning	(4)
14.	Written Test and Critique	3

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
NOTE: Safety. During this block of instruction, stress the removal of all jewelry each day before entering the lab. When working on engines, stress the dangers of placing hands in the turbine and compressor areas of the engine. During removal of electrical components, such as the ignition exciter and igniter plugs, stress the danger of electrical shock. Assure that the students observe proper lifting and safetying techniques throughout all lab area objectives.	
1. Oil System	8
a. Without references, identify facts relating to the JOAP program without error. STS: 12e Meas: PC	(2)
b. Given TO 1C-130B-2-4, identify 7 out of 10 principles about the operation of the oil system. STS: 11d(3) Meas: PC	(6)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-200, C-130E Lockheed Training Manual
C3ABR42633-SG-201, Turboprop Engine Oil System
C3ABR42633-WS-201, Turboprop Engine Oil System
TO 1C-130B-2-4, Maintenance Instructions

Audio Visual Aids
Transparencies, T56 Oil System
Charts, T56 Oil System

Training Equipment
T56-A-7 Engine (12)
QEC Kit (12)
Components, Oil System

Training Methods
Lecture/Discussion (6 hrs)
Supervised Project (SP) (2 hrs)

Instructional Guidance
Objective 1a is an SP assignment, students will complete PT-201 to satisfy this objective. This will take approximately 2 hours to complete. Progress check 21a will be given during the last hour of SP on objective 1a. Explain the operation of the oil system using TOs, charts, transparencies, oil system components, and T56 engine. Have students complete WS-201. Progress check 21b will be given upon objective completion.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
2. Fuel System a. Given TO 1C-130B-2-4, identify 7 out of 10 principles about the operation of the fuel system. STS: 11d(4) Meas: PC	6

SUPERVISOR APPROVAL OF LESSON PLAN

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C3ABR42633 000	II	2	3 April 1984	27

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-200
C3ABR42633-SW-202, Fuel Systems
C3ABR42633-WS-202, Engine Fuel System
TO 1C-130B-1, Flight Manual
TO 1C-130B-2-4

Audio Visual Aids
Charts, T56 Fuel System
Transparencies, T56 Fuel System

Training Equipment
T56-A-7 Engine (12)
QEC Kit (12)
Components, Fuel System

Training Methods
Lecture/Discussion (6 hrs)

Instructional Guidance
Explain the purpose and operation of the fuel system. Use the charts, TOs, selected fuel system components, and T56 engine to trace the operation of the fuel system. Have the students complete WS-202 on the fuel system. Progress check 22. will be given upon objective completion.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
3. Temperature Datum System a. Given TOs 1C-130B-1 and 1C-130B-2-4, identify 3 out of 5 principles about the operation of the temperature datum system. STS: 11d(9) Meas: PC	4

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C3ABR42633 000	II	3	3 April 1984	29

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-200
C3ABR42633-WS-203, Temperature Datum System
TO 1C-130B-1
TO 1C-130B-2-4

Audio Visual Aids
Charts, Temperature Datum System

Training Equipment
T56-A-7 engine (12)
QEC Kit (12)
Components, Temperature Datum System

Training Methods
Lecture/Discussion (4 hrs)

Instructional Guidance
Explain the purpose and operation of the temperature datum system. Be sure students understand that the purpose of the temperature datum system is to protect the engine from an overtemperature condition. Emphasize this in the lesson. Use the TOs, charts, selected temperature datum system components, and T56 engine to trace the operation of the temperature datum system. Have the students complete WS-203. Progress check 23a will be given upon objective completion.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulcion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
4. Starting System	1
a. Given TO 1C-130B-2-4, identify 2 out of 3 principles about the operation of the starting system. STS: 11d(1) Meas: PC	

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-204/205, Turboprop Engine Starter and Ignition System
C3ABR42633-WS-204, Engine Starting System
TO 1C-130B-1
TO 1C-130B-2-4

Training Equipment
T56-A-7 Engine (12)
QEC Kit (12)
Components, Starter System (12)

Training Methods
Lecture/Discussion (1 hr)

Instructional Guidance
Explain the purpose and operation of the starting system. Use TOs, QEC kit, selected starter system components, and a T56 engine to trace the operation of the starting system. Ha students complete WS-204. Progress check 24a will be given upon objective pletion.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
5. Ignition System	1
a. Given TO 1C-130B-2-4, identify 2 out of 3 principles about the operation of the ignition system. STS: 11d(2) Meas: PC	

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C3ABR42633 000	II	5	3 April 1984	33

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-204/205
C3ABR42633-WS-205, Engine Ignition System
TO 1C-130B-1
TO 1C-130B-2-4

Audio Visual Aids
Charts, T56 Ignition System

Training Equipment
T56-A-7 Engine (12)
QEC Kit (12)
Components, Ignition System (12)

Training Methods
Lecture/Discussion (1 hr)

Instructional Guidance
Explain the purpose and operation of the ignition system. Use the TOs, selected ignition system components, and a T56 engine to trace the operation of the ignition system. Have students complete WS-205. Progress check 25a will be given upon objective completion.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
6. Bleed Air System a. Given TO 1C-130B-2-4, identify 2 out of 3 principles about the operation of the bleed air system. STS: 11d(5) Meas: PC	2

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-206, Turboprop Compressor Bleed Air System
TO 1C-130B-2-4

Audio Visual Aids
Chart, Compressor (Bleed Air) System
Transparencies

Training Equipment
T56-A-7 Engine (12)
Components, Bleed Air System (12)

Training Methods
Lecture/Discussion (2 hrs)

Instructional Guidance
Explain the purpose and operation of the compressor bleed air system. Use TOs, selected components, bleed air system, and a T56 engine to trace the operation of the compressor bleed air system. Progress check 26a will be given upon objective completion.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
7. Engine Anti-Icing System	2
a. Given TO 1C-130B-2-10, identify 2 out of 3 principles about the operation of the anti-icing system. STS: 11d(6) Meas: PC	

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-207, Propeller and Engine Anti-Icing and De-Icing System
C3ABR42633-WS-207, Engine Anti-Icing System
TO 1C-130B-1
TO 1C-130B-2-10

Audio Visual Aids
Charts, T56 Anti-Icing System

Training Equipment
T56-A-7 Engine (12)

Training Methods
Lecture/Discussion (2 hrs)

Instructional Guidance
Explain the purpose and operation of the anti-icing system. Use the TOs, charts, and a T56 engine to trace the operation of the anti-icing system. Have students complete WS-207. Progress check 27a will be given upon objective completion.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
8. Engine Indicating System	2
a. Given TO 1C-130B-1 and TO 1C-130B-2-6, identify 4 out of 6 principles about the operation of engine indicating systems. STS: 11d(12) Meas: PC	

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C3ABR42633 000	II	8	3 April 1984	39

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-WS-208, Engine Indicating System
TO 1C-130B-1
TO 1C-130B-2-6

Audio Visual Aids
Cnarts, T56 Engine Indicating

Training Equipment
T56-A-7 Engine (12)

Training Methods
Lecture/Discussion (2 hrs)

Instructional Guidance
Explain the purpose and operation of the engine indicating system. Use the TOs and charts to trace the operation of the indicating system. Have students complete WS-208. Progress check 28a will be given upon objective completion.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
9. Fire Warning System a. Given TO 1C-130B-1, identify 2 out of 3 principles about the operation of the fire warning system. STS: 11d(7) Meas: PC	1

SUPERVISOR APPROVAL OF LESSON PLAN

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C3ABR42633 000	II	9	3 April 1984	41

SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-200
C3ABR42633-WS-209, Fire Warning System
TO 1C-130B-1

Audio Visual Aids
Transparencies, Fire Warning Systems

Training Equipment
T56-A-7 Engine (12)

Training Methods
Lecture/Discussion (1 hr)

Instructional Guidance
Explain the purpose and operation of the fire warning system. Use TOs, transparencies, charts, and T56 engine to trace the operation of the fire warning system. Have students complete WS-209. Progress check 29a will be given upon objective completion.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
10. Overheat Warning System	1
a. Given TO 1C-130B-1, identify 2 out of 3 principles about the operation of the overheat warning system. STS: 11d(8) Meas: PC	

SUPERVISOR APPROVAL OF LESSON PLAN

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials

C3ABR42633-HO-200
C3ABR42633-WS-210, Overheat Warning System
TO 1C-130B-1

Audio Visual Aids

Transparencies, Overheat Warning System

Training Equipment

T56-A-7 Engine (12)

Training Methods

Lecture/Discussion (1 hr)

Instructional Guidance

Explain the purpose and operation of the overheat warning system. Use TO, transparencies, charts, and T56 engine to trace the operation of the overheat warning system. Have students complete WS-210. Progress check 210a will be given upon objective completion.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
11. Negative Torque Signal System	2
a. Given TOs 1C-130B-1 and 1C-130B-2-4, identify 2 out of 3 principles about the operation of the negative torque signal system. STS: 11d(11) Meas: PC	

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-WS-211, Negative Torque Signal System
TO 1C-130B-1
TO 1C-130B-2-4

Audio Visual Aids
Charts, Negative Torque Signal System

Training Equipment
Reduction Gearbox (12)

Training Methods
Lecture/Discussion (2 hrs)

Instructional Guidance
Explain the purpose and operation of the negative torque system. Use TOs, charts, and reduction gearbox to trace the operation of the negative torque system. Have students complete WS-211. Progress check 211a will be given upon objective completion.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
12. Removal, Inspection, and Installation of Accessories	31
a. Given TO 1C-130B-2-4 and working in a group, remove ignition system components with no more than 1 procedural error allowed. STS: 13b(2)(a), 13b(7)(a) Meas: PC	(1)
b. Given handout and working in a group, inspect ignition system components with no more than 1 procedural error allowed. STS: 13b(2)(b), 13b(7)(b) Meas: PC	(.5)
c. Given TO 1C-130B-2-4 and working in a group, install ignition system components with no more than 2 procedural errors allowed. STS: 13b(2)(c), 13b(7)(c) Meas: PC	(1.5)
d. Given TO 1C-130B-2-4, verbal instructions, and working in a group, remove bleed air system components including engine plumbing with no more than 1 procedural error allowed. STS: 13b(1)(a), 13b(7)(a) Meas: PC	(1)
e. Given a handout and working in a group, remove anti-icing system components including engine plumbing with no more than 1 procedural error allowed. STS: 13b(7)(a) Meas: PC	(1)
f. Given handout and working in a group, inspect bleed air system components including engine plumbing with no more than 1 procedural error allowed. STS: 13b(1)(b), 13b(7)(b) Meas: PC	(.5)
g. Given handout and working in a group, inspect anti-icing system components with no more than 1 procedural error allowed. STS: 13b(7)(b) Meas: PC	(.5)
h. Given TO 1C-130B-2-4, verbal instructions, and working in a group, install bleed air system components including engine plumbing with no more than 1 procedural error allowed. STS: 13b(1)(c), 13b(7)(c) Meas: PC	(1)
i. Given handout and working in a group, install anti-icing system components with no more than 1 procedural error allowed. STS: 13b(7)(c) Meas: PC	(1)
j. Given TO 1C-130B-2-4, verbal instructions, and working in a group, remove fuel system components including fuel manifolds and nozzles with no more than 2 procedural errors allowed. STS: 13b(7)(a), 13b(11)(a) Meas: PC	(2)

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k. Given TOs 1C-130B-2-4 and 2J-T56-26 and working in a group, remove oil system components including accessory drive housing with no more than 1 procedural error allowed. STS: 13b(7)(a), 13b(14)(a) Meas: PC (3)

l. Given TO 1C-130B-2-4 and working in a group, remove temperature datum system components with no more than 1 procedural error allowed. STS: 13b(7)(a) Meas: PC (1)

m. Given TO 2J-T56-26, handout, and working in a group, inspect oil system components including accessory drive housing with no more than 1 procedural error allowed. STS: 13b(7)(b), 13b(14)(b) Meas: PC (1)

n. Given handout and working in a group, inspect fuel system components including fuel manifolds and nozzles with no more than 1 procedural error allowed. STS: 13b(7)(b), 13b(11)(b) Meas: PC (1)

o. Given handout and working in a group, inspect temperature datum system components with no more than 1 procedural error allowed. STS: 13b(7)(b) Meas: PC (1)

p. Given handout and working in a group, apply corrosion control procedures to engine accessories with no more than 3 procedural errors allowed. STS: 10c Meas: PC (1)

q. Given TOs 1C-130B-2-4 and 2J-T56-26 and working in a group, install oil system components including accessory drive housing with no more than 1 procedural error allowed. STS: 13b(7)(c), 13b(14)(c) Meas: PC (5)

r. Given TO 1C-130B-2-4, verbal instructions, and working in a group, install fuel system components including fuel manifold and nozzles with no more than 2 procedural errors allowed. STS: 13b(7)(c), 13b(11)(c) Meas: PC (5)

s. Given TO 1C-130B-2-4 and working in a group, install temperature datum system components with no more than 1 procedural error allowed. STS: 13b(7)(c) Meas: PC (1)

t. Given TO 2J-T56-26, electrical components tester, and working in a group, check an engine electrical component with no more than 1 procedural error allowed. STS: 23d(1) Meas: PC (2)

SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-212b, Inspection of Ignition System Components
C3ABR42633-HO-212e, Anti-Icing System Components Removal
C3ABR42633-HO-212f, Inspection of Bleed Air System Components and Engine Plumbing
C3ABR42633-HO-212g, Inspect Anti-Icing System Components
C3ABR42633-HO-212i, Install Anti-Icing System Components
C3ABR42633-HO-212m, Inspection of Oil System and Accessory Drive Housing
C3ABR42633-HO-212n, Inspection of Fuel System Components
C3ABR42633-HO-212o, Inspection of Temperature Datum System Components
C3ABR42633-HO-212p, Corrosion Control
TO 1C-130B-2-4
TO 2J-T56-26

Training Equipment
T56-A-7 Engine (6)
Handtools (6)
Test Set, Electrical Components Checkout Allison P/N 6799053R (12)

Training Methods
Performance (31 hrs)

Multiple Instructor Requirements
Safety, Equipment, Facilities

Instructional Guidance
The student will use TOs 1C-130B-2-4 and 2J-T56-26 to remove, inspect, and install engine system components. The students will spend the first six hours removing, installing, and inspecting the ignition system, bleed air system, and anti-icing system components. The instructor will evaluate them using PC 212a, b, c, d, e, f, and g.

The students will spend the next eight hours removing, inspecting and installing the bleed air system, anti-icing system, oil system, fuel system, and temperature datum system components. The instructor will evaluate them using PC 212h, i, j, k, and l.

The students will spend the next nine hours removing, inspecting, and installing the oil system, fuel system, temperature datum system components and also apply corrosion control procedures to engine accessories. The instructor will evaluate the students using PC 212m, n, o, p, and q.

The students will spend the next eight hours installing the fuel system and temperature datum system components and check engine electrical components with the electrical components tester. The instructor will evaluate students using PC 212r, s, and t.

MIR: Two instructors are required for 31 hours during student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
13. Maintenance Documentation a. Using TOs 00-20-2-4 and 1C-130A-06, complete maintenance data collection forms with no more than 7 errors allowed on the AFTO Form 349 and no more than 2 errors allowed on the AFTO Form 350. STS: 8c Meas: PC	4

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C3ABR42633 000	II	13	4 April 1984	51

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SW-213, Maintenance Documentation
TO 00-20-2-4, Maintenance Documentation for In-Shop Engine Maintenance
TO 1C-130A-06, Work Unit Code Manual
AFTO Forms 349 and 350

Training Methods
Supervised Project (SP) (4 hrs)

Instructional Guidance

Students will complete workbook for documentation of removal, inspection, and installation of selected engine accessories. The instructor will pick up the workbooks at the end of each day and check for completeness. The students will complete SP assignment on Maintenance Documentation, objectives 13a, b, and c. At the end, the students will turn in WB-213 to the instructor so he/she can check for completeness. At the last hour of SP, instructor will administer PC 213a.

14. Test and Critique 3

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
NOTE: Safety - During this area of instruction, stress the removal of all jewelry before entering the lab areas. Stress the dangers of electrical shock throughout the lessons on voltage and resistance. Ensure the guidelines for using safety glasses are followed when performing jobs such as blade repair and soldering.	
15. Propeller Technical Orders	3
a. Given TO 1C-130B-2-11, locate 3 out of 5 facts about basic propeller information. STS: 4b Meas: PC	(1)
b. Given TO 3H1-18-2, locate 3 out of 5 facts about basic propeller information. STS: 4b Meas: PC	(1)
c. Given TO 3H1-18-4, locate 7 out of 10 facts about components of the propeller system. STS: 4b Meas: PC	(1)

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C3ABR42633 000	II	15	3 April 1984	53

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials

C3ABR42633-WB-215, Propeller Technical Publications
TO 1C-130B-2-11, Maintenance Instructions - Propeller
TO 3H1-18-2, Field Maintenance Instructions - Variable Pitch Aircraft Propeller
TO 3H1-18-4, Illustrated Parts Breakdown - Variable Pitch Aircraft Propeller

Training Methods

Supervised Project (3 hrs)

Instructional Guidance

Students will complete WB-215 during SP. This WB will lead them through the objectives in this unit. Section I will be completed in 1 hour on TO 1C-130B-2-11. Section II will be completed in 1 hour on TO 3H1-18-2 and Section III will be completed in 1 hour on TO 3H1-18-4. After the completion of all three sections, the instructor will administer progress checks 15a, b, and c.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
16. Propeller Fundamentals	8
a. Given TOs 1C-130B-2-11 and 3H1-18-2, identify 4 out of 6 facts about propeller constructional features. STS: 19b Meas: PC	(3)
b. Given TOs 1C-130B-2-11 and 3H1-13-2, identify 4 out of 6 facts about propeller operation. STS: 19a Meas: PC	(5)

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C3ABR42033 000	II	16	3 April 1984	55

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-200, C-130 Lockheed Training Manual
C3ABR42633-SG-216, Propeller Fundamentals
C3ABR42633-WB-216, Propeller Fundamentals
TO 1C-130B-2-11
TO 3H1-18-2

Training Equipment
Propeller Assembly (12)
Propeller Components (12)

Training Methods
Lecture/Demonstration (8 hrs)

Instructional Guidance
Explain the operating principles and constructional features of the propeller assembly. Use a propeller assembly and selected propeller components to describe and explain the operating principles and constructional features of the 54H60 propeller and its components. Have students complete WB216 at the end of the lesson on propeller fundamentals. After completing WB-216, the instructor will administer PC 16a and b.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
17. Propeller Control System	13
a. Given TOs 1C-130B-2-11 and 3H1-18-2, identify 7 out of 10 facts about the arrangement of the hydraulic-mechanical control systems. STS: 19d(3), 19d(4) Meas: PC	(1)
b. Given TO 1C-130B-2-11 and 3H1-18-2, identify 7 out of 10 facts about the constructional features of the control assembly. STS: 19c Meas: PC	(4.5)
c. Given TOs 1C-130B-2-11 and 3H1-18-2, identify 7 out of 10 principles about the operation of the hydraulic-mechanical controls. STS: 19e(3), 19e(4) Meas: PC	(5.5)
d. Without reference, identify 2 out of 3 facts about the arrangement of the negative torque signal system. STS: 19d(5) Meas: PC	(1)
e. Without reference, identify 2 out of 3 principles on the operation of the negative torque signal system. STS: 19e(5) Meas: PC	(1)

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C3ABR42633 000	II	17	3 April 1984	57

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-200, C-130 Lockheed Manual
C3ABR42633-SG-217, Propeller Control System Assembly
C3ABR42633-SW-217A, Negative Torque System
C3ABR42633-WB-217, Propeller Control System
TO 1C-130B-2-11
TO 3H1-18-2

Audio Visual Aids
Charts, 54H60 Propeller

Training Equipment
Propeller Components (12)

Training Methods
Lecture/Discussion (11 hrs)
Supervised Project (2 hrs)

Instructional Guidance
Explain the arrangement and constructional features of the hydraulic-mechanical control system for 4 hours the first day and finish it during the first hour and a half of the next day. After the completion of these objectives, the instructor will administer PCs 17a and b. Next, discuss the operation of the same system for 4 and a half hours, finish operation during the first hour of the following day. After the completion of this lesson the instructor will administer PC 17c. Objectives 17d and e are SP assignments where the students will read Section 13 of HO-200 and complete SW-217. After completing SW-217, the instructor will administer PCs 17d and e.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
18. Propeller Electrical Systems	21
a. Without references, identify 4 out of 6 facts about basic electricity. STS: 20a Meas: PC	(5)
b. Given a handout, multimeter, and trainer, measure a voltage within ± 3 volts of the instructor's reading with no more than 1 procedural error allowed. STS: 20c Meas: PC	(4.5)
c. Given a handout, multimeter and trainer, measure a resistance reading within ± 10 of the instructor's reading with no more than 3 procedural errors allowed. STS: 20c Meas: PC	(4.5)
d. Given a propeller electrical diagram, trace the air start circuit with a maximum of 1 error allowed. STS: 20b Meas: PC	(2)
e. Given a propeller electrical diagram, trace the condition lever feather circuit with a maximum of 1 error allowed. STS: 20b Meas: PC	(2.5
f. Given a propeller electrical diagram, trace the emergency feather circuit with a maximum of 1 error allowed. STS: 20b Meas: PC	(2.5)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-218, Propeller Feather and Air Start Control
C3ABR42633-PT-218, Multimeters
C3ABR42633-SG-218, Electrical Safety and the Maintenance Man
C3ABR42633-SG-218A, Fundamentals of AC and DC Electricity
C3ABR42633-HO-218A, Use of Multimeter (Voltage)
C3ABR42633-HO-218B, Use of Multimeter (Resistance)
C3ABR42633-WB-218, Propeller Electrical System/Circuits

Audio Visual Aids
Chart, Propeller Feather and Air Start Schematic

Training Equipment
Multimeter (1)

Training Methods
Lecture/Discussion (4 hrs)
Demonstration/Performance (10 hrs)
Supervised Project (SP) (7 hrs)

Multiple Instructor Requirements
Safety, Equipment, Facilities (?)

Instructional Guidance
Discuss with the students the fundamentals of AC and DC electricity for 1 hour. The other 4 hours are for SP assignment where the students complete SG-218A. Next, discuss the use of multimeters, then in the lab have students measure voltage. Allow students to practice for 1 hour and then complete PC-218B using the remaining 2 hours of this unit. Then discuss taking resistance readings with multimeters for 1 hour. On the next day have the students take resistance readings in the lab for 2 hours. Allow students to practice for the first 30 minutes and administer PC 18c the next hour and a half. The remaining 3 hours of multimeters is for SP where the students will complete PT-218. Discuss and demonstrate tracing propeller electrical circuits in the classroom for 7 hours. You should spend approximately 1 hour explaining and demonstrating the air start circuit and use 1 hour to administer PC 218d. Next, complete the condition lever feather circuit using 1 hour to explain and 1 hour to complete PC 218e. On the next day you will finish by spending one half hour on the condition lever feather circuit and 1 hour explaining the emergency feather circuit. Then you will administer PC 218f using the remaining hour and a half.

MIR: Two instructors are required for 10 hours during demonstration performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
19. Propeller Anti-Icing and Deicing	3
a. Using TOs 1C-130B-1, 1C-130B-2-11, and 3H1-18-2, identify 2 out of 3 facts about the arrangement of the anti-icing system. STS: 19d(1) Meas: PC	(.5)
b. Given TOs 1C-130B-1 and 1C-130B-2-11, identify 2 out of 3 facts about the arrangement of the deicing system. STS: 19d(2) Meas: PC	(.5)
c. Given TOs 1C-130B-1 and 1C-130B-2-11, identify 2 out of 3 principles about the operation of the anti-icing system. STS: 19e(1) Meas: PC	(1)
d. Using TOs 1C-130B-1 and 1C-130B-2-11, identify 2 out of 3 principles about the operation of the deicing system. STS: 19e(2) Meas: PC	(1)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-200
C3ABR42633-SG-207
C3ABR42633-WB-219, (Propeller and Engine) Anti-Icing/Deicing System
TO 1C-130B-2-11
TO 1C-130B-1
TO 3H1-18-2

Audio Visual Aids
Charts, Propeller Anti-Icing and Deicing Systems

Training Equipment
Propeller Assembly (12)

Training Methods
Lecture/Discussion (3 hrs)

Instructional Guidance
Explain the arrangement and operation of the propeller anti-icing and deicing systems. Use TOs to show amperage readings and show illustrations of deicing contact ring which explains what each slipring's function is. Take the students to the lab and demonstrate the system operation of the trainer. Have students complete WB-219 at the end of the lesson. NOTE: Progress checks 219a, b. c, and d will be given upon objective completion. This lesson should take 3 hours to complete.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
20. Universal Protractor a. Given a handout and universal protractor, measure 1 blade angle within ± .5 degrees of the instructor's reading with no more than 1 procedural error allowed. STS: 9c Meas: PC	3

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-220, Universal Protractor

Training Equipment
Trainer, Universal Protractor (12)
Unviersal Protractor (2)
54H60 Propeller (6)

Training Methods
Performance/Demonstration (3 hrs)

Multiple Instructor Requirements
Safety, Equipment, Facilities (2)

Instructional Guidance
Demonstrate to the students how to use the universal protractor. Take the students into the lab and have them measure a blade angle. Allow students to practice the first hour and then administer PC 20a the last 2 hours.

MIR: Two instructors are required for 2 hours during student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR

COURSE TITLE

Turboprop Propulsion Mechanic

BLOCK TITLE

Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
21. Blade Repair a. Using TC 1-18-2, rework one damaged area on the face, camber, leading or trailing edge of the blade with instructor assists allowed on the hardest parts. STS: 21c Meas: PC	3

SUPERVISOR APPROVAL OF LESSON PLAN

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
TO 3H1-18-2

Audio Visual Aids
Charts, Propeller Blade Repair

Training Equipment
Aluminum Propeller Blades (4)
Dial Indicator (12)
Blade Repair Files (2)
Handtools and Equipment (1)

Training Methods
Demonstration/Performance (3 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
Demonstrate how to repair a propeller blade. Take students to the lab and have them repair a propeller blade. Instructor assistance may be given on the hardest parts of the task. Allow the students practice blade repair for 1 hour and then administer PC 21a the following 2 hours.

MIR: Two instructors are required for 2 hours during student performance

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Engine and Propeller Systems Operation

1. COURSE CONTENT	2. TIME
22. Soldering	5
a. Given soldering equipment, wire, electrical components and a handout, solder one electrical connection with no more than 1 procedural error. The connection must not show a cold solder. STS: 20d Meas: PC	

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-222, Soldering Electrical Connections
C3ABR42633-HO-222, Soldering

Audio Visual Aids
FCC 42-9 thru 13; FCC 42-15 thru 16, Soldering

Training Equipment
Soldering Iron (1)
Electrical Components (1)

Training Methods
Demonstration/Performance (3 hrs)
Supervised Project (SP) (2 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
Discuss the purpose and procedures for soldering. Show film clip on how to solder using HO-222. Take the students into the lab and have them solder 3 electrical connectors. The first hour in the lab will be for practice and the following 2 hours will be used to complete PC 22a. Two hours will be used as SP time and the students will complete SG-222.

MIR: Two instructors are required for 2 hours during student performance.

23.	Military Training	6
	a. Physical Conditioning	(6)
24.	Written Test and Critique	3

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Propeller Maintenance

1. COURSE CONTENT	2. TIME
NOTE: Safety - For Blocks III, IV, and V. The use of a mechanical lifting device is subject to certain hazards that cannot be safeguarded by mechanical means. Serious hazards are overloading and dropping or slipping of the load caused by improper hitching or slinging, obstruction to the free passage of the load, and misuse of the machine. Most lifting-device mechanical failure causes can be detected prior to failure if proper inspection procedures are followed.	
Watch for low hanging objects in the high bay and low bay areas which could cause possible head injuries; propeller blades; trainer rails, chain hoist and beams on entrance to high bay. Insure and stress the danger of hands and fingers staying clear of engine inlet and exhaust areas when engine is being rotated. Insure jewelry is removed prior to working in the high and low bay areas. Insure handtools are not carried or stored in pockets.	
Electrical safety procedures for the protection of personnel should include insuring all electrical trainers are properly used. Floors of all work areas, halls and storerooms will be kept clean and orderly. Insure all rails are installed and wheels locked on stands. Insure proper lifting techniques are followed. Each student will be informed of the job hazards to which he or she may be exposed and the equipment items that will be required for employee safety.	
1. Removal of Propeller Assembly	6
a. Given TO 1C-130B-2-11, identify 7 out of 10 facts relating to removal of the propeller assembly. STS: 21a(1) Meas: PC	(1.5)
b. Using TO 1C-130B-2-11, tools, trainer, J-1 hoist, and working in a group, remove a 54H60 propeller, with no more than 1 procedural error allowed. STS: 4b, 9b, 21a(1), 23a(1) Meas: PC	(3.5)
c. Given TOs 00-20-2-2 and 1C-130A-06 and handout, complete maintenance data collection forms for propeller removal with no more than 6 errors allowed. STS: 4b, 8c Meas: PC	(1)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-300, Codes Needed on AFTO Form 350
C3ABR42633-SG-301, Removal of Propeller Assembly
TO 00-20-2-2, On-Equipment Maintenance Documentation
TO 1C-130A-06, Work Unit Code Manual
TO 1C-130B-2-11, Maintenance Instructions - Propeller

Audio Visual Aids
Selected Training Charts, AFTO Form 350
Film, FCC-42-111

Training Equipment
Trainer, Propeller Change (6)
Handtools and Special Tools (6)
Applicable AGE (6)
J-1 Hoist (6)

Training Methods
Discussion (2 hrs)
Demonstration/Performance (4 hrs)

Multiple Instructor Requirements
Equipment, Supervision (^)

Instructional Guidance
Thoroughly explain the process of locating propeller removal procedures (propeller model 54H60-91) in TO 1C-130B-2-11. Explain the importance of following TO procedures while performing the task. Show and discuss propeller removal film FCC 42-111. Then the students will be administered progress check 31A. Next, the students will spend 3 hours in lab performing propeller removal. Using TOs 00-20-2-2 and 1C-130A-06, demonstrate one flight line maintenance data collection form, AFTO Form 350, and then have the students complete PC 31c. The instructor will evaluate the students using PC 31b.

MIR: Two instructors are required for 3.5 hours of student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Propeller Maintenance

1. COURSE CONTENT	2. TIME
2. Removal of Propeller Control, Rear Spinner, and Deicing Contact Ring	6
a. Given TO 3H1-18-2, identify 3 out of 5 facts relating to removal of the propeller control assembly. STS: 22a(1) Meas: PC	(.5)
b. Given TO 3H1-18-2, identify 2 out of 3 facts relating to removal of the propeller deicing contact ring. STS: 22h(1) Meas: PC	(.5)
c. Using TO 3H1-18-2, identify facts relating to removal of the propeller rear spinner without error. STS: 21b(1) Meas: PC	(.5)
d. Using TO 3H1-18-2, tools, J-1 hoist, a trainer, and working in group, remove propeller control, rear spinner, and deicing contact ring with no more than 1 procedural error allowed. STS: 4b, 9b, 22a(1), 22h(1), 23a(1) Meas: PC	(3.5)
e. Given TOs 00-20-2-10 and 1C-130A-06 and handout, complete maintenance data collection forms for removal of propeller control assembly, with no more than 4 errors allowed. STS: 4b, 8c Meas: PC	(1)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-300
C3ABR42633-SG-302, Removal of Control Rear Spinner
TO 00-20-2-10, Documentation for Off-Equipment Maintenance
TO 1C-130A-06
TO 3H1-18-2, Field Maintenance Instructions - Variable Pitch Aircraft Propeller

Audio Visual Aids
Film, FCC 42-113
Chart, AFTO From 350

Training Equipment
Propeller, Model 54H60 (6)
Handtools and Special Tools (6)
J-1 Hoist (6)

Training Methods
Discussion (2 hrs)
Demonstration/Performance (4 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
Thoroughly explain the process of locating the deicing contact ring, control and rear spinner removal procedures in TO 3H1-18-2. Explain the importance of following TO procedures while performing the task. Show and discuss control removal film FCC 42-113. The next hour the students will be administered progress checks 32A, 32B, and 32C. All three progress checks will be given together because they are interrelated and covered by the same section in the TO. The next 3 hours are lab time. The students will remove the deicing contact ring, control, and rear spinner. Using TOs 00-20-2-10 and 1C-130A-06, discuss in-shop maintenance data collection form, AFTO Form 350, and then have the students complete PC 32e. The instructor will evaluate the students using PC 32d.

MIR: Two instructors are required for 3.5 hours during student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Propeller Maintenance

1. COURSE CONTENT	2. TIME
3. Installation of Propeller Control, Rear Spinner, and Deicing Contact Ring	6
a. Using TO 1C-130B-2-11, identify 3 out of 5 facts relating to installation of the propeller rear spinner. STS: 21b(2) Meas: PC	(.5)
b. Using TO 1C-130B-2-11, identify 3 out of 5 facts relating to installation of the propeller deicing contact ring. STS: 22h(2) Meas: PC	(.5)
c. Using TO 1C-130B-2-11, identify 3 out of 5 facts relating to installation of the propeller control assembly. STS: 22a(2) Meas: PC	(1)
d. Using TO 1C-130B-2-11, J-1 hoist, tools, a trainer, and working in a group, install the rear spinner, deicing contact ring, and propeller control assembly with no more than 2 procedural errors allowed. STS: 4b, 9b, 10b, 22a(2), 22h(2), 23a(1) Meas: PC	(4)

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C3ABR42633 000	III	3	3 April 1984	73

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-303, Installation of Rear Spinner, Deicing Contact Ring and the Control Assembly
TO 1C-130B-2-11

Audio Visual Aids
Film, FCC 42-114

Training Equipment
Propeller, Model 54H60 (6)
Handtools and Special Tools (6)
J-1 Hoist (6)

Training Methods
Discussion (2 hrs)
Performance (4 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
Thoroughly explain the process of locating installation of the deicing contact ring, control and rear spinner procedures in TO 1C-130B-2-11. Explain the importance of following TO procedures while performing the task. Show and discuss the control installation film FCC 42-114. The next hour the students will be administered progress checks 33A, 33B, and 33C. All three progress checks will be given together because they are interrelated and covered by the same section of the TO. The next four hours are lab time. The students will install the rear spinner, deicing contact ring, and control. Insure complete and correct application of all hardware and safety devices. The instructor will evaluate student performance using PC 33d.

MIR: Two instructors are required for 4 hours during student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Propeller Maintenance

1. COURSE CONTENT	2. TIME
4. Installation of Propeller Assembly	8
a. Using TO 1C-130B-2-11, identify 7 out of 10 facts relating to installation of the propeller. STS: 21a(2) Meas: PC	(2)
b. Using TO 1C-130B-2-11, J-1 hoist, tools, a trainer, and working in a group, install a 54H60 propeller with no more than 3 procedural errors allowed. STS: 4b, 9b, 10b, 21a(2), 23a(1) Meas: PC	(4)
c. Given TOs 00-20-2-2 and 1C-130A-06 and handout, complete maintenance data collection forms for propeller installation, with no more than 10 errors allowed. STS: 4b, 8c Meas: PC	(2)

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C3ABR42633 000	III	4	3 April 1984	75

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-300
C3ABR42633-SG-304, Installation of Propeller Assembly
TO 00-20-2-2
TO 1C-130A-06
TO 1C-130B-2-11

Audio Visual Aids
Selected Training Chart, AFTO Form 349
Film, FCC 42-118

Training Equipment
Trainer, Propeller Change (6)
Handtools and Special Tools (6)
Applicable AGE (6)
J-1 Hoist (6)

Training Methods
Discussion (2 hrs)
Demonstration/Performance (6 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
Day 4, thoroughly explain the process of locating propeller installation procedures (propeller model 54H60-91) in TO 1C-130B-2-11. Explain the importance of following TO procedures while performing the task. Show and discuss propeller installation film FCC 42-118 then administer PC 34a. The next 4 hours are lab time, students will install the propeller. The instructor will evaluate student performance using PC 34b. The first two hours of day 5, using TOs 00-20-2-10 and 1C-130A-06, thoroughly explain the process of locating procedures required to complete flight line maintenance documentation AFTO Form 349. Demonstrate one AFTO Form 349 and then have the students complete PC 34c.

MIR: Two instructors are required for 4 hours during student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Propeller Maintenance

1. COURSE CONTENT	2. TIME
5. Disassembly of Hub and Blade Assembly	4
a. Using TO 3H1-18-3, identify 3 out of 5 facts relating to disassembly of a 54H60 propeller hub and blade assembly. STS: 21b(1) Meas: PC	(2)
b. Using TO 3H1-18-3, tools, and working in a group, disassemble a 54H60 propeller hub and blade assembly with no more than 2 procedural errors allowed. STS: 4b, 9b, 21b(1) Meas: PC	(2)

SUPERVISOR APPROVAL OF LESSON PLAN

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-305, Disassembly of Hub and Blade Assembly
TO 3H1-18-3

Audio Visual Aids
Film, FCC 42-112

Training Equipment
Propeller, Model 54H60 (6)
Handtools and Special Tools (6)

Training Methods
Discussion (2 hrs)
Performance (2 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
Thoroughly explain the process of locating procedures on disassembling the propeller hub and blades in TO 3H1-18-3. Explain the importance of following TO procedures while performing the task. Show and discuss disassembly of hub and blades film FCC 42-112. The next hour, the students will be administered progress checks 35A and 35B. Both progress checks are interrelated and will be administered together. The next two hours are spent in lab where the students will disassemble the propeller hub and blades.

MIR: Two instructors are required for 2 hours during student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Propeller Maintenance

1. COURSE CONTENT	2. TIME
6. Assembly of Hub and Blade Assembly	6
a. Using TO 3H1-18-2, identify 7 out of 10 facts relating to the assembly of the hub and blade assembly. STS: 21b(2) Meas: PC	(2)
b. Using TO 3H1-18-2, tools, and working in a group, assemble a 54H60 propeller hub and blades with no more than 1 procedural error allowed. STS: 4b, 21b(2) Meas: PC	(2.5)
c. Given TOs 00-20-2-10 and 1C-130A-06 and handout, complete maintenance data collection form for assembly of propeller hub and blades with no more than 2 errors allowed. STS: 4b, 8c Meas: PC	(1.5)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-300
C3ABR42633-SG-306, Assembly of the Hub and Blade Assembly
TO 00-20-2-10
TO 1C-130A-06
TO 3H1-18-2

Audio Visual Aids
Film, FCC 42-132
Chart, AFTO Form 349

Training Equipment
Propeller, Model 54H60 (6)
Handtools and Special Tools (6)

Training Methods
Discussion (2 hrs)
Demonstration/Performance (4 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
Thoroughly explain the process of locating assembly of propeller hub and blades procedures in TO 3H1-18-2. Explain the importance of following TO procedures while performing the task. Show and discuss the film, Assembly of Propeller Hub and Blades, FCC 42-132. Then the students will be administered progress check 36A. Discuss inshop maintenance documentation, AFTO Form 349, and then have the students complete PC 36c. The next 2 hours and 30 minutes are spent in the lab where the students will reassemble the propeller hub and blades. Insure complete and correct application of all hardware and safety devices. The instructor will evaluate student performance using PC 36b.

MIR: Two instructors are required for 2.5 hours during student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Propeller Maintenance

1. COURSE CONTENT	2. TIME
7. Oil Test	9
a. Using TO 3H1-18-2, identify 6 out of 10 facts for oil testing the propeller. STS: 21d Meas: PC	(6)
b. Using TO 3H1-18-2 and tools, perform hydraulic tests on the 54H60 propeller with no more than 1 procedural error allowed. STS: 4b, 21d Meas: PC	(3)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SW-307, Propeller Oil Test
TO 3H1-18-2

Training Equipment
Propeller Assembly, Model 54H60-91 (6)
Tester, Model GS-1221-M9 (6)
Tester, Fixture, HSP 1685 (6)

Training Methods
Performance (3 hrs)
Supervised Project (SP) (6 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
Thoroughly explain the process of locating propeller hydraulic test procedures in TO 3H1-18-2. Demonstrate operation of the tester and then the students will perform hydraulic test procedures on the propeller. The instructor will evaluate student performance using PC 37b. The SP assignment (objective 7a) is passed out to the students after Block II test. After 6 hours of SP, PC 39a will be administered.

MIR: Two instructors are required for 3 hours during student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Propeller Maintenance

1. COURSE CONTENT	2. TIME
8. Disassembly and Assembly of Propeller Control Assembly	3
a. Using TO 1C-130B-2-11, identify 3 out of 5 facts relating to valve housing assembly removal. STS: 22b(1) Meas: PC	(1)
b. Using TO 1C-130B-2-11, identify 3 out of 5 facts relating to valve housing installation. STS: 22b(2) Meas: PC	(1)
c. Using TO 3H1-18-2, identify 2 out of 3 facts on disassembly of the pump housing. STS: 22c(1) Meas: PC	(.34)
d. Using TO 3H1-18-2, identify 3 out of 5 facts on assembly of the pump housing. STS: 22c(2) Meas: PC	(.33)
e. Using TO 3H1-18-2, identify 3 out of 5 procedures for testing the propeller control system components. STS: 22e Meas: PC	(.33)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Mate ials
TO 3H1-18-2
TO 1C-130B-2-11
C3ABR42633-SG-308 (309), Valve Housing Maintenance

Audio Visual Aids
Films: FCC 42-133
FCC 42-134

Training Methods
Discussion/Classroom (3 hrs)

Instructional Guidance
Explain the process of locating valve housing removal and installation procedures in TO 1C-130B-2-11. Show and discuss valve housing removal film, FCC 42-133, and installation film, FCC 42-134. Administer progress checks 38a and b. These progress checks are interrelated and will be administered together. The next hour, explain the procedures of disassembly, assembly and testing of the propeller control in accordance with TO 3H1-18-2. Administer progress checks 38c, 38d, and 38e, all of which are interrelated and are given together.

PLAN OF INSTRUCTION/LESSON PLAN PART I	
NAME OF INSTRUCTOR	COURSE TITLE Turboprop Propulsion Mechanic
BLOCK TITLE Propeller Maintenance	

1. COURSE CONTENT	2. TIME
9. Disassembly, Assembly and Maintenance of Propeller Control Assembly	9
a. Using TO 3H1-18-2, tools, and working in a group, disassemble a pump housing with no more than 1 procedural error allowed. STS: 4b, 22c(1) Meas: PC	(.5)
b. Using TO 3H1-18-2, tools, and working in a group, assemble a pump housing with no more than 1 procedural error allowed. STS: 4b, 22c(2) Meas: PC	(.5)
c. Using TO 1C-130B-2-11, tools and working in a group, remove a valve housing assembly from a 54H60 propeller with no more than 3 procedural errors allowed. STS: 4b, 22b(1) Meas: PC	(1.5)
d. Using TO 1C-130B-2-11, tools, and working in a group, install a valve housing assembly on a 54H60 propeller with no more than 3 procedural errors allowed. STS: 4b, 22b(2) Meas: PC	(1.5)
e. Using TO 3H1-18-2, identify 7 out of 10 facts about adjusting electrical switches. STS: 20e Meas: PC	(5)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-309, Adjustment of Propulsion Electrical Switches
TO 1C-130B-2-11
TO 3H1-18-2

Training Equipment
54H60 Propeller Control Assembly (6)
Handtools and Special Tools (6)

Training Methods
Performance (4 hrs)
Supervised Project (SP) (5 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
The first hour in the lab the students will disassemble and assemble the propeller control assembly. The instructor will evaluate student performance by administering PC 39a and PC 39b. These progress checks are interrelated. The next three hours will also be in the lab where the students will continue removal of the propeller control assembly by removing and installing a propeller valve housing assembly. The instructor will evaluate student performance by using PC 39c and PC 39d which are interrelated. The SP assignment (objective 9c) is passed out to the students for 5 hours and the progress check, 39e, is given during the last hour. The Block IV instructor will assign SP, HO-400, and will administer PC, 41j and 41k, during hour of SP.

MIR: Two instructors are required for 4 hours of performance.

10. Military Training	4
a. Physical Conditioning	(4)
11. Written test and Critique	3

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Engine Repair

1. COURSE CONTENT	2. TIME
1. Repair and Maintenance of Turboprop Engine	64
a. Using TO 2J-T56-26, identify 3 out of 5 procedures on engine disassembly. STS: 13a(1) Meas: PC	(2)
b. Using TO 2J-T56-26, tools, a T56 engine, working in a group and with no more than (x) number of procedural errors allowed for each item, remove the	
(1) Turbine unit assembly (x = 2). STS: 13b(3)(a) Meas: PC	(3)
(2) Combustion section (x = 1). STS: 13b(4)(a) Meas: PC	(2)
(3) Oil metering jets (x = 1). STS: 13b(10)(a) Meas: PC	(2)
(4) Engine bearing (x = 1). STS: 13b(8)(a) Meas: PC	(1)
(5) Engine oil seals (x = 1). STS: 13b(9)(a) Meas: PC	(1)
(6) Turbine rotor and turbine nozzles (x = 1). STS: 13b(5)(a) Meas: PC	(1)
c. Using TO 2J-T56-26, identify 2 out of 3 procedures about engine cleaning. STS: 13a(2) Meas: PC	(.5)
d. Using TO 2J-T56-26, identify 2 out of 3 procedures for engine inspection. STS: 13a(3) Meas: PC	(1)
e. Using TO 2J-T56-26, identify 2 out of 3 procedures on inspection of the compressor module. STS: 13b(6)(b) Meas: PC	(.5)
f. Using TO 2J-T56-26, or handout (item 5), tools, a T56 engine, working in a group and with no more than (x) number of procedural errors allowed, inspect the:	
(1) Turbine unit assembly (x = 1). STS: 13b(3)(b) Meas: PC	(.5)
(2) Engine bearings (x = 1). STS: 13b(8)(b) Meas: PC	(.5)
(3) Combustion section (x = 1). STS: 13b(4)(b) Meas: PC	(1)
(4) Turbine rotor and turbine nozzles (x = 1). STS: 13b(5)(b) Meas: PC	(1)

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(5) Engine oil seals (x = 1). STS: 13b(9)(b) Meas: PC (.5)

(6) Oil metering jets (x = 1). STS: 13b(10)(b) (.5)
Meas: PC

g. Using TO 2J-T56-26, the thermocouple resistance tester, (1)
thermocouples, and working in a group, perform thermocouple resistance checks with no more than one (1) procedural error allowed.
STS: 23d(2) Meas: PC

h. Using TOs 00-20-2-4 and 1C-130A-06, complete maintenance (2)
data collection forms with no more than 16 errors allowed on the AFTO Form 349 and no more than 3 errors allowed on each AFTO Form 350. STS: 8c Meas: PC

i. Using TO 2J-T56-26, identify 3 out of 5 facts about the (2)
reassembly of the engine. STS: 4b Meas: PC

j. Without reference, identify 3 out of 5 facts about the (2)
constructional features of the T56 engine combustion section.
STS: 11b(4) Meas: PC

k. Without reference, identify 3 out of 5 facts about the (5)
constructional features of the T56 engine turbine section.
STS: 11b(5) Meas: PC

l. Using TO 2J-T56-26, tools, a T56 engine and working in a group with no more than (x) number of procedural errors allowed, install the:

(1) Turbine rotor and turbine nozzles (x = 4). (1)
STS: 13b(5)(c) Meas: PC

(2) Engine oil seals (x = 1). STS: 13b(9)(c) Meas: PC (2)

(3) Engine bearings (x = 1). STS: 13b(8)(c) Meas: PC (3)

(4) Oil metering jets (x = 1). STS: 13b(10)(c) (4)
Meas: PC

(5) Combustion section (x = 2). STS: 13b(4)(c) (5)
Meas: PC

(6) Turbine unit assembly (x = 2). STS: 13b(3)(c) (6)
Meas: PC

m. Using TO 2J-T56-26, tools, a T56 engine and working in a group, with no more than (x) number of procedural errors allowed, accomplish the following tasks:

(1) Remove the reduction gearbox (x = 1). STS: 13b(12)(a) (1)
Meas: PC

(2) Inspe t the reduction gearbox (x = 1). STS: 13b(12)(b) (1)
Meas: PC

(3) Install the reduction gearbox (x = 1). STS: 13b(12)(c) (1)
Meas: PC

n. Without reference, identify 3 out of 5 facts about the constructional features of the T56 engine torquemeter. STS: 11b(2. (3)
Meas: PC

o. Without reference, identify 3 out of 5 facts about the constructional features of the T56 engine reduction gearbox. (3)
STS: 11b(1) Meas: PC

p. Using TO 2J-T56-26, tools, a T56 engine and working in a group, with no more than (x) number of procedural errors allowed, accomplish the following:

(1) Remove the torquemeter assembly (x = 1). STS: 13b(13)(a) (1)
Meas: PC

(2) Inspect the torquemeter assembly (x = 1). STS: 13b(13)(b) (1)
Meas: PC

(3) Install the torquemeter assembly (x = 1). STS: 13b(13)(c) (2)
Meas: PC

SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-400, C-130E Hercules Training Manual
C3ABR42633-HO-401, Labyrinth Seal Inspection
C3ABR42633-WB-401A, Combustion, Turbine, Reduction Gearbox, ANT Torquemeter Assembly Constructional Features
TO 1C-1. A-06, Aircraft Work Unit Code Manual
TO 00-20-2-4, Maintenance Documentation for In-Shop Engine Maintenance
TO 2J-T56-26, Field Maintenance
AFTO Forms 349
AFTO Forms 350

Audio Visual Aids
Films: FCC 42-110, 42-146, 42-147, 42-149, 42-150, 42-151, 42-152, 42-153

Training Equipment
T56-A-7 Engine (6)
Thermocouple Resistance Tester (6)
Handtools and Special Tools (6)

Training Methods
Discussion/Demonstration (13 hrs)
Performance (37 hrs)
Supervised Project (SP) (14 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
Day 1 - Explain the procedures in TO 2J-T56-26 for turbine unit removal and disassembly. Administer progress check 41a. Show and discuss movie FCC 42-110, Turbine Unit Removal. The students will use the last 3.5 hours of the day in the lab to remove the turbine. Assign SP HO-400, Turbine and Combusion Section, 7 hours. The instructor will evaluate student performance on PC 41b(1).

Day 2 - Show and discuss film FCC 42-147, Turbine Unit Disassembly. The students will use the last 5.5 hours of the day in the lab to disassemble the turbine unit. The instructor will evaluate student performance on PC 41b(2), (3), (4), (5), and (6) which are all accomplished at the same time.

Day 3 - Explain the procedures in TO 2J-T56-26 for engine cleaning, engine inspections and compressor inspections. Administer progress checks 41c, 41d, and 41e. All three objectives are interrelated and should be given together. The students will use the last 4 hours of the day in the lab to inspect parts of the turbine and combustion section. The instructor will evaluate student performance on PC 41f(1), (2), (3), (4), (5), and (6) which are all accomplished at the same time.

Day 4 - Discuss and perform a thermocouple resistance check through the first hour. Instructor will evaluate student performance on PC 41g. The next two hours will be used to explain the procedures in TOs 00-20-2-4 and 1C-130A-06 for filling out AFTO Forms 349 and 350 for engine removal, disassembly and inspection. Demonstrate AFTO Forms 349 and 350 and administer progress check 41h. The following 2 hours will be used to explain the procedures in TO 2J-T56-26 for turbine unit assembly, installation and torque. Administer progress check 41i. Assign SP HO-400, Torquemeter and Reduction Gearbox, for 6 hours. Progress checks 41n and 41o will be administered the last hour of SP.

Day 5 - Show and discuss film FCC 42-146. The students will use the next 5.5 hours of the day in the lab for turbine assembly. Instructor will evaluate student performance on PC 41l(1)(a), (b), (c), (d), and (e).

Day 6 - Students will complete the 1 hour lab time remaining from day 5. Show and discuss film FCC 42-149. Students will continue in lab for the next 4.5 hours. Instructor will evaluate student performance on PC 41l(1)(e), (2), (3), and (4).

Day 7 - Show and discuss film FCC 42-150. The next 2.5 hours will be spent in the lab. Show and discuss film FCC 42-151 on turbine installation. Students will then go to the lab for 2.5 hours. Instructor will evaluate student performance on PC 41l(5), (6)(a), and (6)(b).

Day 8 - Students will continue in the lab on turbine installation for the first 3 hours of day. Instructor will evaluate student performance on PC 41l(6)(c) thru (i). Show and discuss film FCC 42-152, Gearbox Removal and Installation. Students will work in lab for the next 2.5 hours of the day on gearbox removal and installation. Instructor will evaluate student performance on PC 41m(1), (2), and (3).

Day 9 - Show and discuss film FCC 42-153, Torquemeter Disassembly and Assembly. Students will work in lab for 3.5 hours. Instructor will evaluate student performance on PC 41p(1), (2), and (3). Administer Block IV test. Critique block test. Assssign Block V SP HO-500, Synchrophaser, for 6 hours. Administer PC 52a and 52b in the last hour.

MIR. Two instructors are required for 38 hours of student performance.

2.	Military Training	5
	a. Physical Conditioning	(4)
	b. Commander's Call	(1)
3.	Written Test and Critique	3

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Inspection, Engine Change, and Rigging

1. COURSE CONTENT	2. TIME
1. Engine Removal	6
a. Using TO 1C-130B-2-4, identify 6 out of 10 facts relating to engine removal. STS: 14a(1) Meas: PC	(2)
b. Using TO 1C-130B-2-4, tools, trainer, J-1 hoist, and working in a group, remove a T56 engine, with no more than 3 procedural errors allowed. STS: 14a(1), 14d Meas: PC	(3)
c. Given TOs 00-20-2-2 and 1C-130A-06, complete maintenance data collection form for engine removal, with no more than 2 errors allowed. STS: 4b, 8c Meas: PC	(1)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-501, Engine Removal
TO 00-20-2-2, Maintenance Documentation
TO 1C-130A-06, Work Unit Code Manual
TO 1C-130B-2-4, Maintenance Instruction - Power Plant

Audio Visual Aids
Selected Training Charts, AFTO Form 350
FCC 42-157, Engine Removal

Training Equipment
T56 Engine and Nacelle (6)
Handtools and Special Tools (6)
J-1 Hoist (6)

Training Methods
Lecture/Discussion (2 hrs)
Demonstration/Performance (4 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
Discuss engine removal and general maintenance procedures using TO 1C-130B-2-4. Discuss and show film FCC 42-157 on engine removal and administer PC 51a the first 2 hours of class. The next 3 hours are lab; have the students remove a T56 engine. The instructor will evaluate student performance using PC 51b. Demonstrate and explain AFTO Form 350 documentation for engine removal and have the students complete PC 51c IAW TO 00-20-2-2.

MIR: Two instructors are required for 3 hours during student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Inspection, Engine Change, and Rigging

1. COURSE CONTENT	2. TIME
2. Synchrophaser Arrangement and Operation	6
a. Without reference, identify 6 out of 10 facts pertaining to arrangement of the synchrophaser system. STS: 19d(6) Meas: PC	(3)
b. Without reference, identify 3 out of 5 principles pertaining to synchrophaser operation. STS: 19e(6) Meas: PC	(3)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-WB-502, Synchrophaser Arrangement and Operation
C3ABR42633-HO-500, C130 ...es Training Manual

Training Equipment
Synchrophaser System Components

Training Methods
Supervised Project (SP) (6 hrs)

Instructional Guidance
This SP assignment will be passed out to the students after Block IV test and completed after 6 hours. Instructor will administer progress checks 52a and 52b the last hour of this SP assignment.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Inspection, Engine Change, and Rigging

1. COURSE CONTENT	2. TIME
3. Engine Installation	8.5
a. Using TO 1C-130B-2-4, identify 6 out of 10 facts relating to engine installation. STS: 14a(2) Meas: PC	(2)
b. Using TO 1C-130B-2-4, tools, trainer, J-1 hoist, and working in a group, remove and install a T56 engine with no more than 3 procedural errors allowed. STS: 9b, 14a(2), 14e Meas: PC	(4)
c. Using a J-1 hoist, handout, and working in a group, operate hoisting equipment, with no more than 1 procedural error allowed. STS: 23a(1) Meas: PC	(1)
d. Given TOs 00-20-2-2 and 1C-130A-06, complete maintenance data collection forms for engine installation, with no more than 6 errors allowed. STS: 4b, 8c Meas: PC	(1.5)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-500A (507), Ground Support Equipment (J-1 Hoist and B-4 Stand)
C3ABR42633-SG-503, Engine Installation
TO 00-20-2-2
TO 1C-130A-06
TO 1C-130B-2-4

Audio Visual Aids
Selected Training Charts, AFTO Form 349
Film, FCC 42-158, Engine Installation

Training Equipment
T56 Engine and Nacelle (6)
Handtools and Special Tools (6)
J-1 Hoist (6)

Training Methods
Lecture/Discussion (2 hrs)
Performance (6.5)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
Thoroughly explain and locate information about engine installation using TO 1C-130B-2-4. Administer PC 53a and show engine installation film FCC 42-158 for the first two hours of class. The next four hours will be used for engine installation and J-1 hoist operation. The instructor will evaluate the students using PC 53b for engine installation and PC 53c for J-1 hoist operation. The first 2.5 hours of the following day will be used for engine installation and J-1 hoist operation along with demonstration of AFTO Form 349 and students will complete PC 53d.

MIR: Two instructors are required for 5 hours during student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Inspection, Engine Change, and Rigging

1. COURSE CONTENT	2. TIME
4. Engine Rigging	10.5
a. Using TO 1C-130B-2-4, identify 3 out of 5 facts on arrangement of the mechanical control system. STS: 11c(10) Meas: PC	(1.5)
b. Using TO 1C-130B-2-4, identify 3 out of 5 facts on the operation of the mechanical control system. STS: 11d(10) Meas: PC	(2)
c. Using TO 1C-130B-2-4, tools, trainer, and working in a group, rig the engine control linkage, with no more than 3 procedural errors allowed. STS: 4b, 10b, 14c Meas: PC	(7)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-504, Engine Rigging
TO 1C-130B-2-4

Training Equipment
T56 Engine and Nacelle (6)
Handtools and Special Tools (6)

Training Methods
Lecture/Discussion (3.5 hrs)
Performance (7 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
The last 3.5 hours of day 3 will be spent to thoroughly locate and explain the arrangement and operation of the mechanical control system using TO 1C-130B-2-4 and administer PC 54a and 54b. The next 7 hours the students will rig the engine trainers IAW TO 1C-130B-2-4. The instructor will evaluate students' performance using PC 54c.

MIR: Two instructors are required for 7 hours during student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Inspection, Engine Change, and Rigging

1. COURSE CONTENT	2. TIME
5. Propeller Rigging and Adjustments	6
a. Using TO 1C-130B-2-11, identify 3 out of 5 facts on rigging the propeller control systems. STS: 22f Meas: PC	(1)
b. Using TO 1C-130B-2-11, identify 3 out of 5 facts on adjusting propeller control systems. STS: 21e Meas: PC	(1)
c. Using TO 1C-130B-2-11, tools, trainer, and working in a group, rig and adjust the propeller control system, with no more than 1 procedural error allowed. STS: 4b, 21e, 22f Meas: PC	(3)
d. Using B-4 stand, handout, and working in a group, operate maintenance stands, with no more than 2 procedural errors allowed. STS: 23c(1) Meas: PC	(1)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-HO-500A (507), Ground Support Equipment (J-1 Hoist and B-4 Stand)
C3ABR42633-SG-505, Propeller Rigging and Adjustments
C3ABR42633-HO-505, Ground Support Equipment
TO 1C-130B-2-11

Training Equipment
Trainer, Propeller Change (6)
Handtools and Special Tools (6)
Hoist and Stands (6)

Training Methods
Lecture/Discussion (2 hrs)
Performance (4 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
The first hour of day 5 will be used for engine rigging. The second and third hour will be used to thoroughly explain the procedures for adjustment and rigging a 54H60 propeller using TO 1C-130B-2-11 and administer PC 55a and 55b. These progress checks will be given at the same time because they are interrelated. The next 4 hours will be spent in the lab adjusting and rigging the propeller and operating B-4 maintenance stands. The instructor will evaluate students' performance using PC 55c for propeller rigging.

MIR: Two instructors are required for 4 hours during student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Inspection, Engine Change, and Rigging

1. COURSE CONTENT	2. TIME
6. Scheduled Inspections	13
a. Using TOs 00-20-1 and 00-20-5, identify 3 out of 5 principles per TO pertaining to inspection systems. STS: 8b Meas: PC	(3)
b. Using TO 1C-130A-6WC-14, tools, trainer, and working in a group, perform a home station check inspection, with no more than 2 procedural errors allowed. STS: 12d Meas: PC	(3)
c. Using TO 1C-130A-6WC-15, tools, trainer, and working in a group, perform a minor inspection, with no more than 2 procedural errors allowed. STS: 12d Meas: PC	(5)
d. Using TO 1C-130B-2-4 and working in a group, operate the thermocouple resistance tester, with no more than 1 procedural error allowed. STS: 4b, 23d(3) Meas: PC	(1)
e. Using TO 1C-130B-2-4 and working in a group, operate a borescope, with no more than 2 procedural errors allowed. STS: 4b, 23d(10) Meas: PC	(1)

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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-506, Engine and Propeller Inspections
TO 1C-130A-6WC-14, Home Station Check Inspection Workcards
TO 1C-130A-6WC-15, Aircraft Inspection Workcards
TO 1C-130B-2-4, Maintenance Instructions - Power Plant
TO 1C-130B-2-11, Maintenance Instructions - Propeller
TO 00-20 Series

Training Equipment
T56 Engine and Nacelle (6)
Handtools and Special Tools (6)
Thermocouple Resistance Tester (6)
Borescope (6)
54H60 Propeller (6)

Training Methods
Lecture/Discussion (5 hrs)
Performance (8 hrs)

Multiple Instructor Requirements
Equipment, Supervision (2)

Instructional Guidance
The second, third and fourth hour of day 6 explain the use and information pertaining to inspections of the 00-20 series TOs and administer PC 56a. The last 2 hours of day 6 explain and demonstrate the use of the -14 and -15 workcards. The next 8 hours will be used to perform home station check, minor inspection, and operate the thermocouple resistance tester and borescope. The instructor will evaluate students' performance using PC 56b for a home station check; PC 56c for a minor inspection; PC 56d for operation of the thermocouple resistance tester; PC 56e for operation of the borescope.

MIR: Two instructors are required for 8 hours during student performance.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE

Inspection, Engine Change, and Rigging

1. COURSE CONTENT	2. TIME
7. Inspection Documentation	5
a. Given TOs 00-20-2-2 and 1C-130A-06, complete maintenance data collection forms for an aircraft inspection, with no more than 4 errors allowed on project #1 and no more than 4 errors on project #2. STS: 4b, 8c Meas: PC	(3)
b. Given TO 00-20-5, complete AFTO Form 781 series for an aircraft inspection, with no more than 4 errors allowed. STS: 4b, 8e Meas: PC	(2)

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SIGNATURE AND DATE	SIGNATURE AND DATE

POI NUMBER	BLOCK	UNIT	DATE	PAGE NO.
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SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
TO 00-20 Series
TO 1C-130A-06, Work Unit Code Manual

Audio Visual Aids
Selected Training Charts, AFTO Forms 349 and 781A

Training Methods
Demonstration/Performance (5 hrs)

Instructional Guidance
The third, fourth, and fifth hour of day 8, explain and demonstrate how the look and fix phases of a scheduled inspection are documented on AFTO Form 349 according to TOs 00-20-2-2 and 1C-130A-06 and have students complete PC 57a. The next 2 hours will be used to explain the purpose of the AFTO Form 781 series and demonstrate how to fill out an AFTO Form 781A for a scheduled inspection. Administer PC 57b.

PLAN OF INSTRUCTION/LESSON PLAN PART I

NAME OF INSTRUCTOR	COURSE TITLE
	Turboprop Propulsion Mechanic

BLOCK TITLE
Inspection, Engine Change, and Rigging

1. COURSE CONTENT	2. TIME
8. Engine Block Testing and Adjustments	5
a. Without reference, identify 3 out of 5 facts for block testing the engine. STS: 16a Meas: PC	(2)
b. Using TO 1C-130B-2-4, identify 3 out of 5 facts relating to engine adjustments. STS: 17b Meas: PC	(3)

SUPERVISOR APPROVAL OF LESSON PLAN

SIGNATURE AND DATE	SIGNATURE AND DATE

POI NUMBER	BLOCK	UNIT	DATE	PAGE NO.
C3ABR42633 000	V	8	3 April 1984	107

ATC FORM JUN 78 133 PREVIOUS EDITION OBSOLETE

SUPPORT MATERIALS AND GUIDANCE

Student Instructional Materials
C3ABR42633-SG-508, Engine Block Testing
C3ABR42633-WS-508, Engine Adjustments
TO 1C-130B-2-4, Maintenance Adjustments, Power Plant

Training Methods
Supervised Project (SP) (5 hrs)

Instructional Guidance
The SP assignment (objective 8a) will be passed out to the students for 2 hours and progress check 58a given during the last hour. The SP assignment (objective 8b) will be passed out to the students for three hours and progress check 58b given during the last hour.

9.	Military Training	8
	a. Physical Conditioning	(4)
	b. Commander's Call	(1)
	c. End-of-Course Appointments	(3)
10.	Written Test and Critique	3
11.	Course Critique and Graduation	2

INSPECTION AND OPERATION OF PORTABLE EXTINGUISHERS

OBJECTIVES

After completing this study guide and your classroom instruction, you will be able to identify facts about the use of portable fire extinguishers.

INTRODUCTION

Fire extinguishers are portable, hand-operated appliances which have a limited capacity. They are for emergency use to control or extinguish a fire in its beginning stages. The proper use of these extinguishers on the early stages of a fire can keep the loss of life and property damage low. These extinguishers must be in a place that is readily available and they must be able to extinguishing the fire.

INFORMATION

TYPES OF EXTINGUISHERS

Each type of extinguisher is of value but no one type is good on all classes of fire. The types used in the military will be covered in this study guide. They are:

1. Water (pressurized).

2. Carbon dioxide (CO_2).

3. Dry chemical

Pressurized Water Extinguishers, Figure 1

The pressurized water extinguisher is fast becoming the rule instead of the exception. The 2-1/2 gallon pressurized water extinguisher has replace most all other sizes used.

It will discharge water up to 30 or 40 feet for use on class "A" fires only. The force used to expel the water is 100 psi of stored air pressure or 100 psi of dry nitrogen.

INSPECTION PROCEDURES. Monthly inspection of the pressurized water extinguisher is a complete visual check of the outside of the extinguisher. The pressure gage should read 100 psi and show no damage. Where applicable the pin and seal should be intact and secured around the discharge lever. The hose and nozzle assembly should be free of obstructions, cracks and/or dry rot. The outer part of the tank should be free of rust, cracks and dents in the seams. The instruction plate, head, and nozzle holder

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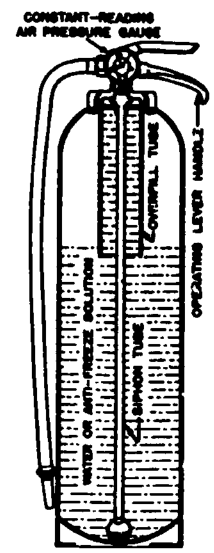
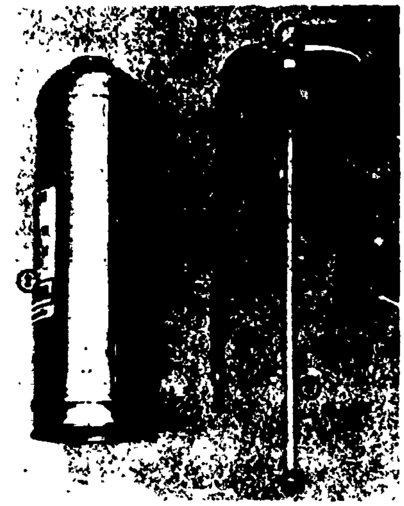
WATER
Stored Pressure

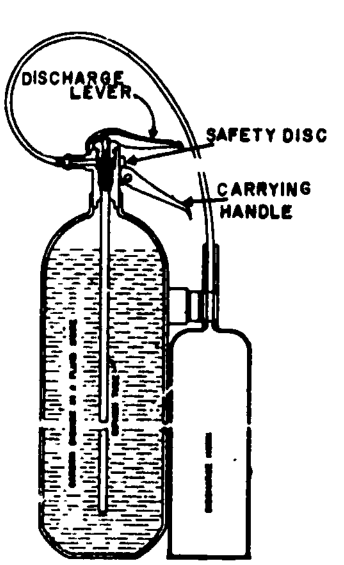


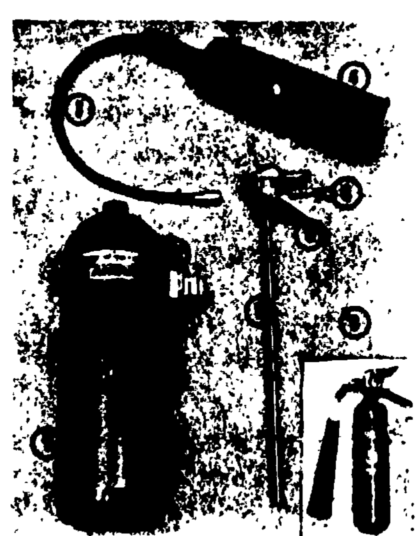


Integral parts of the stored-pressure water extinguisher are: 1) tank or shell; 2) instruction label; 3) hanger; 4) discharge hose; 5) valve assembly with pressure gauge, discharge lever, carrying handle, and locking ring pin; 6) gasket; 7) discharge lever tension spring; 8) siphon tube with bottom screen; and 9) overfill tube.

Figure 1. Water Stored Pressure Extinguisher.

COMPRESSED GAS
Carbon Dioxide





Integral parts of the carbon dioxide extinguisher are: 1) steel shell, 2) instruction plate and holding clamp for discharge horn, 3) hose, 4) discharge horn, 5) combination discharge lever and carrying handle, 6) locking ring pin, 7) siphon tube, and 8) variation of the carbon dioxide unit which has a metal instead of flexible tube.

Figure 2. Carbon Dioxide Extinguisher.

must be the right parts for the extinguisher and the hangar must be in good condition.

Annual inspections call for the same check as the monthly inspection plus an operational check which means discharging the contents. Once the discharge is done; it must be cleaned, refilled, recharged, and repl with a new pin and seal around the discharge lever.

WINTERIZATION. When this extinguisher is exposed to extremely cold temperatures, an antifreeze is needed. Keloy is used to keep the water from freezing at temperatures down to 0°F. Keloy is added with dry nitrogen as the expelling agent for temperatures below 0°F.

Carbon Dioxide (CO_2), Figure 2

The CO_2 extinguishers used by the military range from two pounds to 100 pounds with 15 and 50 pound sizes being the most common. The 15 pound is a portable type hand extinguisher, while the 50 pound is a wheel type. The extinguisher is made up of a seamless steel cylinder which holds liquified carbon dioxide. At room temperature, carbon dioxide has a pressure of 800 to 875 psi in the extinguisher. This internal pressure will push the liquid carbon dioxide out which turns to a vapor when it comes in contact with air. Consideration must be given to their effective range since it is only three to eight feet which is short when compared to other portable fire extinguishers. The CO_2 extinguisher will be used on class "B" and "C" fires since carbon dioxide does not conduct electricity.

> Caution: Due to the -110°F temperature produced by the discharging of this extinguisher, special care must be given to its operation or frostbite may occur. When used in confined spaces, asphyxiation could occur.

INSPECTION PROCEDURES. Monthly inspection of the carbon dioxide extinguishers will include a check on the wire and seal to insure that the seal is intact. The plastic seal will be checked to make sure that it is in place on the safety pressure release disc. Check the extinguisher's location to make sure that it is not in high temperatures or in the direct rays of the sun. Check the hose for deterioration and the horn for damage. If the wire and seal or the plastic seal is missing; weigh, recharge (if necessary), and reseal the extinguisher.

Annual inspection of this extinguisher will be a complete visual inspection and weighing of the extinguisher to be sure of a full charge. It will be recharged if it falls below 10% of its rated capacity.

WINTERIZATION PROCEDURES. Carbon dioxide extinguishers do not normally require winterization. However, the pressure in the extinguisher may drop when the temperature drops. When it is to be used in temperatures below 0°F and all airborne carbon dioxide fire extinguishing cylinders should be winterized by adding 200 psi dry nitrogen to the carbon dioxide. With the addition of dry nitrogen, the extinguisher can be used through the temperature range of minus 65°F to plus 160°F. Dry nitrogen is not affected by heat and cold as is carbon dioxide and it gives more pressure for expelling carbon dioxide from the cylinder. The cylinder safety disc will not blow out below 160°F; thus, it will work at high temreratures without the danger of discharge. Dry nitrogen should be added to the cylinder when it is charged for extreme temperature operation (regardless of size) until the pressure is 200 psi at 70°F or corresponding pressures for other temperatures.

Figure 3. Dry Chemical Extinguisher.

Dry Chemical Extinguisher, Figure 3

Dry chemical extinguishers come in sizes of 2-1/2 to 30 pounds. This extinguisher will be used on class "B" and "C" fires. Discharge reach is from 5 to 20 feet. Discharge time is 10 to 25 seconds. Figure 6 shows a dry chemical extinguisher.

OPERATING PRINCIPLE. The chemical in these extinguishers is sodium bicarbonate or potassium bicarbonate, which has been treated to make it moisture resistant and free-flowing. This compound is discharged under pressure and directed at the fire.

The extinguisher may have a cartridge of carbon dioxide or nitrogen gas, either inside or alongside the main container to expel the dry chemical. When the pressure enters the main cylinder, the dry chemical will be expelled when you open the shutoff nozzle. Some are pressurized with inert gas or DRY air and do not have cartridges.

METHOD OF OPERATION. These extinguishers are made to be carried to the fire and used in accordance with instructions which are on the extinguisher. In the case of cartridge-operated extinguishers, the gas in the cartridge pressurizes the dry chemical chamber and expels the dry chemical. The discharge is controlled by a shutoff valve. With a pressurized dry chemical extinguisher, both the dry chemical and expellant are stored in one chamber and the dry chemical will be expelled when you open the valve. Release of the valve gives it a shutoff feature. In each case, a cloud of dry chemical is expelled from the nozzle. On fires in liquids, you should aim at the base of the flames. For best results, start at the near edge of the fire and move forward moving the nozzle rapidly with a side-to-side sweeping motion.

INSPECTION PROCEDURES. Inspection includes checking the hose, nozzle, and container for cracks, leaks, and corrosion; tightness of connections between cartridge and extinguisher; and that the pin and seal are holding the valve in position.

ANNUAL. The annual inspection will be a complete check and operational test of the extinguisher. Remove the spent cartridge. Remove the cap from the extinguisher. Check the extinguisher for damage. If not damaged, start recharging. Refill it with the right amount of dry chemical. Replace the cap and tighten it. Replace the cartridge with one that is sealed and has the proper weight. If the cartridge is 1/2 ounce below the weight shown on the container, get another cartridge. Place the pin and nozzle in their proper place and seal it.

QUESTIONS

Answer these questions on a separate sheet of paper which will be given to your instructor for correction and evaluation. Do not write in this book.

1. The ____________ ____________ ______________ is responsible for inspection and ______________ of fire extinguishers.

2. Fire extinguishers are portable, hand-operated appliances having a ______________ capacity and are used on a fire in its __________ stage.

3. The most common water extinguisher is of what type?

_________________________ _________

4. On the monthly inspection, the pressure in the water extinguisher should be ______________ psi.

5. In extremely cold temperatures, the pressurized water extinguisher is winterized with __________________.

6. A CO_2 extinguisher is winterized by adding ___________ psi of ______________ ______________________.

7. Dry chemical extinguishers come in sizes of -__________ to __________ pounds.

REFERENCE

1. International Fire Service Training Association - IFSTA 101.

HANDOUT

C3ABR42633-HO-104

Technical Training

Tur prop Propulsion Mechanic

GLOSSARY

22 April 1982

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

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GLOSSARY

INTRODUCTION

This handout consists of words and terms used in this course. Use this glossary for the meaning of words and terms you don't understand as you read the study guide assignments.

ABORT	- To stop or fail in the early stages. To turn back without completion.
ACCELERATION	- The rate of change in velocity (a change in speed).
ACTUATOR	- Something which transmits motion.
AIR START	- Engine start mode in flight using ram air to rotate the engine compressors.
AMBIENT AIR	- Air surrounding all sides of an engine, air available for consumption.
ANNEALING	- A process of heat treating to soften metal.
ANTI-FRICTION	- Reducing friction; having rolling contact instead of sliding contact (ball bearing).
ANTI-ICING	- Prevention of ice formation
ATOMIZED	- To reduce to fine particles or spray.
AXIAL	- Along an axis.
AXIAL FLOW	- Refers to the path of air, as it passes along the axis (or shaft) of engine rotating assembly.
AXIALLY	- Extending in a direction essentially parallel to the main axis of the engine.
BAFFLE	- An obstruction designed to control the flow of air or fluids. Something for deflecting, checking, or otherwise regulating flow.
BLENDING	- To mix or fuse thoroughly so parts are no longer distinct.

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BOWING - Curving or gradual deviation from original line or plane usually caused by lateral force and/or heat.

BRINNELLING - Indentations sometimes found on surface of ball or roller bearing parts.

BURRS - A rough edge or a sharp projection on the edge of surface of the parent material.

BYPASS - A pipe between two points that avoids or is auxiliary to the main way.

BYPASS VALVE - A valve that allows oil to go around a filter that is clogged.

CAGE - A frame for holding bearing in place around in shaft journal.

CATEGORY - A classification division in any field or knowledge.

CENTRIFUGAL - Moving or directed outward from the center.

CHAFFING - A rubbing action between two parts having limited relative motion, which will cause wear.

CLOGGED - To become stopped up (such as a fuel line becoming blocked).

CLUSTER - A number of things of the same sort gathered or growing together; bunch (a cluster or a bunch of fuel nozzles such as six (6) nozzle for each of the eight (8) combustion chamber in a J57 engine).

COMPRESSOR BLADE (ROTOR) - A rotating airfoil shaped component which moves the air along.

COMBUSTION CHAMBER - A place where fuel and air are mixed and the fuel burned.

COMPRESSOR VANE (STATOR) - A stationary airfoil-shaped component which raises pressure.

COMPRESSOR STAGE - One row of rotating blades (rotor) plus one row of stationary vanes (stators).

COMPRESSOR SURGE - A disturbance of normal airflow, sometimes known as a stall.

COMPRISED - To include, sum up.

CONFIGURATION - Form contour or structure as determined by the arrangement of parts.

CONFINED - To keep within limits; to keep shut up.

CONTAMINATION - To make impure, pollute, dirty (such as a dirty oil filter).

CONVERGENT - To tend to meet in a point on a line. Incline toward each other.

CONVERGENT DUCT - Becoming continuously smaller in the direction of flow.

DAMPENED - To moisten; to deaden; depress, reduce or lessen.

DEAERATOR - A unit that removes air from the oil.

DEENERGIZE - To check the flow of current through (an electrical device).

DEGREASING - To remove grease or oil from metals with hot or cold chemicals.

DEMAGNETIZE - The purpose is to eliminate the residual magnetism which would cause particles to adhere to the bearing.

DEMINERALIZED - To remove the mineral matter from (as water).

DEPRESERVATION - The act of removing the barrier so that the engine could be put into use.

DIFFUSER - A rapidly expanding area where air from the compressor is directed to the combustion section and to other internal and external takeoffs. Used to increase pressure and decrease velocity.

DISCARDED - To get rid of; to throw away.

DIVERGENT - Pertaining to a condition brought about by a net flow of air from a given region or air moving in different directions from a common point.

DIVERGENT DUCT - Becoming continuously larger in the direction of flow.

DRONE - A pilotless airplane directed by remote control.

DUCT - A passage which contains and controls the flow of gases in motion.

DUAL - Meaning two (2).

DUET - A composition for two voices or instruments.

DUPLEX (OR DOUBLE) BEARING	- Two independent bearings paired up and acting as one.
ENERGIZE	- To give energy to. To apply a source of voltage or current to.
ENERGY	- The ability to do work.
FACILITATE	- To make easier or less difficult.
FAILURES	- The act, fact, failing, falling short, not doing or succeeding in passing a test or part not operating their normal times.
FERRULE	- To give added strength to metal. Enclosing the end of a tool. Handle or similar object to strengthen it or prevent spilling and wearing.
FIRMLY	- Not yielding easily under; solid; steady.
FLAMEOUT	- Unintentional flame stoppage.
FLANGE	- A rim or edge (as on a shaft or a pipefitting) projecting at right angles to provide strength or means of attachment to another part.
FLUORESCENT	- To make cracks readily visible when viewed under ultra-violet light.
FLUORESCENT PENETRANT	- Is a nondestructive means of inspecting materials and parts for surface cracks or discontinuities.
FLUSH	- Making an even line or plane, even with a margin or edge, so as to be level or in alignment.
FRAGILE	- Easily broken, damaged or destroyed, frail, delicate.
GALLING	- A transfer of metal by rubbing one surface to another. To wear away by friction.
GASKET	- A piece or ring of rubber metal, etc, placed around a piston or joint to make it leakproof.
HUB	- The center part of a wheel. The central part of a motor - driven fan to which the blades are attached.
INGESTION	- To take as by swallowing or absorbing. Foreign object that may be swallowed by a jet engine which would cause damage.

INTERMEDIATE	- Lying or being in the middle place, coming in between. J57 engine has what is called intermediate front bearing (no. 2) and intermediate rear bearing (no. 3) which is between the front and rear compressors.
JAMMED	To squeeze into or through a confined space. To become wedged or stuck fast.
JOURNAL	- A machined surface on which the inner ring of anti-friction bearing is mounted.
LEAKAGE	- An act or instance of leaking; the amount that leaks in or out of an area.
LUG	- An earlike projection by which a thing is held or supported. A projection on a casting to which a bolt or another part may be fitted.
MANIFOLD	- A connecting pipe which may take any of various forms.
MATING SPLINES	- The act of matching splines (a series of projecting keys and fitting into an internal grooved cylindrical member).
MATTER	- The substance of which physical object consist of or are composed of. Found in three states; solid, liquid and gas.
MISCELLANEOUS	- Consisting of various kinds, mixed hardware, such as nuts, bolts, studs and etc.
MULTI	- A word element meaning "many" (such as three or more).
NACELLE	- The enclosed part of an airplane in which the engine is housed.
NOMENCLATURE	- Technical name or description of an item.
NOZZLE	- A duct of varying cross-section, used in discharging liquids or gases, in which the velocity of the fluid or gas is increased.
OBSTRUCTION	- Something to block or make difficult the passage or aisle to the nearest exit.
ORIFICE	- An opening or mouth as of a tube. A small hole.
OVERTEMP	- An EGT in excess of the maximum allowable for a given condition.

OXIDATION	- The state or result of being oxidized (to combine with oxygen or with more oxygen).
PENETRANT	- To pass into or through; to enter or go through by overcoming resistance. Discover the inner contents. Recognize the precise nature of the metals.
PERPENDICULAR	- Meeting a given line or surface at right angles. Air flow is at right angles to the axis.
PINION	- A gear with a small number of teeth designed to mesh (mate) with a larger gear.
PNEUMATIC	- Relating to air or air pressure.
POSITIVE DISPLACEMENT	- A pump that will displace the same amount of liquid in any one cycle.
PRESERVATION	- To prevent corrosion by placing a barrier between critical metal surfaces and moisture during the time the engine is idle.
PRESSURIZE	- To keep nearly normal air pressure inside of (an airplane, space suit) as at high altitudes. To subject to high pressure.
PROBE	- A small diameter sensing element extending into the air or gas stream to measure pressure, temperature, or velocity. To examine or investigate thoroughly, to search.
QUADRANT	- Something shaped like a quarter of a circle, as a part of a machine. Placed in the cockpit where the throttle is; used to control the fuel flow to the engine.
RACE	- A groove for the balls in a ball bearing or rollers in a roller bearing.
RADIAL	- Branching outward in all directions from a common center.
RAM AIR	- The pressure buildup at the engine inlet, created by the forward motion of the aircraft.
RELAXED	- To rest or give rest to, from work, worry.
RESPECTIVE	- As relates to individually to each of two or more. Noticing with attention. Regardful of particular persons or things.
RETAINING	- To keep in one's mind.

RIGID - Not bending or flexible: stiff.

SCAVENGE - To return all to the tank from the sump. To remove residue. To remove dirt, waste, or other impurities from a space (sump).

SCHEMATIC - Pertaining to or of the nature of a plan or drawing.

SCORING - Deep scratches made during engine operation by sharp edges or foreign particles; elongated gouges.

STANDARD DAY - A set of theoretical atmospheric conditions, used as a reference in making TO charts which are used for making engine adjustments and computing thrust.

STATIC - Not moving.

START - To successfully bring the engine into operation.

STRETCH - To reach out. To extend over a given space, distance, or time.

SUMP - A low place where fluid (oil) will collect.

SWIRL - To move with a whirling motion.

SWIRL CUP - A device that is built into a dome of a combustion chamber to move the air with whirling motion as it mixes with the fuel from the nozzles.

SYNTHETIC - Not real or genuine, artifical, man-made. Produced by artificial process. Something produced by putting together elements so as to form a whole.

TACHOMETER - A device which shows the rotational speed of a shaft.

TAPPED - To make a hole for drawing off liquid. Make or open holes.

TECHNICAL ORDERS (TOs) - Printed and detailed information concerning operation, maintenance, inspection, and repair of Air Force equipment.

TERMED - Limited ended. Such as a limited or definite extent of time.

THERMOCOUPLE - A temperature sensing device. A device for measuring temperature in which two electrical conductors of dissimilar (not alike) metals are joined at the point where heat is to be applied and the free ends are connected to an electrical measuring instrument (as an ammeter).

TIE ROD BOLTS	- A bolt used as a connecting member of a compressor (as in a J57 engine) along a bolt ties all rotating members (disc) of the front compressor.
TORQUE	- A force that will produce rotation.
TORQUE VALUE	- The amount of force aplied; common units are inch-pounds or foot-pounds.
TOXIC	- Poisonous or injurious to respirator organs.
TRANSDUCER	- A device that transmits energy from one system to another.
TRIM	- To adjust properly.
TRIM CHARTS	- Reference charts consulted while making adjustments on the engine (found in equipment technical orders).
THERMO	- Relating to heat
THERMOCOUPLE	- A temperature sensing device.
THRUST	- The forward force produced in reaction by the escaping gases in jet propulsion. Formula: Trhust - Mass times Acceleration (T = M x A).
THRUST AUGMENTATION	- Any method of temporarily increasing thrust.
TURBULENCE	- A disturbed pattern of airflow.
VENTILATED	- To circulate fresh air in a room. To let air or gas to escape overboard from the aircraft.
WARP	- A distortion to become bent or twisted out of shape. The action, process, or the result of bending or twisting out of shape.
WELD	- To unite (pieces of metal) by heating until molten and fused or until soft enough to hammer or press together.
WELDMENT	- A unit formed by welding together an assembly of pieces.

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WB-104
13 January 1984

JET ENGINE THEORY

OBJECTIVES

When you have completed this workbook and your classroom instruction, you will be able to identify facts pertaining to engine operation.

PROCEDURE

Using the information presented in the classroom presentation, fill in the spaces provided with the correct information.

1. Give the meaning of each term.

   a. Mass - ______________________

   b. Acceleration - ______________________

   c. Density - ______________________

   d. Velocity - ______________________

   e. Pressure - ______________________

   f. Humidity - ______________________

   g. Thrust - ______________________

2. Newton's third law of ____________ states that for every ____________, there is an ____________ and ____________ reaction.

   a. Name two examples that would illustrate Newton's third law of motion.

      (1) ______________________

      (2) ______________________

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3. Bernoulli's principle states that when gases or ______________ flow through a pipe whose cross sectional diameter varies, ______________ will be the greatest where the cross section is the greatest, and the ______________ will be the least.

a. Simply stated, ______________ and ______________ vary inversely with each other in Bernoulli's principle.

b. List the three types of ducts below.

(1) ______________

(2) ______________

(3) ______________

c. Explain what happens to PRESSURE and VELOCITY in each of these ducts.

(1) ______________

(2) ______________

(3) ______________

4. The engine manufacturer uses standard day conditions to make comparisons for engine ______________ and computing ______________.

a. What are the three standard day (atmospheric) conditions that affect thrust?

(1) ______________

(2) ______________

(3) ______________

b. What happens to thrust in the following atmospheric conditions?

(1) Temperature increases, thrust ______________.

(2) Humidity increases, thrust ______________.

(3) Pressure increases, thrust ______________.

5. Jet Engine

a. Definition - a ______________ device which develops forward thrust by accelerating a ______________ rearward through a jet or nozzle.

b. Types of jet engines.

(1) Ramjet

(a) The ramjet is the ______________ type of jet engine.

(b) The ramjet cannot ______________ from rest.

(2) Turbojet

(a) Most ______________ used type of jet engine.

(b) The turbojet can create ______________ at ______________ speed.

(3) Turboprop

(a) The turboprop engine is an ______________ flow turbojet engine driving a ______________ assembly which is connected to a ______________.

(b) Able to ______________ and ______________ on short runways.

(4) Turbofan

(a) The turbofan produces a ______________ airstream through accelerated air from the fan tips.

(b) Used on ______________ and ______________ aircraft.

6. Classification of Turbojet Engines

a. Classification of turbojet engines is determined by the type of ______________.

b. Centrifugal flow is when the airflow through the engine is ______________ to the axis of the engine.

c. Axial flow is when the airflow through the engine is ______________ to the axis of the engine.

d. In an axial flow engine, one row of ______________ blades and one row of ______________ vanes makes one stage of compression.

7. Directions in reference to a turbojet engine

a. Stand at the ______________ facing engine.

b. The numbering of units is ______________ from the rear.

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WB-[redacted] 10KA
3 December 1981

T56 ENGINE CASES AND PARTS

OBJECTIVES

When you have completed this workbook and your classroom instruction, you will be able to identify and locate the T56 engine cases and parts.

EQUIPMENT

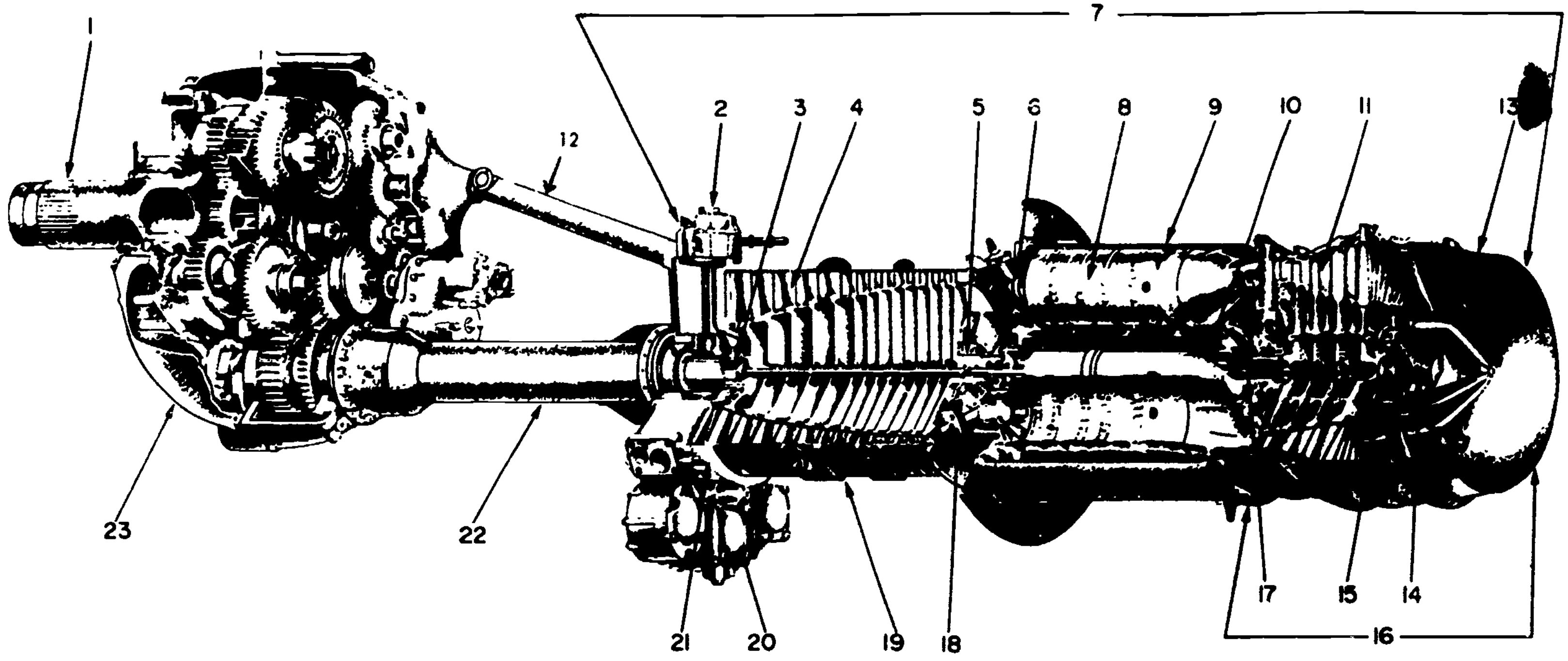
	Basis of Issue
T56 engine	1/15 students
Selected bearings and system parts	1/15 students

PROCEDURE

Use the information given in the classroom presentation, discussion, and aid from the instructor. Fill in the spaces provided under the illustration with the information from the list below that correctly identifies each item in the figure.

REDUCTION GEAR ASSEMBLY	INNER COMBUSTION CASING
TORQUEMETER ASSEMBLY	COMBUSTION LINERS
ACCESSORY DRIVE HOUSING ASSEMBLY	TURBINE ROTOR
COMPRESSOR ASSEMBLY	REAR BEARING SUPPORT
TURBINE ASSEMBLY	FUEL NOZZLE
POWER SECTION	BREATHER
PROPELLER SHAFT	REAR SCAVENGE PUMP
COMPRESSOR AIR INLET HOUSING	NUMBER 4 BEARING
COMPRESSOR DIFFUSER	NUMBER 3 BEARING
OUTER COMBUSTION CASING	NUMBER 2 BEARING
COMPRESSOR CASE	NUMBER 1 BEARING
TIE STRUT	

Supersedes 3ABR42633-WB-105B, 10 March 1980.
RGL: N/A
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 500; DAV - 1
Designed for ATC Course Use. Do Not Use on the Job.



1. ______________________ 12. ______________________
2. ______________________ 13. ______________________
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4. ______________________ 15. ______________________
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6. ______________________ 17. ______________________
7. ______________________ 18. ______________________
8. ______________________ 19. ______________________
9. ______________________ 20. ______________________
10. ______________________ 21. ______________________
11. ______________________ 22. ______________________
23. ______________________

STUDY GUIDE

3ABR42633-[redacted]/104A/104B/104C
SG 110

Technical Training

Jet Engine Mechanic
Turboprop Propulsion Mechanic

INTRODUCTION TO COMMON HANDTOOLS, HARDWARE, MEASURING DEVICES, AND SAFETY WIRING

11 April 1980

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

RGL: 9.3

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Supersedes 3ABR42632-102, 102A, 102B, 102C, 12 September 1977.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-J - 600; TTVSA - 1

COMMON HANDTOOLS

OBJECTIVES

After you have completed this study guide and your classroom instruction, you will be able to:

1. Select common handtools.

2. Care for common handtools.

3. Use common handtools on trainers.

INTRODUCTION

Technical Order 32-1-101, Maintenance and Care of Handtools, lists many common types of handtools. This study guide will also list some of the more commonly used handtools. As a jet engine mechanic, you will have handtools in your tool box or otherwise available if you should need them.

INFORMATION

FILES AND RASPS

Files and rasps are used to remove burrs from rough metal, tubing ends, and to smooth rough areas and edges on sheet metal. Figure 1 shows the construction of files and also shows examples of the more common types of files.

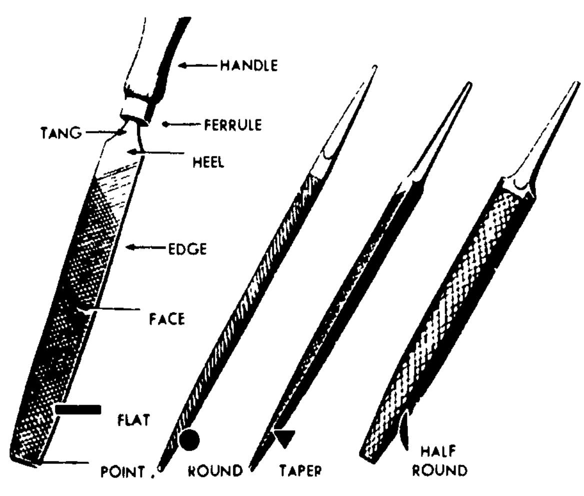


Figure 1. Files.

A file should always have an appropriate handle. The handle permits you to use the file with greater ease and safety.

A file can be cleaned with a file brush or soft metal cleaning pin.

The file is designed to cut on the forward stroke; however, the file should <u>not</u> be forced down by applying pressure on the point, figure 2.

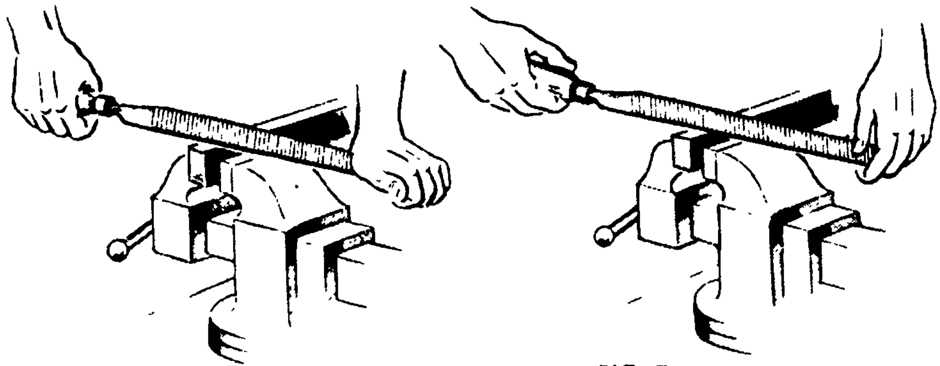


Figure 2. Use of Files.

HAMMERS, MALLETS, MAULS, AND SLEDGES

Hammers, mallets, mauls and sledges should be kept clean, free of grease and dirt. Grease and dirt on these tools create an additional safety hazard for persons using the tools; also, other persons in the immediate area will be subjected to increased danger.

Different types of hammers are shown in figure 3. They are quite varied for use on different jobs and materials. The rawhide mallet, for example, has a hard head which will allow a firm sharp head which will allow a firm sharp blow to metal and produce very little surface damage to the metal. The rounded ball portion of the ball-peen hammer can be used for bending or reshaping metals or rivets.

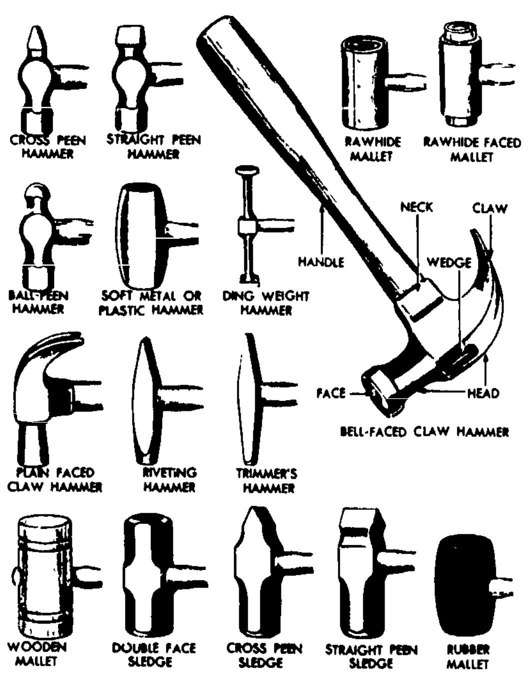


Figure 3. Hammers, Mallets, Mauls and Sledges.

CAUTION: A LOOSE HAMMER HEAD SHOULD BE TIGHTENED WITH A METAL WEDGE; THE HAMMER SHOULD NOT BE USED IF THE HEAD IS LOOSE ON THE HANDLE OR IF THE HANDLE IS CRACKED.

PLIERS

Pliers are used as an extension for the mechanic's fingers, for holding, bending and cutting metals, and materials when performing maintenance tasks. Figure 4 shows examples of pliers the mechanic may use.

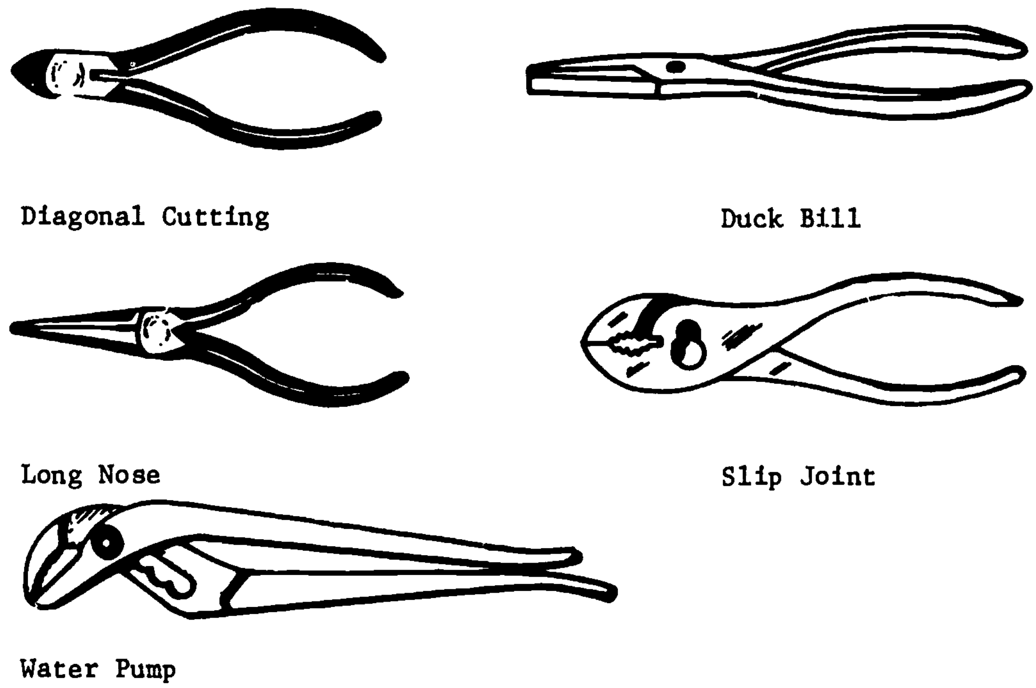


Figure 4. Pliers.

Diagonal side cutting pliers, commonly called "dikes," are used for cutting safety wire or removing cotter pins.

Long nose pliers, commonly called "needle-nose pliers," are used for grasping small items in tight places where fingers cannot reach.

Slip-joint pliers, usually called "common pliers," are used as a general purpose holding tool for bending pieces of metal or wire.

Water-pump pliers are very effective as a large capacity holding tool.

Duck bill pliers are used for pulling and twisting safety wire.

CAUTION: PLIERS SHOULD NOT BE USED TO APPLY TORQUE TO NUTS OR BOLTS; THIS WILL DAMAGE THE TOOL AND ALSO THE HARDWARE.

PUNCHES

Punches have many uses, the prick punch is used to make fine marks and to pierce thin sheet metal, figure 5.

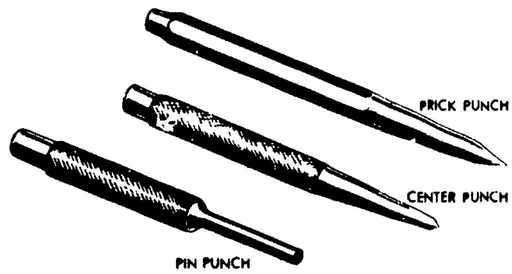


Figure 5. Punches.

The center punch is used to mark metal for drilling holes.

The pin punch is used to help drive rivets from holes after the rivet is loosened.

Note: The screwdriver should <u>NOT</u> be used as a punch.

SCREWDRIVERS

Screwdrivers are used to tighten or loosen screws. There are several different types of screwdrivers to fit different types of screws, figure 6.

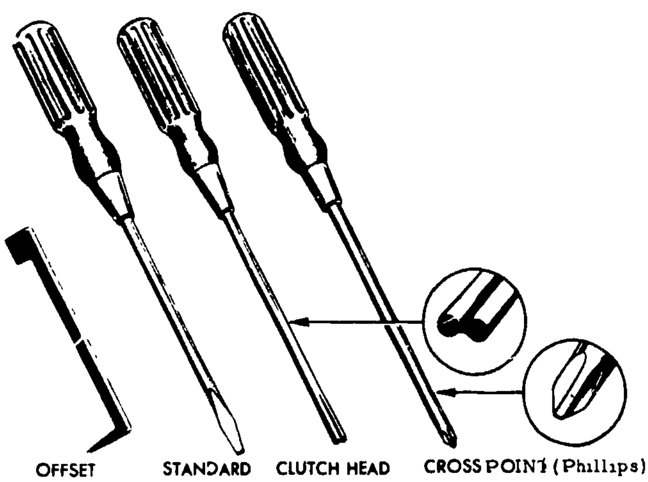


Figure 6. Screwdrivers.

The common standard screwdriver is used frequently by most mechanics.

The cross point screwdrivers, used on cross point screws, are the Phillips and the Reed and Prince.

The off-set screwdriver is ideal to use on screws that are located in a close or difficult position.

The clutch head screwdriver is to be used on screws of this particular head design.

CAUTION: USE THE SCREWDRIVER FOR THE PURPOSE AND IN THE MANNER IT WAS DESIGNED TO BE USED. DO NOT USE THE SCREWDRIVER TO PRY, TO SCRAPE, TO PUNCH, TO CHISEL OR AS A LEVER. DO NOT USE PLIERS ON THE SHANK OF THE SCREWDRIVER TO GAIN EXTRA LEVERAGE, FIGURE 7.

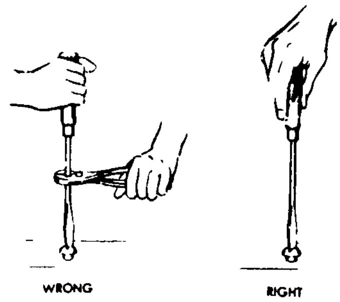


Figure 7. Use of the Screwdriver.

WRENCHES

Wrenches are used to apply a tightening force or, on the other hand, is used to loosen nuts, bolts and lines.

The mechanic on the job, will use socket wrenches, open end wrenches, box wrenches and adjustable wrenches, figure 8.

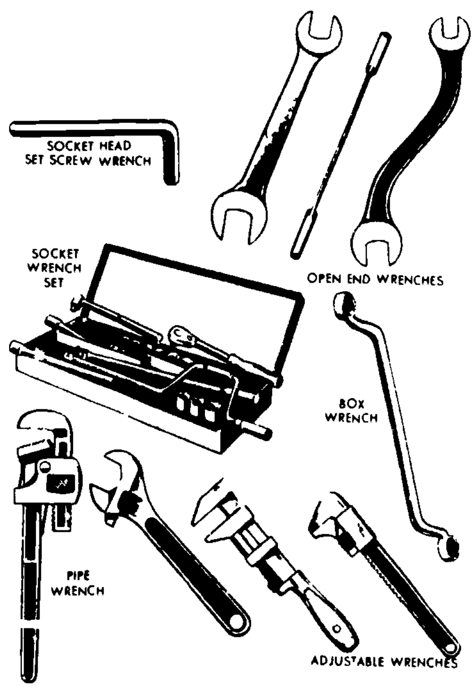


Figure 8. Wrenches.

Note: Safety, speed, and application are important aspects to remember when selecting a wrench. That is, the mechanic should select and use the wrench that is the most practical and safe, for a particular job of tighening or loosening parts on an engine. The wrong application of the adjustable wrench can be hazardous and also may damage engine parts, figure 9.

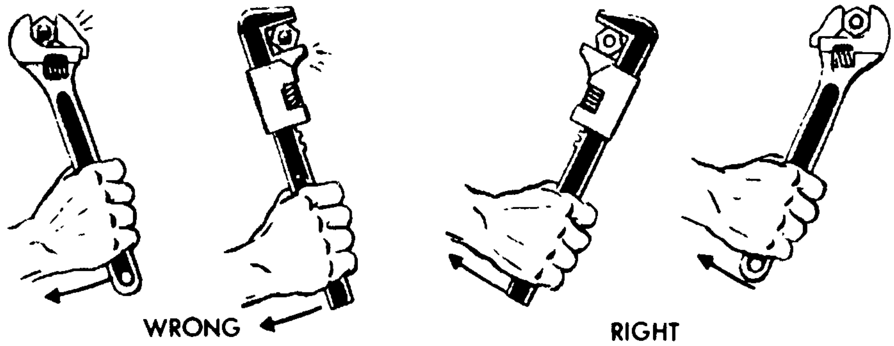


Figure 9. Use of the Adjustable Wrench.

CAUTION: DO NOT USE PIPE OR OTHER EXTENSIONS TO INCREASE THE LEVERAGE ON A WRENCH. THE USE OF AN EXTENSION WILL USUALLY DAMAGE THE EQUIPMENT AND MAY ALSO CAUSE INJURY TO THE PERSON USING THE TOOL, FIGURE 10.

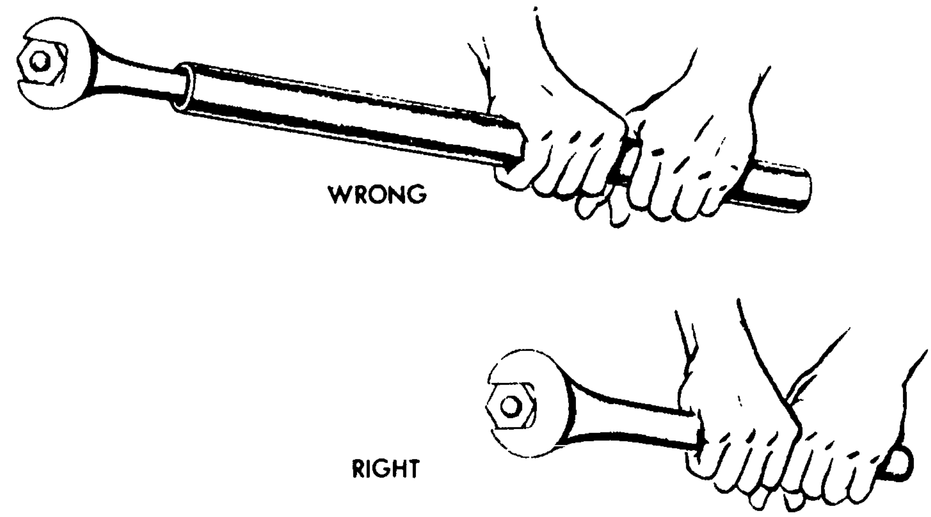


Figure 10. Use of the Wrench.

QUESTIONS

1. What is used to clean a file?

2. Name three t pes of hammers.

3. Why are pliers used?

4. Name three types of punches.

5. Name two types of cross-point screwdrivers.

6. What are three important things to remember when selecting wrenches?

HARDWARE

OBJECTIVES

After you have completed this study guide and your classroom instruction, you will be able to:

1. State the purpose of hardware.

2. Identify the types of hardware.

INTRODUCTION

The purpose of this study guide is to introduce some of the aerospace hardware that you may use as a mechanic. Because of the small size of some hardware, its importance is sometimes overlooked. This study guide is designed to cover only a portion of aircraft and engine hardware. The information is general; for more current data refer to TO 1-1A-8 on aircraft hardware, also the TO pertaining to your specific equipment.

INFORMATION

SCREWS

The screw is the most common type of threaded fastener used on aircraft. They are similar to other types of threaded fasteners, but usually have a lower material strength or loose thread fit. Each type screw requires a particular type screwdriver. There are four main groups of screws, the structural screw, machine screw, self-tapping screw, and set screw.

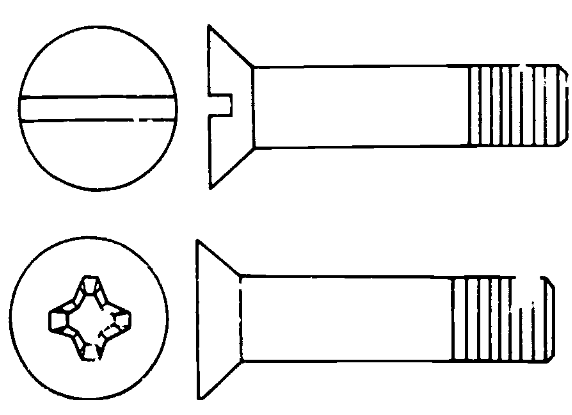


Figure 11. Structural Screw.

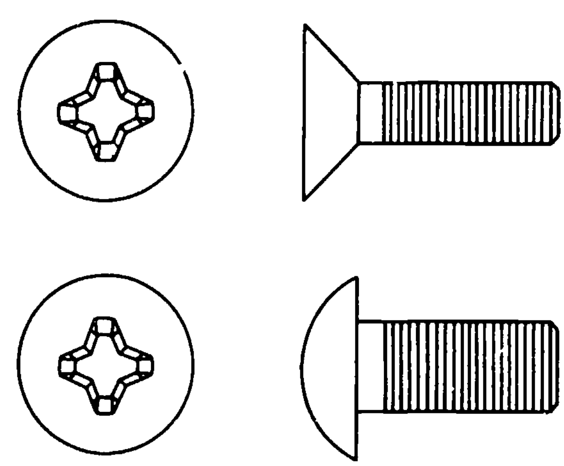


Figure 12. Machine Screw (Flathead and Roundhead).

The structural screw is used in the primary structure of the aircraft as are rivets or bolts, figure 11.

The machine screw is widely used and there are many varied types and designs, for example, the flathead, roundhead, fillister head, socket head, pan and truss head, figure 12.

Self-tapping screws tap their own threads as they bore into the materials. Examples of the self-tapping screws are wood screws and sheetmetal screws, figure 13.

Set screws are used to secure or position units such as gears or pulleys on shafts, figure 14.

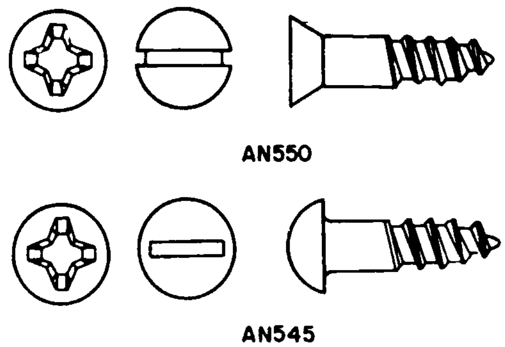


Figure 13. Self-Tapping Screws.

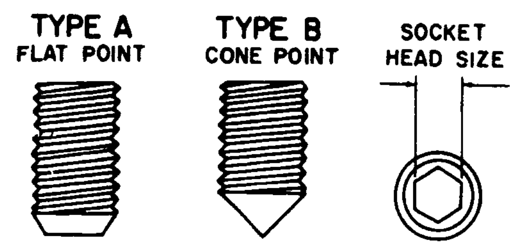


Figure 14. Set Screws.

BOLTS

Most bolts used for the aircraft structure are general purpose, internal wrenching, or close-tolerance bolts. Some bolts are designed for a particular purpose and application, these should always be replaced with like items. These special bolts are usually designed by the manufacturer and marked on the head with a stamped letter "S," for special. Before any bolt is tightened or replaced the equipment TO should always be checked for proper hardware identification and replacement information. Standard aircraft bolts are designed for general applications that involve certain tension or shearing loads. The size of the bolt is determined by the three size readings, figure 15. The length of the shank (a), the diameter of the shank (b), and the number of threads per inch (c).

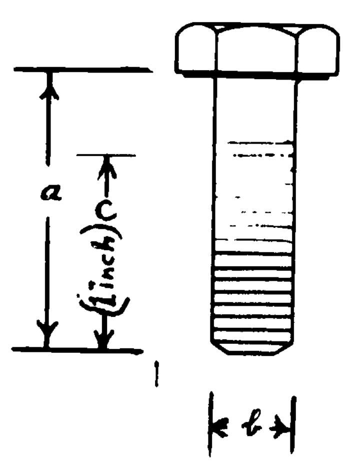


Figure 15. Determining Bolt Size.

The standard aircraft bolt head will be in the shape of a hexagon design, figure 16. A special head such as an internal wrenching, figure 17, a 12 point external wrenching, figure 18, or an eye bolt, figure 19, will be used as specified by the TO.

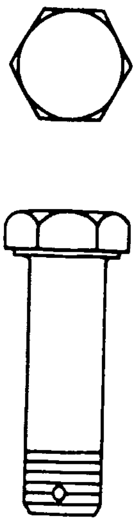


Figure 16. Standard Aircraft Bolt.

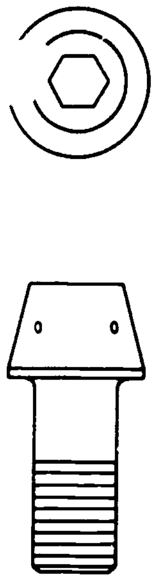


Figure 17. Internal Wrenching.

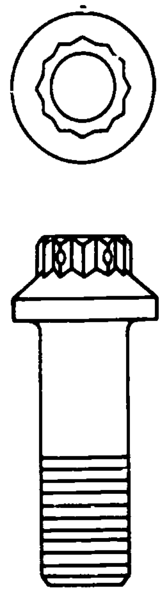


Figure 18 12-Point External Wrenching.

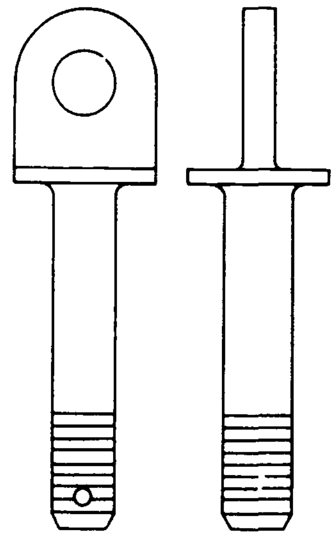


Figure 19 Eye Bolt.

Note: The holes in the bolt heads are for lockwire; and, in the shank end the holes are used for lockwire or cotter pins.

Bolt heads are stamped (coded) to show the physical characteristics of a particular bolt, figure 20.

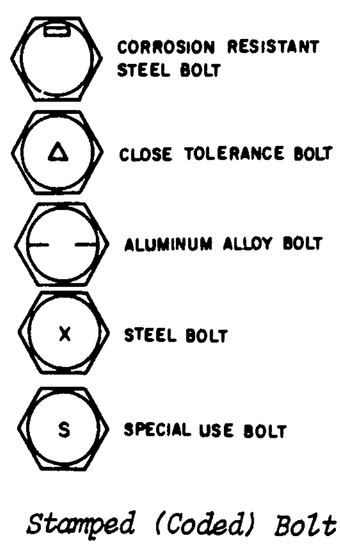


Figure 20. Stamped (Coded) Bolt Heads.

Note: Other letters or numbers used to code bolts are explained in TO 1-1A-8, Aircraft Structural Hardware. When the TO specifies a steel bolt is to be used it cannot be replaced with bolts made of aluminum or other materials. The markings or codes on the bolts make the identification and selection of the correct bolt easy and saves time.

STUDS

Studs are used in soft metals or materials where damage could result if bolts used to fasten parts were removed and installed repeatedly. The stud is installed in the unit and a nut is used on the exposed end of the stud to secure the part or accessory.

There are many types of studs; the most common types are the straight and stepped, figures 21 and 22.

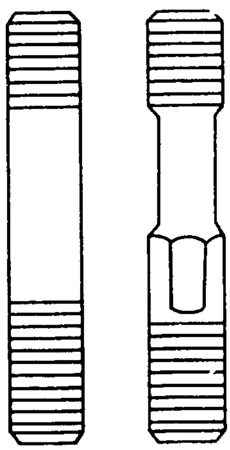


Figure 21.
Straight Studs.

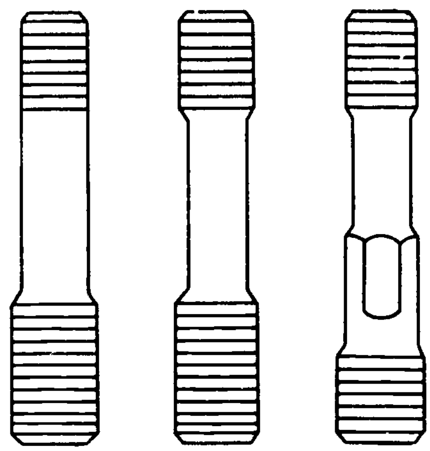


Figure 22.
Stepped Studs.

NUTS

The nut is threaded internally to mate with the threads on a bolt or screw. The primary function of a nut (fastener) is to apply tension to the bolt or stud. This tension holds the joined members together. Before torquing any nut or bolt, check the TO for proper torque to apply on any specific item of equipment.

There are many types of nuts used on Air Force equipment and the military standard nuts are of one piece construction. An exception to the one piece construction, is the nonmetallic inserted nut.

Self-locking nuts provide a tight connection which will not loosen because of vibration. The two major types of self-locking nuts are the torque type and free-spinning nuts. The torque type nut requires the use of a wrench throughout the entire tightening cycle after the bolt or screw threads have been engaged. An example of the torque nut is the nonmetallic inserted (fiber) nut. This nut has a nylon locking section which grips the bolt or screw thread and prevents the nut loosening. This nut is not used where it would be subjected to temperatures above 250°F.

Note: No self-locking nut is to be used at a joint or aircraft structure that is subjected to rotational movement in relation to the bolt.

Nonself-locking nuts vary in design and purpose. Examples are the plain, check, wing and castle nuts.

Plain Nut

The plain nut, figure 23, is used to a very limited extent on the aircraft. It must be locked, usually with a check nut or lock washer.

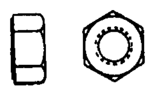


Figure 23. Plain Nut.

Check Nut

The check nut, figure 24, is used for a locking device for plain nuts, set screws, threaded rod ends and other devices.

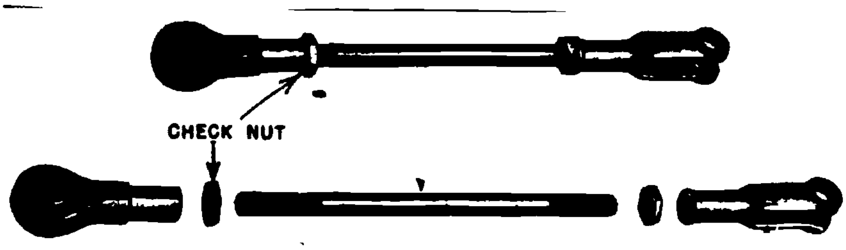


Figure 24. Check Nut.

Wing Nut

The wing nut, figure 25, is used where the desired torque is to be applied by the use of the fingers.

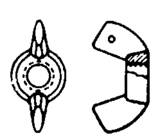


Figure 25. Wing Nut.

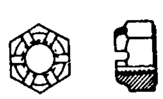


Figure 26. Castle Nut.

Castle Nut

The castle nut, figure 26, is used on a drilled bolt or screw and is secured by a cotter pin.

WASHERS

Washers: The most commonly used washers on an aircraft are the plain washers, lock washers and special washers.

Plain washers, figure 27, are used under nuts and bolts to provide a smooth surface and protect the surface from crushing damage when the nut is tightened. Aluminum or aluminum alloy plain washers are used under bolts and nuts on magnesium units to prevent corrosion.

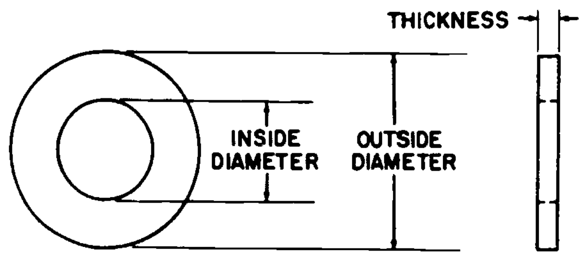


Figure 27. Plain Washers.

Lockwashers, figure 28, provide a spring pressure under the nut to prevent loosening. It is used only if the equipment TO specifies its use. When used on soft surfaces a plain washer must be used under the lockwasher to prevent damage to the soft materials.

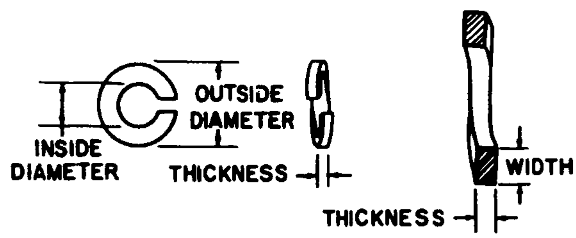


Figure 28. Lockwashers.

Special washers, figures 29 and 30, are designed to be used in special locations for special jobs; the TO shows where and when to use special washers.

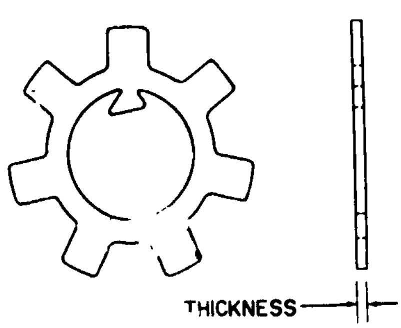


Figure 29. Special Washer.

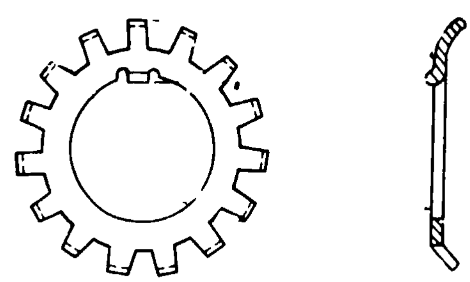


Figure 30. Special Washer.

PINS

Pins are used to secure aircraft hardware items or units. There are many types of pins, such as tapered pins, flat pins, cotter pins, spring pins and quick release pins.

Tapered pins, figure 31, are used in joints that carry shear loads and where the absence of clearance is essential.

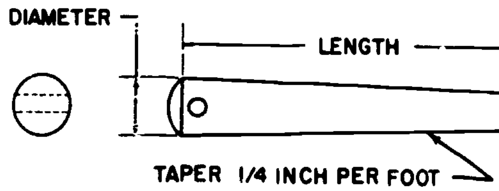


Figure 31. Tapered Pin.

Flat head pins, figure 32, are used with tie rod terminals or secondary controls. The flat head pin is secured with a cotter pin.

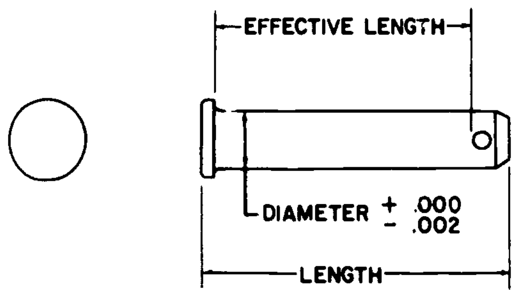


Figure 32. Flat Head Pin.

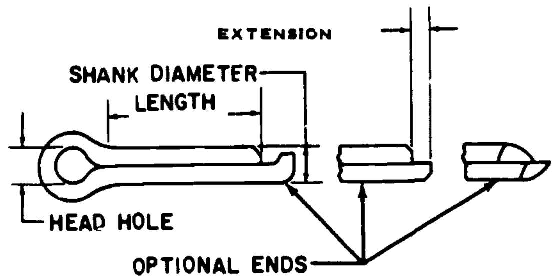


Figure 33. Cotter Pin.

Cotter pins, figure 33, are used to secure bolts, nuts, screws, and pins where necessary. Cotter pins are used one time and should never be reused, but should be replaced with a new pin.

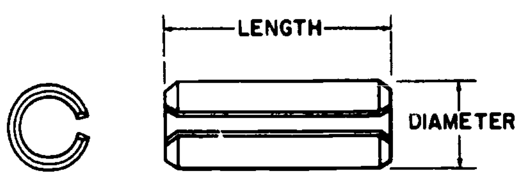


Figure 34. Spring Pin.

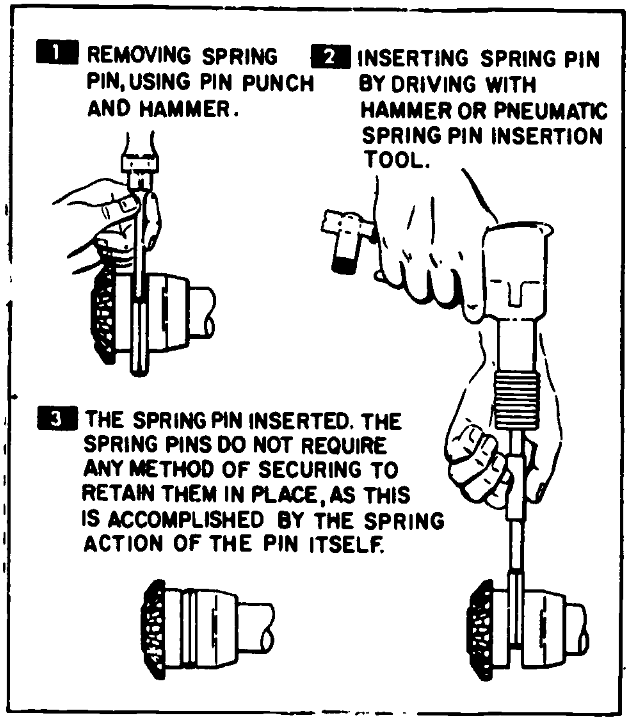


Figure 35. Spring Pin, Removal and Installation.

Spring pins, figures 34 and 35, are heat treated to obtain maximum strength and toughness in the pins. The outside diameter of a pin is greater than the hole the pin is installed in, therefore, a steady pressure is exerted by the spring pin after it is installed.

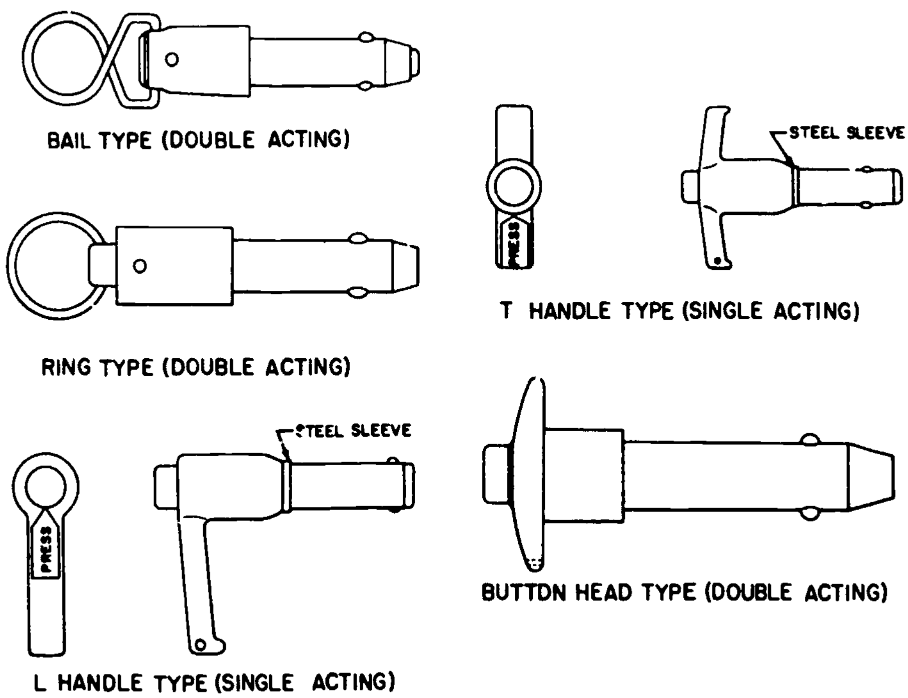


Figure 36. Quick Release Pins.

Quick release pins, figure 36, sometimes referred to as "pip" pins, where rapid removal and replacement of equipment is necessary.

THREADED INSERTS

Threaded inserts are commonly used in aircraft, engines and accessories to protect and strengthen tapped threads in light materials, metals and plastics, particularly in locations or on parts that require frequent assembly and disassembly. The three types of threaded inserts are the lock ring, clinch nut and the one-piece threaded insert.

The lock ring threaded insert of the standard or self-tapping type, figure 37, can be placed in any material that can be drilled and tapped. The lock ring threaded insert is constructed of strong steel and bolts, studs, or screws will not cause damage to its internal teeth. The lock ring, installed by pressure, prevents the insert from coming loose because of vibration or removal of the bolt.

The clinch nut type threaded insert, figure 38, provides a permanent fastener where a nut is to remain in place. This allows for simplicity and speed in removal and reassembly of the unit.

One piece threaded inserts, figure 39, are precision formed coils of diamond-shaped wire and are used as screw thread bushings. The one piece threaded inserts are available in various diameters and thread sizes. They are used in some instances with steel studs and bolts.

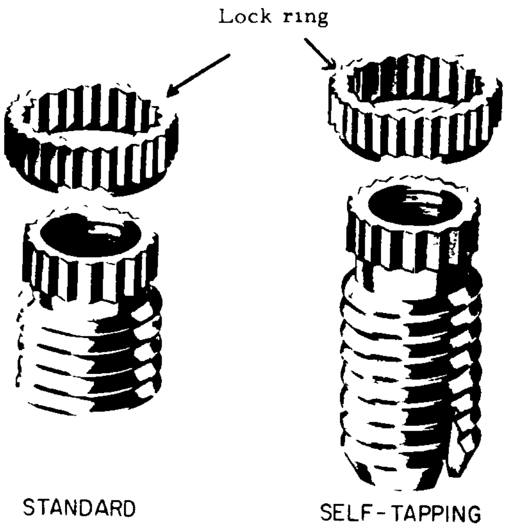


Figure 37. Lock Ring Threaded Inserts.

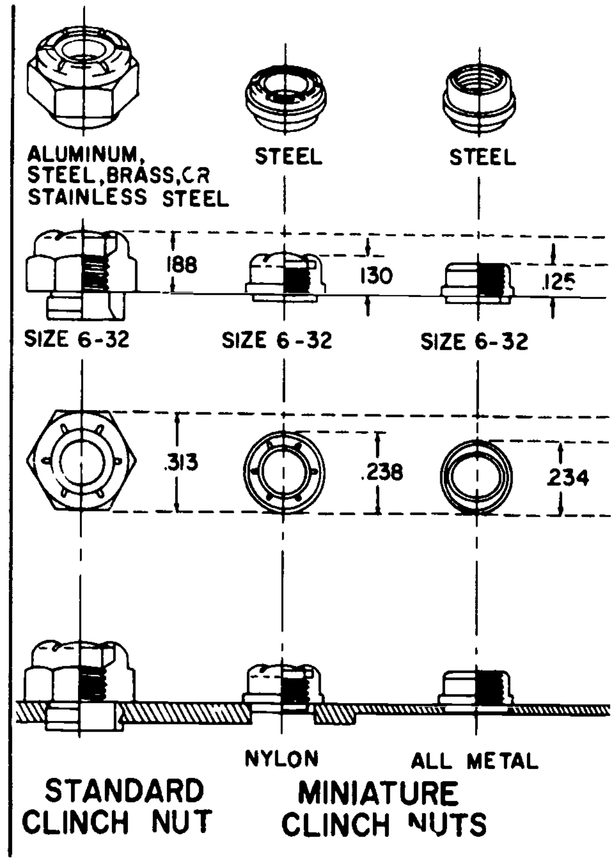


Figure 38. Clinch Nut Type Threaded Inserts.

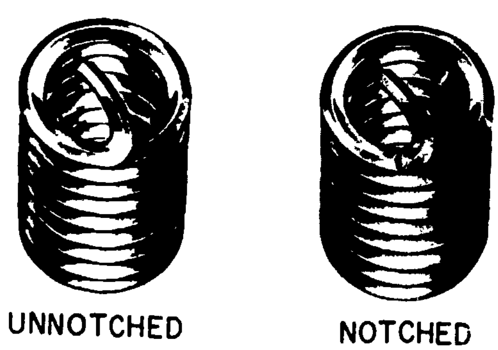


Figure 39. One-Piece Threaded Inserts.

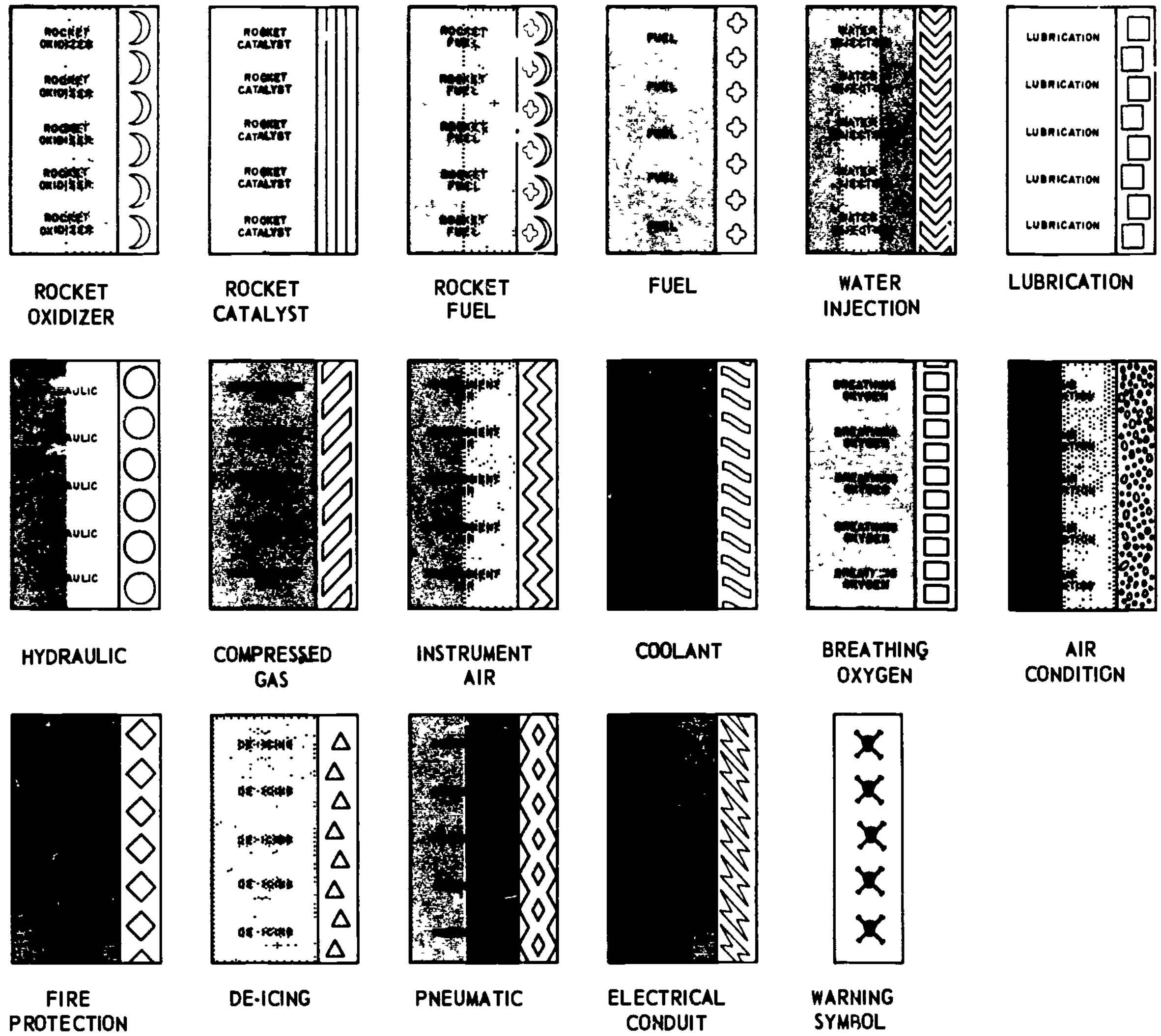
TUBING AND SYSTEM IDENTIFICATION

Tubing such as stainless steel and aluminum alloy are used to carry fluids and gases in the various systems. The color coded tape, figure 40, is used to aid in rapid and accurate identification of the tubes (lines) of the various systems.

Stainless steel tubing is corrosion resistant and used in high pressure systems. This tubing will withstand as much as 3000 psi, such as is used in hydraulic system for landing gear, wing flaps and brakes.

Aluminum alloy tubing is used for geneal purpose lines and conduits for low fluid pressures. This tubing is used for instrument lines, electrical and ventilating conduits and drain lines.

Note: All tubing should be handled carefully to prevent sharp bends, kinks, nicks, or scratches on the tubing.



THE ABOVE COLOR CODES REPRESENT DESIGNATION FOR SYSTEMS ONLY. FOR CODING LINES WHICH DO NOT FALL INTO ONE OF THESE SYSTEMS THE CONTENTS SHALL BE DESIGNATED BY BLACK LETTERING ON A WHITE TAPE.

SUBSIDIARY FUNCTIONS OR IDENTIFICATION OF LINE CONTENT MAY BE INDICATED BY THE USE OF ADDITIONAL WORDS OR ABBREVIATIONS WHICH SHALL BE CARRIED ON A SECOND TAPE ADJACENT TO THE FIRST OR ALTERNATIVELY, INTERPOSED BETWEEN THE WORDS DESCRIPTIVE OF THE MAIN FUNCTION.

WARNING SYMBOL TAPES, 3/8-INCH WIDE, SHALL BE APPLIED TO THOSE LINES WHOSE CONTENTS ARE CONSIDERED TO BE DANGEROUS TO MAINTENANCE PERSONNEL, WARNING TAPES ARE TO BE PLACED ADJACENT TO SYSTEM IDENTIFICATION TAPES.

ONE BAND SHALL BE LOCATED ON EACH TUBE SEGMENT, 24 INCHES OR SHORTER. ONE BAND SHALL BE LOCATED AT EACH END OF EACH TUBE SEGMENT LONGER THAN 24 INCHES. ADDITIONAL BANDS SHALL BE APPLIED WHEN THE TUBE SEGMENT PASSES THROUGH MORE THAN ONE COMPARTMENT OR BULKHEAD. AT LEAST ONE BAND SHALL BE VISIBLE IN EACH COMPARTMENT OR ON EACH SIDE OF THE BULKHEAD.

PRESSURE TRANSMITTER LINES SHALL BE IDENTIFIED BY THE SAME COLORS AS THE LINES FROM WHICH THE PRESSURE IS BEING TRANSMITTED.

FILLER LINES, VENT LINES AND DRAIN LINES OF A SYSTEM SHALL BE IDENTIFIED BY THE SAME COLORS AS THE RELATED SYSTEM.

TAPES SHALL NOT BE USED ON FLUID LINES IN THE ENGINE COMPARTMENT WHERE THERE IS A POSSIBILITY OF THE TAPE BEING DRAWN INTO THE ENGINE INTAKE. FOR SUCH LOCATIONS, SUITABLE PAINTS, CONFORMING TO THIS COLOR CODE, AND WHICH HAVE NO DELETERIOUS EFFECT ON THE MATERIAL USED FOR THE LINES, SHALL BE USED FOR IDENTIFICATION PURPOSES. IN THESE CASES THE GEOMETRICAL SYMBOLS MAY BE OMITTED.

Figure 40. Color Coding for Tubing and Hoses.

QUESTIONS

1. Name four types of screws.
2. Name four types of bolts.
3. Name two types of studs.
4. When are plain washers used?
5. When are castle nuts used?
6. Name two types of pins.
7. Name three types of threaded inserts.
8. Name two types of tubing.
9. What is the color code for fuel lines or hoses?
10. What is the color code for hydraulic lines or hoses?

Jet Engine Branch
Chanute AFB, Illinois

3ABR42633-SG-104B

MEASURING DEVICES

OBJECTIVES

After you have completed this study guide and your classroom instruction, you will be able to:

1. Identify types of measuring devices.

2. Use measuring devices on simple projects.

INTRODUCTION

The work of a mechanic is no more accurate than the measurements he may make. It is important, therefore, that he learns to hold, use, and read the measuring device correctly and accurately. There are many different types and kinds of measuring devices; each device is designed to be used for a specific purpose. Examples of measuring devices are: a 6-inch steel rule, thickness gage, screwpitch gage, calipers, and micrometers.

MICROMETER

The micrometer is the most accurate of the adjustable measuring instruments. It is used to measure to within one-thousandth (0.001) of an inch. If it is equipped with a vernier scale, it will measure to within one ten-thousandth (0.0001) of an inch. An outside micrometer is shown in figure 41. The principle parts of an outside micrometer are the anvil, spindle, frame, barrel and thimble. Some micrometers are equipped with a lock and ratchet stop.

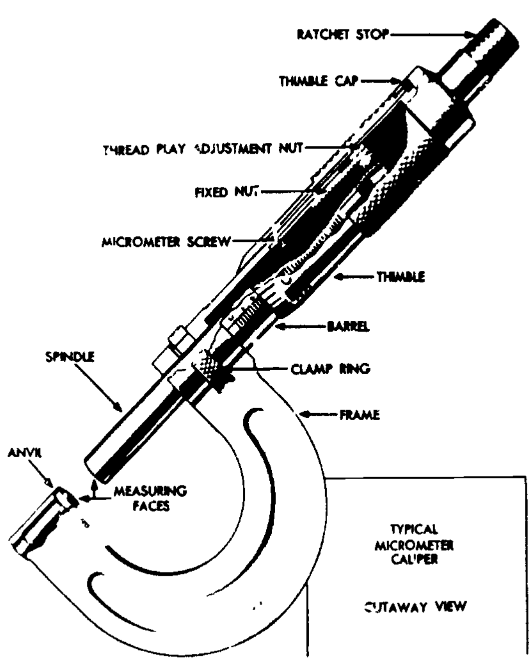


Figure 41. Outside Micrometer.

The anvil is one of the two measuring faces between which the work is measured. The anvil is mounted in the frame opposite the spindle face, figure 41.

The spindle is the other of the two measuring faces of the micrometer. A clockwise rotation of the thimble will cause the spindle to move toward the anvil, while a counterclockwise rotation of the thimble will cause the spindle to move away from the anvil.

The frame, figure 42, holds the anvil in place, and is also held in the mechanic's hand when he is measuring or working with the micrometer.

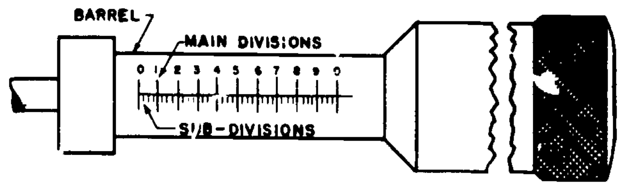


Figure 42. Main and Subdivision on the Barrel.

The barrel of a micrometer that has a range of one inch is divided into ten main divisions, each division equaling one-hundred thousandths of an inch (0.100). Each main division of the barrel is then subdivided into four equal subdivisions of twenty-five thousandths (0.025) of an inch, figures 42 and 43.

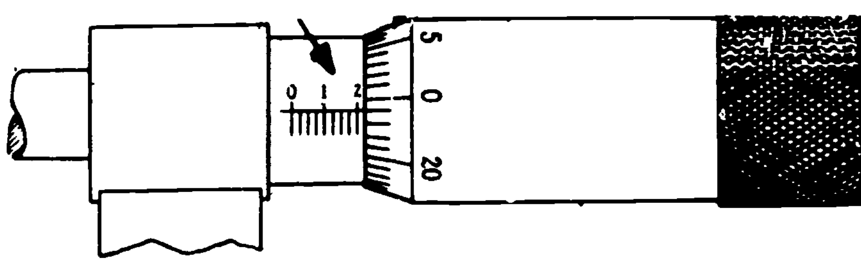


Figure 43. Micrometer Readings.

The thimble has a beveled edge which is divided into 25 equal divisions, each of these divisions equals one thousandths of an inch (0.001). These divisions are marked, for convenience, at every five spaces by 0, 5, 10, 15 and 20. One complete turn of the thimble will move the spindle twenty-five thousandths (0.025) of an inch, figure 43.

Different types of micrometers are used for different types of measurements, mainly outside measurements, inside measurements and depth measurements. The principles, of use and operation of all types of micrometers is about the same.

An inside micrometer, figure 44, is used to measure the inside diameter of cylinders, the width of recesses and other similar inside dimensions.

A depth micrometer, figure 45, is used to measure the depth of a recess or hole.

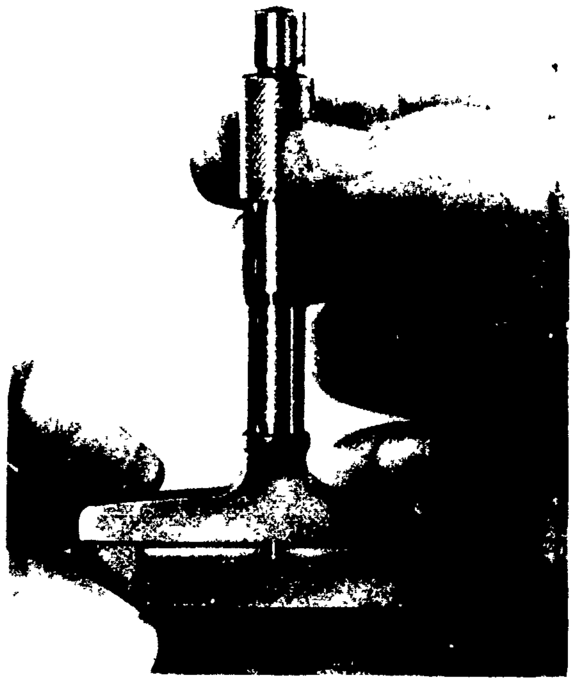


Figure 45. Using a Depth Micrometer.

Figure 44. Measuring with an Inside Micrometer.

Figure 46. Inside Micrometer Caliper.

An inside micrometer caliper, figure 46, is another form of micrometer that is designed for inside measurements such as small diameters and narrow slots.

The first step in learning to use a micrometer is to hold it correctly, figure 47. The thumb and first finger are used to turn the thimble until the anvil and spindle just touch the material. Only a very slight tension should be applied, and it should be the same every time the micrometer is used. Many micrometers have a ratchet on the end of the thimble which will slip when tension becomes too great and will prevent overtightening.

The spindle of the micrometer should always be perpendicular to the material being measured. If it is not, the micrometer reading will be slightly greater than the actual size of the material.

Figure 47. Correct Way to Hold a Small Outside Micrometer.

The micrometer is a most delicate measuring instrument, rough handling or misuse will reduce its accuracy or cause it to be inoperable. When the micrometer is not being used, place it gently on a smooth clean surface. Do not bump or drop the micrometer. Place a light film of clean oil on the surface of the micrometer. Never use dirty oil, or permit dirt particles, to touch or accumulate on the micrometer -- KEEP IT CLEAN. Do not tighten the thimble, but use a very light touch when adjusting the micrometer for measurements.

CALIPERS

Calipers are used for measuring or transferring diameters and distances or comparing distances and sizes. They are classified as sliding or spring calipers, and either classification may be used for inside or outside measurements. Measurements taken with calipers are considered more accurate than those taken with a rule. They can be used to take measurements to within one thousandth (0.001) of an inch.

The caliper rule, figure 48, has a fixed jaw at the end of a bar and a movable jaw fastened to a frame which slides on this bar. The bar has a scale on it and the frame has two index marks labeled IN and OUT. One side of the jaw is used to take outside measurements and the other side of the jaw is used to take inside measurements.

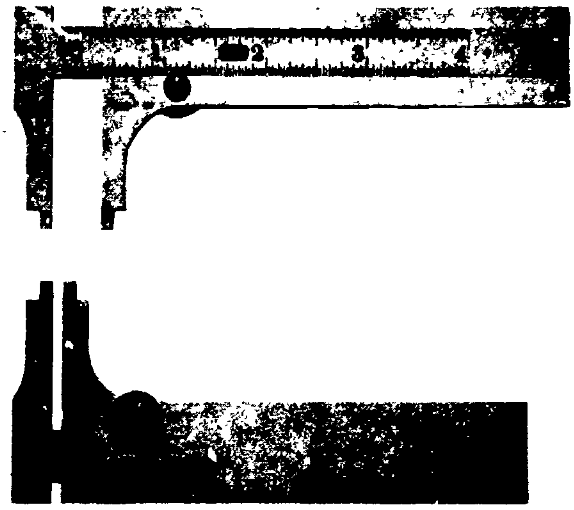


Figure 48. Two Views of a Simple Caliper Rule.

Spring calipers, figures 49 and 50, have no scale and are used mainly to transfer dimensions. They are used to take the inside or outside dimensions of a piece of material.

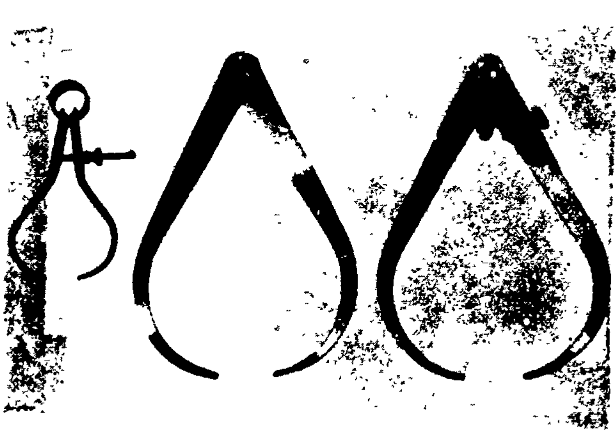


Figure 49. Three Types of Outside Calipers.

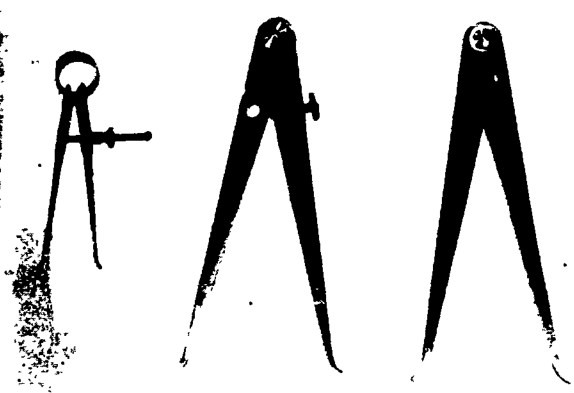


Figure 50. Three Types of Inside Calipers.

Sliding calipers should be kept clean and oiled. They should never be jammed tightly on the material, this may spring the jaws and damage the calipers.

Spring calipers should not be used when material is moving, nor should the calipers be forced on the material. They may not be damaged, but they will spring slightly and give an inaccurate measurement.

SCREW PITCH GAGE

This gage is sometimes referred to as a thread pitch gage. It is similar in appearance to the thickness gage; however, all the leaves have about the same thickness. The edge of each leaf has a different number of teeth per inch cut in it, figure 51. The screw pitch gage is used to determine the number of threads per inch on a screw, bolt, or other threaded units. The number of threads per inch on a threaded object may be determined by trying various leaves of the gage until one fits perfectly. The number stamped into the leaf indicates the number of threads per inch (TPI), figure 52.

Figure 51. Thread Pitch Gage.

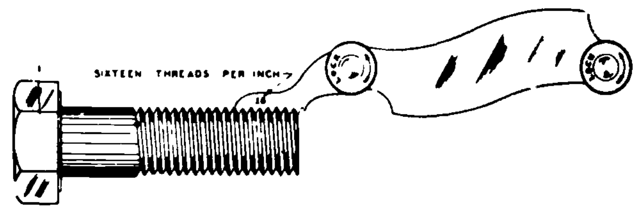


Figure 52. Use of Screw Pitch Gage.

THICKNESS GAGE

The thickness gage consists of thin leaves of hard steel, figure 53. Each leaf is precision ground to a definite thickness. The leaves are usually in sets, with one end of the leaf fastened in a case. A set usually includes 26 leaves that range in size from fifteen ten-thousandths (0.0015) to twenty-five thousandths (0.025) of an inch.

Figure 53. Typical Thickness Gage.

Thickness gages are used to measure the clearance between two parts. One leaf at a time is tried until the leaf which will enter the opening is found. The thickness of that leaf is then read and the clearance determined. The leaf should be wiped off before trying to insert it between two parts. It should never be forced! Only a light pressure should be applied. If the leaf is forced, it may spread the opening slightly, thus giving an inaccurate indication of size. There is danger also of kinking and damaging the leaf. If a leaf of the proper thickness is not available, two leaves may be wiped clean and used together.

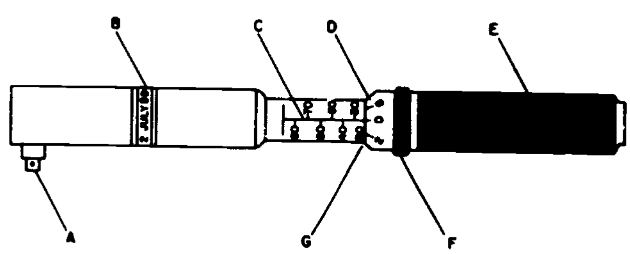
STEEL RULES

Rules are usually made of steel and are 4, 6, or 12 inches in length. The largest unit of measurement common to these rules is the inch. The inch may be divided into smaller parts known as fractional parts of an inch. There are four graduations on a steel rule. They are 1/8, 1/16, 1/32 and 1/64 of an inch.

The rule is a measuring instrument. It is not a screwdriver, a pry, a scraper, or a putty knife. The rule should never be used for one of these tools.

TORQUE WRENCHES

A torque wrench consists of a torque handle and a socket. It enables a mechanic to tighten a nut or bolt with exactly the proper amount of tightness. Two different types of torque handles used in the Air Force are the automatic release or breakaway and ratchet "T" handle, figure 54.



IDENTIFICATION CODE

- A SQUARE DRIVE
- B COLOR CODE
- C SHAFT SCALE
- D GRIP MARKINGS
- E GRIP
- F GRIP LOCK
- G GRIP END

Figure 54. Automatic Release or Breakaway Torque Handle.

The automatic release of breakaway type torque handle is designed in such a way that when the set amount of torque is reached the handle will automatically release or "break." When the handle releases, it will have approximately fifteen to twenty degrees of free travel. The desired torque setting is accomplished by turning the grip (E) section of the handle clockwise to raise the torque and counterclockwise to lower the torque. The numbers on the shaft scale (C) and grip markings (D) represent foot pounds or inch pounds, according to the size of the handle being used. When the grip lock (F) is unlocked, the grip (E) can be turned to any given setting within the range of the scale. As the grip is turned it moves along the shaft scale. One revolution of the grip moves the grip end through a 10 inch pound range or from one number to the next. The grip markings (D) are used to obtain a setting which falls between two consecutive numbers on the scale. Two reference lines must be considered when setting the handle to a given torque. First, the grip end is the reference line for reading numbers on the shaft scale. Second, the shaft scale line (C) is the reference line the reading numbers on the grip end. If it is desired to set the torque indicating handle to 20 inch pounds, turn the grip until the grip is on the 20 mark and the 0 on the grip end is in line with the shaft scale line (C).

The "T" handle torque wrench, figure 55, is shaped like a "T," as the name implies. It has a preset torque and cannot be adjusted like the other torque wrenches. When a nut or hose clamp has been tightened to the set torque, the handle will ratchet, if the handle is turned further it will not tighten the nut any more.

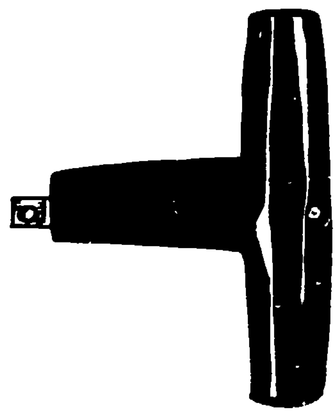


Figure 55. "T" Handle Torque Wrench.

The purpose of tightening a screw or a nut on a stud is to place the screw or stud under tension. The amount of tension is very critical in some assemblies. If a nut is left too loose, it does not hold securely. If it is tightened too tight, it may pull the bolt, strip the threads, or put an unnecessary and possibly dangerous strain on the members being held together. If a set of nuts on a unit are not all tightened with the same torque, internal stresses will be set up in the unit. These stresses may cause eventual failure of the unit. Check after check has shown that structural failure and rapid wear have been caused by improper tightening of nuts and bolts.

Torque exerted by the mechanic while using the torque wrench, is an approximate measure of the tension. However, torque as a measure of screw or stud tension is approximately accurate, only, if proper technique is used while the torque wrench is being used.

When the torque wrench is being used and the specified torque is approached, keep the nut or screw moving with a steady, slow, sweep of the wrench until the specified torque is reached.

Note: A fast or jerky motion will result in an improperly torqued or damaged fastener.

In all torque requirements, the desired torque value is predetermined and may be found in the appropriate technical order.

Torque wrenches should be calibrated every 60 days or more often depending upon how much the handle is used. A strip of color code tape and the day, month and year, will be placed on the handle to indicate when the handle is next due. Treat a torque wrench as a delicate instrument. A torque wrench cannot be treated as carelessly as a box wrench or screwdriver without losing its accuracy. If the torque wrench is dropped, it must be calibrated before using it again.

QUESTIONS

1. Name the four principle parts of an outside micrometer.

2. The barrel of a micrometer is divided into how many main divisions?

3. Name three types of micrometers.

4. When are calipers used?

5. What is the purpose of a screwpitch gage?

6. What is the purpose of a torque wrench?

7. How often are torque handles calibrated?

8. Where are all torque requirements found?

SAFETY WIRE (LOCKWIRING)

OBJECTIVES

After you have completed this study guide and your classroom instruction, you will be able to use safetywire correctly by lockwiring three bolts together.

INTRODUCTION

Safetywire is used to secure aircraft and engine hardware items such as nuts, bolts, lines, and caps. After the hardware item has been tightened properly, safetywire is installed to prevent the items from loosening because of vibration or strain.

BASIC RULES OF LOCKWIRING

Lockwire must be tight after installation to prevent failure due to rubbing or vibration.

Lockwire must be installed in a manner that tends to tighten and keep the part locked in place, thus counteracting the natural tendency of a part to loosen.

Lockwire must not be overstressed, it will break under vibration if twisted too tightly. Lockwire must be taut when it is being twisted, but shall have minimum tension, if any, when secured.

Lockwire ends must be bent toward the engine or part, to avoid sharp or projecting ends which might present a safety hazard or vibrate in the air stream.

Internal wiring must not cross over or obstruct a flow passage when an alternate method can be used.

The applicable TO should be consulted befor using lockwire on any piece of equipment.

Always apply the correct torque to nuts and bolts before installing the safety wire.

TWISTING THE LOCKWIRE

To prevent mutilation of the twisted section of the wire when using pliers, grasp the wire at the ends or at a point where the wire will not be twisted. Lockwire must not be nicked, kinked or mutilated. Never twist or break the wire ends off with pliers. When cutting off the wire ends, leave at least three complete turns after the loop; also, exercise extreme care to prevent wire ends from falling into the engine. The strength of the lockwire holes in nuts and bolts is marginal, never twist the wire off with the pliers. In the event the original lockwire hole is damaged on the nuts, an additional hole may be drilled on the opposite side of the nut.

Caution: Remove burrs and sharp edges from the damaged lockwire holes.

Methods of lockwiring include the double twist method and the single strand method. Refer to the TO on specific equipment for the preferred method to use on lockwiring.

The double twist method is done two different ways, the over the head method and around the head method.

LOCKWIRING PROCEDURES

Figures 56, 57, and 58 illustrate typical lockwiring procedures. There are many lockwiring procedures performed on the engines, and practically all of the procedures are derived from the basic examples shown in these figures.

QUESTIONS

1. Name four basic rules of lockwiring.

2. Name two methods of lockwiring.

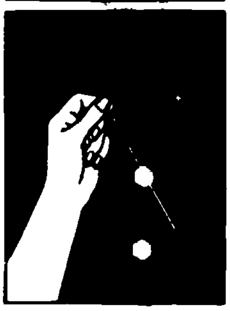
3. How many turns (twists) should be left on the end of lockwire?

4. Name two ways the double twist method can be done.

5. On specific equipment, what method of lockwiring should be used?

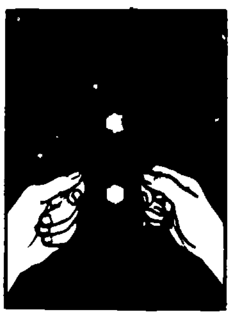
1

Position the holes



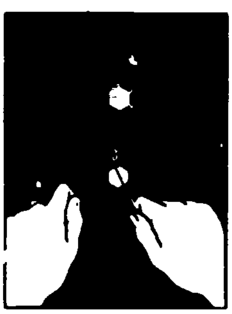
2

Insert proper gage wire. To determine the proper wire to be used in conjunction with a particular tightening operation refer to the correspondingly designated engine parts catalog or illustrated parts breakdown. Lockwire which is specially treated for 982°C (1800°F) applications has a dark gray to black color.



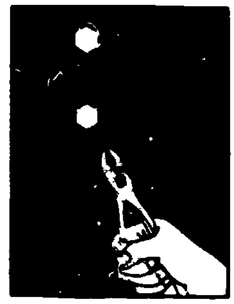
3

Grasp upper end of the wire and bend it around the head of the bolt; then under the other end of the wire. Be sure wire is tight around head.



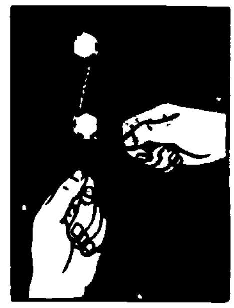
4

Twist wire until wire is just short of hole in the second bolt.



5

Insert the uppermost wire, which points towards the second bolt, through the hole which lies between the nine and twelve o'clock position. Grasp the end of the wire with a pair of pliers and pull the wire tight.



6

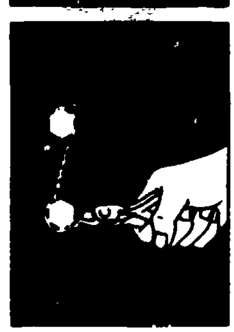
Bring the free end of the wire around the bolt head in a counterclockwise direction and under the end protruding from the bolt hole. Twist the wire in a counterclockwise direction.

7

Grasp the wire beyond the twisted portion and twist the wire ends counterclockwise until tight.

8

During the final twisting motion of the pliers, bend the wire down and under the head of the bolt.



9

Cut off excess wire with diagonal cutters.

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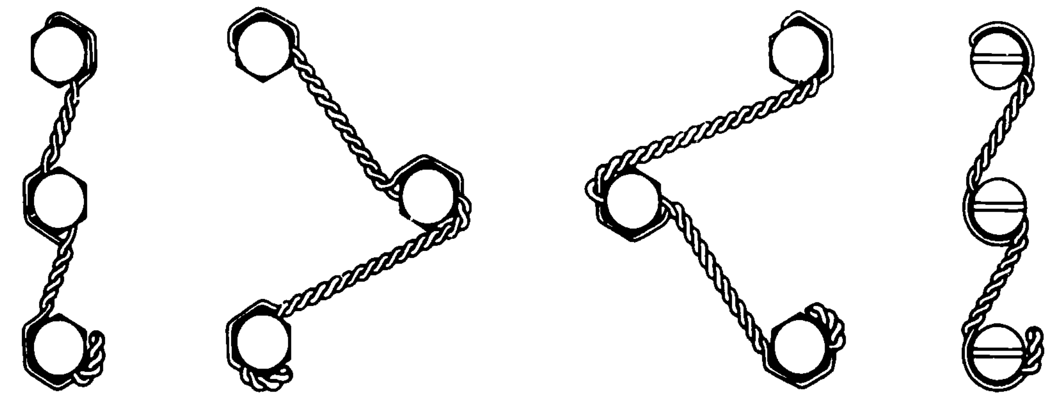
Figure 56. Lockwiring Procedures.

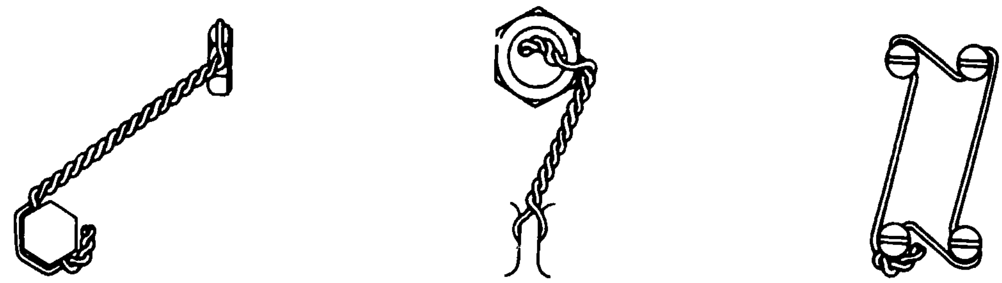


EXAMPLE 1 EXAMPLE 2 EXAMPLE 3 EXAMPLE 4

Exomples 1, 2, 3 ond 4 opply to oll types of bolts, fillister heod screws, squore heod plugs, ond other similor ports which ore wired .o that the loosening tendency of either port is counterocted by tightening of the other part. The direction of twist – from the second to the third unit is counterclockwise to keep the loop in position ogoinst the heod of the bolt. The wire entering the hole in the third unit will be the lower wire ond by moking o counterclockwise twist of- ter it leoves the hole, the loop will be secured in ploce oround the heod of thot bolt.

EXAMPLE 5 EXAMPLE 6 EXAMPLE 7 EXAMPLE 8

Exomples 5, 6, 7 & 8 show methods for wiring vorious stondord items. Note: Wire moy be wropped over the unit rother thon oround it when wiring costelloted nuts or on other items when there is o .eoronce problem.



EXAMPLE 9 EXAMPLE 10 EXAMPLE 11

Exomple 9 shows the method for wiring bolts in different planes. Note thot wire should olwoys be opplied so tha: tension is in the tightening direction.

Hollow heod plugs sholl be wired os shown with the tob bent inside the hole to ovoid snogs ond possible in- jury to personnel working on the engine.

Correct opplication of single wire to closely spoced multiple group

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Figure 57. Lockwiring.

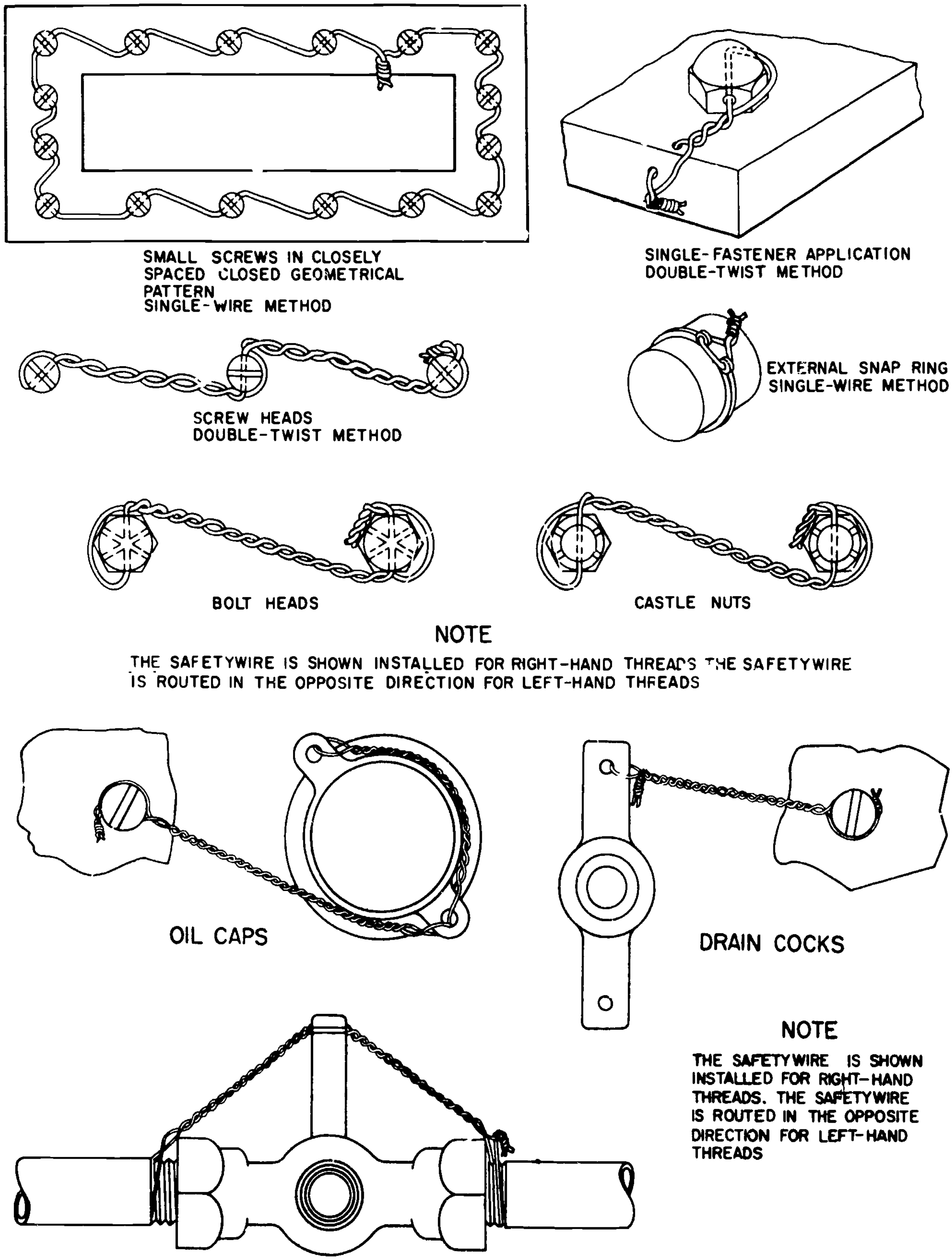

Figure 58. Lockwiring.

Jet Engine Branch
Chanute AFB, Illinois

3ABR42632-WB-104B
3ABR42633-WB-104B
7 April 1980

AIRCRAFT AND ENGINE HARDWARE

OBJECTIVES

When you have completed this workbook and your classroom instruction, you w be able to identify and state the purpose of selected hardwa items.

EQUIPMENT

	Basis of Issue
3ABR42632-SG-104A/3ABR42633-SG-104A	1/student

PROCEDURE

Use the information presented in the classroom presentation, discussion, study guide, and aid from the instructor. Fill in the spaces provided with the correct information.

1. Screws

a. A screw has a lower material strength th a

____________________.

b. Generally speaking if you can use a ______________ or Allen wrench on it, its called a screw.

c. Four main groups of sc s

(1) ______________ - Found in the framework of the aircraft.

(2) ______________ - Used where high material strength is not important.

(3) ______________ - Cut their own threads in the material.

(4) ______________ - Used to hold pulleys or ge s on shafts.

Supersedes 3ABR43230-WB-102F, 1 November 1972.
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2. Bolts

a. Bolts are stronger than ________________.

b. Available in many special designs as well as

____ ____________ shapes and designs.

c. Types of bolts used

(1) ________________________________ - Used throughout the aircraft frame and engine.

(2) ________________________________ - The wrench goes inside the head of the bolt.

(3) ________________________________ - Fits the hole very tightly and used where there is vibration or load reversals.

(4) ________________________________ - Made for special applications.

d. When removing and replacing bolts it is important that you use ____________________ bolts.

e. Identification markings

(1) Bolts are marked with a code to identify their physical ____________________.

(2) Some examples of markings on bolts are:

(a) + ____________ ____________

(b) - ____________ ____________

(c) - - ____________ ____________

(3) Many bolts are marked with ______________ ______________ which indicates specific metals and alloys.

f. Bolt size is determined by:

(1) ____________

(2) ____________

(3) ____________ ____________ ____________

3. Nuts

a. Nuts are used to properly ________________ the bolted assembly.

b. Identification markings on nuts are the same as

________________.

c. Tightening of nuts and bolts

(1) Check the specific TO for proper ________________ value.

(2) Always use proper ________________ procedures when tightening nuts and bolts.

4. Studs

a. Studs are used to ________________ removable parts to castings made of soft metals.

b. Types of studs used are:

(1) ________________

(2) ________________

c. Studs can be ________________ or ________________ on the nut end.

5. Hoses

a. Hoses are used for making ________________ that move or subject to vibration.

b. Hoses will ________________ so the movement will not do any harm.

6. Tubing

a. Tubing is used to carry ________________ and

________________.

b. Types of tubing

(1) ________________ ________________ - Used in high pressure systems.

(2) ________________ ________________ - Used in low pressure systems.

c. Color coding for tubing

(1) Color coding on tubing aids in ______________ identification.

(2) Most common colors used are:

(a) Red = ______________

(b) Yellow = ______________

(c) Blue & Yellow = ______________

(d) Red - Grey - Red = ______________ ______________

REVIEW QUESTIONS

1. Name the four main groups of screws

2. Which type of screw is used to secure a pulley to a shaft?

3. A sheetmetal screw is an example of a ______________ ______________ screw.

4. If you can use a screwdriver or an ______________ ______________ on the head, its generally called a screw.

5. Name the four types of bolts. ______________

____

____

6. ______________ have a higher material strength than a screw.

7. Which type of bolt is used where there is vibration or load reversals?

8. When you remove and replace a bolt make sure the replacement bolt is a like ______________.

9. Allen wrenches are used on ______________ ______________ bolts.

10. Steel alloy bolts are marked with a ______________.

11. Aluminum alloy bolts are marked with a ______________.

12. Corrosion resistant steel bolts are marked with a

_________________.

13. The size of a bolt is determined by the _____________,

_________________, and _________________ _________________

_________________.

14. Always check the TO for proper _________________ value on nuts and bolts.

15. Two types of studs used on engines are _______________

and _________________.

16. Connections that move or subject to vibration are joined

by _________________.

17. Two types of tubing used is _____________ _____________

and _________________ _________________.

18. Color coding on tubing is used for rapid _______________.

19. Red color coding designates _________________ lines.

20. Blue and yellow color coding designates _______________ lines.

T56 MAJOR SECTIONS AND PARTS

OBJECTIVES

After completing your classroom instructions and this workbook, you will be able to:

Identify facts about the constructional features of the reduction gearbox, torquemeter assembly, compressor section, combustion section, turbine section and the accessory drive housing section.

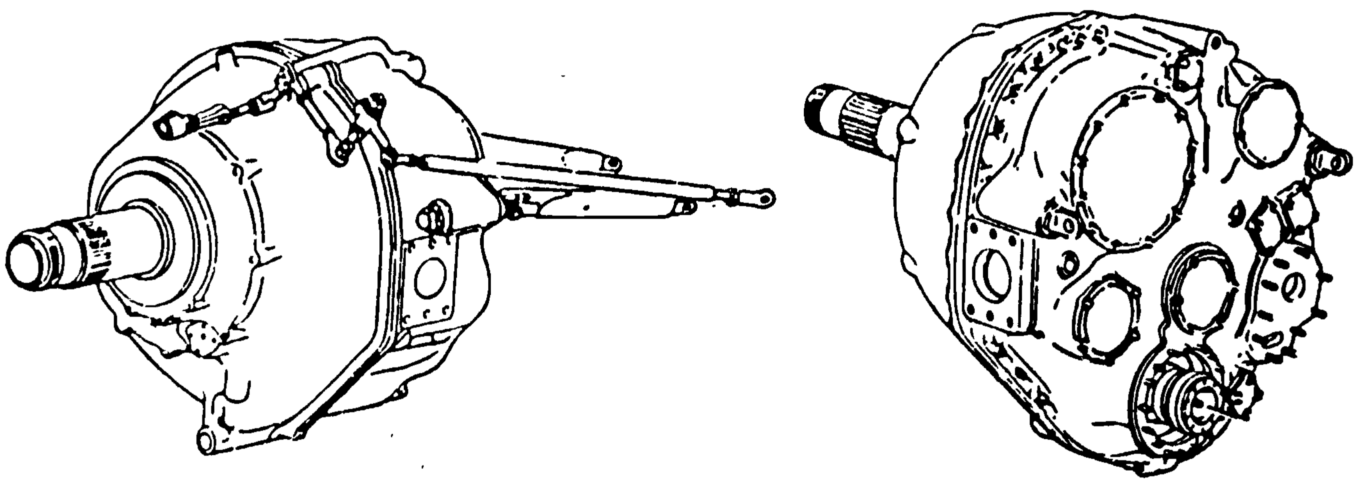
EQUIPMENT

	Basis of Issue
C3ABR42633-SG-104	1/student

PROCEDURE

Using the information presented in the classroom presentation and study guide, fill in the spaces provided with the correct information.

Section 1. REDUCTION GEARBOX



CI 83-569
·21i

Figure 1. Reduction Gearbox.

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1. What are the four major sections of the reduction gearbox?

a. ______________ ______________

b. ______________ ______________

c. ______________ ______________

d. ______ ______ ______ ______

2. What prevents the propeller from rotating while the engine is shut down? ______________ ______________

3. How many stages of reduction are there? ______________

Section 2. TORQUEMETER

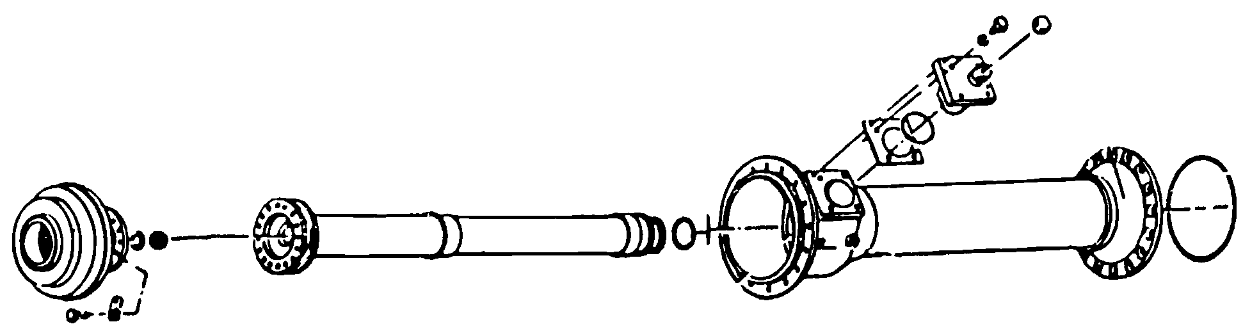

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Figure 2. Torquemeter.

1. What are the tw names of the shafts in the torquemeter assembly?

a. ______________ (______________) ______________

b. ______________ (______________) ______________

2. What is located at the forward (9) nine o'clock position of the torquemeter housing? ______________ ______________

3. What (2) two items adds additional support between the engine and reduction gearbox? ______________ - ______________

Section 3. COMPRESSOR SECTION

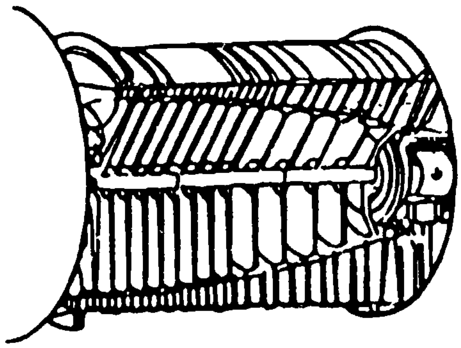

Figure 3. Compressor Air Inlet Housing.

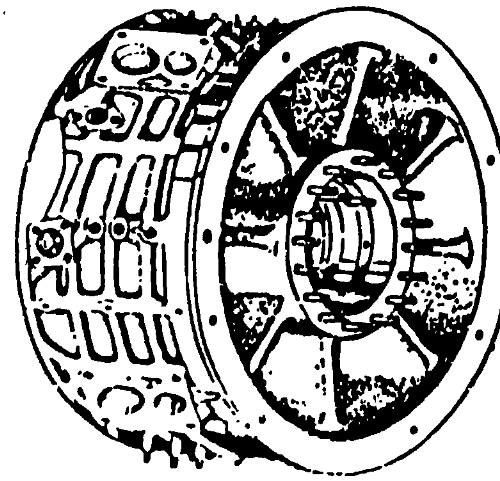

Figure 4. Compressor Rotor, an Compressor Case.

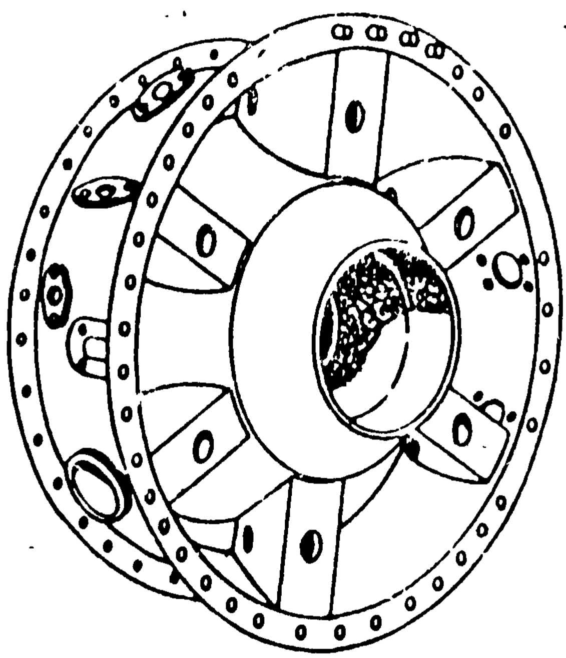

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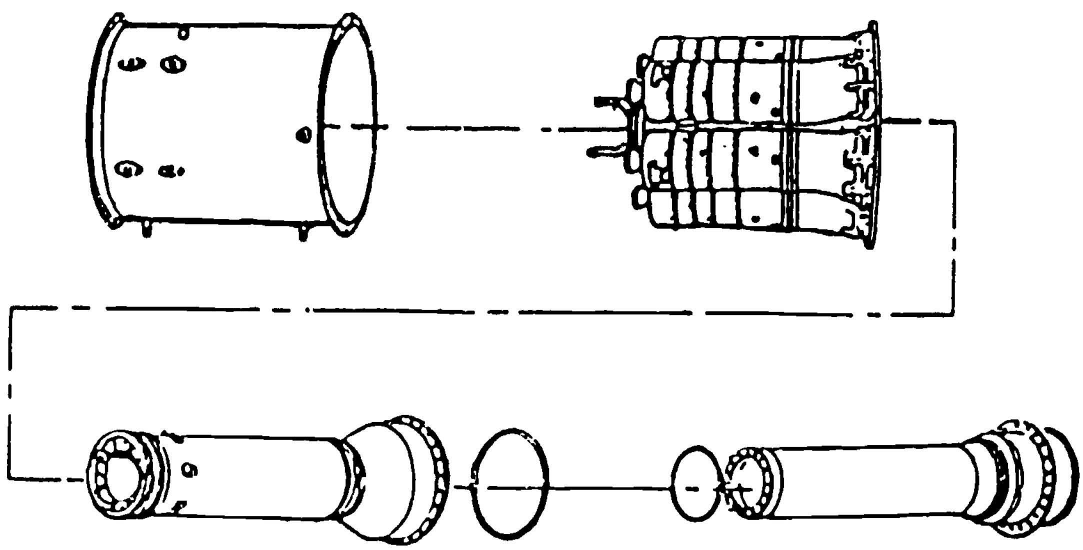
Figure 5. Compressor Diffuser.

1. Of the (8) eight radial struts in the compressor air inlet housing, how many are hollow? ______________

2. How many sections make up the compressor case? ______________

3. The compressor diffuser provides an mounting place for how many fuel nozzles? ______________

Section 4. COMBUSTION SECTION



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0-21i

Figure 6. Combustion Section.

1. What type of combustion chamber does the T56 engine have?

____

2. What type of metal is the outer combustion case made of?

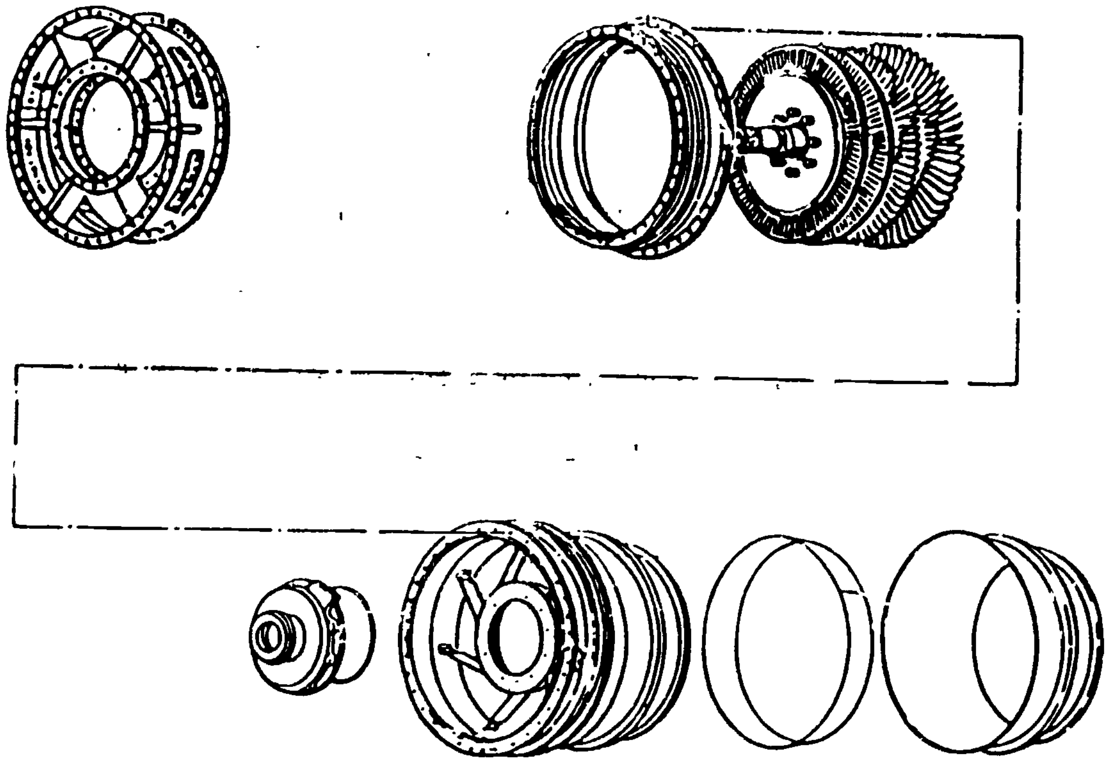
____

3. Name the two inner cases in the combustion section.

   a. ______________________________

   b. ______________________________

Section 5. TURBINE SECTION



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0-21i

Figure 7. Turbine Section.

1. How many thermocouples are mounted to the turbine inlet case?

____

2. How many tangential struts does the rear bearing support case have?

____

3. What do the tangential struts do during changes of exhaust gas temperature? ____________ and ____________.

Section 6. ACCESSORY DRIVE HOUSING

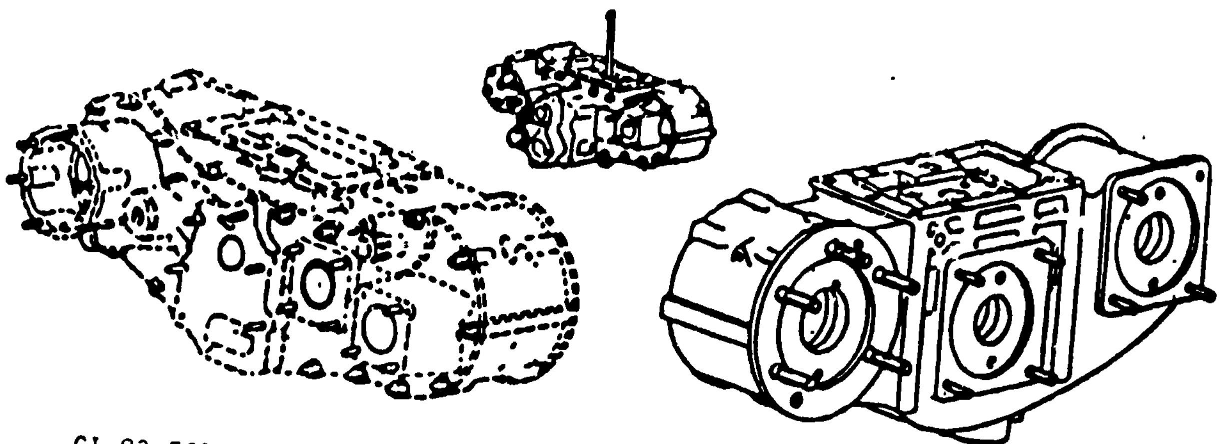

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Figure 8. Accessory Drive Housing.

1. How many mounting pads does the accessory drive housing have?

____

2. What type of gear is on the compressor extension shaft?

____

3. What type of alloy is the accessory drive housing made of?

____

STUDY GUIDE

3ABR42633-SG-105

Technical Training

Jet Engine Mechanic

AIRCRAFT AND ENGINE FUNDAMENTALS

26 March 1981

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

Designed for ATC Course Use.

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AIRCRAFT AND ENGINE FUNDAMENTALS

OBJECTIVES

After you have completed this study guide and your classroom instruction, you will be able to:

1. State the principles of jet engine operation.

2. State how a jet engine develops thrust and the atmospheric conditions that affect thrust.

3. State the meanings of aircraft and engine designations.

4. Name the major sections and parts of a T56 engine and state its principles of operation.

5. State the purpose and location of the T56 engine systems and parts.

INTRODUCTION

An understanding of how a jet engine develops thrust is essential to troubleshooting of gas turbine engines. This study guide is devoted to an introductory discussion of jet propulsion and jet engines. It has been simplified to establish an easy understanding upon which the following lessons can be built. There is a glossary at the back of this study guide. You can find the meaning of many new technical terms in this glossary.

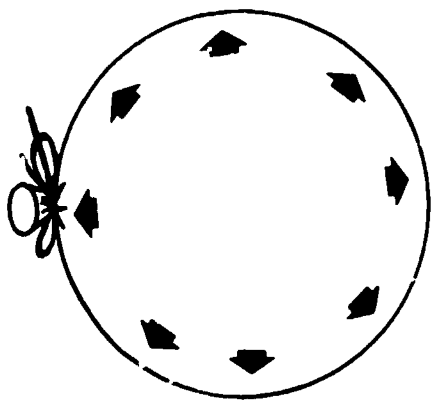

Figure 1. Equal Pressure in all Directions.

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INFORMATION

JET ENGINE THEORY

If a toy ballon is blown up and the stem released, it will travel at a high rate of speed until the air is exhausted. When a balloon is inflated, the inside air pressure is greater than the outside pressure. With the stem tied closed, this inside pressure pushes with equal force in all direction, figure 1. The balloon remains stationary.

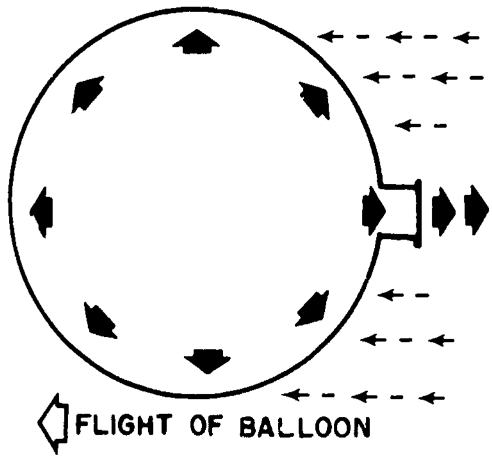

Figure 2. Unequal Pressure Causes Moving Force.

Releasing the tie on the balloon stem causes the balloon to move away from the stem, figure 2. What causes this to happen? With the stem open, that section of the balloon that air pressure was pushing against has been removed. The air pressure, however, continues to push on the side opposite the stem. It is this unequal pressure that causes the balloon to move in the direction opposite the stem. A jet engine operates on the same principle.

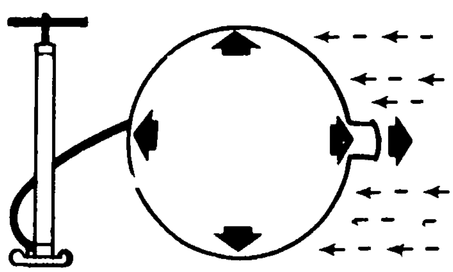

Figure 3. Maintaining Pressure in the Balloon.

The flight of the balloon is short because the air pressure is soon exhausted. This can be overcome by maintaining air pressure in the balloon with a tire pump, figure 3.

To change this machine into a jet engine, the tire pump is replaced with a rotary pump or compressor, figure 4. Now, by turning the compressor at a high rate of speed, large volumes of air will pass through

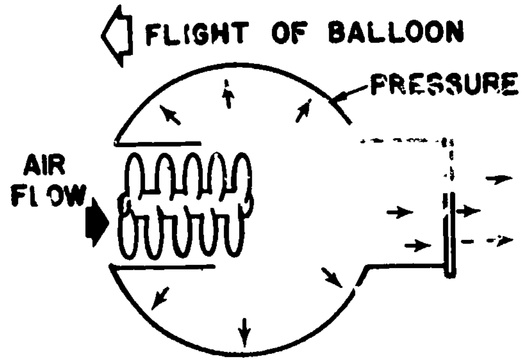

Figure 4. Replaces Tire Pump with Rotary Pump.

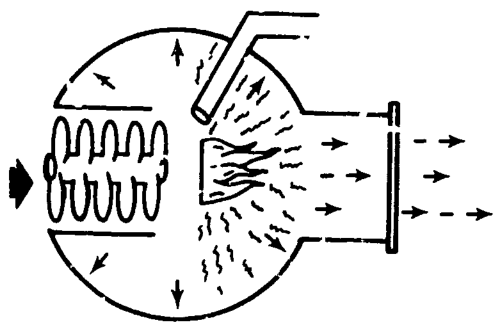

Figure 5. Fuel is Burned in the Airstream.

the balloon while continuing to hold a high pressure inside. To produce energy, fuel is introduced and burned in the airstream behind the compressor, figure 5. Burning the fuel expands the air, greatly increasing the pressure within the "engine" and the velocity of the air through the opening.

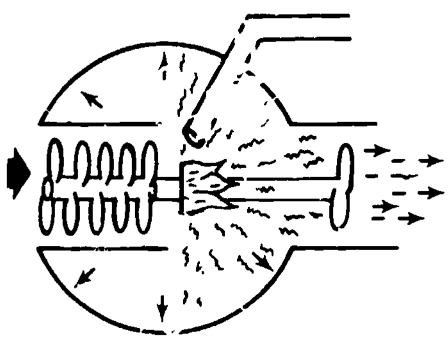

Figure 6 Add Turbine to Drive Compressor.

Now, the only requirement necessary to complete the engine is some internal means of operating the compressor. Figure 6 shows how this is done. A turbine wheel is placed in the path of the heated gases with a connecting shaft to the compressor. Some of the hot gas energy is used to turn the turbine wheel, which, in turn, drives the compressor. Most of the remaining gas energy is expended through the exhaust nozzle, creating thrust.

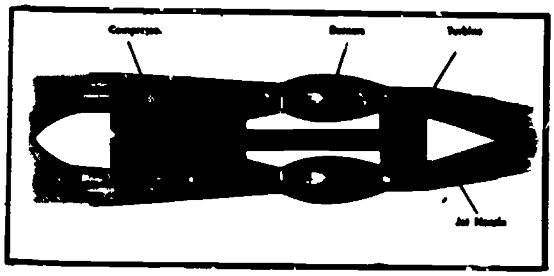

Figure 7. A Typical Turbojet Engine.

This simplified jet engine can now be compared with a typical turbojet engine, figure 7. Its operation is a continuous cycle that will operate as long as it receives fuel.

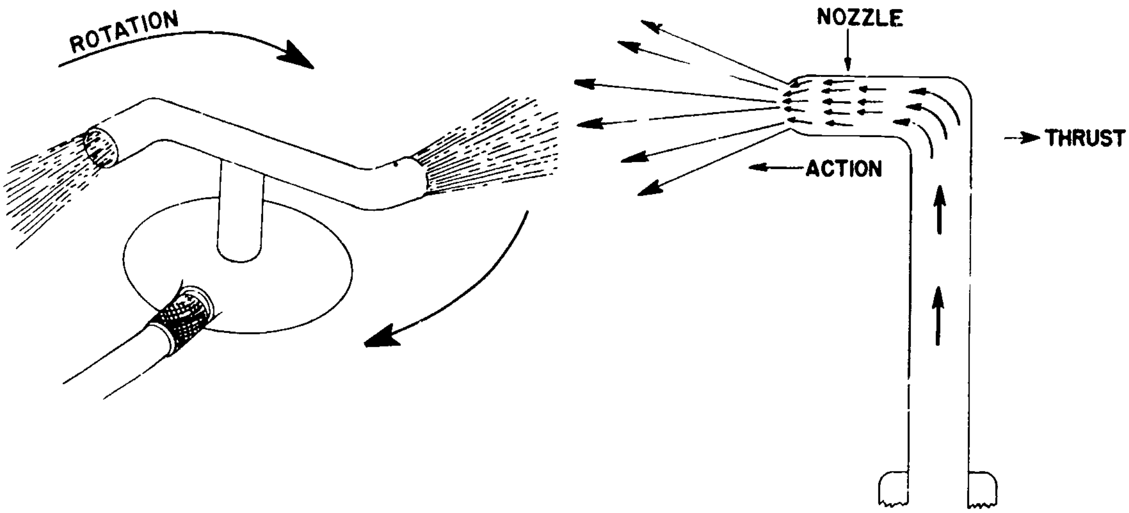

Figure 8. Water Sprinkler, Action and Reaction.

Figure 9. Fire Hose, Action and Reaction.

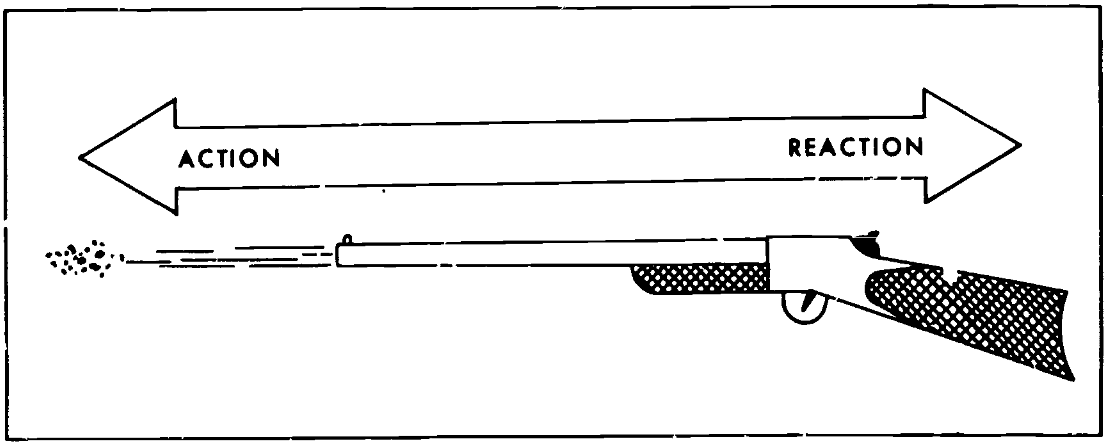

Figure 10. Gun, Action-Reaction.

The principles of jet propulsion involve basic laws which are easier to understand if explained with common everyday examples. A jet engine is defined as a reactionary device which develops forward thrust by the acceleration of a mass rearward through a jet or nozzle. The thrust forward and mass accelerated rearward can best be explained using Newton's 3rd law of motion. Newton states, "To every action there is an equal and opposite reaction." This is important in understanding the term "reactionary device." Devices that can be used to illustrate this principle are shown in figures 8, 9, and 10. The water sprinkler, figure 8 uses water forced through a nozzle as an action. The resulting reaction (thrust) is the rotation of the sprinkler head around its base. Figure 9, illustrated by a fire hose, is also the result of a water mass exiting in one direction. The reaction is in the opposite direction, which requires the firemen to hold the hose. You may experience this on a smaller scale when you water a garden or wash your car. How about when you fired a gun while hunting or target shooting? The "kick" is also an example of action - reaction, figure 10. The weapon produces an action by accelerating the bullet in one direction. The reaction is the recoil felt on your shoulder. The larger the caliber or gauge, the greater the reaction of "kick" as the mass leaves the weapon.

The idea of expelling a mass through a jet or nozzle in the definition of a jet engine is better explained using Bernoulli's principle. Bernoulli's principle may be stated as follows: When the same amount of fluid leaves as enters a pipe, but the cross sectional diameter of the pipe varies, the pressure will be the highest where the cross section is the largest and the velocity will be the lowest.

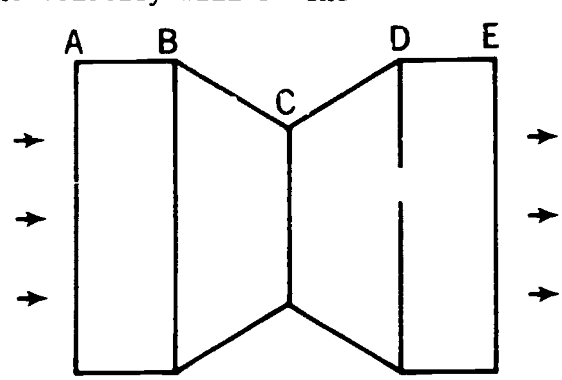

Figure 11. Bernoulli's Principle.

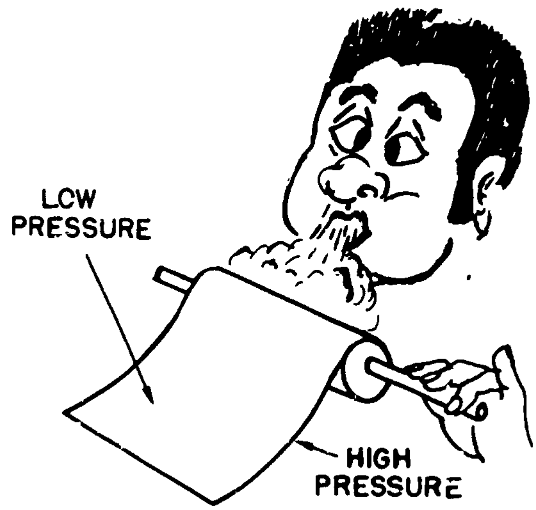

Figure 12. Creating Lift.

Figure 11 shows a duct with several different diameters. According to Bernoulli's principle, the pressure at points A, B, D and E is higher than at point C. Larger diameters create higher pressures. Pressure drops from point B tc point C, and velocity increases. This reverses as it passes from point C to point D. The pressure begins to increase at point C and the velocity begins to decrease. Figure 12 shows how Bernoulli's principle can be applied to a sheet of paper to create lift. The velocity over the top of the paper increases and the pressure drops, so the pressure underneath is slightly higher which tends to lift the sheet of paper. Jus remember, when the velocity increases, the pressure decreases.

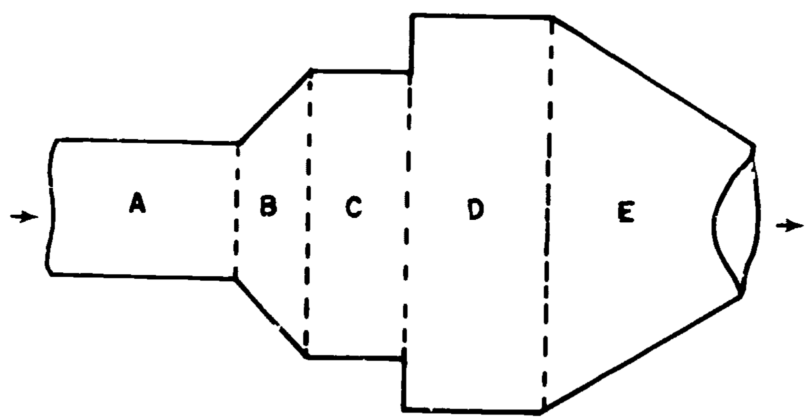

Figure 13. Pipe, Varying Diameters.

In figure 13, as the fluid moves through the pipe, the pressure increases through sections B, C, and D because the diameters are larger than section A. Remember, that as the pressure increases, the velocit will decrease.

In order to accelerate a gas through a jet or nozzle, the diameter of the duct must converge, or get smaller. The speed of velocity of the gas will increase. This is what happens through section E.

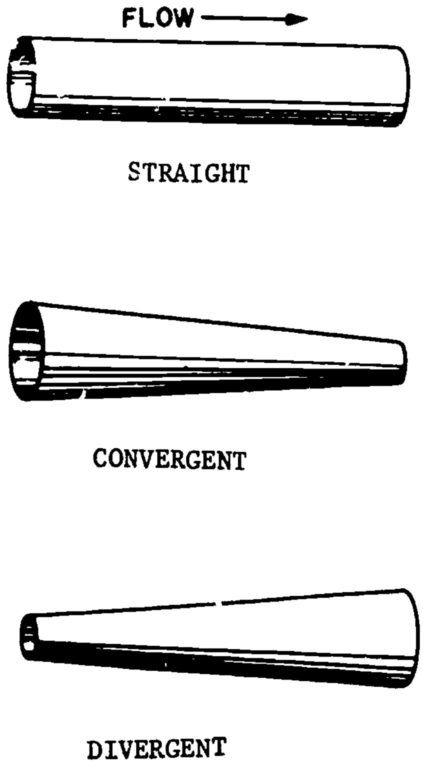

Figure 14. Types of Ducts.

Simply stated, to increase velocity you decrease the duct size. This duct is called a convergent duct. To increase pressure, you must increase the diameter of the duct. This duct is called a divergent duct. If pressure and velocity remain the same through a duct it is called a straight duct. Examples of these ducts are shown in figure 14.

TERMS USED IN REFERENCE TO JET ENGINES

Matter

Matter exists in three states: solid, liquid, and gas. Liquids and gases are grouped together as fluids since they have many characteristics in common. Everything is made of matter, even air.

Mass

Mass is a quantity of matter. One pound and one kilogram are measures of mass.

Density

This is the amount of mass in a given space or mass per unit volume. Imagine two boxes the same size, one filled with feathers and the other with bricks, figure 15. There is more mass in the box of bricks. Since the bricks weigh more than the feathers, the bricks have more mass in the same volume. Therefore, they are denser than the feathers.

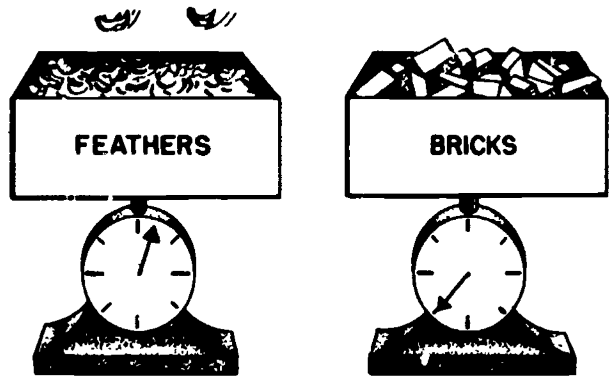

Figure 15. Density.

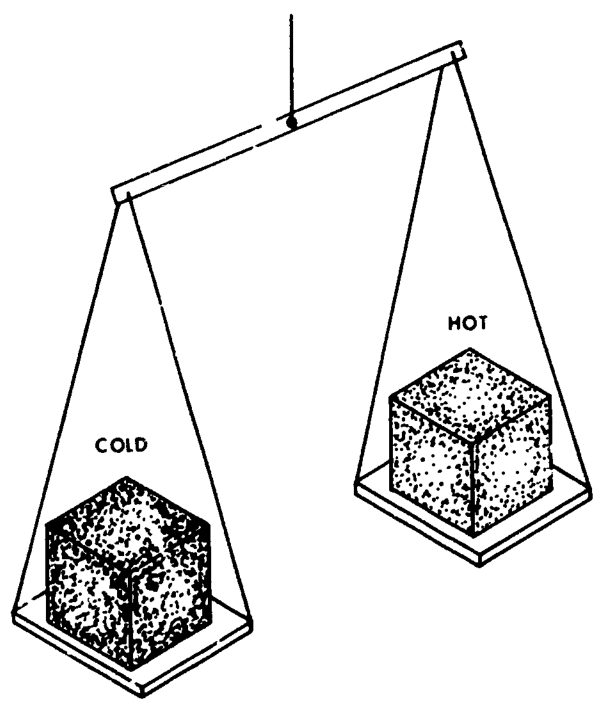

Figure 16. Air Density.

In figure 16, we see a cube of cold air and a cube of hot air. As temperature increases air becomes less dense; therefore, a cube of cold air has a greater density and will weigh more.

Velocity

Velocity is the rate of change of position in relation to time. Velocity is almost the same as speed, except that velocity also includes direction. So 35 miles per hour south is a measure of velocity.

Acceleration

Acceleration can be positive or negative. Acceleration includes your zero to 60 time for your car, as well as the 60 to zero time that you might think of as your braking time. Acceleration is a change in velocity, whether it be positive or negative.

Force

Force is the total push or pull on matter, as the result of something pushing on an object or the pull of gravity. Force is the cause of motion.

Pressure

Pressure is the intensity of the force exerted against an opposing body. For example, the water in a tank has weight or force (F) of 100 pounds, and the area (A) of the bottom of the tank is 10 square inches. The pressure (P) on the bottom of the tank is 10 pounds per square inch (psi).

$$F = 100 \text{ lb}$$

$$A = 10 \text{ sq in}$$

$$P = \frac{F}{A} = \frac{100}{10} = 10 \text{ psi}$$

Atmosphere

The earth is attended by a gaseous sea of air called the atmosphere. Because it is invisible, we frequently remain unconscious of it. Air is necessary for combustion and to transmit sound. The atmosphere furnishes a highway for aircraft. An aircraft moves through the air as a submarine moves through the water. The atmosphere is a mixture of gases, primarily nitrogen and oxygen.

Atmospheric Pressure

The atmosphere is piled on the earth's surface like hay in a haystack. The bottom layers are packed down more compactly, due to the weight of the hay above. They are more dense than the layers near the top where the hay is loose. You can also understand atmospheric pressure if you compare it with a water tank. The pressure is greatest at the bottom. Since everything is attracted to the earth by gravity, atmospheric pressure is the weight of the air above that level where the pressure is measured.

Pressure is expressed in units of weight (force) per unit area or psi (pounds per square inch). We say that the atmospheric pressure is 14.7 psi at sea level. This means that a 1 inch square column of air would weigh 14.7 pounds if it reached to the top of the atmosphere.

Barometer

Atmospheric pressure is measured by a barometer and is usually expressed in inches or centimeters of mercury, figure 17. If a glass tube closed at one end, and 30 inches or more in length, is filled with mercury and inverted in a bowl of mercury, the mercury will stand in

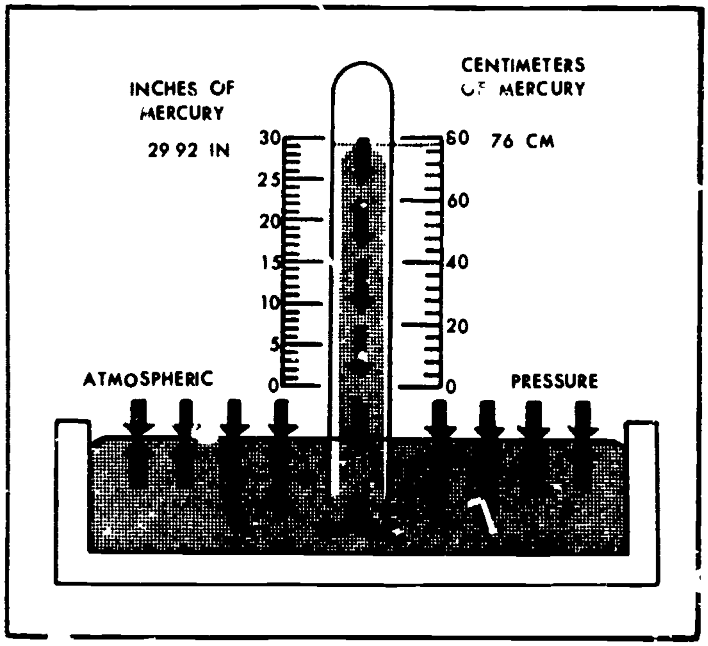

Figure 17. The Mercury Barometer.

the tube to a height of about 30 inches. Note in figure 17 the weight of the column of mercury will be exactly the same as atmospheric pressure. Naturally, if the atmospheric pressure is lowered, the level of mercury in the tube will be lowered, and vice versa.

Temperature

This is the degree of hot or cold of anything, usually measured with a thermometer. The term ambient temperature refers to the temperature around or surrounding the area where the reading was taken.

Humidity

Humidity is a term used to express the presence of water vapor in the air. Relative humidity is the actual amount of water vapor in the air compared to the maximum amount of vapor the air can hold at that temperature. For example, if water vapor could make up 4% of the total volume of the atmosphere at the present temperature without condensing. If only 2% of the atmosphere is actually water vapor, the relative humidity is 50% or half of what the air is capable of holding at that temperature.

ATMOSPHERIC CONDITIONS AFFECTING JET ENGINE THRUST

Formula for Computing Thrust

Thrust (force) = mass (M) times acceleration (A) (T = M x A), is from Newton's second law of motion.

Pressure

When the pressure increases, it will compress more air molecules (mass) into the jet engine, increasing the jet engine thrust.

Temperature

When the temperature increases, the air will expand, reducing the mass being taken into the jet engine. This reduces the jet engine thrust.

Humidity

When the humidity increases, the water vapor displaces the heavier molecules of air. The thrust will decrease because of the reduced mass being taken into the jet engine.

Standard Day Conditions

These conditions are used to compute the jet engine thrust using Air Force technical orders and specially designed tables. Standard day temperature is 59°F, humidity 0%, and barometric pressure 29.92 inches of mercury (Hg).

QUESTIONS

1. State Newton's third law of motion.

2. List and explain two examples of Newton's third law of motion.

3. What are three atmospheric conditions which affect jet engine thrust?

4. What are the standard day settings used to compute thrust?

5. What is humidity?

6. What are the three kinds of ducts and what are their effects on pressure and velocity?

7. Does a jet engine have to push against something (like the atmosphere) to move? Why or why not?

8. What is acceleration? Does it have anything to do with thrust?

9. Which is denser, hot or cold air?

CHARACTERISTICS OF JET PROPULSION POWER PLANTS

Jet propulsion power plants may be divided into two general classes, air breathing and non-air breathing engines.

Rockets are non-air breathing and, therefore, are self-contained. That is, all of the materials necessary for operation are contained within the rockets. The operation is independent of the atmosphere because they carry their own supply of oxygen. Rockets are further classified according to the type of propellants used, which may be either liquid or solid.

Air breathing power plants use the surrounding atmosphere to support combustion for the necessary addition of heat. They can operate only where air (oxygen) exists.

where air (oxygen) exists. Included in this group are the ramjet and turbojet engines.

Types of Jet Engines

RAMJET. A ramjet engine gets its name from the ram action which makes possible its operation. Theoretically, the speed that can be attained by a ramjet engine is unlimited. Actually, the faster it moves the better it runs and the more thrust it develops.

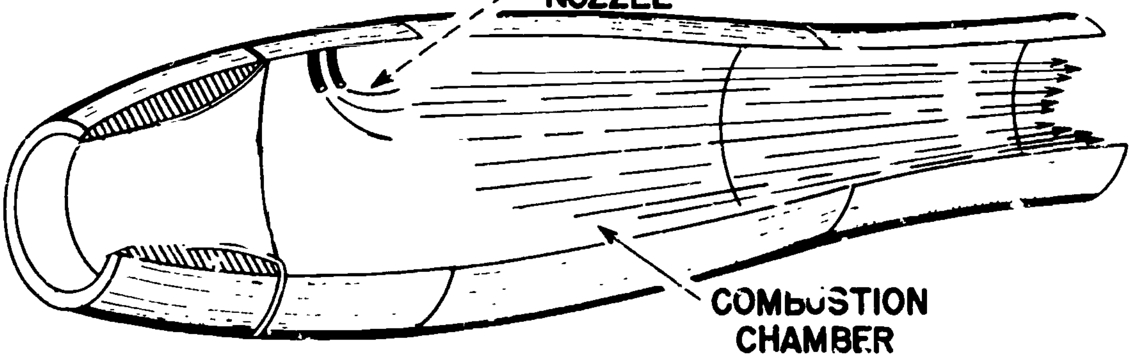

Figure 18. Ramjet Engine.

The major disadvantage of a ramjet is that it cannot accelerate from rest; therefore, it cannot take off under its own power. If a ramjet were operated at rest, high-pressure combustion gases would escape out of the front as well as the rear, since the ramjet engine, figure 18, has no mechanical compressor.

This engine must be brought up to high speed by some outside means so the forward motion will be high enough to compress the air. Then fuel is introduced into the combustion chamber by a fuel spray nozzle and ignited with a spark plug after the forward speed is high enough to sustain operation.

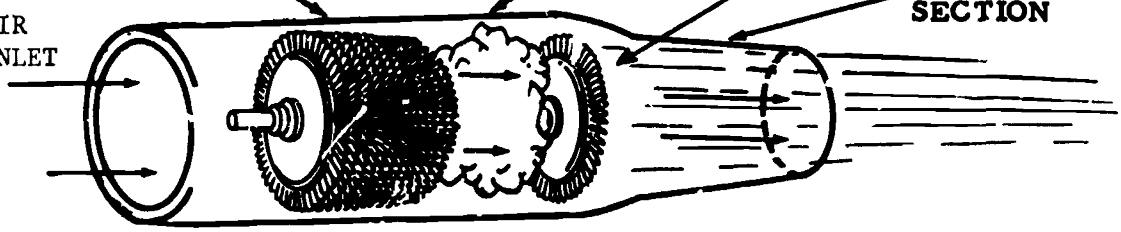

Figure 19. Turbojet Engine.

TURBOJET. A turbojet engine is an air-breathing, jet-propulsion device that gets its name from its design. This means that it uses an exhaust-gas-driven turbine wheel to drive its compressor. The same events occur in a turbojet as in the conventional four cycle piston engine. In the turbojet engine, a separate section is devoted to each function. All functions occur at the same time and without interruption. These sections are the compressor section, combustion section, turbine section, and exhaust section, as shown in figure 19.

In operation, the compressor brings in and compresses air. Fuel is then injected into the combustion area and burned. The heated air expands through the turbine and drives the compressor. The remaining gas energy is expended in accelerating the exhaust gas through a jet nozzle and produces thrust.

A turbojet engine is a complete power plant. This is true of any type of turbojet engine, whether it is large or small, simple or complex. All of the engines work on the few simple laws you have learned. It would be very simple if the Air Force used only one type of engine. This is impossible, because of the different missions for which aircraft are designed, new ideas, design changes, and manufacturers competing with each other to develop more powerful and more efficient engines.

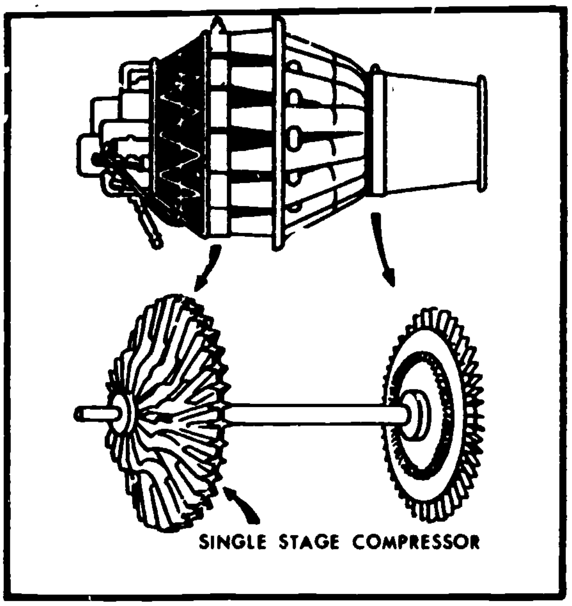

Figure 20. Centrifugal Flow Compressor.

When the Air Force became interested in turbojet engines, the first compressor design was the centrifugal flow, single stage compressor, shown in figure 20. Engine speed was limited in this type of engine. Some of these types are still in use. The axial flow, multistage compressor, shown in figure 21, allows straight-through airflow. The axial flow compressor allows higher compression ratios with less frontal area. So it became the accepted design in general use throughout the Air Force.

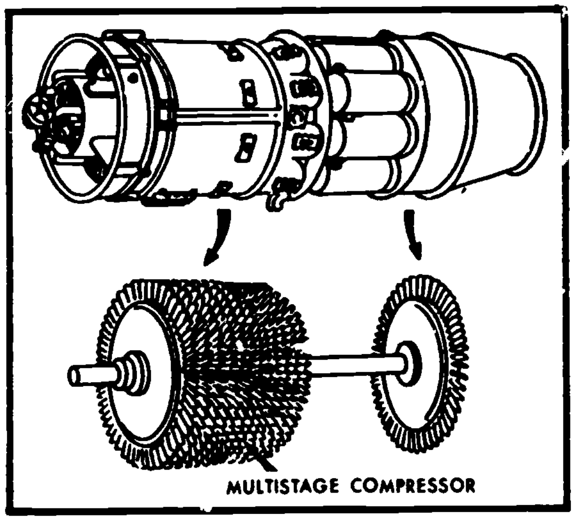

Figure 21. Axial Flow Compressor.

TURBOPROP. The need for aircraft of greater size, carrying capacity, range and speed created a demand for more powerful engines. The turbojet engine with its high power-to-weight ratio supplied the power but without some of the desirable features of propeller-equipped engines. It follows, then, that the most desirable engine would combine the best characteristics of the turbojet and propeller-equipped engines.

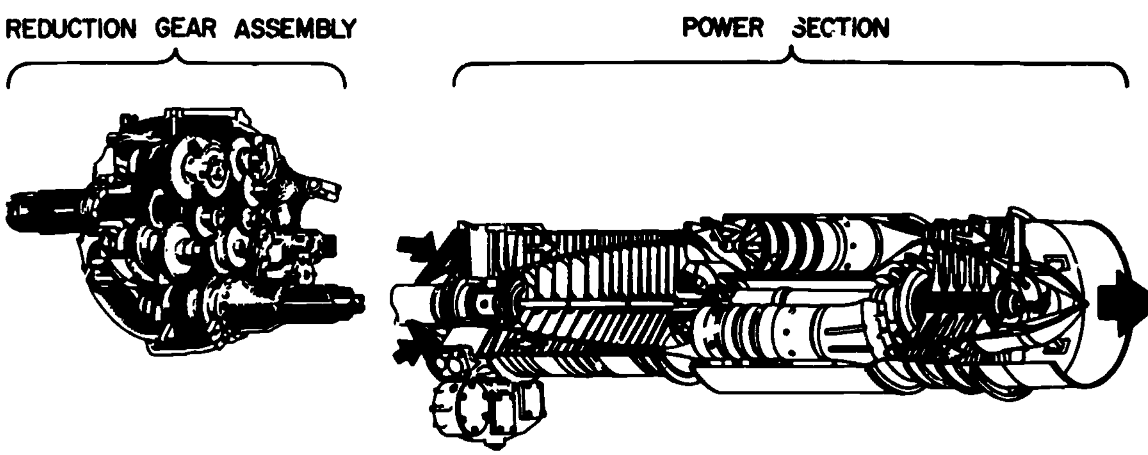

Figure 22. Turboprop Engine (Cutaway).

In an attempt to combine into one engine the best characteristics of each type, the turboprop engine, shown in figure 22, was developed. This type of engine is currently installed in production aircraft. It offers several advantages; economical operation, little vibration, the propeller for takeoffs and landings on moderate sized airstrips, and high power with low weight.

The turboprop is not a conventional jet engine, although they use jet reaction as an additional source of power. The power developed by the gas turbine power section drives a propeller through a reduction gear assembly, shown in figure 22.

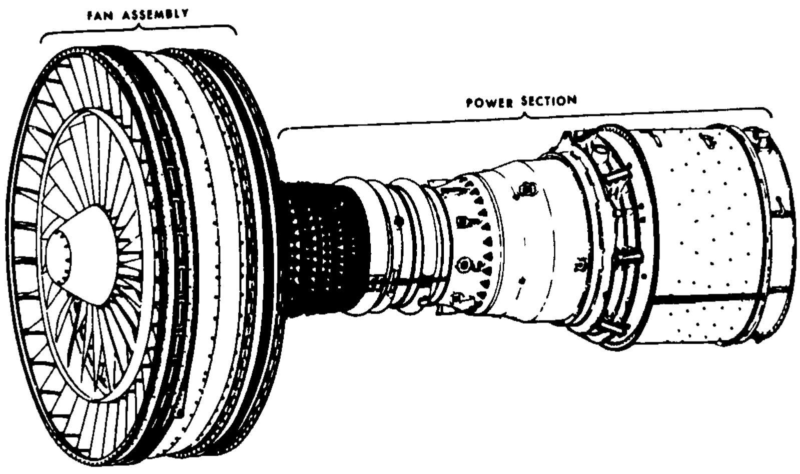

Figure 23. Axial-Flow Fan.

TURBOFAN. In principle, the turbofan gas turbine engine is the same as the turboprop except that the geared propeller is replaced by an axial-flow fan that is driven at engine speed. See figure 23. Secondary air is the air passing through the outer part of the fan, but not through the power section. The ratio of secondary to primary airflow is greater than 1.

Directional References

Directional references is the term used to describe the standard method for labeling and locating parts of an engine or aircraft. This is done as if you are standing at the rear looking forward. Also, the location of any item would be given in clock positions. An example of this would be if some unit was on the right-hand side, it would be labeled as the 3 o'clock position. Study figure 24.

DESIGNATIONS

Aircraft Designations

BASIC MISSION AND TYPE SYMBOL. This is a letter used to indicate the primary function or capability of an aircraft. Modified mission symbols are used with "type symbols" (such as "H" for helicopter) to determine what the aircraft is being used for. Some examples are:

Letter	Title
A	Attack
B	Bomber
C	Cargo/Transport
F	Fighter
*H	Helicopter
L	Observation
T	Trainer
U	Utility
X	Research

*Type symbol

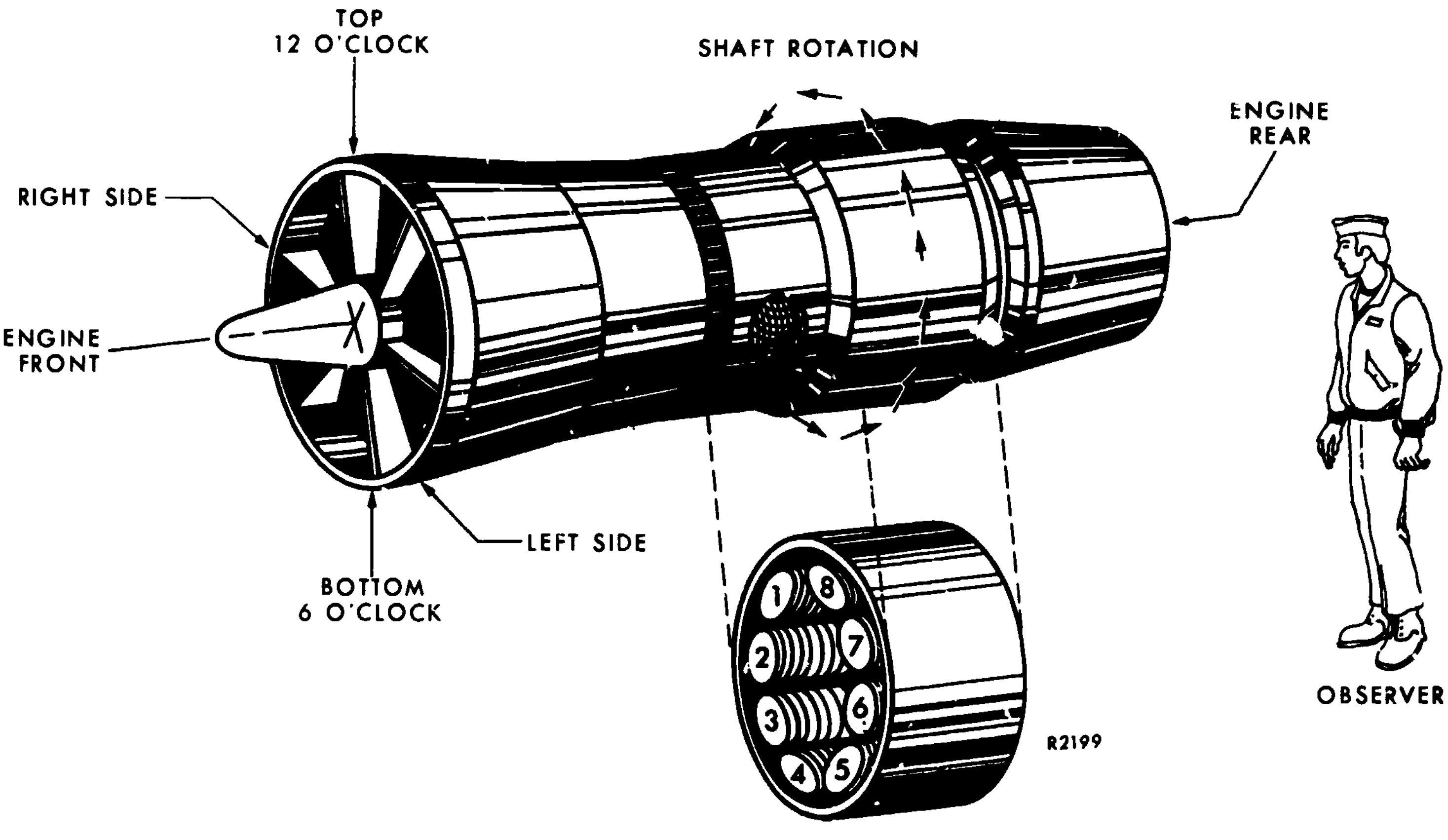

Figure 24. Directional References (Rear Looking Forward).

MODIFIED MISSION SYMBOL (PREFIX LETTER). This is used to show the present use of an aircraft when it is so modified that its original function is no longer possible or is restricted in capability. Only one modified mission symbol can be placed to the left (prefix) of any basic mission symbol. Example: The KC-135 aircraft was designed to carry cargo but has been modified to a tanker for refueling use.

Modified mission symbols include:

Letter	Title
A	Attack
C	Cargo/Transport
E	Special Electronic Installation
H	Search Rescue
K	Tanker
R	Reconnaissance
T	Trainer
U	Utility
V	Staff
W	Weather

DESIGN NUMBER. This is a sequenced number following the basic mission symbol for each new design of the same type of aircraft. Some are never mass produced. After the numbers got too high in value, the Air Force started counting from 1 again. Hence the C-5 and the F-4 and F-15.

Below are examples of aircraft chosen at random from those put into production.

B-52	C-5
B-57	F-100
B-66	F-101
C-119	F-104
C-121	F-105
C-124	F-111
C-130	F-4
C-135	F-15
C-141	

SERIES LETTER. The series letter is used to show changes in aircraft that affect logistic or support requirements. Series letters start with "A" but do not include "I" or "O" to eliminate confusion with numerals.

Examples of some series changes would be the installation of different engines, extra fuel tanks, electronic equipment, etc. The C-130, for instance, has several series changes, such as C-130B, C-130E, and so on to C-130H.

STATUS PREFIX SYMBOL (CLASSIFICATION LETTER). When a status prefix letter is used on an aircraft, it shows use for experimentation, or special or service test. The status prefix letter is placed to the left of the basic mission symbol or the modified mission symbol.

Some examples are:

Letter	Title
G	Permanently Grounded
J	Special Test, Temporary
N	Special Test, Permanent
X	Experimental
Y	Prototype
Z	Planning

Engine Designation

TYPE LETTER. Type letters are used to identify different types of power plants.

Some examples are:

Letter	Title
R	Reciprocating
J	Turbojet
RJ	Ramjet
TF or F	Turbofan
T	Turboprop
K	Rocket

MODEL NUMBER. Model numbers are used to show the model of the engine. Numbers are used with the letters to identify specific engines in a type. These numbers start with 30 for each type of power plant and progress in sequence. Even numbers, such as 30, 32, 34, 36, etc., are used for engines which are developed for the Navy. Odd numbers, such as 31, 33, 5[illegible], 79, etc., are used for engines which are developed for the Air Force.

For example, the J33 is the second turbojet engine developed for the Air Force, and the T34 is the third turboprop engine developed for the Navy.

Examples of design numbers with type letters are:

Air Force	J33, TF39, J57, F101
Navy	', J48, T56, T400

MANUFACTURER'S CODE LETTERS. The manufacturer's code letter is used to indicate who manufactured the engine. More than one manufacturer could build the same type and model engine.

Examples:

T56-<u>A</u>	Built by Allison
J79-<u>GE</u>	Built by General Electric
J75-<u>F</u>	Built by Ford

Other manufacturer code letters are:

R - Fairchild	NA - North American
T - Continental	ST - Studebaker
L - Lycoming	W - Wright Aeronautical

SERIAL NUMBER. The series number is used to indicate the major changes to the model and to indicate who is using the engine. The Air Force uses <u>odd</u> numbers (1, 3, 5, 9, etc). The Navy uses the <u>even</u> numbers (2, 4, 6, etc).

Examples:

J57-P-<u>6</u>	designed for the Air Force and being used by the Navy
T56-A-<u>7</u>	designed for the Navy and being used by the Air Force

Higher series numbers indicate more recent changes to the engine model.

SERIES MODIFICATION LETTER. Series modification letters are used to show factory changes to the series. These changes are used to show improvements or modifications to the series. These letters are added only with the manufacturer's authorization.

Some examples of series modification letters are:

T56-A-7A

T56-A-7B

T56-A-9A

T56-A-9B

CLASSIFICATION LETTER. Classification letters are used to show the status of the engine.

Examples:

Letter	Title
X	Experimental
Y	Prototype

QUESTIONS

1. List the types of jet engines discussed in this study guide.

2. Explain the designation KC-97L.

3. For a flight to the moon a turbojet would be of little use. Why?

4. What type of jet engine is designated "TF"? "J"? "T"?

5. Explain the directional reference of a jet engine.

6. Explain the engine designation YT56-A-7B.

CHARACTERISTICS AND MAJOR SECTIONS OF THE T56 ENGINE

The T56 engine is an axial flow, continuous-burning turboprop engine. It is rated at 4,050 equivalent shaft horsepower. Its length is 13 feet, with the power section taking up 8 feet of that. It is 2 feet in diameter, and weighs 1845 pounds. It develops 2.2 horsepower per pound of engine weight.

The T56 engine is made up of three sections, shown in figure 25. The power section, the torquemeter and tie struts, and the reduction gearbox. The power section is divided into four assemblies. The compressor, the combustion, the turbine, and the accessory gearbox. These will be described in the following paragraphs.

Power Section

COMPRESSOR ASSEMBLY. The purpose of the compressor assembly is to deliver air to the combustion assembly and the other air operated parts, under high pressure and moderate velocity. The compressor assembly is

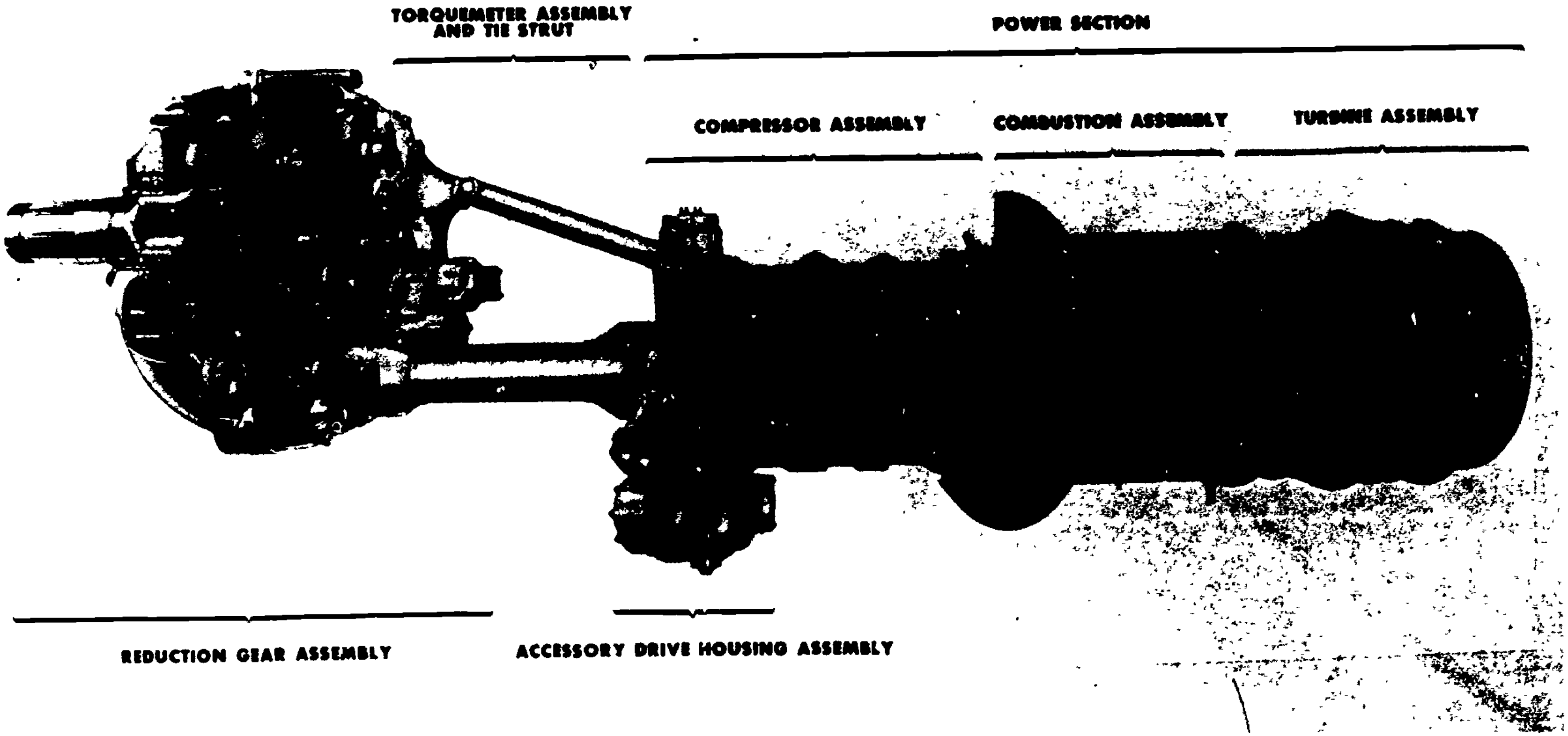

Figure 25. Major Engine Assemblies.

made up of four main parts. The air inlet housing, compressor rotor, compressor case, and compressor diffuser.

The air inlet housing is used to direct the air into the compressor. It has eight hollow support struts to allow flow of anti-icing 14th stage air. It also houses the compressor extension shaft which connects the torquemeter to the compressor, and the No. 1 bearing.

The compressor rotor consists of 14 stages of compressor blades, which are separated by stator vanes. The rotor is supported on each end by an antifriction bearing.

The compressor case houses the compressor rotor, and is the part that the stator vanes are mounted to. The case is made of four 90 degree segments, which are bolted together.

The compressor diffuser is located at the rear of the compressor assembly and is used to prepare the air for entry into the combustion assembly. It is a divergent type duct which will increase the pressure and decrease the velocity. Housed inside the diffuser is the No. 2 bearing. It is a ball type bearing, and is used to support the rear of the compressor rotor. It is also used to prevent axial movement of the compressor rotor and turbine rotor. Also attached to the diffuser are six fuel nozzles at the 2, 4, 6, 8, 10, and 12 clock positions, extending into the combustion chamber liners.

COMBUSTION ASSEMBLY. The purpose of the combustion assembly is to provide an area where fuel and air can be mixed together and burned. Approximately 25% of the air supplied by the compressor assembly is used for combustion, while the remaining 75% is used for cooling of the engine turbine assembly.

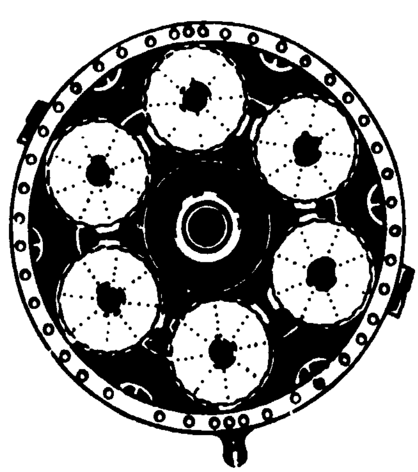

Figure 26. Canannular Combustion Section.

The combustion assembly is of the canannular type. This is shown in figure 26. This type uses a set of combustion liners around an inner combustion case and is surrounded by an outer combustion case. This combines the "burner can" efficiency of the individual chamber, with the strength and increased airflow of the annular type or single burner can.

The major parts of the combustion assembly are the, six combustion chamber liners, the combustion outer case, and the combustion inner case.

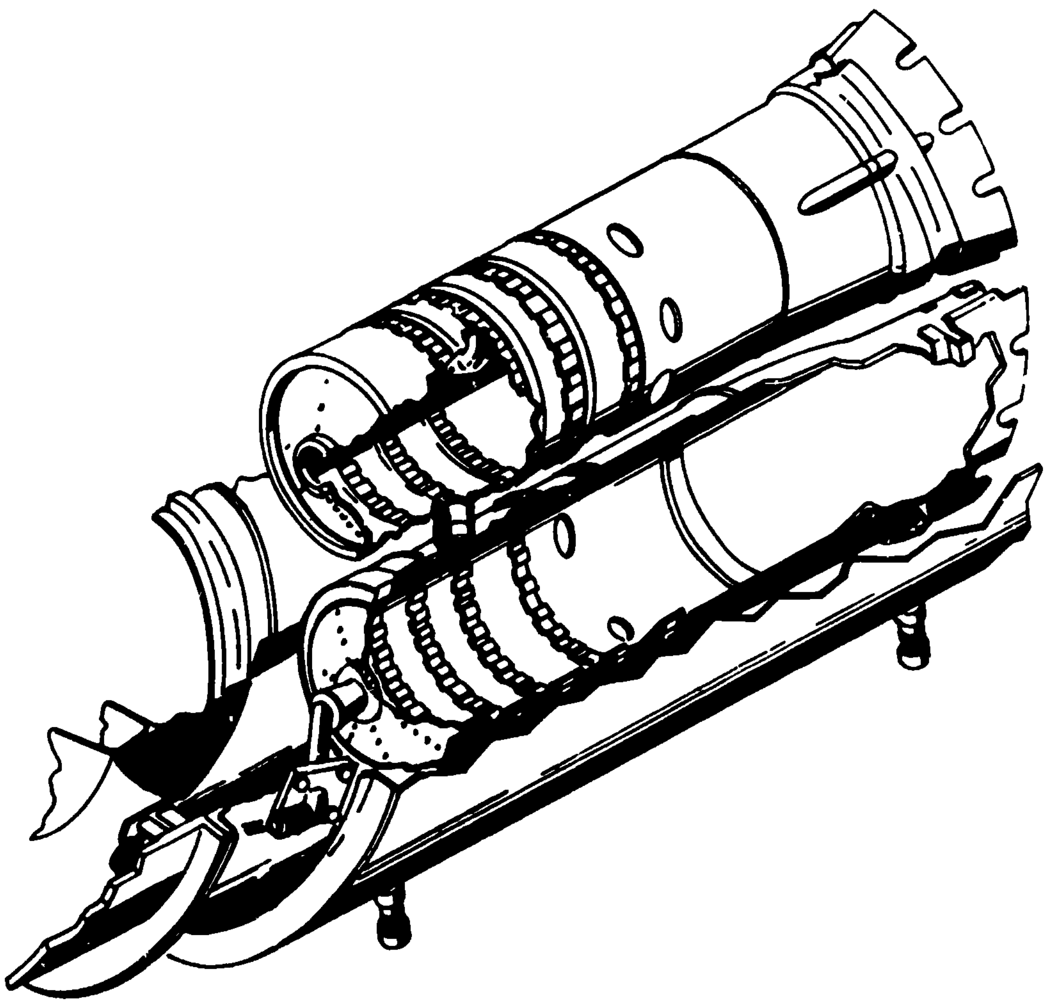

Figure 27. Combustion Chambers.

The six combustion chamber liners are located at the even clock positions around the inner combustion case, see figures 26 and 27. They provide an area where fuel and air can be mixed and burned efficiently. The combustion is started by use of two igniter plugs that extend into the number two and five chambers. Flame is spread to the remaining chambers by use of flame crossover tubes.

The combustion outer case makes up the outer wall of the combustion assembly, see figure 28. It surrounds the six combustion chamber liners and contains the extra 75% cooling air.

The combustion inner case makes up the inner wall of the combustion assembly. Housed inside are the inner case liner, two oil lines, and the turbine coupling shaft. Insulation for these parts is provided by the dead air space between the inner combustion case and the inner combustion case liner.

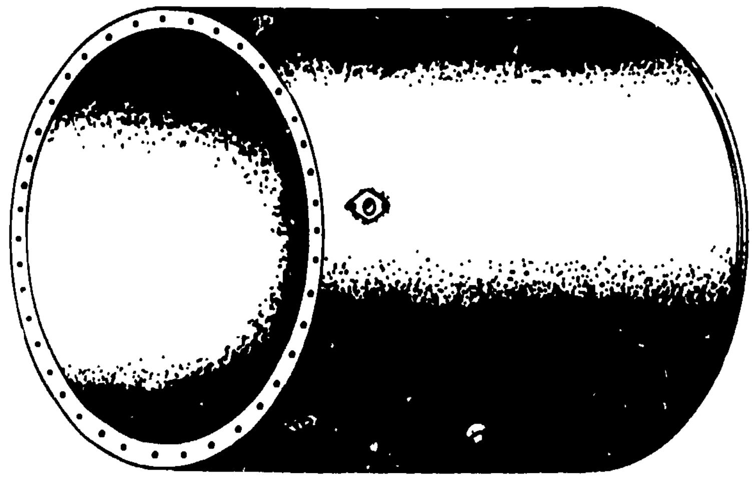

Figure 28. Outer Combustion Casing.

TURBINE ASSEMBLY. The purpose of the turbine assembly is to extrac energy from the combustion gases and convert it to mechanical energy to drive the compressor and the engine driven accessories. The major parts of the turbine assembly are the turbine inlet case, the turbine vane case, the turbine rotor, and the rear bearing support.

The turbine inlet case is used to direct the gases into the turbine assembly. It houses the first stage of the turbine nozzle vanes and 18 thermocouple assemblies. The No. 3 bearing is also housed in the turbine inlet case.

The turbine vane casing forms the outer wall around the turbine rotor and vane assembly. It houses the second, third, and fourth stage turbine nozzle vanes, and the first, second, and third stages of the turbine rotor.

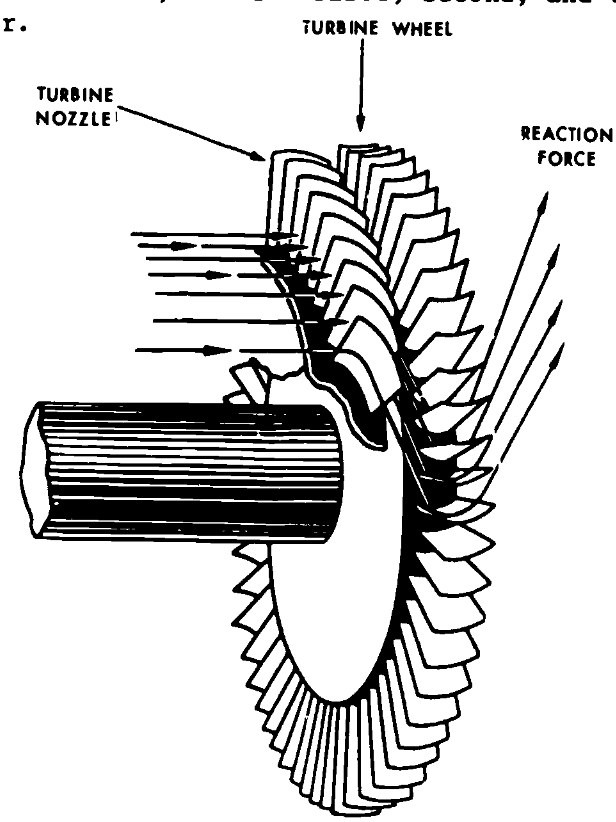

Figure 29. Reaction-Type Turbine Rotor.

The turbine rotor is of a four-stage, reaction-type, see figure 29. The four stages are needed to extract enough energy to drive the compressor, accessories, and propeller. It is supported at each end by an antifriction bearing to provide ease of rotation. It is attached to the compressor by means of a turbine coupling shaft and a turbine tie bolt. The tie bolt passes through the turbine rotor and the coupling shaft and threads into the rear of the compressor. This prevents axial movement of the turbine rotor.

ACCESSORY DRIVE ASSEMBLY. The purpose of the accessory drive assembly is to provide a place to mount and drive accessories to maintain operation of the engine. The accessory drive housing is located at the bottom of the air inlet housing. The power needed to drive the accessory drive housing is taken off the compressor extension shaft. This is by use of a side gear and a vertical drive shaft which passes through the 6 o'clock strut in the air inlet housing.

The parts that are mounted to the accessory drive housing are the:

1. Speed Sensitive Valve - On the outer, left hand, front side.

2. Speed Sensitive Control - On the inner, left hand, front side.

3. Oil Pump - On the inner, right hand, front side.

4. Oil Filter - On the outer, right hand, front side.

5. Fuel Control - On the left hand, rear side.

6. Fuel Pump - On the right hand, rear side.

7. External Scavenge Pump - On the center, rear side.

Torquemeter and Tie Struts

The torquemeter assembly is used to connect the power section to the reduction gearbox and to transfer all the torque developed by the power section to the reduction gearbox. It also provides a means of measuring the torque. This will be discussed in a later section.

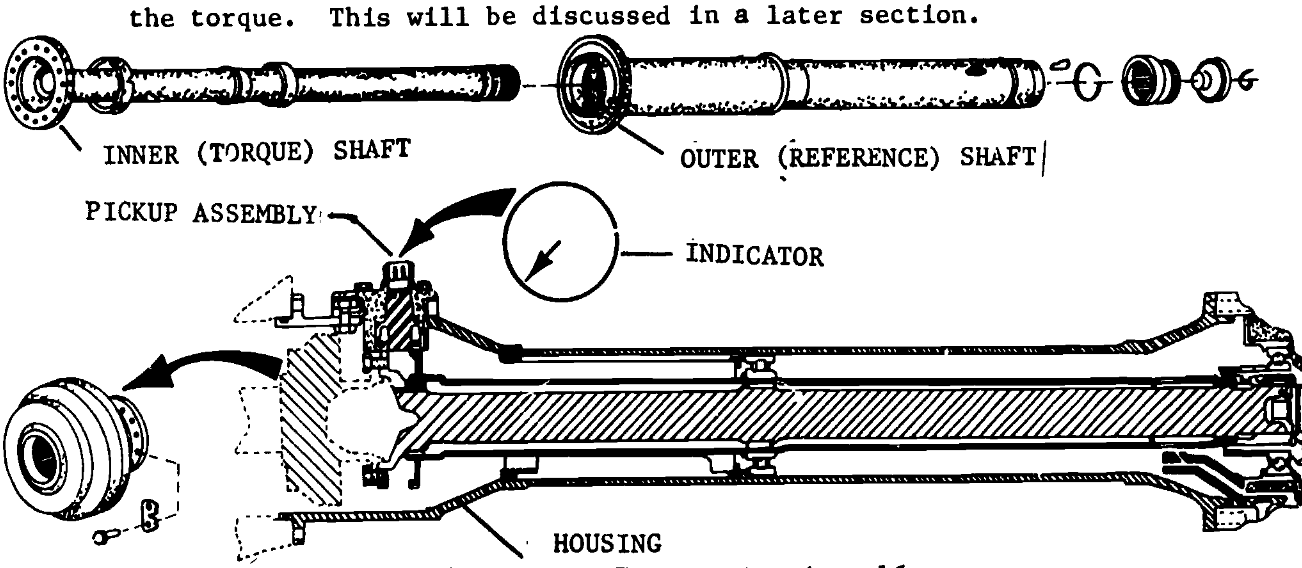

Figure 30. Torquemeter Assembly.

The torquemeter itself is made up of two separate shafts, see figure 30, an inner (torque) shaft and an outer (reference) shaft. Both shafts are attached together at the rear, but remain separate everywhere else. It is splined to the compressor extension shaft at the rear, and bolted to the safety coupling in the reduction gearbox at the front.

The torquemeter is housed in the torquemeter housing, which is bolted to the reduction gearbox (RGB) in the front and to the air inlet housing in the rear. The torquemeter housing provides most of the support between the RGB and the power section.

The tie struts are bolted to the top of the air inlet housing at the 2 and 10 o'clock positions at the rear, and the 2 and 10 o'clock positions of the rear side of the RGB at the front. These provide additional support between the RGB and power section and help stabilize the RGB.

Reduction Gearbox

The reduction gearbox is used to reduce the engine rpm to a safe rpm which can be used by the propeller. It does this by means of a two stage gear reduction process. providing an overall reduction rate of 13.54 : 1.

There are four major cases to the RGB. They are the front case, rear case, bearing diaphragm, and rear case inner diaphragm.

The front case houses and supports the forward parts of the RGB. Some of these parts are the propeller shaft, main scavenge pump, nose scavenge pump, negative torque signal system parts, thrust plate, and two magnetic drain plugs.

The rear case supports and houses the rear parts. Some of the accessories and parts on the rear case are the starter, hydraulic pump generator, oil pressure pump, and tachometer generator.

The bearing diaphragm is located between the front case and the rear case and is the midstructural member for the RGB. It supports the front of the pinion gear and the rear of the planetary gear carrier.

The rear case inner diaphragm is used to support the front of the gears used to drive the accessories.

The gear reduction consists of two stages. The parts of the first stage of reduction consists of the pinion gear and the main drive gear. These gears provide a gear ratio of 3.125 : 1. The parts of the second stage of gear reduction consists of the sun gear, planetary gears, and the ring gear. These gears provide a gear ratio of 4.333 : 1.

The reduction gearbox also has three safety features; the propeller brake, safety couplings, and negative torque signal system.

The propeller brake is located in the rear case of the starter drive pad. It is used to prevent windmilling of the propeller while in flight when in the feather position. It also aids in stopping the rotation of the propeller during normal engine shutdown.

The safety coupling is located at the bottom rear of the RGB. It is bolted to the pinion gear. It is used to disengage the power section from the reduction gearbox in case of excessive negative torque. If the safety coupling disengages, the engine must be shut down because it will not reengage.

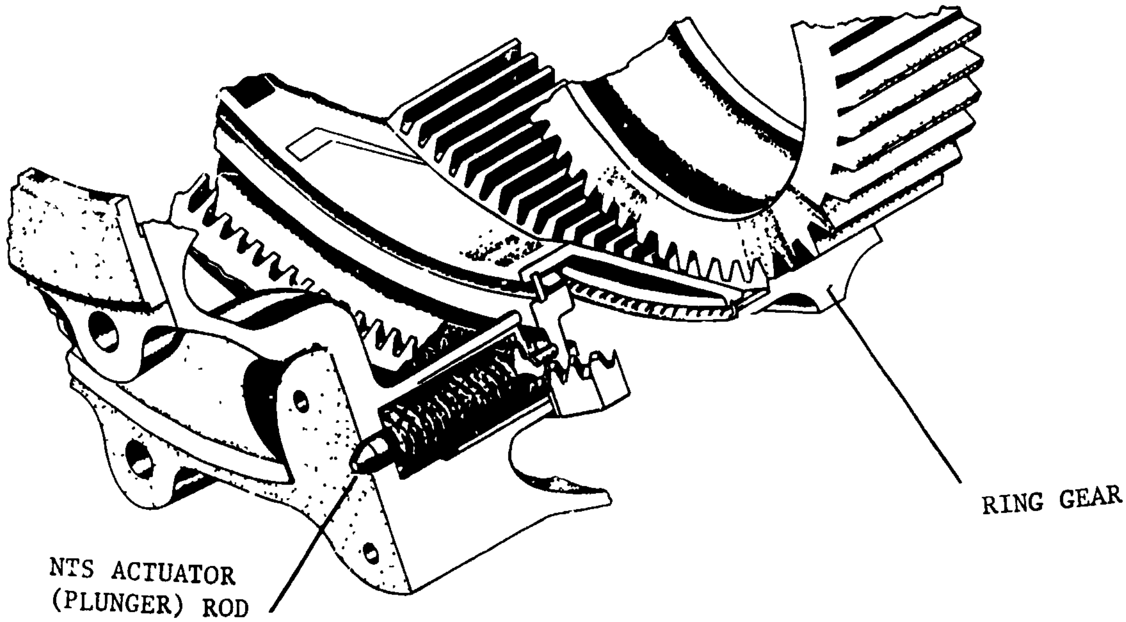

Figure 31. Negative Torque Signal System.

The Negative Torque Signal (NTS) System, shown in figure 31, is located in the upper portion of the RGB front case. It is used to prevent the propeller from driving the engine. It does this by means of a ring gear, plunger, and bracket. These will signal the propeller control assembly to increase the blade angle when negative torque exists. This will create more drag on the propeller, allowing the engine to, once again, drive the propeller.

QUESTIONS

1. What are the three major sections of the T56 engine?

2. What are the four major assemblies of the power section?

3. What is the purpose of the reduction gearbox?

4. What is the purpose of the torquemeter and tie struts?

5. What is the purpose of the power section?

T56 ENGINE SYSTEMS

The turboprop engine is designed to drive a prop to drive the aircraft through the air. But the engine cannot do this on its own. It needs other systems to allow it to operate correctly at all altitudes and power settings. Just like a car engine needs its systems, such as the cooling, ignition, starting, and other systems to operate efficiently.

Some of the systems used on the T56 are the starting, ignition, compressor bleed, fuel, oil, rpm and torque indicating, turbine inlet temperature indicating, negative torque signal system, anti-icing, and fire warning. A description of their parts and locations will be given in the following paragraphs.

Starting System

The purpose of the starting system is to turn the engine compressor to a self-sustaining rpm. "Self-sustaining" is the speed which the compressor must reach before the engine will keep running. The compressor will then be able to supply the needed amount of air to support combustion and cooling.

Parts of the starting system consists of the following:

1. Starter.

    a. Type - Pneumatic.

    b. Location - The center rear side of the RGB.

    c. Purpose - To convert kinetic energy from an air source to mechanical energy to bring the engine to a self-sustaining rpm.

2. Starter control valve.

    a. Type - Butterfly.

    b. Location - The upper right-hand side of the nacelle.

    c. Purpose - To regulate and control the air to the starter.

Ignition System

The purpose of the ignition system is to provide a high voltage, high energy spark to ignite the fuel/air mixture. This high energy spark is needed to blast away any deposits that may be on the spark igniters. These deposits occur because the ignition system operates only during the starting phase of engine operation. Unlike an automobile engine, whose ignition system operates continuously.

Parts of the ignition system consists of the following:

1. Speed Sensitive Control.

    a. Purpose - To energize the ignition relay at 16% rpm and de-energize the ignition relay at 65% rpm.

    b. Location - The inner left-hand front side of the accessory drive housing.

2. Ignition Relay.

    a. Purpose - To complete the circuit and send the voltage to the ignition exciters.

b. Location - At the 11 o'clock forward position of the compressor case.

3. Ignition Exciter.

a. Purpose - To step-up the voltage received from the ignition relay and convert 28 VDC to 20,000 - 25,000 VDC.

b. Location - At the 1 - 3 o'clock forward position of the compressor case.

c. Type - Capacitor discharge.

4. Igniter Plugs.

a. Purpose - To provide an air gap for the ignition of the fuel/air mixture.

b. Location - Is bolted to the outer combustion case at the 2 and 8 o'clock positions, extending into the number 2 and 5 combustion chamber liners.

c. Type - Self-gapping, nonadjustable (creepage).

Oil System

The purpose of the oil system is to clean, cool, and lubricate all bearings and moving parts of the engine. There are two basic types of oil systems, wet sump and dry sump. The T56 engine uses the dry sump type, which means the oil is stored outside of the engine in an external oil tank. Engines with wet sump systems have the oil contained within the engine, such as an automobile engine.

The type oil used in the T56 engine oil system is of the synthetic base instead of petroleum base. The military specification is MIL-L-23699. Although MIL-L-7808 can be used for emergencies.

Parts of the oil sys[illegible]ists of the following:

1. Oil Tank.

a. Purpose - To provide an area to store the engine oil.

b. Location - The upper portion of the nacelle, above the compressor.

c. Capacity - 12 gallons of oil.

7.5 gallons of air for oil expansion.

19.5 gallons total capacity.

2. Oil Tank Pressurizing Valve.

a. Purpose - To maintain 3.5 psi of air pressure in the oil tank.

b. Location - The upper forward side of the oil tank.

3. Oil Quantity Tank Unit.

a. Purpose - To send an indication of the amount of oil in the oil tank to the cockpit.

b. Location - The left-hand side of the oil tank.

4. Scupper-Filler.

a. Purpose - To provide an area for servicing of the oil tank and a way of catching the overflow oil.

b. Location - The right-hand side of the oil tank.

5. Oil Tank Sump.

a. Purpose - To provide an area for the sediment to settle and also for draining the oil tank.

b. Location - The bottom of the oil tank.

6. Oil Tank Shut-Off Valve.

a. Purpose - To provide a means of shutting off the engine oil supply in case of an emergency.

b. Location - Is attached to the right-hand side of the oil tank sump.

c. Type - Gate type.

7. Oil Temperature Bulb.

a. Purpose - To send an indication of the oil temperature to the cockpit.

b. Location - In the oil tank outlet line.

8. Pressure Pumps.

a. Power Section.

(1) Location - The center front side of the accessory drive housing.

(2) Purpose - To supply pressurized oil to all bearings and moving parts of the power section.

b. Reduction Gearbox.

(1) Purpose - To supply pressurized oil for all bearings and moving parts of the RGB.

(2) Location - The right-hand rear side of the RGB.

9. Oil Filters.

a. Power Section.

(1) Purpose - Filter the contaminants from the power section oil system.

(2) Location - On the outer right-hand front side of the accessory drive housing.

b. Reduction Gearbox.

(1) Purpose - Filter the contaminants from the RGB oil system.

(2) Location - On the RGB oil pump housing.

10. Oil Scavenge Pumps.

a. Purpose - To return the oil from the bearing areas to the oil tank.

b. Power Section Locations.

(1) Main Scavenge Pump - The inner right-hand front side of the accessory drive housing, behind the pressure pump.

(2) External Scavenge Pump - The center rear side of the accessory drive housing.

(3) Rear Turbine Scavenge Pump - Inside the exhaust cone, in the rear bearing support.

c. Reduction Gearbox Locations.

(1) Main Scavenge Pump - The bottom of the front case of the reduction gearbox.

(2) Nose Scavenge Pump - Beneath the propeller shaft, inside the front case of the reduction gearbox.

11. Fuel Heater Strainer.

a. Purpose - Uses hot scavenge oil to heat the fuel and prevent ice from forming in the fuel.

b. Location - Right-hand side of the nacelle.

12. Oil Cooler.

a. Purpose - To cool the oil after the engine warms up.

b. Location - The lower part of the nacelle.

c. Type - Air/oil type.

13. Oil Cooler Flap.

a. Purpose - To control the amount of air passing through the air cooler.

b. Location - In the lower part of the nacelle, behind the oil cooler flap.

14. Oil Cooler Flap Actuator.

a. Purpose - To position the oil cooler flap for control of the oil temperature.

b. Location - Inside the nacelle, above the oil cooler flap.

15. Oil Temperature Control Thermostat.

a. Purpose - Signal the flap actuator when to open or close the oil cooler flap according to the oil temperature.

b. Location - The upper left-hand side of the nacelle, behind the oil tank.

Fuel System

The purpose of the fuel system is to supply the engine with the correct amount of fuel, for combustion, during all engine operating conditions. The correct operation of this system is necessary in order to control the engine temperature and the rate of acceleration and deceleration to prevent flameout of the engine.

The T56 engine fuel system consists of a fuel heater strainer, an engine driven fuel pump, fuel filters, a hydromechanical fuel control, fuel enrichment valve, electronic temperature datum valve, fuel manifold drain valve, fuel manifold, six fuel nozzles, and two burner drain valves.

Parts of the fuel system consists of the following:

1. Fuel Heater Strainer - Is the same as in the oil system.

2. Fuel Pump.

a. Purpose - To pressurize and deliver fuel to the rest of the system parts.

b. Location - The right-hand rear side of the accessory drive housing.

c. Type - Dual, centrifugal boost, with spur-gear type secondary and primary pumps.

3. Low Pressure Fuel Filter.

a. Purpose - To filter the fuel after it leaves the centrifugal boost pump and sends it to the secondary pump.

b. Location - The right-hand side of the engine, next to the fuel pump.

c. Type - Paper throw-away.

4. High Pressure Fuel Filter.

a. Purpose - To filter the fuel as it leaves the primary pump.

b. Location - The bottom of the fuel pump.

c. Type - Waifer air maze.

5. Fuel Control.

a. Purpose - To meter fuel for combustion according to atmospheric and mechanical variables.

b. Location - On the left-hand rear side of the accessory drive housing.

c. Type - Hydromechanical.

6. Enrichment Valve.

a. Purpose - To provide additional unmetered fuel for starting the engine during cold weather.

b. Location - Mounted to the back of the external scavenge pump.

7. Temperature Datum Valve.

a. Purpose - To meter the fuel according to the signals received from the temperature datum control.

b. Location - The bottom of the compressor case, behind the fuel pump.

8. Fuel Manifold Drain Valve.

a. Purpose - To drain the fuel in the fuel manifold after engine shutdown.

b. Location - The bottom of the compressor case, behind the fuel control.

9. Fuel Manifold.

a. Purpose - To distribute the fuel to the six fuel nozzles.

b. Location - Around the compressor diffuser.

10. Fuel Nozzles.

a. Purpose - To atomize the fuel for more efficient combustion.

b. Location - At the even clock positions on the compressor diffuser.

11. Burner Drain Valves.

a. Purpose - To drain the fuel from the outer combustion case in the event of an unsuccessful start.

b. Location - At the forward and rear positions of the outer combustion case, at the 6 o'clock position.

Compressor Bleed System

The compressor bleed system provides an automatic means of controlling the compressor airflow. Its purpose is to reduce or prevent compressor surges and stalls.

During low speed operation, the compressor provides more air than the combustion section can handle or use. Therefore, the compressor bleed system must discharge this extra air overboard to prevent surges and stalls.

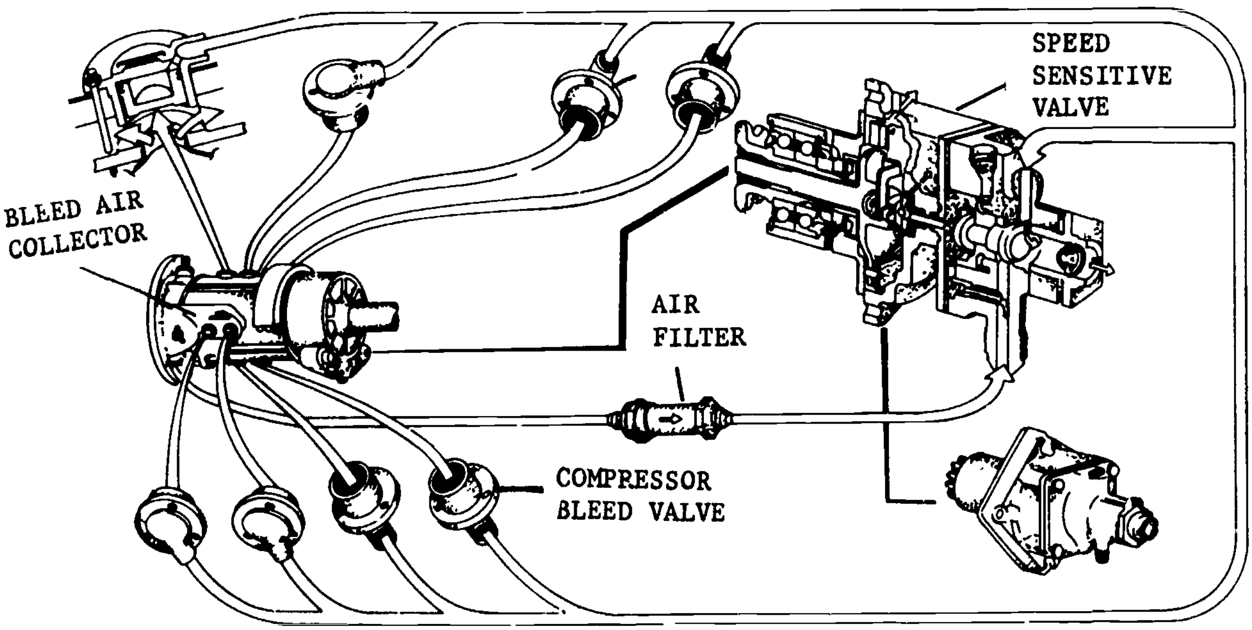

Figure 32. Compressor Bleed System.

The parts of the compressor bleed system, shown in figure 32, are the speed sensitive valve, eight compressor bleed valves, and the bleed air collectors.

1. Speed Sensitive Valve.

a. Purpose - To control the operation of the compressor bleed valves.

b. Location - On the outer left-hand front side of the accessory drive housing.

2. Compressor Bleed Valves.

a. Purpose - To bleed excess air from the compressor to prevent surges and stalls.

b. Location - Two each at the 3, 6, 9, and 12 o'clock positions, over the 5th and 10th stage of compression.

3. Bleed Air Collectors.

a. Purpose - To act as air ducts to route the compressor bleed air overboard.

b. Location - At the 3 and 9 o'clock positions on the compressor.

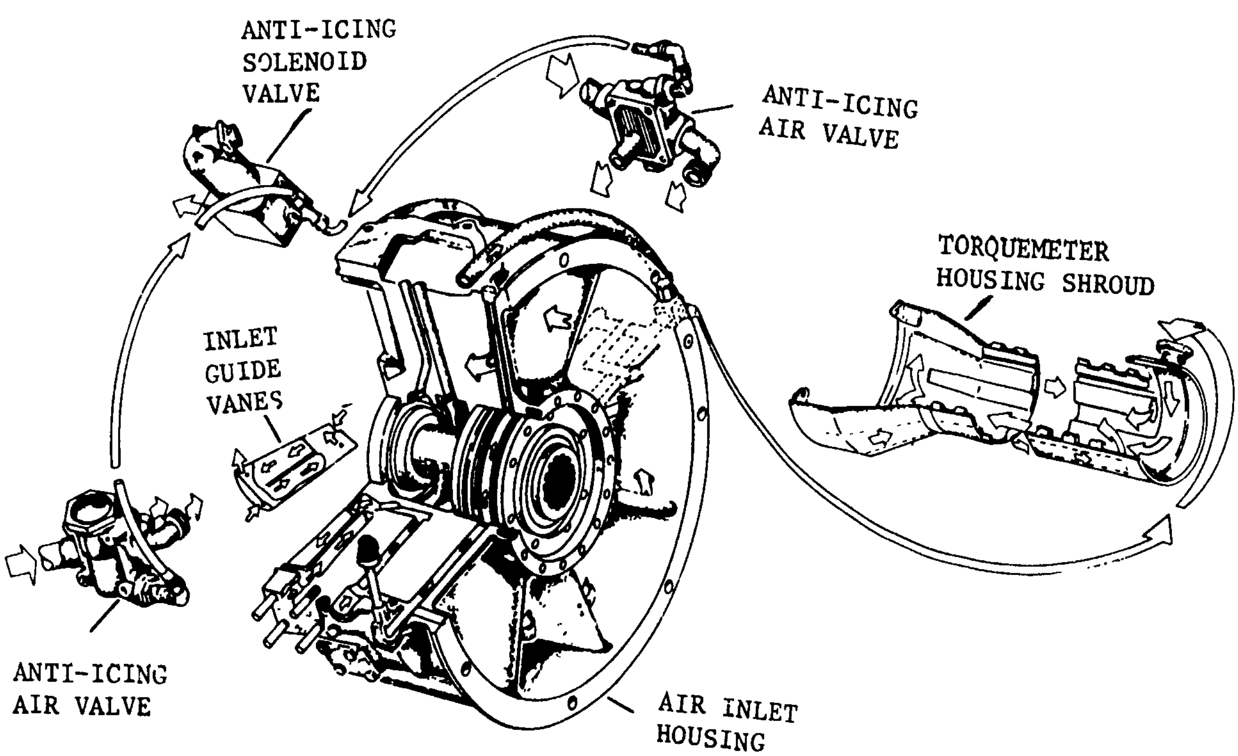

Figure 33. Anti-Icing System.

Anti-Icing System

The purpose of the anti-icing system, shown in figure 33, is to prevent ice from forming on the engine in its air inlet area. Heat for anti-icing is provided by routing hot 14th stage compressor air to the inlet area. There it is routed through hollow struts and ducts to prevent ice from forming. After heating the inlet area, the hot 14th stage air is then discharged into the front of the compressor.

The items of the engine that are anti-iced are the air inlet housing, inlet guide vanes, and the lower half of the torquemeter housing shroud.

The parts of the anti-icing system are the anti-icing master switch, anti-icing solenoid valve, and two anti-icing air valves.

1. Master Switch

a. Purpose - Provides control over the anti-icing systems on the aircraft.

b. Location - On the anti-icing control panel in the cockpit.

2. Anti-Icing Solenoid Valve.

a. Purpose - Provides primary control of the engine anti-icing system.

b. Location - At the 11 o'clock forward position on the compressor case.

3. Anti-Icing Air Valves.

a. Purpose - To control the flow of anti-icing air to the air inlet housing.

b. Location - Bolted to the air inlet housing at the 3 and 9 o'clock position.

4. Anti-Icing Air Lines.

a. Purpose - To route hot 14th stage air from the diffuser to the anti-icing air valves.

b. Location - Between the anti-icing system parts.

TIT Indicating System

The purpose of the TIT indicating system, shown in figure 34, is to monitor the temperature of the combustion gases at the turbine inlet and send an indication to the gage in the cockpit. The temperature of the engine must be monitored and controlled to prevent the engine from getting too hot. This could lead to quick deterioration of the turbine section which could cause an engine failure and change.

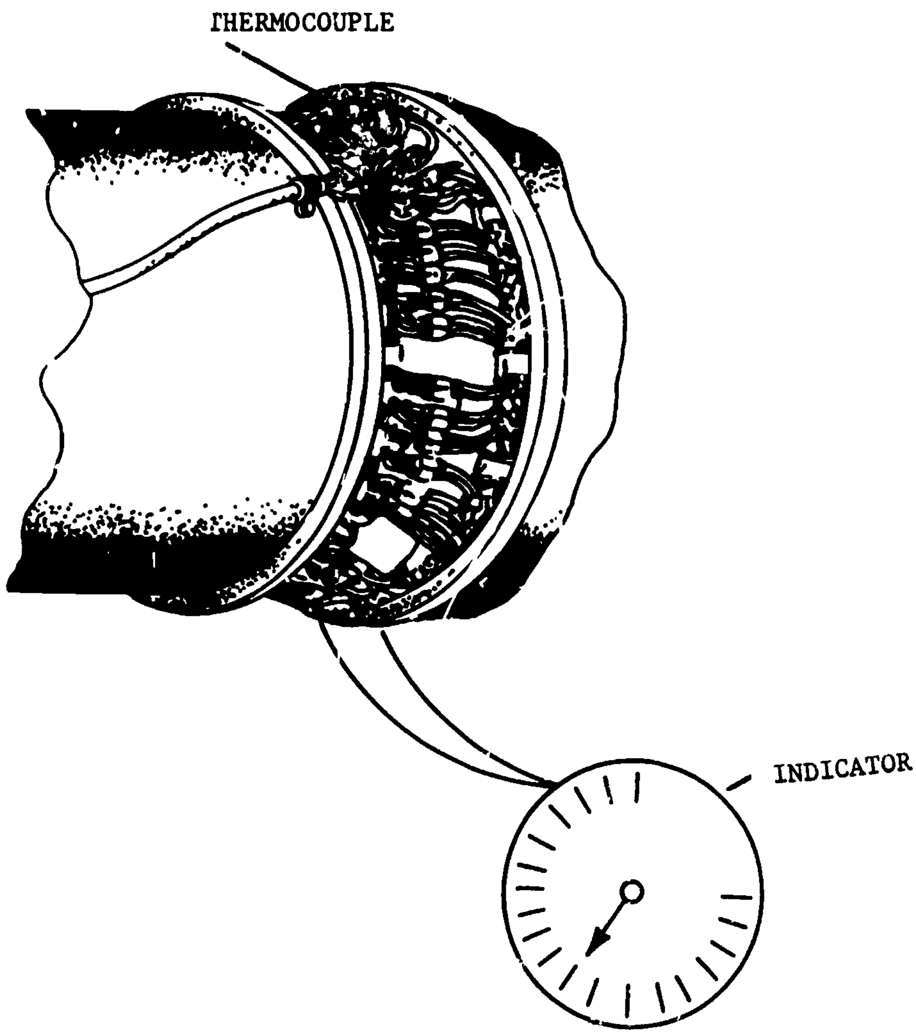

Figure 34. TIT System.

The parts of the TIT indicating system are:

1. Thermocouples.

a. Purpose - To measure the temperature of the combustion gases at the turbine inlet.

b. Location - Around the turbine inlet case.

c. Type - Alumel, chromel.

2. Indicator.

a. Purpose - To indicate, to the engine operator, the temperature of the turbine inlet gases, in degrees Celsius.

b. Location - On the engine instrument panel in the cockpit.

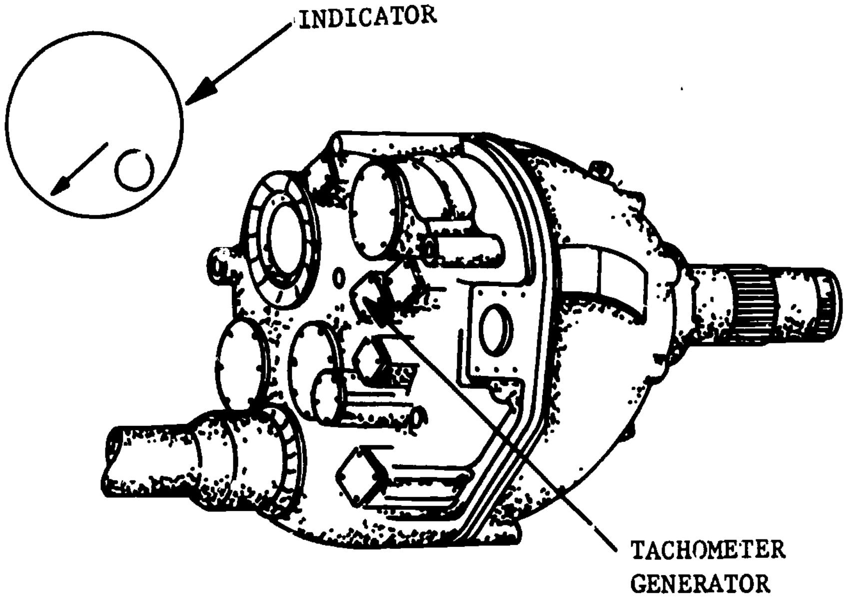

Figure 35. RPM Indicating System.

RPM Indicating System

The purpose of the rpm indicating system, shown in figure 35, is to give an indication to the pilot of the speed of the compressor. This indication will be in percent of the maximum rpm. For example, when the indicator shows 100% the actual rpm is 13,820 and when the indicator shows 94%, the actual rpm is 13,000.

It is important to monitor the rpm, because if the turbine is allowed to overspeed, the blades could stretch due to the excessive centrifugal force. This could cause the turbines to drag or rub against the case, which could cause an engine failure.

The rpm indicating system consists of the following parts:

1. Tachometer Generator.

    a. Purpose - To send a variable voltage signal to the indicator, for measuring rpm.

    b. Location - On the right-hand rear side of the RGB.

2. Tachometer Indicator.

    a. Purpose - To indicate, to the pilot, the speed of the compressor in percent of maximum rpm.

    b. Location - On the engine instrument panel in the cockpit.

Torque Indicating System

The purpose of the torque indicating system, shown in figure 30, is to provide a way of measuring the torque produced by the power section. The torque reading will be in inch-pounds of torque.

The monitoring of the torque produced is important so as not to overstress the drive parts and the propeller. Too much excessive torque could even cause the torquemeter shaft to shear or break. This would cause an engine shutdown and possible an aborted mission.

The torque indicating system parts consists of the indicator, torquemeter pickup, and the torquemeter.

1. Indicator.

a. Purpose - To indicate to the pilot the amount of torque being produced by the engine power section in inch-pounds.

b. Location - In the engine instrument panel in the cockpit.

2. Torquemeter Pickup.

a. Purpose - To measure the amount of twist in the torquemeter shaft and send an electrical signal to the indicator.

b. Location - The left-hand forward side of the torquemeter housing.

3. Torquemeter.

a. Purpose - To transfer the torque produced by the power section of the engine to the RGB and provide a unit from which the torque can be measured.

b. Location - Inside the torquemeter housing, between the power section and the RGB.

Negative Torque Signal (NTS) System

The NTS system, shown in figure 31, is used to keep the prop from driving the engine. This occurs when negative torque exists. It does this by signalling the propeller control to increase the blade angle. This will put more drag on the prop and thereby remove the negative torque condition.

The negative torque signal system consists of the following:

1. Ring Gear.

a. Purpose - Acts as a sensing device and will move forward to move the NTS plunger forward when a negative torque condition exists.

b. Location - In the front case of the RGB.

2. NTS Plunger.

a. Purpose - To transmit ring gear movement to the NTS bracket.

b. Location - At the 1 o'clock position on the front case of the RGB.

3. NTS Bracket.

a. Purpose - Acts as the final linkage to transmit the ring gear movement to the propeller control assembly.

b. Location - At the 1 o'clock position in front of the NTS plunger on the front case of the RGB.

Fire Warning and Overheat Warning Systems

While the previous systems are required for proper operation of the engine, the overheat and fire warning systems are not. Instead, they are used to signal the pilot when the engine is malfunctioning. To be more specific, to tell him when it is on fire or overheating.

There are three systems that will do this. The fire warning, turbine overheat warning, and nacelle overheat warning systems.

The fire warning systems is used to detect a fire in one of the five engines (four main and one GTC). The turbine overheat warning system is used to detect an overheat condition in the turbine area of the four main engines. The nacelle overheat warning system is used to detect an overheat condition in the four engine nacelles.

Parts of the fire warning and overheat warning systems consists of the following:

1. Fire Warning System.

a. Master Light.

(1) Purpose - To indicate to the pilot when there is a fire in one of the five engines.

(2) Location - On the pilot's instrument panel.

b. Fire Handles (T-Handles) (5).

(1) Purpose - To indicate which engine the fire is in.

(2) Location - Emergency fire control panel.

2. Turbine Overheat Warning System.

a. Master Light.

(1) Purpose - To indicate to the pilot when an overheat condition exists in one of the four main engines.

(2) Location - On the pilot's instrument panel.

b. Turbine Overheat Warning Lights (4).

(1) Purpose - To indicate which one of the four main engines is in a turbine overheat.

(2) Location - In the four main engine T-handles on the emergency fire control panel.

3. Nacelle Overheat Warning System.

a. Overheat Warning Lights (4).

(1) Purpose - To indicate an overheat condition in one of the four engine nacelles.

(2) Location - In the copilot's instrument panel.

QUESTIONS

1. What is the purpose of the engine systems used on the T56?

2. What system prevents surges and stalls of the compressor?

3. What are the parts used in the ignition system?

4. What systems provide performance data of the engine and propeller?

5. What system monitors the temperature of the engine?

6. What are the parts used in the starter system?

7. What is the purpose of the engine oil system?

8. What system prevents ice from forming on the engine?

9. What is the purpose of the fuel system?

10. What is the purpose of the negative torque signal system?

11. What is the purpose of the fire and overheat warning system?

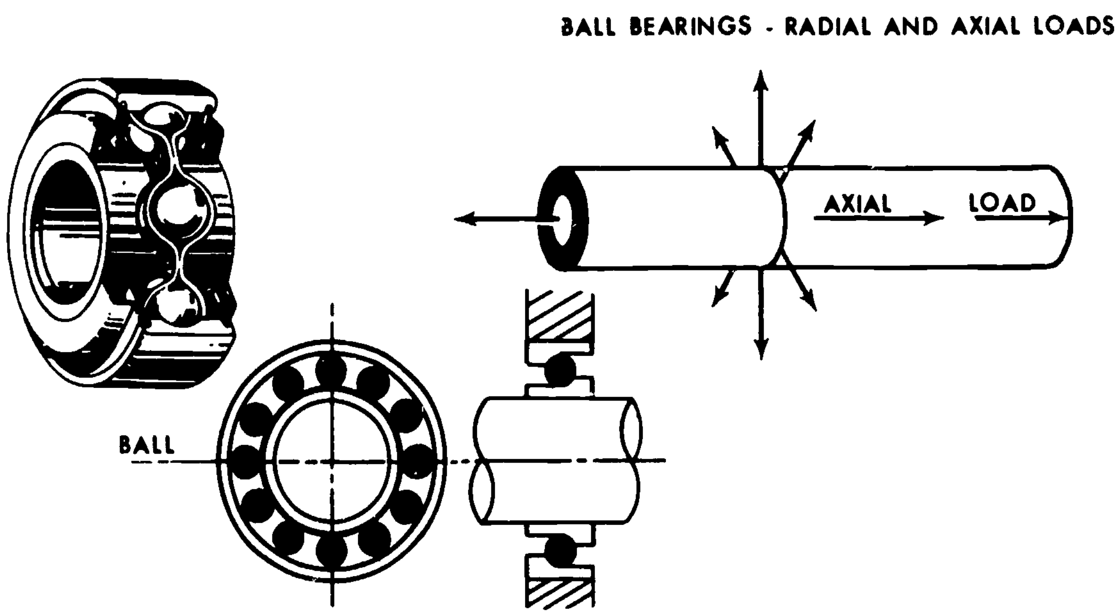

Figure 36. Ball Bearings.

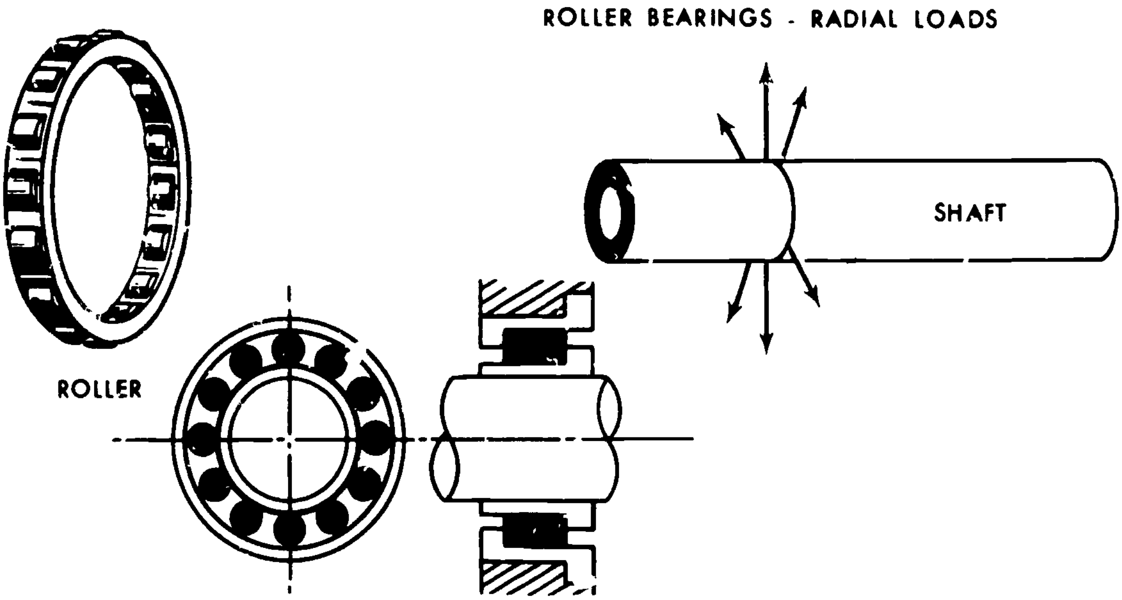

Figure 37. Roller Bearings.

T56 MAIN BEARINGS AND SEALS

The T56 engine uses four main shaft bearings. One is a ball bearing and three are roller bearings, see figures 36 and 37. Ball bearings are used to take up both radial and axial loads, whereas roller bearings take up radial loads only. Ball bearings are sometimes called thrust bearings. In a T56, the compressor rear (No. 2) bearing is the thrust bearing.

The compressor front bearing, or No. 1 bearing, is located in the air inlet housing. The No. 1 bearing is a roller type bearing and supports the radial load at the front of the compressor.

The compressor rear bearing, or No. 2 bearing, is located in the compressor diffuser. The No. 2 bearing is a ball bearing and supports the radial and axial load of the compressor.

The turbine front bearing, or No. 3 bearing, is located in the turbine inlet housing. The No. 3 bearing supports the radial load at the front of the turbine.

The turbine rear bearing, or No. 4 bearing, is located in the rear bearing support. The No. 4 bearing supports the radial load at the rear of the turbine.

These bearings need to be lubricated to operate properly. But this lubricating oil cannot be allowed to leak into the engine. Therefore, the T56 engine uses "labyrinth seals" to keep the oil from leaking out of the bearing areas. The labyrinth seals use a series of baffles where 6th or 14th stage air is used to prevent the oil from leaking over them. These labyrinth seals are used in each bearing area for a total of four seal assemblies.

QUESTIONS

1. How many main bearings are used on a T56 engine?

2. How many ball (thrust) bearings are used in a T56 engine?

3. What prevents oil from leaking out of the bearing cavities?

4. What is used to pressurize the labyrinth seals?

5. What type of bearings are used in a T56 engine?

GLOSSARY

ACCELERATION - The rate of change in velocity (a change in speed).

ACTUATOR - Something which transmits motion.

AIR START - Engine start made in flight, using ram air to rotate the engine compressors or propeller.

AMBIENT AIR - Air surrounding all sides of an engine, air available for consumption.

ANNEALING - A process of heat treating to soften metal.

ANTI-ICING - Prevention of ice formation.

AXIAL - Along an axis.

AXIAL FLOW - Refers to the path of air, as it passes slong the axis (or shaft) of engine rotating assembly.

BAFFLE - An obstruction designed to control the flow of air or fluids.

COMBUSTION CHAMBER - A place where fuel and air are mixed and the fuel burned.

COMPRESSOR BLADE (ROTOR) - A rotating airfoil-shaped component which moves air.

COMPRESSOR VANE (STATOR) - A stationary airfoil-shaped component which raises pressure.

COMPRESSOR STAGE - One row of rotating blades (rotor) plus one row of stationary vanes (stators).

COMPRESSOR SURGE - A disturbance of normal airflow, sometimes known as a stall.

DIFFUSER - A rapidly expanding area where air from the compressor is directed to the combustion section and to other internal and external takeoffs. Used to increase pressure and decrease velocity.

DUCT - A passage which contains and controls the flow of gases in motion.

CONVERGENCE DUCT - Becoming continuously smaller in the direction of flow.

DIVERGENT DUCT - Becoming continuously larger in the direction of flow.

ENERGY - The ability to do work.

FLAMEOUT - Unintentional flame stoppage.

MANIFOLD - A connecting pipe which may take any of various forms.

NOMENCLATURE - Technical name or description of an item.

NOZZLE - A duct of varying cross-section, used in discharging liquids or gases, in which the velocity of the fluid or gas is increased.

OVERTEMP - An EGT in excess of the maximum allowable for a given condition.

PNEUMATIC - Relating to air or air pressure.

PROBE - A small diameter sensing element extending into the air or gas stream to measure pressure, temperature, or velocity.

RADIAL - Branching outward from the common center.

RAM AIR - The pressure buildup at the engine inlet, created by the forward motion of the aircraft.

SCAVENGE - Remove residue.

STANDARD DAY - A set of theoretical atmospheric conditions, used as a reference in making TO charts which are used for making engine adjustments and computing thrust.

STATIC - Not moving.

START - To successfully bring the engine into operation.

SUMP - A low place where fluid will collect.

TACHOMETER - A device which shows the rotational speed of a shaft.

TECHNICAL ORDERS (TOs) - Printed and detailed information concerning operation, maintenance, inspection, and repair of Air Force equipment.

TORQUE - A force that will produce rotation.

TORQUE VALUE - The amount of force applied; common units are inch-pounds or foot-pounds.

TOXIC - Poisonous or injurious to respirator organs.

TRIM - To adjust properly.

TRIM CHARTS - Reference charts consulted while making adjustments on the engine (found in equipment technical orders).

THERMO - Relating to heat.

THERMOCOUPLE - A temperature sensing device.

THRUST - The forward force produced in reaction by the escaping gases in jet propulsion. Formula: Thrust = Mass times Acceleration (T = M x A).

THRUST AUGMENTATION - Any method of temporarily increasing thrust.

TURBULENCE - A disturbed pattern of airflow.

WELDMENT - A welded assembly.

SERVICE TEST
PROGRAMMED TEXT
C3ABR42633 000-PT-105

Technical Training

Turboprop Propulsion Mechanic

MAINTENANCE MANAGEMENT

20 October 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

Designed for ATC Course Use.

Do Not Use on the Job.

VALIDATION

This programmed text is designed for students in the C3ABR42633 000, Turboprop Propulsion Mechanic Course. Tryout of this programmed text and technical information was conducted using students with no prior exposure to this material. At least 70% of the 30 students used to validate the material surpassed the standards specified in the objectives. The average time required to complete this programmed text is 4 hours and 5 minutes.

OBJECTIVES

Having completed this programmed text and without the aid of any references, you will be able to identify facts pertaining/relating to the:

1. Functions of the Deputy Commander for Maintenance.
2. Responsibilities of the Deputy Commander for Maintenance.
3. Functions of the management units that make up the Deputy Commander for Maintenance staff.
4. Processing material.
5. Controlling material.
6. Cross-utilization training.
7. Maintenance system.
8. Maintenance data collection.

INSTRUCTIONS

This programmed text presents information in small steps called frames. Carefully study the written material in each frame until you are satisfied that you understand its contents. Each frame requires you to respond to the information in some way. Specific instructions are provided in each frame. Check the accuracy of your work by checking your responses with the correct responses given before the next frame.

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Good management doesn't happen by accident. It's the result of many people. working hard for a common goal. In this PT, we will be talking about some of the people who manage the Air Force maintenance organizations. The mission of the maintenance organization has always been to maintain Air Force equipment in a highly serviceable and safe-to-operate condition. As we strive to reach this goal, we will have frequent meetings with these managers beginning with the Deputy Commander for Maintenance.

NO RESPONSE REQUIRED

Frame 2

FUNCTIONS OF THE DCM

The Deputy Commander for Maintenance (DCM) has a big job. This job could be to plan, schedule, keep control, and direct the use of all assigned maintenance personnel. To do his job, the DCM has two major functions. They are:

1. Control all assigned maintenance personnel.

2. Control all assigned equipment. The DCM needs your help. He needs you to do your best.

Place an "X" by the function(s) of the Deputy Commander for Maintenance.

____ 1. Controls airman assignments from base to base.

____ 2. Plans the use of maintenance resources.

____ 3. Controls all assigned maintenance personnel.

____ 4. Schedules maintenance resources.

____ 5. Controls all assigned equipment.

Answers to Frame 2: ____ 1. X 2. ____ 3. ____ 4. X 5.

Frame 3

RESPONSIBILITIES OF THE DCM

The responsibilities of the DCM are many, too many for us to deal with in this text. So we will look at only a few that need your full support. The DCM is responsible for:

1. Making sure that jobs done on all equipment are done in a timely manner and are of a high quality.

2. Providing all the directions for accomplishing AF regulations and all of the unit command rules.

3. Getting in the middle of the working unit to find out the maintenance support requirements.

4. Making sure that the unit's job(s) are included in all plans, programs, and host-tenant agreements.

5. Ruling on the assignment of all maintenance facilities.

6. The maintenance funds program.

7. Ensuring training unit(s) will be set up to ensure good training.

8. Having a self-inspection system set up in the unit.

Place an "X" by the responsibilities of the DCM.

____ 1. Inform the squadron when an airman fails to use the TO before he does a job.

____ 2. Be in charge of unit funds program.

____ 3. Make sure that there is enough personnel to sign off red diagonal symbols.

____ 4. Ensure training units are set up.

____ 5. Have a self-inspection system.

Answers to Frame 3: ____ 1. __X__ 2. ____ 3. __X__ 4. __X__ 5.

Frame 4

BASIC FUNCTIONS OF MANAGEMENT UNITS THAT MAKE UP THE DCM STAFF

Section 1

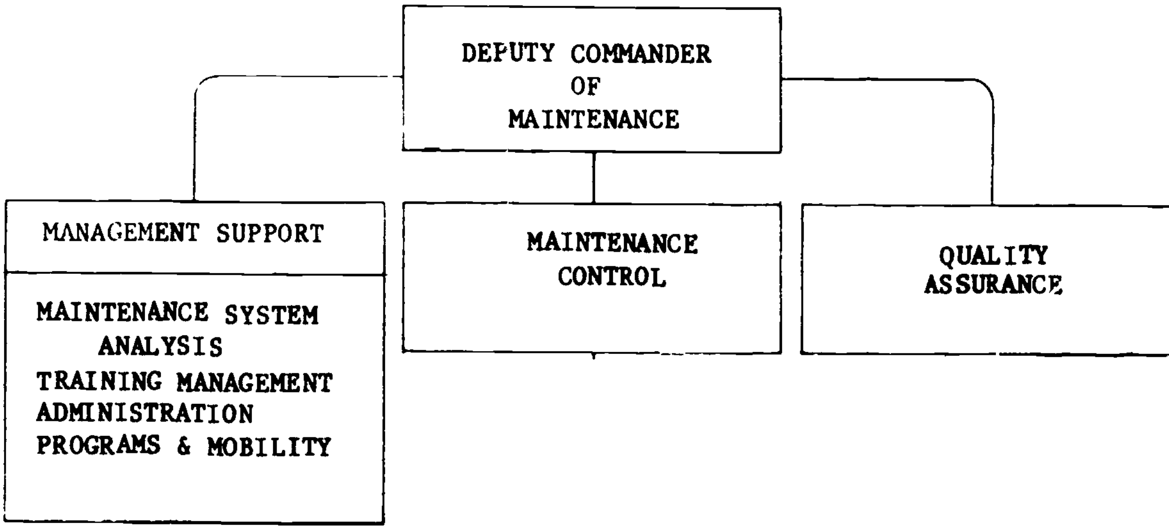

Figure 1. Management Units of DCM's Staff.

The DCM's job is very broad and demanding. So, to be an effective man[illegible] the DCM must delegate his authority to his staff. The DCM's staff is split up into three main parts: MANAGEMENT SUPPORT, MAINTENANCE CONTROL, and QUALITY ASSURANCE (see figure 1). Each of the main parts are then split up by their functions. Management Support has four functions: Administration. Production Analysis, Training management, and Programs and Mobility. The management support functions are set up to do their duties in the maintenance complex which do NOT relate to the direct control of maintenance production, so we will keep our attention on the other two parts: Maintenance Control and Quality Assurance. These two parts monitor and control all flightline maintenance shops.

Answer the following questions:

1. What are the three main departments in the DCM's staff?

   a.

   b.

   c.

2. Management Support performs duties that are __________ specifically related to the direct control of __________ production.

Answers to Frame 4 (Section 1):

1. a. Management Support, b. Maintenance Control, c. Quality Assurance
2. Management Support performs duties that are NOT specifically related to the directed control of maintenance production.

Frame 4 (Cont'd)

MAINTENANCE CONTROL

Section 2

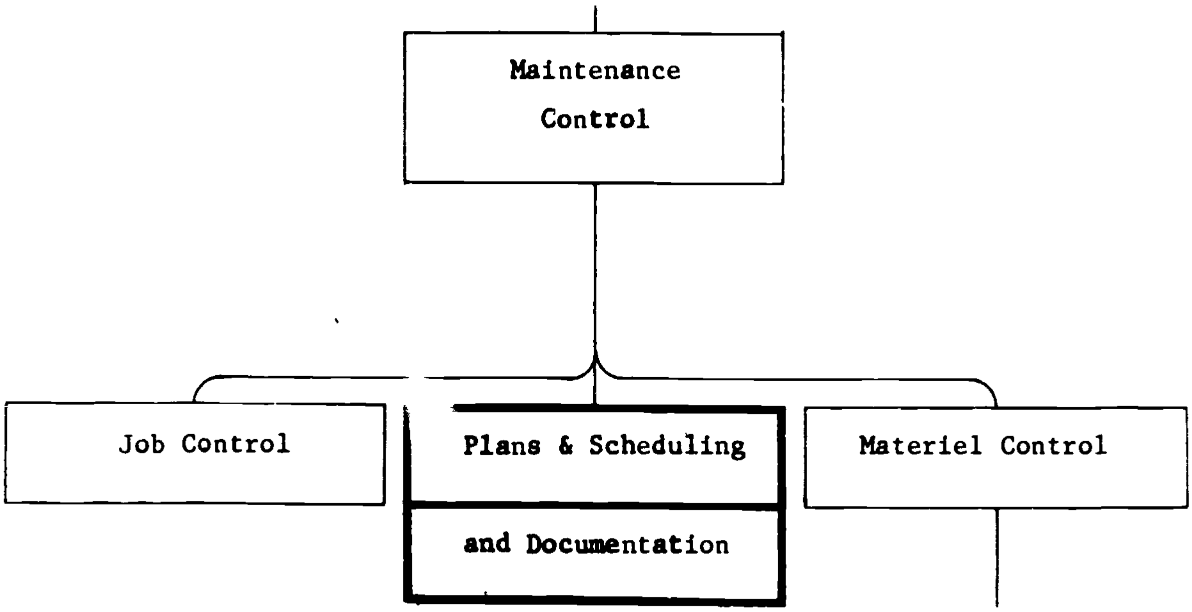

Figure 2. Functions of Maintenance Control.

Maintenance control is responsible for scheduling and directing all work on the aircraft and support equipment. This is a big job when you think about what it takes to keep the aircraft in the air. The job is so big that Maintenance control is split up into three functional parts. These parts are JOB CONTROL, PLANS & SCHEDULING, and DOCUMENTATION, and MATERIEL CONTROL (see figure 2). These threc parts fulfill the responsibilities of Maintenance Control and will do the following:

1. Schedule the aircraft and aircrew to be used.
2. Set up the maintenance resources in support of the unit requirements.
3. Tell what will be worked on first. second, third, etc.
4. Help maintenance personnel in resolving the unit problems.
5. Have unit records for aircraft and other designated unit equipment.
6. Helps the DCM long term plans.

Place an "X" by the Maintenance control duty.

____ 1. Sets up all maintenance resources.

____ 2. Tell what will be worked on by priority (first, second, third, etc).

____ 3. Ensures quality maintenance.

Answers to Frame 4 (Section 2): X 1. X 2. ___ 3.

Frame 4 (Cont'd)

QUALITY ASSURANCE

Section 3

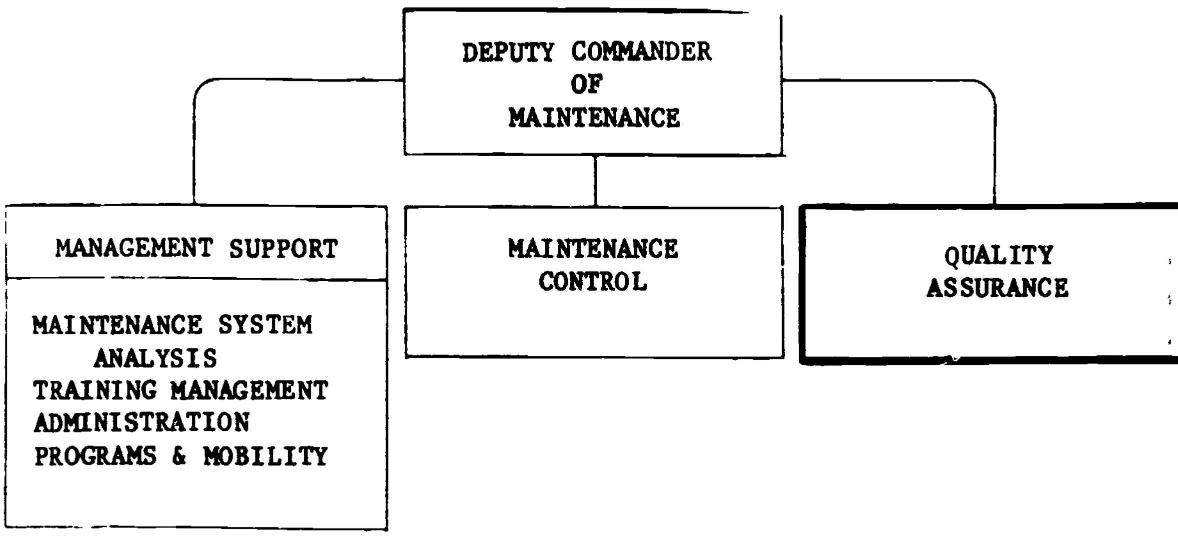

Figure 3. Quality Assurance, Third Staff Department of DCM.

Part of the DCM staff is Quality Assurance (QA) (see figure 3). As you may have guessed, the main job of QA is to make sure that the work done on the aircraft and the equipment is of a high quality. This means you do your best. The best way and only way to do a job is by the tech order. QA will make spot checks on the flightline and shops to make sure the TOs are being used by all maintenance personnel. If you have any questions on the information in the TOs, QA is the place to start. If there is any place in the TO that is in error, QA will look at those areas with you and help you fill out the right forms to fix the error. They also take care of a central Tech Order Library. So, if your shop does not have the TO you need, see your QC section; they should have it.

Place a QA by the functions of Quality Assurance in the following list.

____ 1. Manages all maintenance resources.

____ 2. Ensures quality maintenance.

____ 3. Monitors TO changes that are suggested.

____ 4. Ensures technical orders are followed.

____ 5. Monitors training programs.

Answers to Frame 4 (Section 3): ____ 1. QA 2. QA 3. QA 4. ____ 5.

Frame 4 (Cont'd)

MANAGEMENT SUPPORT FUNCTIONS

Section 4

The Management Support Functions are set up for duties in the unit complex which are not related to the direct control of work production. These jobs are administration, maintenance systems analysis, training management, and programs and mobility. All these jobs must be done in the best way to support the unit's work load. The management support will help by doing the following:

1. Every week, they will make a list of new, changed, or revised manuals and/or regulations.

2. Keep and file paperwork for the office of the DCM.

3. Make sure that all shops get their TOs and regulations.

4. Set up and prepare TDY orders for the DCM.

Place an "X" by the work of the Management Support.

____ 1. Files paperwork for the DCM.

____ 2. Sets up TDY orders.

____ 3. Ensures quality maintenance.

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Answers to Frame 4 (Section 4): _X_ 1. _X_ 2. ____ 3.

Frame 5

PROCESSING AND CONTROLLING MATERIAL

Section 1

General Information

The main section of maintenance management responsible for processing and controlling material is called Materiel Control. Their job is to coordinate between the work place and supply, manage supply transactions for the work place, and to manage the production of assets in the repair cycle. The efforts of Materiel Control must be continually directed toward maintenance support.

Place an "X" by the functions of Materiel Control.

____ 1. Establishment of files and the proper disposition of documents.

____ 2. Provide coordination between maintenance and supply.

____ 3. Manage supply transactions for the maintenance complex.

____ 4. Reviewing TCTOs for their applicability to unit maintained equipment.

____ 5. Manage the production of assets in the repair cycle.

Section 2

Controlling Material

The responsibilities of Materiel Control are split up into two parts: maintenance supply liaison and production control. Maintenance supply liaison manages supply actions and helps the maintenance personnel in resolving problems with supply. Their responsibilities are to include:

1. Advising affected personnel of the overall supply situation as it affects the work being done.

2. To set up a system for effectively programming parts, tools, and equipment requirements for maintenance.

3. To make sure that maintenance personnel are aware of procedures for the automatic issue of items that can be interchanged.

Answers to Frame 5 (Section 1): ____ 1. X 2. X 3. ____ 4. X 5.

Frame 5 (Section 2 Cont'd)

Processing Material

Production Control monitors and controls the flow of parts that can be repaired. They do this by using the Reparable Processing Center (RPC). When you take a part off of the aircraft, it is turned in to RPC. They will schedule the part to the shop to be fixed. After the part is fixed, it will be brought back to RPC where it will be put back in to the supply system. Their responsibilites include:

1. Making sure that planned shop production output is accomplished.

2. Making sure that items that require build-up or functional check prior to issue are processed in a timely manner.

3. Turns in serviceable, condemned, and not reparable this station (NRTS) parts from shops to supply.

4. Manages the production scheduling program.

5. Manages the local manufacture of special tools.

6. Operates storage areas for assets in awaiting maintenance (AWM) status.

1. Place an "X" by the two sections of Materiel Control.

____ a. Quality Control

____ b. Production Control

____ c. Production Analysis

____ d. Maintenance Supply Liaison

2. Place "MSL" by the statement concerning the maintenance supply liaison. Place "PC" by those concerning production control.

____ a. Monitors and controls the flow of reparable components.

____ b. Manages supply actions.

____ c. Resolves supply problems.

____ d Schedules reparable items to the shops.

____ e. Makes sure maintenance personnel are aware of procedures for the automatic issue of interchangeable items.

____ f. Insures that planned shop production output is accomplished.

____ g. Manages the local manufacture of approved items.

Answer to Frame 5 (Section 2): 1. ____ a. X b. ____ c. X d.
2. PC a. MSL b. MSL c. PC d.
MSL e. PC f. PC g.

Frame 6

CROSS UTILIZATION TRAINING (CUT)

CUT is the training necessary to provide an individual with the ability to perform, with little or no supervision, selected tasks that are not part of his or her primary AFSC. This is made up of practical training and may also include training conducted by the Field Training Detachment (FTD). Supervisors determine who needs to get CUT as well as identify the tasks to be taught in CUT. As a result of CUT. the turboprop mechanic becomes a "Jack or Jackie of all trades." The properly trained turboprop mechanic can help the crew chief change a tire, tow, fuel and launch the plane as well as "remove and replace" units of a related system. As we mentioned earlier. the specialists with like AFSCs are assigned to more than one squadron. This on-equipment work was formerly done by specialists who were dispatched from the shops and worked only within their specialties.

The turboprop mechanics, of course, continue to provide maintenance in their areas of expertise, but the unproductive time lost in dispatching has been done away with.

Place an "X" by the information that pertains to CUT.

____ 1. A turboprop mechanic can help a crew chief change an aircraft tire.

____ The supervisor determines who needs to receive CUT.

____ 3. FTD can't conduct CUT.

____ 4. The specialists with like AFSCs are assigned to more than one squadron.

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841175.BPT.1m

SQUADRON MAINTENANCE

Section 1

The following is a list of the common duties and responsibilities of the aircraft maintenance squadrons not under the Production Oriented Maintenance Organizations (POMO). AFR 66-1.

a. Organization Maintenance Squadron (OMS). This activity does on-equipment work that is in the capability of their personnel, equipment, and facilities. It does on-equipment work on assigned and transient aircraft and provides alert force and mobility capabilities as required. It is normally made up of:

(1) Staff Element and Alert Force Branch

(2) Transient Branch

(3) Flight Line Branch

(4) Inspection Branch

(5) Support Equipment Branch

Answer the following statements True or False.

____ 1. OMS does on-equipment maintenance beyond the capabilities of assigned personnel.

____ 2. OMS provides alert force capabilities as required.

____ 3. OMS does on-equipment maintenance through its Transient and Flight Line Branch.

841175.BPT.lm

Answers to Frame 7 (Section 1a): __F__ 1. __T__ 2. __T__ 3.

Frame 7 (Cont'd)

b. Field Maintenance Squadron (FMS). This activity does off-equipment ork in the capability of specialists, equipment, and facilities, and also does on-equipment work beyond the capabili~y of other assigned maintenance activities. It is normally made up of:

(1) Staff Element

(2) Fabrication Branch

(3) Propulsion Branch

(4) Aerospace Syctems Branch

(5) Aerospace Ground Equipment (AGE) Branch

Answer the following statements True or False.

____ 1. FMS does off- and on-eouiment maintenance.

____ 2. FMS performs on-equipment maintenance beyond the capabili~y of others.

____ 3. Th^ DCM Branch is part of FMS.

841175.BPT.1m

Answers to Frame 7 (Section 1b): T 1. T 2. F 3.

Frame 7 (Cont'd)

c. Avionics Maintenance Squadron (AMS). This activity does work on avionics systems and associated equipment in the capability of their specialists, equipment and facilities. It is normally made up of:

(1) S aff Element and Communications-Navigation Branch.

(2) Mission Systems Branch.

(3) Automatic Flight Control-Instrument Branch

(4) Precision Measuring Equipment Lab (PMEL) Branch

(5) Integrated Avionics Flight Line Maintenance Branch

Answer the following statements True or False.

____ 1. AMS performs maintenance on communications-navigation equipment.

____ 2. AMS takes care of the AGE lab.

____ 3. PMEL is part of AMS.

Answers to Frame 7 (Section 1c): __T__ 1. __F__ 2. __T__ 3.

Frame 7 (Cont'd)

d. Munitions Maintenance Squadron (MMS). This activity does loading of munitions works on conventional and nuclear munitions, guns, missiles, weapons s ion and release systems, and associated equipment. It is normally made up of:

(1) Staff Element and Munitions Services

(2) Maintenance and Storage

(3) Equipment Maintenance

(4) Explosive Ordnance Disposal (EOD)

Answer the following statements True or False.

____ 1. MMS loads conventional and nuclear weapons.

____ 2. MMS is normally made up of Staff Element and Alert Force Branch.

____ 3. MMS maintains aircraft weapons suspension and release systems.

Answers to Frame 7 (Section 1d): T 1. F 2. T 3.

Section 2

The following is a list of the common duties and responsibilities of the aircraft maintenance squadrons under the Production Oriented Maintenance Organization (POMO). AFR 66-5.

a. Aircraft Generation Squadron (AGS). The people that are assigned to the AGS will perform on-equipment work on the assigned aircraft. It is normally made up of:

(1) Aircraft Maintenance Unit

(2) Alert Branch

Answer the following statements True or False.

____ 1. AGS works on assigned aircraft.

____ 2. AGS is normally made up of Aircraft Maintenance Unit and Alert Branch.

Answers to Frame 7 (Section 2a): __T__ 1. __T__ 2.

Frame 7 (Cont'd)

b. Component Repair Squadron (CRS). The CRS does off-equipment work of aircraft and the support equipment. It is normally made up of:

(1) Accessory Maintenance Branch

(2) Propulsion Branch

(3) Conventional Avionics Branch

(4) Integrated Avionics Branch

(5) Aircrew Training Devices Branch

(6) Test, Measurement and Diagnostic Equipment Branch

Answer the following statements True or False.

____ 1. CRS works on on-equipment.

____ 2. CRS has a Propulsion Branch.

841175.BPT.lm

Answers to Frame 7 (Section 2b): __T__ 1. __T__ 2.

Frame 8

MAINTENANCE DATA COLLECTION

a. Information concerning maintenance actions must be recorded on "something." We must also have a way of collecting this information. Two forms that have been made for recording maintenance information are the AFTO Forms 349 and 350. The system to collect this information and deliver it to statistical services is known as the data collection system. We want to introduce the AFTO Forms 349 and 350 here, because they are also a kind of management tool.

Fill in the blank spaces for question 1.

1. What two forms have been developed for recording maintenance information? ______________ and ______________

241

841175.BPT.1m

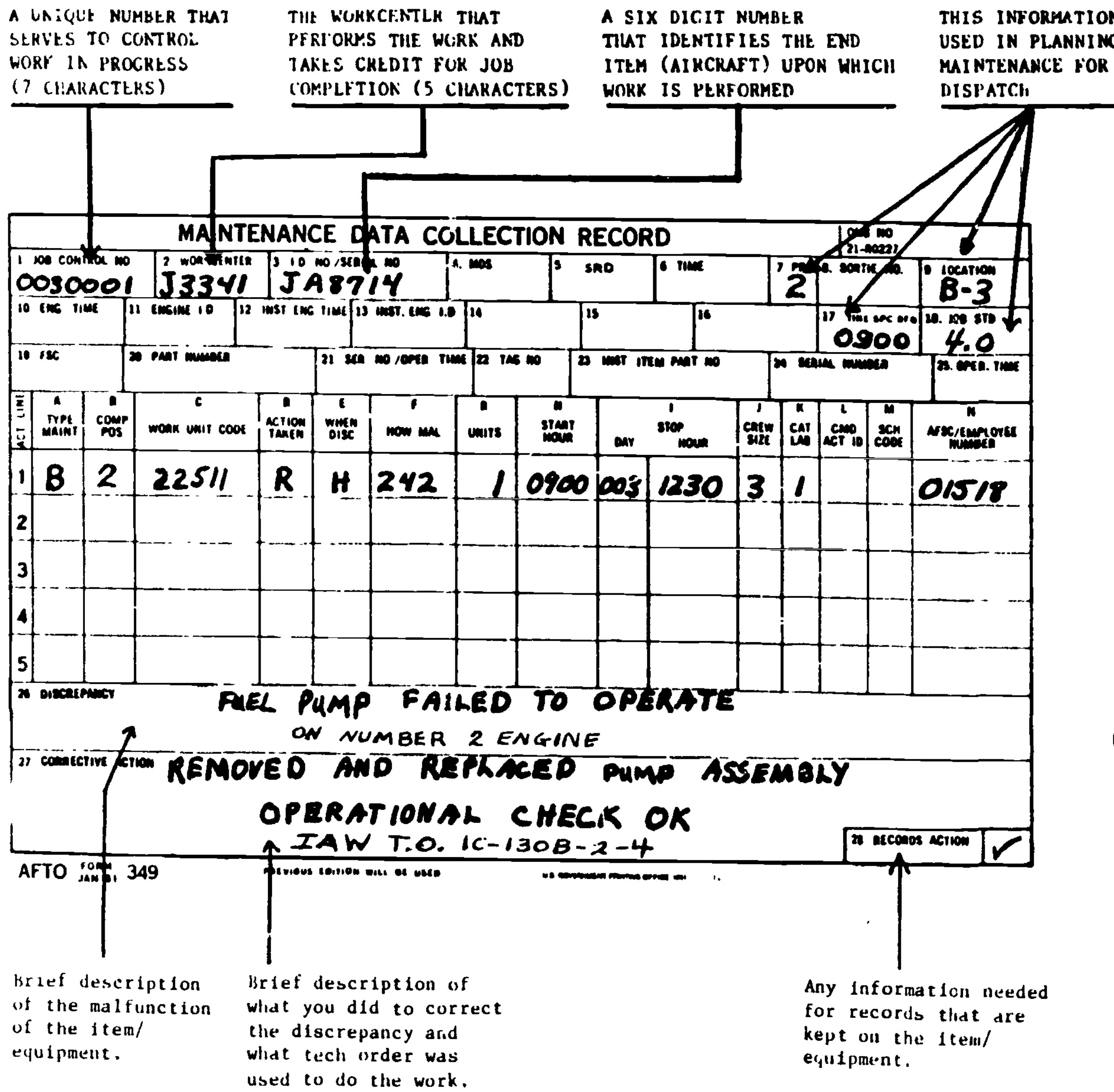


Figure 4. AFTO Form 349.

242

841175.BPT.1m

Answers to Frame 8a: AFTO Form 349 and AFTO Form 350

Frame 8 (Cont'd)

AFTO FORM 349

b. Figure 4 shows a sample AFTO Form 349. As you can see, the form has a lot of numbered blocks, some of which are split up into a number of small parts. The 00-20-2 tech orders have the detailed instructions as to which blocks must be filled in for any maintenance performed.

The AFTO Form 349 is used as a dispatch form and as a maintenance form. When the AFTO Form 349 is completed, it is turned in to statistical services. Here, along with lots of other 349s, it is a very important source of information for maintenance management. The mechanic may start the 349 to record actions taken, or he may be dispatched with a partially filled out 349 to do a job or task. In this case, he will complete the 349 by entering the necessary data for the job he has done.

In figure 4, codes shown in columns A and C through F have been taken from the -06 Work Unit Code Manual for the C-130 aircraft. These codes convert verbal descriptions of maintenance performed into computerized language which lends itself to the machine accounting system used in the maintenance data collection system.

Notice the code shown in column C (22511). This describes the number 2 engine fuel pump of the C-130 aircraft. The code (242) shown in column F translates to the verbal description of "Failed to Operate," thus columns F and C state that the number 2 engine fuel pump failed to operate.

Fill in the blank spaces for the following statements.

1. What are the two uses of the AFTO Form 349? ____________________

____

2. Blocks 7, 9, 17, and 18 are only used for ____________________.

3. Column C describes the ______________ of the ______________ aircraft.

841175.BPT.1m

FRONT SIDE

AFTO FORM 350 AUG 78
PREVIOUS EDITION WILL BE USED

BUDGET BUREAU
NO 21-R0227

REPARABLE ITEM PROCESSING TAG

1 JOB CONTROL NO	2 ID/SERIAL NO	3 TM	3A SRD	4 WHEN DISC
0030001	JA8714	B	AMH	H

5 HOW MAL	6 MDS	7 WORK UNIT CODE	8 ITEM OPER TIME	9 QTY
242		22511		1

10 FSC	11 PART NUMBER
2995	6827283

12 SERIAL NUMBER	13 SUPPLY DOCUMENT NUMBER
37544	

14 DISCREPANCY

#2 eng fuel pump failed to operate

15 SHOP USE ONLY

15A CMD/ACT ID	15B SHOP ACTION TAKEN

TAG NO 622271 AFTO 350 PT I

16 SUPPLY DOCUMENT NUMBER

17 NOMENCLATURE
fuel pump

18 PART NUMBER
6827283

19 NSN
2995-00-803-4268

20. ACTION TAKEN	21 QTY	22 RPC USE ONLY

TAG NO 622271 AFTO 350 PT II

BACK SIDE

☆U S GOVERNMENT PRINTING OFFICE 1978-760-470

WARNING
Unauthorized persons removing, defacing, or destroying this tag (or label) may be subject to a fine of not more than $1,000 or imprisonment for not more than one year or both (18 USC 1 36 1)

REPAIR CYCLE DATA

23. NSN	24. SRAN CODE
25. TRANSPORTATION CONTROL NUMBER	

STATUS CHANGED TO

26. SERVICEABLE

27. CONDEMNED

28. SUPPLY INSPECTOR'S STAMP

29 BASE REPAIR CYCLE DATA		MO	DAY	YR	TIME
DATE REMOVED 01/03/9	REC'D BY RPC				AWM
TO:					
TO:					AWP
TO					
TO:					
TO:					
DATE COMPLETED					

Figure 5. AFTO Form 350.

Answers to Frame 8b: 1. dispatch and maintenance form, 2. dispatch, 3. #2 fuel pump, C-130

Frame 8 (Cont'd)

AFTO FORM 350

c. Figure 5 shows an AFTO Form 350. This form is the reparable tag for on- and off-base processing. The AFTO Form 350 is a two-part form. Part 1 is the processing document, and part 2 is for reparable processing center (RPC). Use of this tag is essential. It makes sure that the status of reparable parts is always identified and provides a source document for information required in completing other maintenance data documents. This form also provides a means of controlling parts flowing to and from shops. In practice, the 349 and 350 forms are often used together.

Circle the correct answers for question 1.

1. Which of the following are uses of the AFTO Form 350?

a. Ensure status of reparable items is always identified.

b. Record time spent doing maintenance.

c. Provides a source document for information required in completing other maintenance data documents.

d. Controls items flowing to and from maintenance shops.

Answers to Frame 8c: 1. a, c, d
Frame 8 (Cont'd)

d. If a reparable part is taken off of an aircraft, the mechanic would initiate both an AFTO Form 349 and 350. The 349 would be used to document the action taken and time used. The 350 would be started and attached to the part to expedite and control the part through the repair cycle and back into the normal supply channels.

All entries on these forms with the exception of personal signatures will be typed or printed. Signatures may be typed or printed if copied by an individual other than the signer. The handscribed entries should be made in black pencil, unless otherwise specified, to ensure neatness and to permit correction of minor errors.

For the time being, you should consider the 349 and 350 as management tools used to increase the efficiency of the maintenance organization.

NO RESPONSE REQUIRED

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WB-106A
2 November 1983

AIRCRAFT MAINTENANCE CONCEPT

OBJECTIVE

Given the aircraft work unit code manual, 00-20- series TOs, AFTO Forms 349, 350 and 781A, document maintenance actions with no more than four errors on each form.

EQUIPMENT

	Basis of Issue
TO 1C-130A-06	1/student

PROCEDURE

Use the aircraft work unit code manual to locate codes for the word descriptions below and record them on this sheet. By doing this, it will help you to meet the objective.

WORD DESCRIPTIONS	CODE
1. Action Taken Codes	
a. Equipment checked-no repair required	________
b. Clean	________
c. Remove and Replace	________
d. Inspect	________
e. Repair and/or replacement of minor parts	________
f. Bench checked NRTS-lack of parts	________
2. When Discovered codes	
a. Special inspection	________
b. Engine test start operation	________
c. In-shop repair	________
d. Phased inspection	________
e. During disassembly for maintenance	________
f. During unscheduled calibration	________

Supersedes C3ABR42633-WB-106C, 9 November 1982. RGL: N/A
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 350; DAV - 1

3. How Malfunctioned codes

   a. Stripped ________
   b. Loose ________
   c. Cracked ________
   d. Leaking internal ________
   e. No defect-technical order compliance ________
   f. Bent ________
   g. Foreign object damage ________
   h. Burned ________
   i. Missing nut ________
   j. Broken safety wire ________

4. Support General Codes

   a. Serving of oil into turboprop engines ________
   b. Preservation, depreservation, and storage ________
   c. Engine buildup or teardown ________

5. Unique Data Codes (indirect labor)

   a. Leave ________
   b. Maintenance training ________
   c. Alert duty ________

6. Work Unit Codes (engine)

   a. Igniter plug ________
   b. Starter (Bendix) ________
   c. External scavenge pump ________
   d. Fuel control ________

7. Work Unit Codes (prop)

   a. Low pitch stop assembly ________
   b. Pitch lock regulator ________
   c. Spinner, center and rear ________
   d. Feedback shaft ________

8. What does TCI stand for? ________________________________

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WB-107A
11 January 1984

ENGINE SYSTEMS LOCATION

OBJECTIVES

After completing your classroom instructions and this workbook, you will be able to:

1. Identify facts about the arrangement of the starter system.

2. Identify facts about the arrangement of the ignition system.

3. Identify facts about the arrangement of the oil system.

4. Identify facts relating to the arrangement of the fuel system.

5. Identify facts relating to the arrangement of the bleed air system.

6. Identify facts relating to the arrangement of the anti-icing system.

7. Identify facts relating to the arrangement of the fire warning system.

8. Identify facts relating to the arrangement of the overheat warning system.

9. Identify facts relating to the arrangement of the negative torque signal system.

10. Identify facts relating to the arrangement of the engine indicating system.

PROCEDURE

Using the information presented in the classroom presentation and study guide, fill in the spaces provided with the correct information.

Supersedes C3ABR42633-WB-107, 7 October 1982
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 100; DAV - 1

SECTION I. STARTER SYSTEM

1. The four (4) engine ground start switches are located on what panel? ______________ ______________ panel.

2. On what side of the nacelle in the bleed air duct is the starter control valve located? ______________ ______________

______________ ______________.

3. The pneumatic starter is located where on the reduction gearbox?

______________ ______________ ______________

SECTION II. IGNITION SYSTEM

1. The speed sensitive control is located where on the accessory drive housing? ______________ ______________ ______________.

2. Where on the compressor casing is the ignition relay located?

______________ ______________ ______________ side.

3. The ignition exciter is located on what hand portion of the compressor casing? ______________ ______________

SECTION III. OIL SYSTEM

1. Where on the oil tank is the sump located? ______________

2. On what portion of the engine nacelle is the oil cooler located?

______________ ______________

3. What item is mounted to the oil cooler flap, inside the engine nacelle (QEC) kit? ______________ ______________ ______________

______________.

SECTION IV. FUEL SYSTEM

1. Where on the accessory drive housing is the fuel control located?

______________ ______________ ______________ ______________.

2. The fuel manifold is located around what section? ____________

____.

3. The burner drain valves are mounted to the bottom of what item?

____.

SECTION V. BLEED AIR SYSTEM

1. At what clock positions are the compressor bleed valves at the 5th and 10th stage located? ________, ________, ____________, ________.

2. On what case are the two sheet metal collector ducts located?

____

3. Flex lines interconnect the speed sensitive valve to the outboard side of what item? ______________________

SECTION VI. ANTI-ICING

1. On what panel are the engine inlet air duct anti-icing switches located? ____________ - ______________________________________.

2. At what clock position is the anti-icing solenoid valve mounted?

____

3. What is the torquemeter anti-icing shroud mounted around?

____.

SECTION VII. FIRE WARNING SYSTEM

1. What is the fire emergency control panel mounted on? ________

____

2. The agent discharge switch is located on what panel? ________

____

3. What two items is the loop detector located throughout?

______________________, ____.

SECTION VIII. OVERHEAT WARNING SYSTEM.

1. What panel on the overhead control panel is the turbine overheat detector test switch located? _______________

2. Where is the nacelle overheat control panel located?

____

3. Where is the nacelle overheat test switch located? _______________

____

SECTION IX. NEGATIVE TORQUE SIGNAL SYSTEM

1. In what case is the ring gear mounted in of the reduction gearbox? _______________

2. What is the pad called on the upper right front case of the RGB, that the negative torque signal bracket is mounted to? _______________

____

3. Where is the negative torque signal system light located at?

____

SECTION X. ENGINE INDICATING SYSTEM

1. The tachometer indicator is located on what panel?

____

2. Where are the fuel low pressure warning lights located?

____

3. On which side of the oil tank is the float-type oil quantity tank unit located? _______________

252

SERVICE TEST
PROGRAMMED TEXT

C3ABR42633-PT-108

Technical Training

Turboprop Propulsion Mechanic

AF SUPPLY DISCIPLINE

26 March 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

Designed for ATC Course Use.

Do Not Use on the Job. RGL: 10.3

VALIDATION

This programmed text is designed for students in the C3ABR42633, Turboprop Propulsion Mechanic course. Tryout of this programmed text and technical information was conducted using students with no prior exposure to this material. At least _____ % of the _______ students used to validate the material surpassed the standards specified in the objectives. The average time required to complete this programmed text is _____ hours and _____ minutes.

OBJECTIVES

Having completed this programmed text and without the aid of any references, you will be able to identify facts pertaining/relating to the:

- Maintenance Supply Concept
- Use of Tags
- Use of Issue Slips
- Use of Turn-in Slips
- Property Accountability
- Supply Responsibility

The standard for these objectives is the students will identify facts, two out of three times for each objective.

INSTRUCTIONS

This program presents information in small steps called "FRAMES." After reading the information in each frame, you are asked to actively respond in this booklet. Check the accuracy of your response. The correct response is at the end of the following frame. If you made an incorrect response, study the frame again before going on to the next frame. Work as fast as you possibly can, but DO NOT HURRY.

OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 100; DAV - 1

Frame 1

Public law 9832 states that "all property owned by the US Government and under the control of the US Air Force must be properly recorded." The property actually belongs to you as a taxpayer. You can use it, but you must protect it. If property is destroyed or lost, you can be held liable.

NO RESPONSE REQUIRED

MAINTENANCE SUPPLY CONCEPT

Frame 2

It is everyone's responsibility to practice the maintenance supply concept. It is enforced to insure that all equipment is available for use when needed. The four following principles must be observed and practiced by everyone in the Air Force:

1. Make maximum use of available equipment and supplies for their intended use.

2. Safeguard and preserve all Air Force property.

3. Comply with the existing regulations that specify how to control and manage supplies and equipment.

4. Continually screen the supplies and equipment on hand, and promptly turn in those items not being used or required.

Maintenance supply concept is nothing more than management of supplies and equipment for efficient operation and mission completion. If you use an Air Force vehicle for your private convenience, you may be preventing someone from completing his mission. Most Air Force maintenance activities have strict directives against having extra parts, and this includes nuts and bolts in your toolbox. The parts that you like to keep may prevent others from doing their jobs.

Check (√) each of the following statements which apply to the maintenance supply concept.

_____ a. Make maximum use of available equipment and supplies for their intended purposes.

_____ b. Safeguard and preserve all Air Force property.

_____ c. Use government equipment for your own private use.

_____ d. Comply with existing regulations which specify how to control and manage supplies and equipment.

_____ e. Continually screen supplies and equipment on hand, and promptly turn in those items not being used or required.

Answer to Frame 1: No Response Required

Frame 3

Maintenance supply concept is essential to successful materiel management and applies to both maintenance and supply personnel. Maintenance personnel must clearly understand that:

1. A reparable item is as important as a serviceable item, since the reparable may represent the only source of supply. Reparable components removed from the end item must be processed into repair channels promptly and controlled throughout the repair cycle. Documentation for all reparable or serviceable items entering or leaving a maintenance shop must be processed through the appropriate production control scheduler.

2. Double ordering wastes funds, reduces credibility, and must not be condoned. When double ordering is discovered, immediate action must be taken to cancel the erroneous request.

3. A valid delivery priority must be assigned to each demand placed upon the supply system. The delivery priority is normally identical to the maintenance repair priority of the equipment for which the part is needed. All levels of supervision share the responsibility for maintaining an effective and credible priority system.

Check (✓) each of the following statements that apply to the maintenance supply concept.

_____ a. Reparable components removed from the aircraft or engine must be processed into repair channels.

_____ b. When double ordering is discovered, no immediate action is to be taken.

_____ c. The delivery priority is normally identical to the maintenance repair priority of the equipment for which the part is needed.

Answers to Frame 2: _✓_ a. _✓_ b. ____ c _✓_ d. _✓_ e.

Frame 4

Status tags and labels must accompany packaged supply property and are used to identify the package contents. They (tags and labels) are also used to indicate at a glance (from their colors, titles and numbers) the condition of items. These tags and labels are Department of Defense (DD) Forms. Tags are normally found on the inside of a packaged item, whereas labels (gummed-back) are normally pasted to the outside of the container.

Check (√) the true statements below:

_____ a. Status tags and labels are AF Forms.

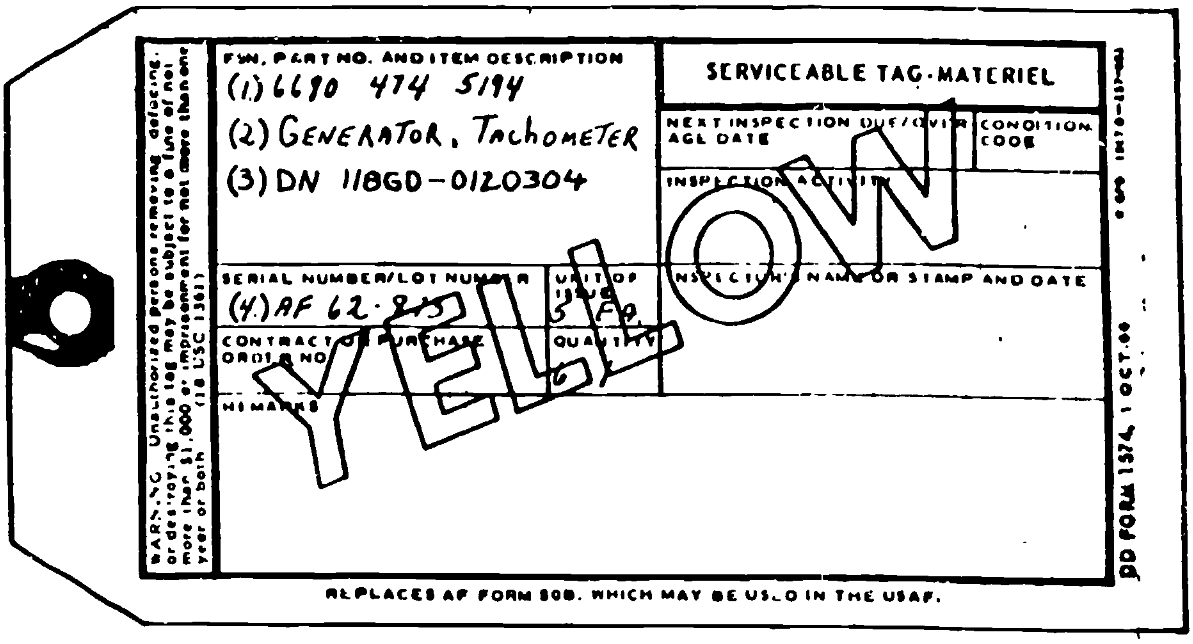
_____ b. Attached to equipment, status tags and labels identify and indicate the condition of the equipment.

_____ c. Tags are normally found on the outside of a package and have gummed backs.

Answers to Frame 3: __√__ a. _____ b. __√__ c.

Frame 5

The different status tags and labels are covered in AFM 67-1. Filling out these tags, as you will see, is self-explanatory and in most instances (see tag below) information for (1), (2), (3) and (4) is found on the equipment's "name plate."



The DD Form 1574, Serviceable Tag (yellow in color), is used when an item is serviceable (ready to use). All packaged supply items should have this tag, and in most instances, it will be inside the package tied to the item.

Check (√) the true statements below:

_____ a. AFM 67-1 gives information on status tags and labels.

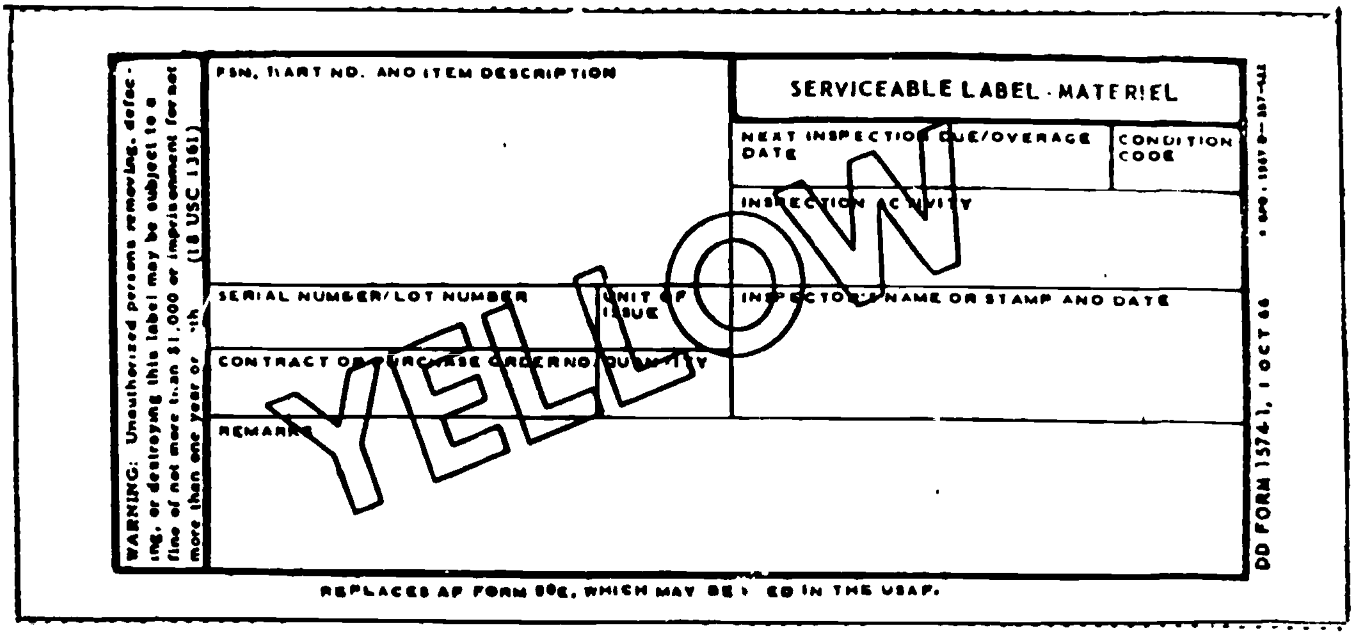
_____ b. DD Form 1574 is a label.

_____ c. No information is taken from the equipment when filling out the tags or labels.

Answers to Frame 4: _____ a. __√__ b. _____ c.

Frame 6

The DD Form 1574-1, Serviceable Label, yellow in color, is used the same as DD Form 1574 except, in most instances, it is placed on the outside of the package. The tag and label are the same except the label has a gummed back and is applied to the outer surface of the container.



Check (✓) the true statements below:

_____ a. The DD Form 1574-1 will likely be found inside the package.

_____ b. The DD Form 1574-1 attached to equipment indicates that the equipment can be used.

_____ c. The difference between the serviceable tag and label is the label has a gummed back.

Answers to Frame 5: __✓__ a. _____ b. _____ c.

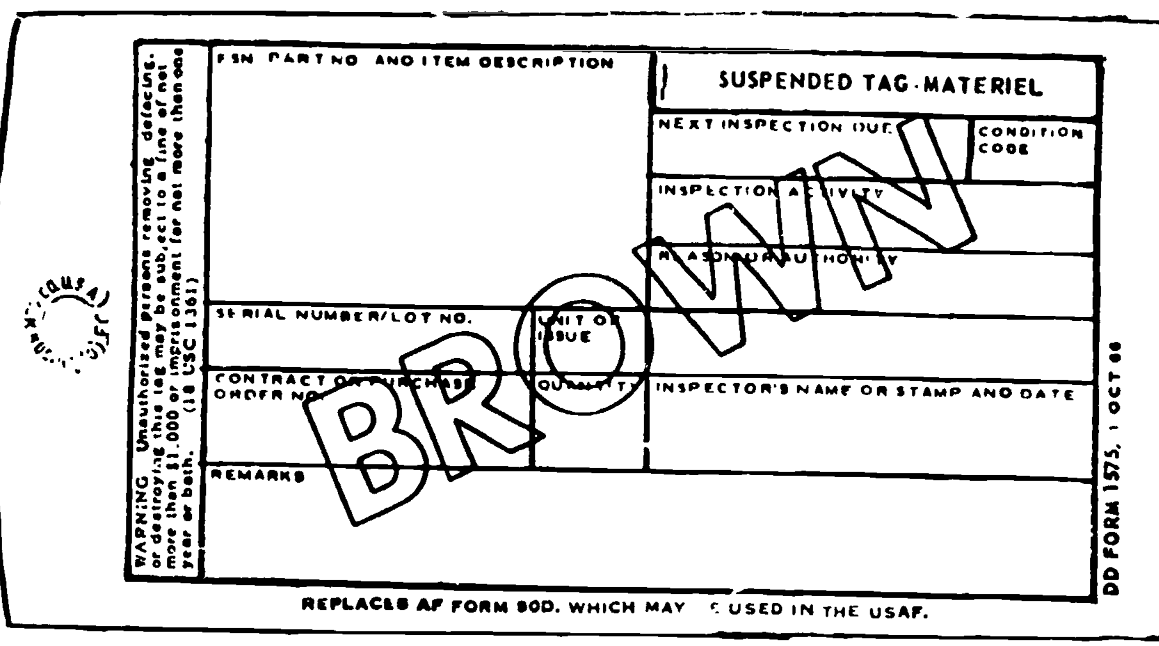
Frame 7

DD Form 1575, Suspended Tag, brown in color, is used when work on reparable parts or items cannot be accomplished due to the following:

1. Awaiting Maintenance (AWM): Due to higher priority items being needed, lack of personnel, test equipment being repaired, there may be a delay before bench check and repair can be accomplished.

2. Awaiting Parts (AWP): After bench checking has been accomplished and the defective part has been determined, it must be ordered. During the time the part is ordered and the time it arrives, work has stopped on the item.

Note: If a long delay is expected (30 days or more) for either AWM or AWP the item may be returned to depot (factory or repair center) for repair.


WARNING Unauthorized persons removing, defacing, or destroying this tag may be subject to a fine of not more than $1,000 or imprisonment for not more than one year or both. (18 USC 1361)

FSN PART NO AND ITEM DESCRIPTION

SUSPENDED TAG-MATERIEL

NEXT INSPECTION DUE | CONDITION CODE

INSPECTION ACTIVITY

REASON OR AUTHORITY

SERIAL NUMBER/LOT NO. | UNIT OF ISSUE

CONTRACT OR PURCHASE ORDER NO. | QUANTITY | INSPECTOR'S NAME OR STAMP AND DATE

REMARKS

BROWN

DD FORM 1575, 1 OCT 66

REPLACES AF FORM 80D, WHICH MAY BE USED IN THE USAF.

Check (√) the true statements below:

_____ a. A DD Form 1575 will not be used when there is continuous work on a reparable item.

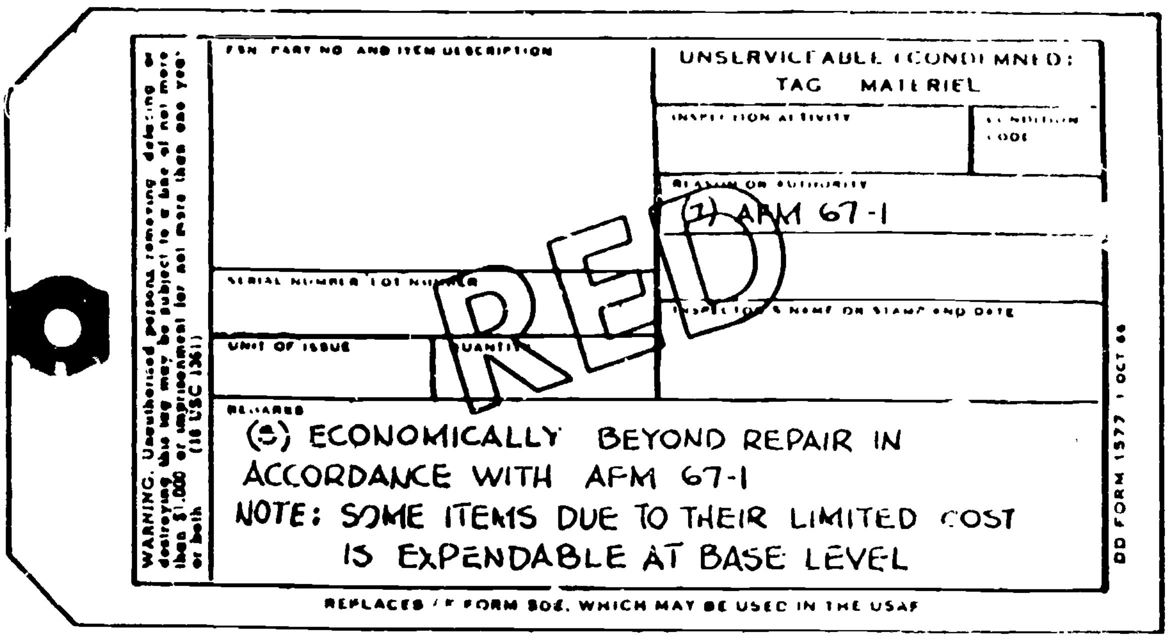
_____ b. Awaiting maintenance or awaiting parts are reasons for using the suspended tag.

_____ c. DD Form 1575 is brown in color.

Answers to Frame 6: _____ a. _____ b. __√__ c.

Frame 8

DD Form 1577, Unserviceable (Condemned) Tag, red in color, is used when an item is unserviceable and has been condemned. Notice (7) and (8) listings on the tag below. Condemned items are not returned to depot for repair, but end up at "Distribution and Marketing" and sold as unwanted AF equipment. DD Form 1577-1 is the label (gummed back) counterpart of the tag, DD Form 1577. This label is not used often since condemned items are not normally ...ked for Distribution and Marketing.



Check (√) the true statements below:

_____ a. DD Form 1577 identifies items returning to depot for repair.

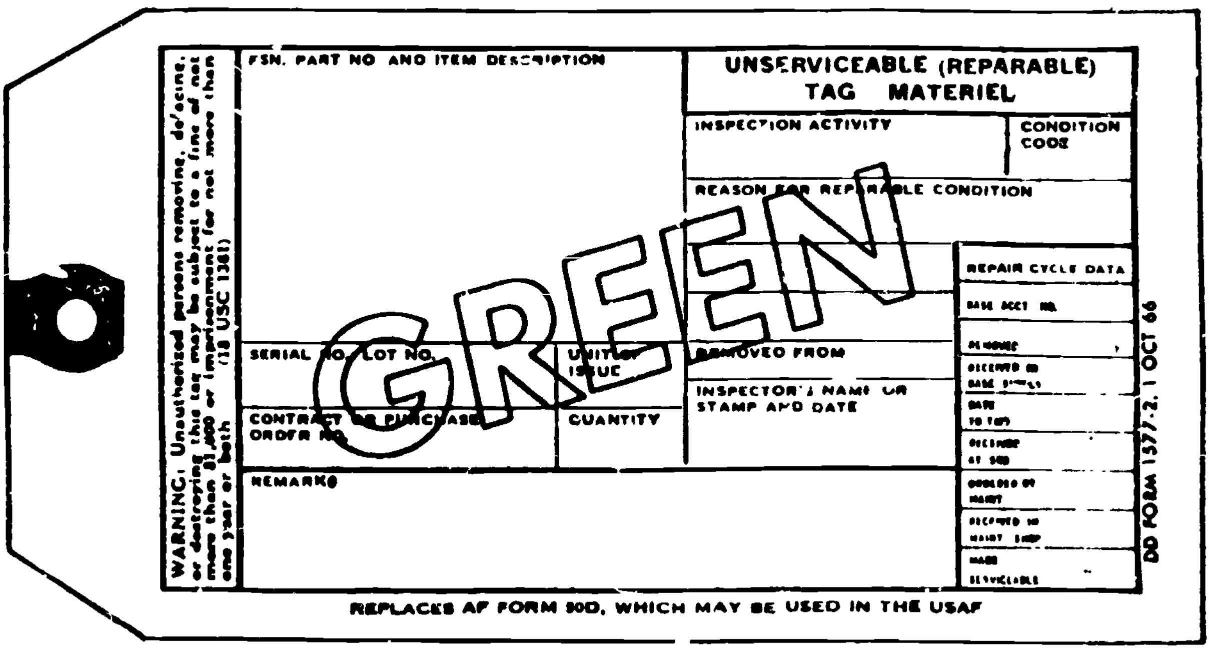
_____ b. Condemned items will have a DD Form 1577 attached.

_____ c. When sent to "Distribution and Marketing," condemned items will normally be packed.

Answers to Frame 7: √ a. √ b. √ c.

Frame 9

DD Form 1577-2, Unserviceable (Reparable) Tag, green in color, is used when an item is found to be defective, but can be repaired and made serviceable. DD Form 1577-3 is the label counterpart to the tag, DD Form 1577-2. The tag and label will be used especially when parts cannot be repaired on the base and must be shipped back to depot for repair. The tag and label are used the same as the other tags and label counterparts.


WARNING: Unauthorized persons removing, defacing, or destroying this tag may be subject to a fine of not more than $1,000 or imprisonment for not more than one year or both (18 USC 1361)

FSN, PART NO AND ITEM DESCRIPTION

UNSERVICEABLE (REPARABLE) TAG MATERIEL

INSPECTION ACTIVITY | CONDITION CODE

REASON FOR REPARABLE CONDITION

REPAIR CYCLE DATA

BASE ACCT NO.

SERIAL NO./LOT NO. | UNIT OF ISSUE

REMOVED FROM

INSPECTOR'S NAME OR STAMP AND DATE

CONTRACT OR PURCHASE ORDER NO. | QUANTITY

REMARKS

DD FORM 1577-2, 1 OCT 66

REPLACES AF FORM 500, WHICH MAY BE USED IN THE USAF

Check (✓) the true statements below:

_____ a. All reparables must be sent to depot for repair.

_____ b. The DD Form 1577-3 is green.

_____ c. The unserviceable (reparable) tag is green and it is a DD Form 1577-3.

_____ d. The DD Form 1577-2 would normally be found inside the packing container.

Answers to Frame 8: _____ a. __✓__ b. _____ c.

Match DD Form numbers to titles by placing the letter that represents the form number in the space provided to the left of each title.

A.	Title		DD Form Number
_____ 1.	Serviceable	a.	1577 (Red)
_____ 2.	Suspended	b.	1574 (Yellow)
_____ 3.	Unserviceable (Reparable)	c.	1577-2 (Green)
_____ 4.	Unserviceable (Condemned)	d.	1575 (Brown)

Match the titles of status tags to the status of equipment by placing the letter that represents the equipment status in the space left of each title:

B.	Title		Equipment Status
_____ 1.	Serviceable	a.	New equipment just received from supply.
_____ 2.	Suspended	b.	Economically beyond repair.
_____ 3.	Unserviceable (Reparable)	c.	Beyond shop repair capabilities and must be returned to Depot for repair
_____ 4.	Unserviceable (Condemned)	d.	Due to lack of parts, work cannot be completed.

Answers to Frame 9: _____ a. __✓__ b. _____ c. __✓__ d.

Frame 11

Expendable supplies may be requested by radio, telephone, intercom, teletype, mail, or in person. Requests are normally made on AF Form 2005. The method of submission is covered in AFR 67-23, chapter 3.

ISSUE/TURN-IN REQUEST

A INCHECKER NAME DATE (TIN)

B INSPECTOR, NAME-STAMP, DATE (TIN)

I 54 867 Routch J. TSgt Ø95Ø/2123

REQUESTER TIME & DATE (ISU)

STOCK NUMBER — NSC — NIIN — ADDN — UNIT OF ISSUE — QUANTITY

C For time change items date required)

DOCUMENT NUMBER — ACI — ORG — SHOP — DATE — SER NO.

1560ØØ1237654 EA ØØØØ1 X23ØP52123Ø05Y2

D PART NUMBER/MGFR CODE OR NAME/REMARKS

(Manufacturer's code or name if PN request)

E TO REFERENCE/TECHNICAL PUBLICATION OR END-ITEM APPLICATION/NEXT HIGHER ASSEMBLY

(For P/N requests)

WORK ORDER — SHIP TO — WS — PRO. CT — PRI — UJC — MARK FOR — DOCUMENT NUMBER — POST/POST

F TO PSC AND/OR ERRC

Ø1 Ø4 BQ781ØØ64AFT

G TIME & DATE OF DELIVERY — H DELIVERY TIME — J NOMENCLATURE

Propwash

AF FORM SEP 80 2005 PREVIOUS EDITION WILL BE USED.

Send issue requests to one of the following central points:

1. Demand Processing Unit (supplies).

   a. Expedite call-in point (delivery priorities 01-04).

   b. Routine call-in point (other than delivery priorities 01-04).

2. Bench Stock Support Unit.

3. Supply Point.

4. Allowance and Authorization (A&A) Section.

5. Individual Equipment Unit.

6. Base Service Store Unit.

AF Form 2005, is also used to show who ordered the part. Where the part is to be sent. The national stock number in blocks 8 thru 20 of this form can be used by supply for locating the part. Blocks 23 thru 29 show how many you need. Blocks 30 thru 44 is for your supply document number.

Blocks 60 and 61 are for the priority numbers. Blocks 65 thru 80 show what aircraft or engine the part is being ordered for. Block J is for the name of the part you have ordered.

Check (✓) the true statements below:

_____ a. AF Form 2005 is used to order parts.

_____ b. Issue slip is used to show when parts will break.

_____ c. Issue slips show how many parts you are ordering.

Answers to Frame 10:

A. __b__ 1. B. __a__ 1.

__d__ 2. __d__ 2.

__c__ 3. __c__ 3.

__a__ 4. __b__ 4.

TURN-IN SLIPS

Frame 12

For turning in parts to supply, there are several slips that can be used. The slip to be used depends on the part that you are to turn-in.

If the part you are turning in to supply is a Non-DIFM item, this means the organization is not accountable for the part. You may use the AF Form 2005.

When parts are on the organization's supply account, you will use the AF Form 601 (AF Form 601B may be used). This will be removing the responsibility and accountability of the organization.

Those parts that are DIFM, parts that supply keeps records on for repair, use the AF Form 350 and the right status tag.

Use AFR 67-23, chapter 4, to help you locate information on the use of turn-in slips.

Check (✓) the true statements below:

_____ a. AF Form 601 is used for non-DIFM parts.

_____ b. AF Form 601 relieves the organization from accountable.

_____ c. Use AF Form 350 for DIFM parts to be turned in.

Answers to Frame 11: __✓__ a. _____ b. __✓__ c.

Frame 13

SUPPLY ACCOUNTABILITY

Accountability is concerned primarily with records of property. These records are maintained on stock numbered property which is subject to audit (inventory). When property is issued, and you sign a receipt, you are then held accountable for that property and must, upon request, show that you have it, (or have a receipt for it) return it, or pay for it if you have lost it.

Check (✓) each true statement below:

_____ a. Accountability is concerned with property that is NOT recorded stock numbered items.

_____ b. Record stock numbered property is NOT subject to audit.

_____ c. Accountability is concerned with the record of stock numbered property that is subject to audit.

Answers to Frame 12: _____ a. __✓__ b. __✓__ c.

Frame 14

Accountability can be transferred when a receipt is issued for the property being transferred When you sign a receipt for a piece of equipment, you become acc able. The receipt serves as the record of transfer.

Examples of property transfer:

1. Base Supply to an individual.

2. One individual to another.

3. One squadron or unit to another.

Remember a receipt must be issued to transfer accountability.

Check (✓) each true statement below:

_____ a. Accountability for property cannot be transferred.

_____ b. Accountability is transferred when a worker takes equipment out of the shop without signing a receipt.

_____ c. Accountability is transferred only when a receipt for the property has been issued.

Answers to Frame 13: _____ a. _____ b. __✓__

Frame 15

The Base Supply Officer (BSO) is held accountable for all record stock numbered items on base subject to audit. He must maintain records of how many items he has and who is accountable for them.

Check (✓) each true statement below:

_____ a. The Base Supply Officer is responsible for all property on base.

_____ b. The Base Supply Officer is held accountable for all record stock numbered items on base subject to audit.

Answers to Frame 14: _____ a. _____ b. __✓__ c.

Frame 16

When you have signed for property, you become the CUSTODIAN or accountable for that property. It is your duty to account for the property at any time that you are requested to do so.

Check (✓) each true statement below.

_____ a. When you sign for property you need not account for it.

_____ b. When you sign for property you become the property custodian.

_____ c. You must account for property you signed for when requested.

Answers to Frame 15: _____ a. __✓__ b.

SUPPLY RESPONSIBILITY

Frame 17

RESPONSIBILITY

The term responsibility means "a thing or person for whom one is responsible." During your tour of duty in the Air Force, you will use numerous pieces of Air Force equipment that someone else is accountable for. Anytime you have this equipment in your possession, whether you signed a hand receipt for the equipment or use it without a hand receipt, it is your obligation or responsibility to take care of it and return it to the custodian.

NO RESPONSE REQUIRED

Answers to Frame 16: _____ a. __✓__ b. __✓__ c.

Frame 18

Command Responsibility

The term "Command Responsibility" naturally indicates that it will apply to commanders. Commanders at all levels are charged with the responsibility for all property under their jurisdiction. Whether the Commander is at base, group, or squadron level, it is his responsibility to insure that the property he controls is maintained and secured properly.

Check (√) each true statement below.

_____ a. The Base Commander is charged with responsibility for all facilities and property on base.

_____ b. The Squadron Commander is charged with the responsibility for all special equipment on base.

_____ c. The Squadron Commander is charged with the responsibility for all facilities and property under his jurisdiction.

_____ d. The Squadron Commander is charged with the responsibility for all recreation equipment on base.

Answer to Frame 17: No Response Required

Frame 19

To have command responsibility, an individual must have the work "commander" in his title.

In the list below, place a check (√) beside those who would have command responsibility by virtue of their assignment.

_____ a. Legal Officer.

_____ b. Base Commander.

_____ c. Supply Officer.

_____ d. Technical School Commander

_____ e. Squadron Commander.

_____ f. Protocol Officer.

Answers to Frame 18: __√__ a. _____ b. __√__ c. _____ d.

Supervisory Responsibility

The next type of responsibility is "supervisory responsibility." It is defined in AFR 67-10 as that person who exercises supervision over property. The supervisor of an engine shop is responsible for all of the engines being repaired or stored. This also applies to special tools, equipment, and other facilities used in his shop. If there is an officer assigned to the shop as OIC (Officer-In-Charge), he shares supervisory responsibility with the NCOIC (Noncommissioned-Officer-in-Charge). He could also be accountable for the property as account custodian.

Check (√) each true statement below:

_____ a. If you are left in charge of the shop, you are not held responsible for the equipment.

_____ b. The supervisor of an engine shop is responsible for all of the equipment in his shop.

_____ c. Supervisory responsibility is the duty of all men working in a shop.

_____ d. Supervisory responsibility is defined in AFR 67-10.

Answers to Frame 19: ___ a. _√_ b. ___ c. _√_ d. _√_ e. ___ f.

Frame 21

Custodial Responsibility

The last of the three areas of responsibility for governmental property is "custodian responsibility." This type of responsibility applies to any individual who gains possession of property through any of the following circumstances:

1. When it is issued for his official or personal use; this applies whether or not he has signed a receipt for it.

2. When it is under his direct control for storage, use, custody, or protection.

3. When it is found. This would indicate that it was pr[illegible]ly lost, stolen, or abandoned.

Anyone who obtains property under such circumstances has custodial responsibility. When you are issued a pair of overshoes, you have custodial responsibility. When you use a special piece of equipment to do your job, you have custodial responsibility.

Check (✓) each true statement below:

_____ a. Custodial responsibility applies when using special tools to perform a job.

_____ b. Upon finding lost or stolen property you automatically have custodial responsibility.

_____ c. When a piece of equipment is stored under your control you do not have custodial responsibility.

_____ d. Signing a receipt for an article of clothing gives you custodial responsibility.

_____ e. A worker who takes equipment from the shop to the flight line (without a receipt) has custodial responsibility.

Answers to Frame 20: _____ a. __✓__ b. _____ c. __✓__ d.

Frame 22

Write the number of the type of responsibility next to the letter of the situation that describes it. More than one situation may apply to each type of responsibility.

Responsibilities		Situations
1. Command Responsibility	_____	a. Special tools are stored in his area.
2. Supervisory Responsibility	_____	b. The recreation equipment in the squadron dayroom.
3. Custodial Responsibility	_____	c. A captain is issued a personal flying suit, helmet, etc.
	_____	d. You are issued cold weather clothing.
	_____	e. Electronic equipment is repaired in this area.
	_____	f. All base facilities

Answers to Frame 21: _✓_ a _✓_ b. ___ c. _✓_ d. _✓_ e.

Frame 23

Remember, the responsibility to use and properly maintain US Government equipment applies to anyone associated with the Air Force. This applies to you regardless if it is issued to you, you sign for it, or if it is part of the shop equipment you use to perform your job.

NO RESPONSE REQUIRED

Answers to Frame 22: _2_ a. _1_ b. _3_ c. _3_ d. _2_ e. _1_ f.

Answer to Frame 23: No Response Required

PROGRAMMED TEXT

C3ABR42633-PT-109

Technical Training

Turboprop Propulsion Mechanic

ENGINE PRESERVATION AND STORAGE

1 December 1983

CHANUTE TECHNICAL TRAINING CENTER(ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE.
DO NOT USE ON THE JOB.

RGL: N/A

OBJECTIVES

Having completed this programmed text, you will be able to:

1. Identify procedures relating to engine removal from shipping container.

2. Identify procedures relating to installing engines in shipping containers.

3. Identify procedures about preserving engines.

4. Identify procedures concerning depreserving engines.

INSTRUCTIONS

This programmed text presents information in small steps called "frames". After reading the information in each frame, you are asked to actively respond in this booklet. Check the accuracy of your response. The correct response is at the end of the following frame. If you made an incorrect response, study the frame again before going on to the next frame. Work as fast as you can, but DO NOT HURRY!!!

EQUIPMENT

	Basis of Issue
TO 1C-130B-2-4	1/student

Supersedes ST C3ABR42633-PT-109, 28 October 1982.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 350; DAV - 1

REMOVAL FROM SHIPPING CONTAINER

Frame 1

To remove an engine from the shipping container, follow the steps as outlined in TO 1C-130B-2-4, page 9-46, para 9-82, steps a thru l or on page 9-50, para 9-84, steps a thru j. Place all loose container parts that you have removed in the storage box. You will need to dispose of the dehydrating agent, and indicators so that they will not be used on other engines to be preserved. Always use fresh dehydrating agent and indicators. You will need to take every precaution to keep the engine and its accessories clean and free from foreign material at all times. When you clean individual parts by removing preservatives and tape or other materials, use the solvent type cleaners and do all safety items in AFOSH STD 127-3 when you use solvents. You need to take great care to ensure that the removal of any precipitate residues have been removed. Wipe the parts first with a cloth containing some finger print remover that conforms to specification of MIL-C-15074, and then after you have done this, clean the parts with a cloth containing solvent of specification P-D 680 type II only.

Mark the following statements either true (T) or false (F) in the space provided.

____a. You may use the old dehydrating agent and indicator for an engine to be preserved.

____b. You need to keep the engine and its accessories clean and free from foreign material of any kind.

____c. The removal of precipitate is [illegible] required on engines that will will be removed from a shipping container.

INSTALLING ENGINES IN SHIPPING CONTAINERS

Frame 2

The first thing you need to do when you put an engine into a shipping container is to take off the service receptacle cover (refer to TO 1C-130B-2-4, page 9-42, item #9 and/or on page 9-43, item #29). After you take off the service receptacle cover you need to let off the air pressure that is in the shipping container by loosening or taking off the air valve which is located under the service receptacle cover. Doing this you will prevent possible injury to you and others because the shipping containers should be stored with some air pressure in them, and by letting off the pressure before you take off the container cover bolts the cover will not be thrown off by air inside the container. So think of this as you are doing this job. After all the cover bolts and nuts have been taken off, and the container cover has been taken off, you will need to look at the inside of the engine shipping container. What are you to be looking for is cleanliness and/or damage from handling, and/or internal dampness (internal dampness is/or could be caused by condensation). You are to make sure that the container is free from accumulated water, oil, and/or other foreign material. Also you need to look at the closure flange mating surfaces and at the gasket for the general condition of it including the damage from handling and presence of foreign matter. While you are doing your inspection of the shipping container, there will be mounting rails and/or mounting brackets depending on the type of engine and container you are working with that need to be removed (refer to TO 1C-130B-2-4, page 9-41, para 9-81, steps a thru d, and page 9-46, para 9-83, steps a thru d).

Mark the following statements either true (T) or false (F) in the space provided.

____a. The shipping container should be free from damage, and/or internal dampness.

____b. You can leave the air pressure in the shipping container while you take off the shipping container cover bolts.

____c. When you are installing an engine into a shipping container, the first thing you should do is take off the service receptacle cover.

Answers to Frame 1: F a. __ b. F c.

PRESERVING ENGINES

Frame 3

When an engine has been removed from an aircraft, (or even an engin has not been removed from the aircraft due to the aircraft being grounded for some item), the engine must have some type of preservation done to it. For those engines that have been removed, you will follow the TO 1C-130B-2-4, starting on page 9-41, para 9-79, general preparation, and page 9-57 thru page 9-59, para 9-94 thru 9-102. The engines that have been left on the aircraft will receive a different type of preservation. If the aircraft has not been in active flying status for a period of 1 to 180 days, it will be given a ground run-up for a period of 2-3 minutes at ground idle power settings. When it's known that the aircraft and engine will be inactive for a period greater than 180 days, such as storage of the aircraft or overhaul backlog, and/or aircraft undergoing modification, the engine may be treated for preservation by running or motoring the engine for 2 minutes. If the engine cannot be run it will be removed and placed in a shipping container. IAW TO 2J-1-18, you will make entries on the AFTO Form 781A: TO 2J-1-18, section _______, paragraph __________, C/W (date) (inspectors name and/or stamp).

Mark the following statements either true (T) or false (F) in the spaces provided.

_____a. Removed engines will be preserved as outlined in TO 1C-130B-2-4, section 9.

_____b. Engines that have been left on the aircraft need not be inspected.

_____c. Engines that have been removed from an aircraft, not in use over 180 days, need no entries on the AFTO Forms 781A.

Answers to Frame 2: T a. F b. T c.

Frame 4

The depreservation of a T-56 engine starts on page 9-40, para 9-74 of TO 1C-130B-2-4. You will need to do some electrical work before you start depreserving the engine. Make sure that the fuel control manual shutoff valve is in the open position. There will be drain plugs to be taken off and lines to be disconnected. You need to let the engine drain for at least 5 minutes, before you replace the plugs and lines. Make sure that you take out, clean, and put back in the oil filters. You must always take care not to damage the prop brake when motoring the engine more than twice without oil pressure indications. After you install the engine on the airplane, you should run it at "Flight Idle" for 5 minutes. Look at the oil temperature for the RGB and power unit, it should not exceed 68°C (154°F).

Mark the following statements either true (T) or false (F) in the space provided.

____a. The fuel control shutoff valve should be in the open position.

____b. The engine should drain for 5 minutes before replacing plugs.

____c. The oil temperature should not exceed 68°C (154°F).

Answers to Frame 3: T a. F b. F c.

Answers to Frame 4: T a. T b. T c.

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WB-109
4 May 1983

ENGINE PRESERVATION AND STORAGE

OBJECTIVES

1. Identify procedures relating to engine removal from shipping container, 2 out of 3 times correctly.

2. Identify procedures relating to installing engines in shipping containers, 2 out of 3 times correctly.

3. Identify procedures concerning depreserving engines, 2 out of 3 times correctly.

4. Identify procedures about preserving engines, 2 out of 3 times correctly.

EQUIPMENT

	Basis of Issue
TO 1C-130B-2-4	1/student

PROCEDURE

Fill in the blank spaces with the appropriate information using TO 1C-130B-2-4, Section IX.

SECTION I

1. When removing an engine from shipping container, Allison Part No. 6800444, the RH harness distribution box will be reattached to the accessory drive housing and torqued to what inch pounds?

________________ to ________________

2. When removing an engine from shipping container, Allison Part No. 68002[illegible], which bolts and washer will be used to reinstall the propeller con[illegible] rear bracket? ____________ ____________ ____________

____________ ____________ ____________ ____________

____________ ____________ ____________ ____________

3. What grade of corrosion preventive compound is used to coat the nut of the closure flange, service receptacle, and records receptacle bolts? ________________________

Supersedes ST C3ABR42633-WB-109, 14 October 1982. RGL: N/A
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 200; DAV - 1

Designed for ATC Course Use. Do Not Use on the Job.

SECTION II

1. When installing an engine into a shipping container, Allison Part No. 6800216, the torque of the two locknuts which secure the forward yoke mounting brackets to the forward yoke is ____________

to ____________ inch-pounds.

2. Using shipping container, Allison Part No. 6800397, what two items will be replaced if immediately before shipment you see that the humidity indicator has changed from light blue to lavender? ____________

and ____________________________________.

3. What is the torque of the drain plug (if it was not installed) when you are installing the engine into shipping container, Allison Part No. 6800444? ____________ to ____________

inch-pounds.

SECTION III

1. When depreserving a T56 engine, what items will you need to provide, to drain the nozzle lines at the manifold? ____________

and ____________

2. How will you know when flushing of the fuel system is complete?

____

____

3. What pins are used to close the fuel control shutoff valve?

pin ____________ is grounded.

pin ____________has 28 volt DC power apply

SECTION IV

1. When preserving the oil system of a T58 engine, what is the specification of the oil used to immerse the filters? ____________

____________________.

2. What grade of oil would be used in the fuel system if the engine is to be stored more than 45 days? ____________

3. What will you need to do for oil and fuel lines or components that may leak during shipment? ____________

items.

PROGRAMMED TEXT
3ABR42632-PT-104
110

Technical Training

Jet Engine Mechanic

MECHANIC'S HANDTOOLS

17 June 1980

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

VALIDATION

This programmed text is designed for students in the C3ABR42632, Jet Engine Mechanic Course. Tryout of the learning format and technical information was conducted using students with no prior exposure to the subject material. More than 90 percent of the 34 students used to validate the material surpassed the criteria specified in the objectives approved by Air Training Command. The average time required to complete this programmed text was 2 hours.

OBJECTIVES

Upon completion of this programmed text, you will be able to:

1. State the factors to consider in the selection of handtools for a job.

2. State the procedures for proper use and care of handtools.

INTRODUCTION

This text discusses the selection, care, and use of common handtools that will be used daily during your training as a jet engine mechanic.

As you progress through this programmed text, you will understand the importance of choosing and using the correct tools to do a job correctly.

INSTRUCTIONS

This program is presented in steps called "frames." As a part of each step you are asked to respond by selecting the correct answer from multiple answers, choose either TRUE or FALSE, or match descriptions to nomenclatures. These answers which you are required to furnish were taught in that or previous frames of this text.

To use this text, use a piece of paper or a card as a mask to cover the printed material. Slide this mask down the page until the top of a row of slashes (//////////) is exposed. One step or frame is now exposed. Read the material presented and make your response or selection by selecting the letter, or choosing TRUE or FALSE for the questions asked. Then slide the mask down and compare your answer with the correct one found just below the slashes. If your answer is correct, go on to the next frame; if you are wrong, read the frame again and see how the correct response was derived.

Supersedes 3ABR42632-PT-105, 20 February 1979.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-J - 3000; TTVSA - 1

FRAME 1. SAFETY PRECAUTIONS, USE, AND CARE OF HANDTOOLS

Proper care and use of handtools go hand in hand with safety. Improper care and use of tools are violations of safety precautions and may lead to serious harm to yourself or a fellow airman. They may even cause the loss of an aircraft and crew. The following list of statements pertains to proper care, use, and safety precautions concerning your handtools.

a. Do not carry tools in your pocket.

b. Keep all tools clean, free of rust, corrosion, grease, and other foreign matter.

c. Check tools for defects prior to use.

d. Turn in defective tools for new ones.

e. Oil the moving parts of tools. Use oil SAE No. 10.

f. Inventory your tools before and after each job to prevent foreign object damage.

g. Use solvent for cleaning tools. Never use gasoline or JP-4.

h. Always use the right tool for the job.

i. Use an authorized tool storage area for storing your toolbox.

j. Your toolbox will be locked when it is to be left unattended.

k. Do not horseplay with tools.

l. Do not use the toolbox to store special tools.

m. Mechanics are financially responsible for their tools.

Mark the following statements as either true (T) or false (F) in the space provided.

1. _______ When removing grease or oil from handtools, it is permissible to use unleaded gasoline.

2. _______ Tools should be inventoried only before the job is started.

3. _______ Financial responsibility for handtools rests with the individual.

/ /

1. False. Gasoline will not be used for any type of cleaning.

2. False. You should inventory your tools before and after each job.

3. **True. Financial responsibility rests with** the individual.

BEST COPY AVAILABLE

FRAME 2. WRENCHES

Wrenches are tools used for tightening or removing nuts or bolts. They are generally classified as socket sets, adjustable or nonadjustable wrenches.

Use and Care of Wrenches

a. Never use a wrench that does not fit the nut or bolt exactly. Use only the correct size wrench.

b. Use adjustable jaw wrenches so the pulling force is on the stationary jaw.

c. Always pull on a wrench -- don't push. The nut or bolt may break loose unexpectedly.

d. Do not use a pipe on the handle of a wrench. Use a wrench with a longer handle.

e. Use solvent to clean wrenches.

f. Use oil (SAE 10) to lubricate the moving parts of wrenches and other handtools.

Mark the following statements as either true (T) or false (F) in the space provided.

1. ______ Use pulling force when using a wrench.

2. ______ A wrench should fit a nut or bolt exactly.

3. ______ It is permissible to use JP-4 to clean wrenches.

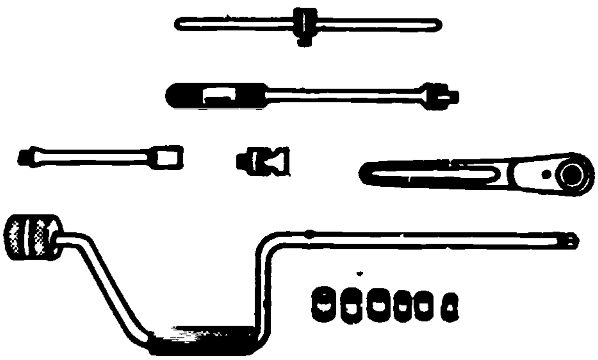
//////////////////////

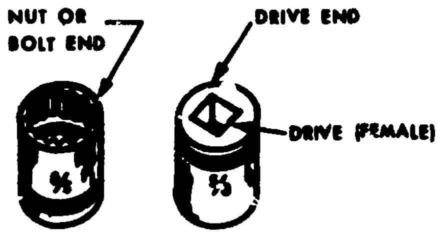
1. True. Pulling on a wrench gives you better control.

2. True. There is a wrench made for each type of nut or bolt.

3. False. Read Frame 1, paragraph g.

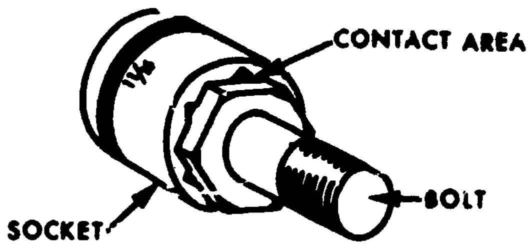
FRAME 3. SOCKET (WRENCH) SET

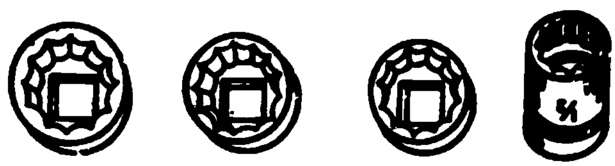




Socket sets, because of their versatility* and speed, are considered the mechanics' first choice of wrenches. They consist of various types of sockets, handles, and attachments which can provide the ideal wrench combination for almost any maintenance job. Socket sets are identified by the size of their (square) drives. Some common socket set sizes are the 1/4 size, 3/8 size, and 1/2 inch.

*Defined as variable, adaptable, reversible, and ease of turning.





SHALLOW SOCKETS

Sockets are made to fit the nut or bolt on all corners and are provided in all needed sizes. The size is stamped on the side of the socket and indicates the wrench size of the nut or bolt which it will fit. There are three types of sockets: shallow, deep well, and universal. Shallow sockets (shown above) are used for most normal work. Individual sockets are sized according to the size of the drive and the size of the nut or bolt end.

Mark the following statements as either true (T) or false (F) in the space provided.

1. ______ One reason that mechanics select the socket set as their first choice of wrenches is because of their versatility.

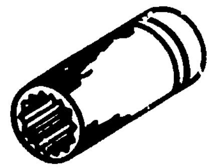
2. ______ Individual sockets are sized by the size of the drive.

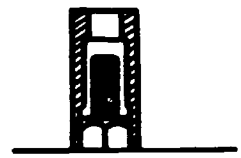
3. ______ The size stamped on the socket identifies the size of the drive.

/ /

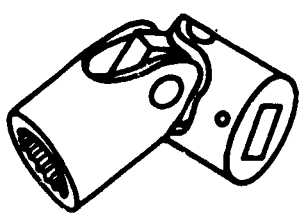
1. True. The many types of handles and sockets make them ideal for mechanic's use.
2. False.
3. False. The size stamped on the socket is the size of the socket.

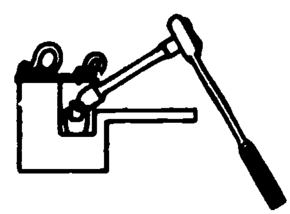
FRAME 4. SOCKET (WRENCH) SET continued





In some installations, the threaded part of a bolt or stud may extend thru the nut to the extent that a shallow socket will not reach the nut. This is a job for the deep well socket. It is used where socket depth is needed. In some cases, it is possible to avoid the use of an extention by using a deep well socket.





The universal socket is used in areas where there is not a straight approach to a nut or bolt. The universal part of this socket permits it to be used at an angle.

Mark the following two statements as either true (T) or false (F) in the space provided.

1. _______ A deep well socket is used where space is needed above a nut to clear the threaded portion of a bolt.

2. _______ Where there is an angular approach to a nut, it may be removed by using a unive al socket.

Circle the letter of the correct answer.

3. The size of a socket set is determined by the

   a. socket size.

   b. size of the drive.

   c. deep well of the socket.

   d. size stamped on the socket.

/ /

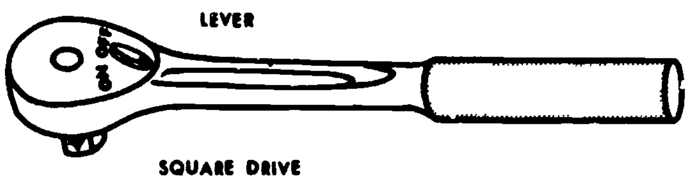
1. True. A deep well socket would be used in order to provide a clearance above the top of the nut.

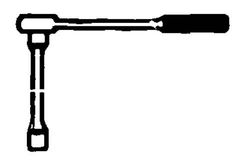
2. True. A universal socket can be used at an angle.

3. b. size of the drive.

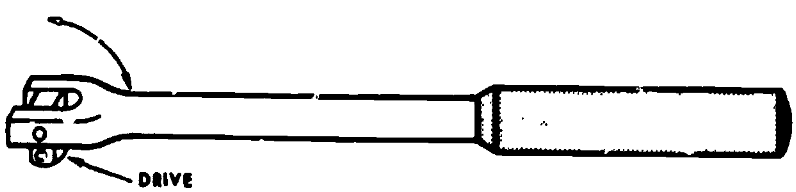
FRAME 5. SOCKET (WRENCH) SET continued

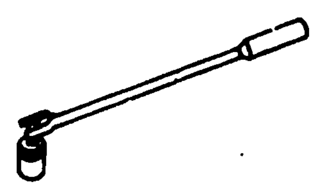
Handles. Since sockets are detachable, a variety of handles may be used for different kinds of work. These add to the versatility of the socket set. The four types of handles used with the socket set are ratchet, "T", speed, and hinge handles.



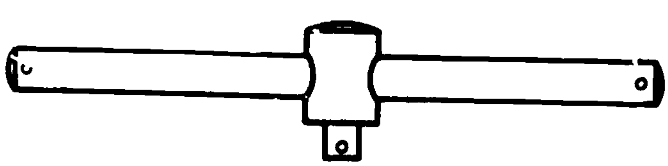
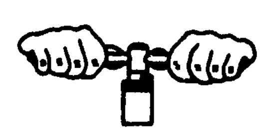


a. The ratchet handle ratchets (slips) in one direction when loosening a nut or bolt and in the other direction when tightening a nut or bolt. There is a lever on the ratchet head that is used to change the direction of the ratchet action. The ratchet is useful where the swing arc is restricted. This handle should not be used for high torque, such as breaking loose a tight nut or bolt.

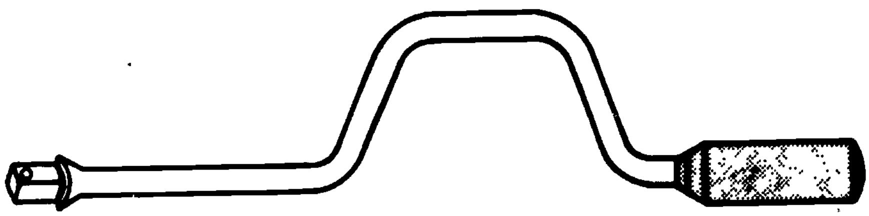




b. The hinge handle is used to break loose nuts or bolts. To loosen a tight nut or bolt, the handle can be used at a right angle to the socket to give the greatest usable leverage. Then, if the fastener is sufficiently loosened, the handle can be hinged to the vertical position where it may be turned with the fingers.

c. The "T" handle is another of the various handles used for driving sockets. The "T" shape makes it possible to apply equal force with both hands because the drive is in the center. The drive may be moved to one end of the bar for more leverage.



d. The speed handle is a rapid means of turning a socket. It is usually used where there are many nuts or bolts and the swing arc is not restricted.

Match the items in column B to the statements in column A.

Column A	Column B
1. ___ Used when fast removal or installation of nuts or bolts is required and the swing arc <u>is not</u> restricted.	a. "T" handle.
2. ___ Used to break loose a tight nut or bolt.	b. Ratchet handle.
3. ___ To tighten or loosen a nut or bolt without having to remove or position the socket, when the swing arc is restricted.	c. Speed handle.
4. ___ Used to apply equal force with both hands when the drive is positioned in the center.	d. Hinge handle.

Mark the following statements as either true (T) or false (F) in the space provided.

5. ___ The hinge handle can be used at a right angle to the socket for a straight pull for greatest leverage.

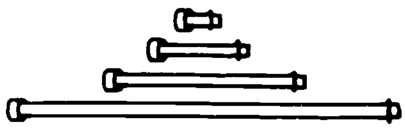
6. ___ Nuts or bolts should be broken loose with a hinge handle.

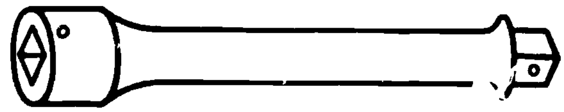
/ /

1. c 2. d 3. b 4. a 5. true 6. true

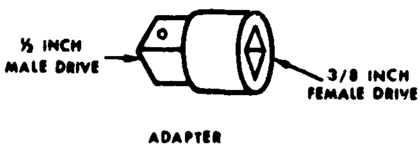
FRAME 6. SOCKET (WRENCH) SET continued

Attachments are used to change the drive size, angle, or length.



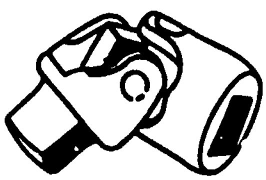


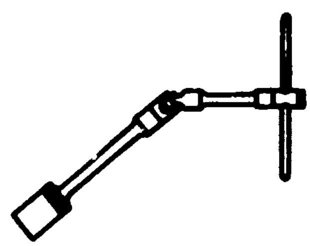
a. An extension is used to extend a socket into hard-to-reach places. Extensions are provided in many different lengths.



DOWN Can Be Adapted To Drive Sockets in This Drive Size	Originating Drive Size	UP Can Be Adapted To Drive Sockets in This Drive Size
-	1/4	3/8
1/4	3/8	1/2
3/8	1/2	3/4
1/2	3/4	1

b. An adapter provides the means for changing the drive size. 1/4" to 3/8", 3/8" to 1/2", etc.





c. A universal joint is used to change the angle of a drive when there is not a straight approach to a nut or bolt. It may be used on handles, extensions, and sockets.

Mark the following statements as either true (T) or false (F) in the space provided.

1. ___ An extension is used to change the angle of the drive.

2. ___ An adapter is used to change a 1/2" drive to a 3/8" drive.

3. ___ The parts of a socket set which are used to change the sizes, angles, or lengths of drives are called attachments.

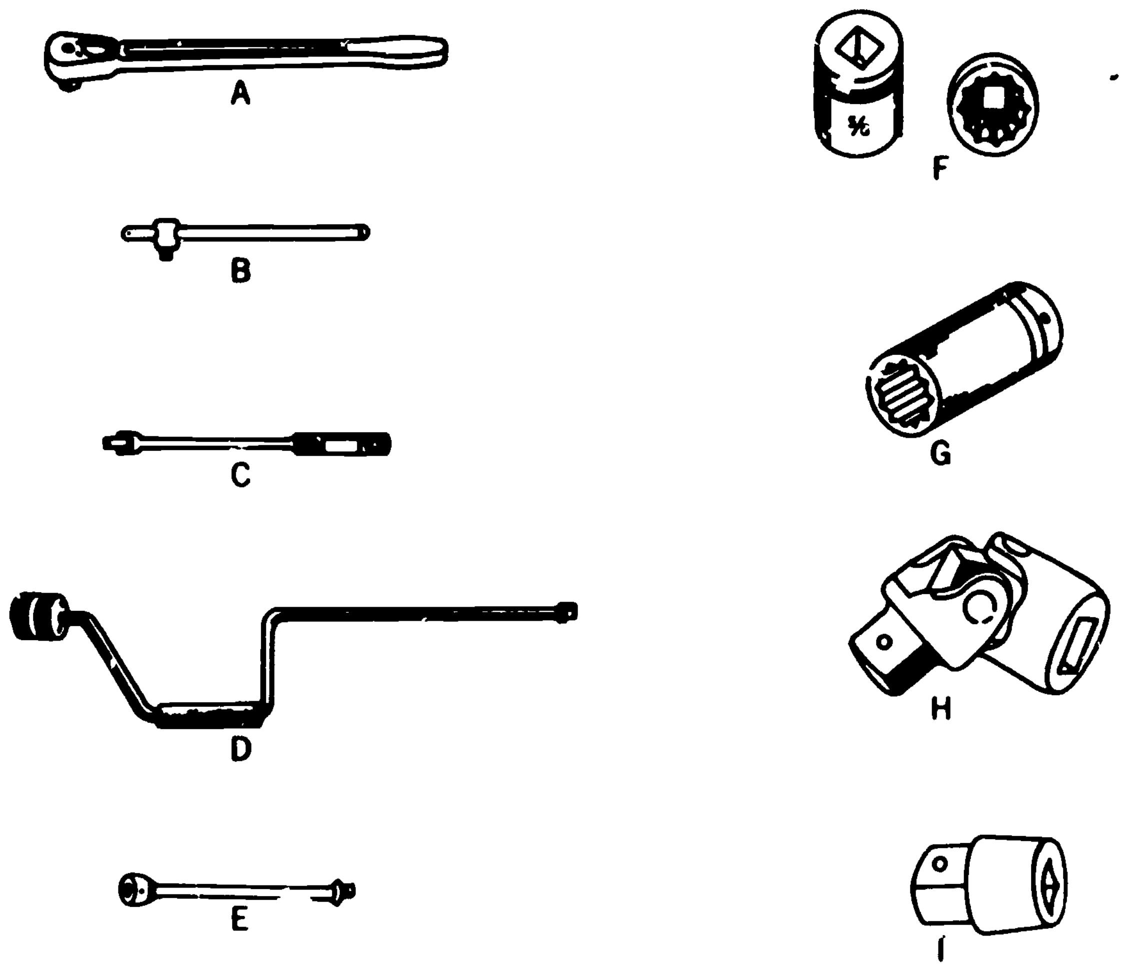
/ /

1. False. An extension lengthens the drive.

2. True. Adapters permit the use of handles on more than one set of sockets.

3. True. Attachments alter the drive for more handle versatility.

FRAME 7. REVIEW FOR SOCKET (WRENCH) SET



Match the items illustrated above with the statements listed below.

1. ___ Changes drive angle.

2. ___ A handle that provides speed for tightening many nuts or bolts.

3. ___ A handle used to tighten or loosen nuts or bolts in a restricted area.

4. ___ A shallow socket, used for most normal "nut and bolt" jobs.

5. ____ A handle used to apply force with both hands when the drive is in the center.

6. ____ A handle used to break loose nuts or bolts.

7. ____ Used to extend sockets into hard-to-reach places.

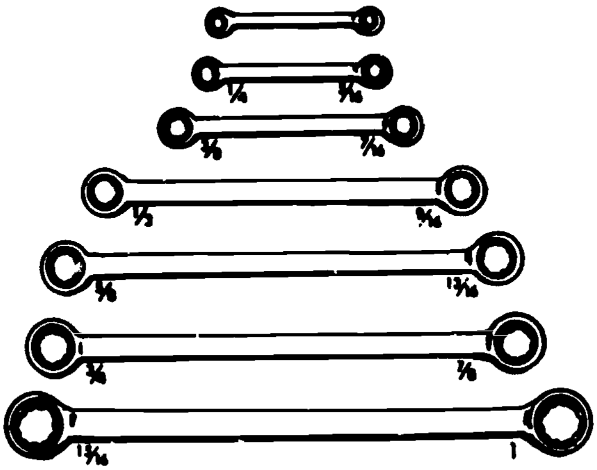
8. ____ A socket, used where the threaded part of a bolt extends a considerable distance above the nut. May be used also to eliminate the use of a short extension.

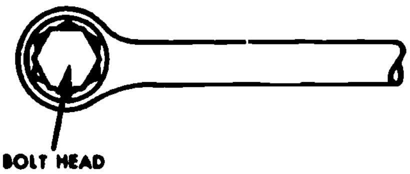
9. ____ Used to change the size of the drive.

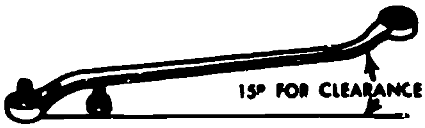
/ /

1. H 2. D 3. A 4. F 5. B 6. C 7. E 8. G
9. I

FRAME 8. BOX END WRENCHES







Box end wrenches are considered the mechanics' second choice of wrenches. They are given the name "box end" because they box (surround) the nut or bolt head. These wrenches are ideal for use where there are close quarters, and to "break loose" tight nuts and bolts. The main disadvantage of the box end is that it must be lifted off the nut or bolt and repositioned each time it is turned. Handles of most box end wrenches are offset 15°, as shown above. The purpose of this feature is to provide hand and wrench clearance.

Circle the letter of the correct answer.

1. If the socket set is not available, the mechanics' second choice of wrenches would be the

   a. "T" handle. c. ratchet handle.

   b. box end wrench. d. speed handle.

2. The box end wrench is offset 15° to

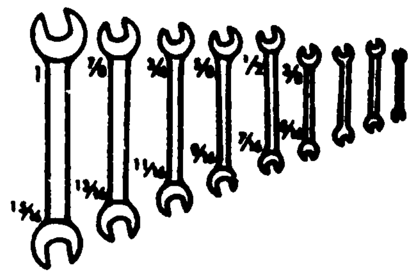
   a. aid in getting a new grip on the nut or bolt.

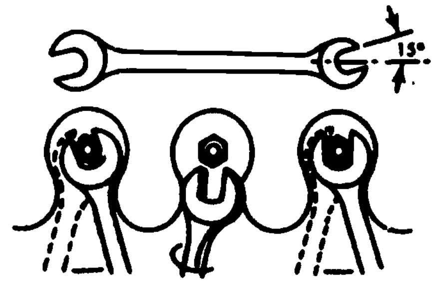
   b. allow for clearnace of obstructions.

/ /

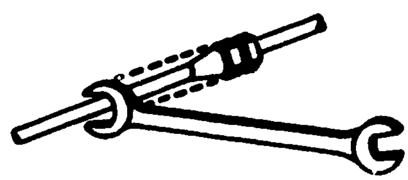
1. b 2. b

FRAME 9. OPEN END WRENCHES





Open end wrenches are light, strong, and convenient to use. Each wrench normally has two different wrench sizes, one on each end of the handle. The jaws of open end wrenches are set at a 15° angle so that in restricted swing space, the wrench may be "flopped" over each time for a new grip on the nut or bolt CAUTION: The jaws may spread under heavy torque.



Because of the open end, this wrench can be used to loosen or tighten nuts which secure hose assemblies and tubing, as illustrated above.

Mark the following statements either true (T) or false (F) in the space provided.

1. ___ Open end wrenches are used on the nuts which secure hose assemblies and tubing.

2. ___ The jaws are set at a 15° angle so the wrench can be flopped over and a new grip taken on the nut or bolt.

3. ___ Open end wrenches usually have one size per handle.

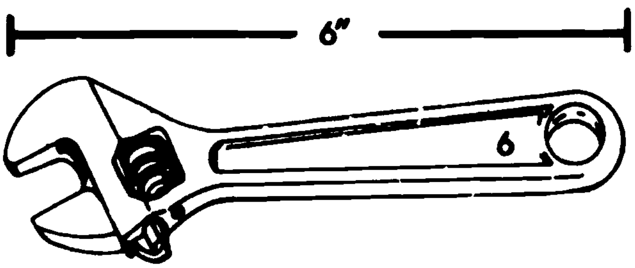
/ /

1. True. The box end or socket wrench would not fit over these nuts.

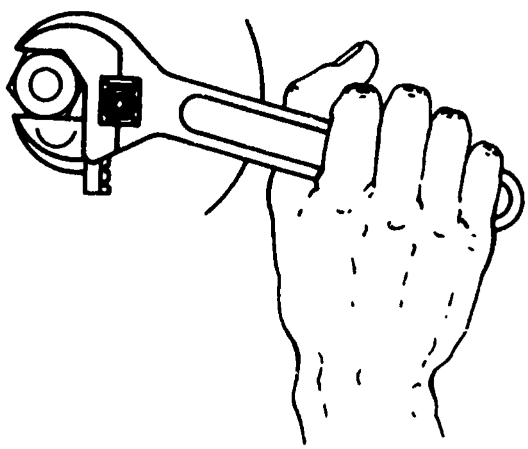
2. True. If the wrench was not turned, it could not fit the flats of the nut.

3. False. Open end wrenches are usually manufactured with two sizes per handle

FRAME 10. ADJUSTABLE JAW WRENCH



An open end wrench is sometimes required but the correct size is not available. An adjustable jaw wrench would be used as a last resort for these jobs. The size of an adjustable jaw wrench is usually stamped on the handle and is determined by the overall length of the wrench.



Accidents and rounding off the corners of nuts and bolts usually result from the misuse of this tool. The wrench should be pulled with the force being applied to the stationary (solid) jaw. The adjustable jaw should always point in the direction of rotation.

Mark the following statements as either true (T) or false (F) in the space provided.

1. ___ The adjustable jaw wrench would be used as a last resort.

2. ___ Force is applied to the stationary jaw.

3. ____ The size of the adjustable jaw wrench is determined by the width of the jaws.

/ /

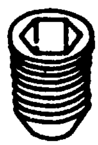
1. True. Because misuse is easy and accidents can occur from misuse.

2. True. The adjustable jaw will point in the direction of rotation.

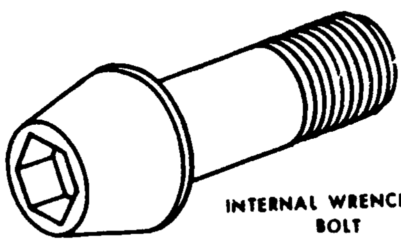
3. False. The size is determined by the overall length and is stamped on the handle.

FRAME 11

The wrench pictured above is commonly called an "Allen wrench, hex head, or internal wrenching wrench.



SET SCREW



INTERNAL WRENCHING BOLT

These wrenches are six-sided "L" shaped keys used in internal wrenching bolts and set screws.

Circle the letter/letters of the correct answer.

1. The allen wrench is also called

   a. key set.

   b. hex head.

   c. internal wrenching wrench.

   d. all of the above.

2. Allen wrenches are used to install and remove. (Two responses.)

a. set screws.

b. common screws.

c. hex head bolts.

d. internal wrenching bolts.

/ /

1. both b and c 2. a, d

295

FRAME 12. REVIEW FOR WRENCHES

Match the items illustrated below with the following statements.

1. ___ One detachable part of a socket set.

2. ___ An "L" shaped wrench that is used in tightening or loosening internal wrenching bolts or set screws.

3. ___ A nonadjustable wrench that fits the nut on all corners and is offset 15° to allow wrench and hand clearance.

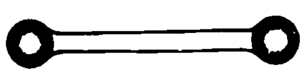
4. ___ A wrench that is used as a last resort and the size is determined by the overall length of the wrench.

5. ___ A nonadjustable wrench that is used to tighten or loosen nuts on hose assemblies and tubing.

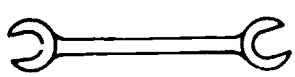
6. ___ Illustrates the correct use of an adjustable jaw wrench.

A

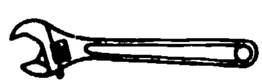
E



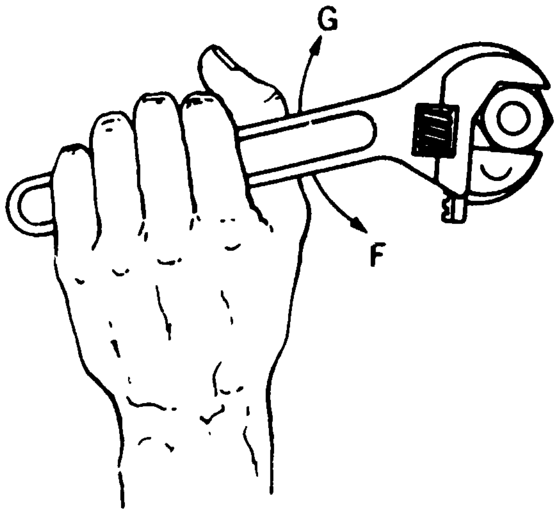
B



C



D

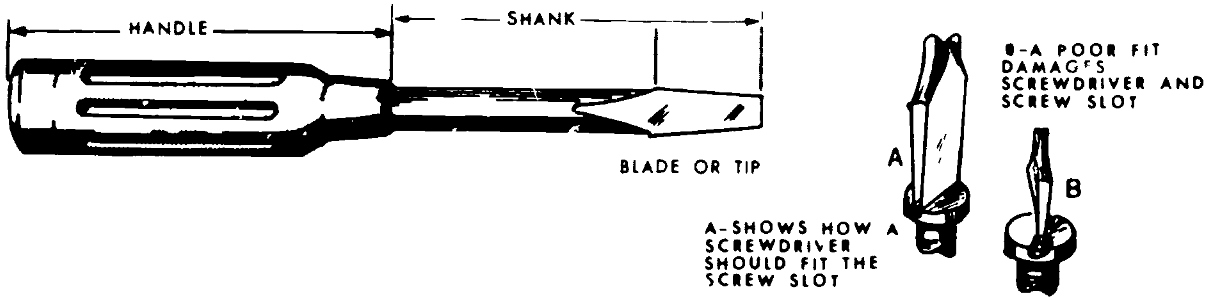


/ / / / / / / / / / / / / / / / / / / /

1. E 2. A 3. B 4. D 5. C 6. F

FRAME 13. SCREWDRIVERS

Screwdrivers are used to drive (turn) slotted head or cross head screws in threaded holes. A screwdriver consists of three parts: handle, shank, and blade or tip. The blade must fill the slot of the screw, both in width and depth, and should also fill most of the length of the slot



Use and Care of Screwdrivers

a. Never use a screwdriver as a chisel.

b. Do not use a screwdriver as a pry bar.

c. Use Reed and Prince screwdrivers in Reed and Prince screws.

d. Use Phillips screwdrivers in Phillips screws.

e. Clean and oil the blade to prevent corrosion.

f. Clean the handle of all grease or oil before using.

Mark the following statements as either true (T) or false (F) in the space provided.

1. ____ A screwdriver consists of a handle, shank, and blade or tip.

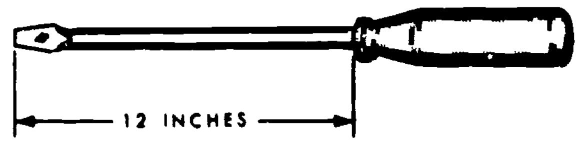
2. ____ The blade of a screwdriver should be 1/2 the width of the slot.

/ / / / / / / / / / / / / / / / / / / /

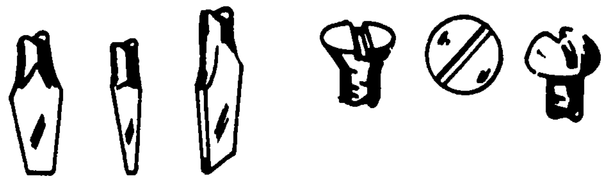
1. True. See picture above.

2. False. To prevent damage to the screwdriver blade or screw slot, the screwdriver tip should fill the slot.

FRAME 14. **SCREWDRIVERS** continued.



The size of a screwdriver is determined by the length of the shank and blade in inches.



The common or standard screwdrivers have flat blades and are used to drive slotted head screws. When selecting a common screwdriver for a job, you should use one that has the proper size of blade.

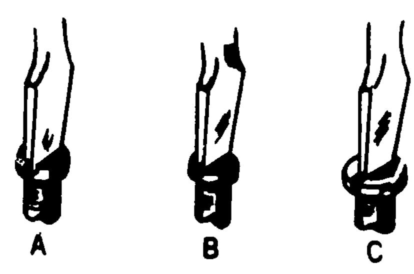
Mark the following statements as either true (T) or false (F) in the space provided.

1. ___ The size of a common screwdriver is determined by the width of the blade or tip.

2. ___ The common screwdriver is used to drive slotted head screws.

Select from the drawings below the one that shows the proper fit of the blade in the screw slot. Place the letter in the space provided.

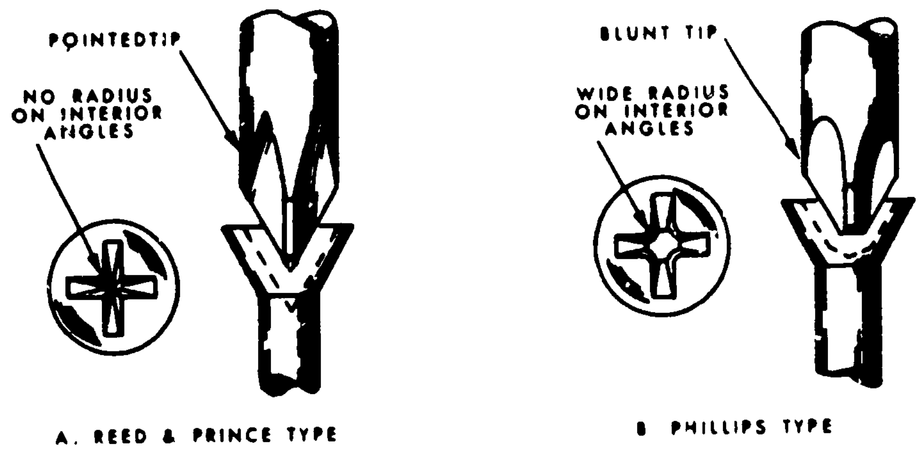
3. ___



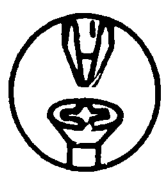
/ /

1. False. The length is measured from the tip to the bottom of the handle.
2. True. See picture above.
3. B.

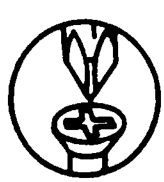
FRAME 15. SCREWDRIVERS continued



Two types of crosspoint screwdrivers in use by the Air Force are the Reed and Prince (picture A above) and the Phillips (picture B above). The correct screwdriver must be used to avoid damage to the screw head and screwdriver.



Phillips screwdrivers have blunt tips and are used in cross slot screws that have rounded corners. See picture above.



Reed and Prince screwdrivers have pointed tips and are used in cross slot screws that have square corners. See picture above.

Mark the following statements as either true (T) or false (F) in the space provided.

1. ___ A Phillips screwdriver has a pointed tip.

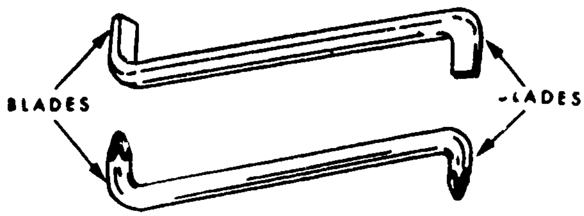
2. ___ Reed and Prince screwdrivers are used in screw slots that have square corners.

/ /

1. **False.** See picture on preceding page.

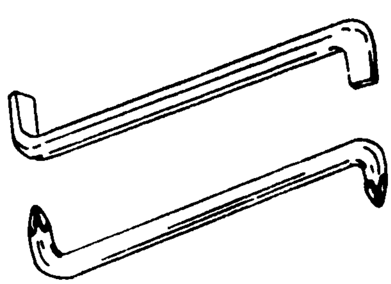
2. **True.** See picture on preceding page.

FRAME 16. **SCREWDRIVERS continued**



Offset screwdrivers may have either standard or cross point blades. They are used when working in spaces where there is not en ugh room to use a regular screwdriver. Blades of offset screwdrivers are set 90° from the shank and handle.

Label the screwdrivers below with their proper name.



1. ______________________

____

2. ______________________

____

/ /

330

1. Common or standard offset.

2. Cross point offset.

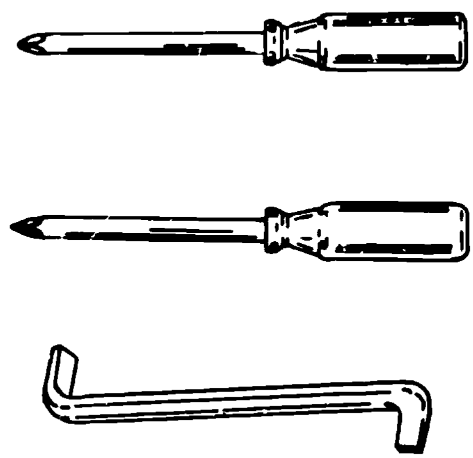
FRAME 17. REVIEW FOR SCREWDRIVERS

Write the name of the three kinds of screwdrivers in the spaces provided.

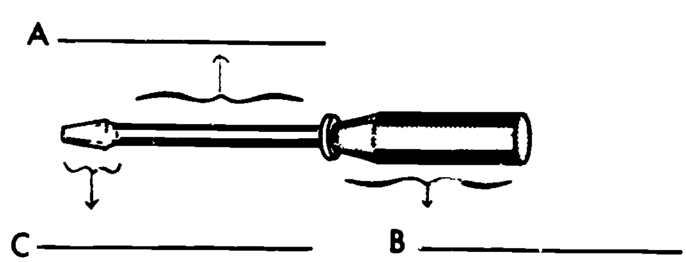
1. ______________________

2. ______________________

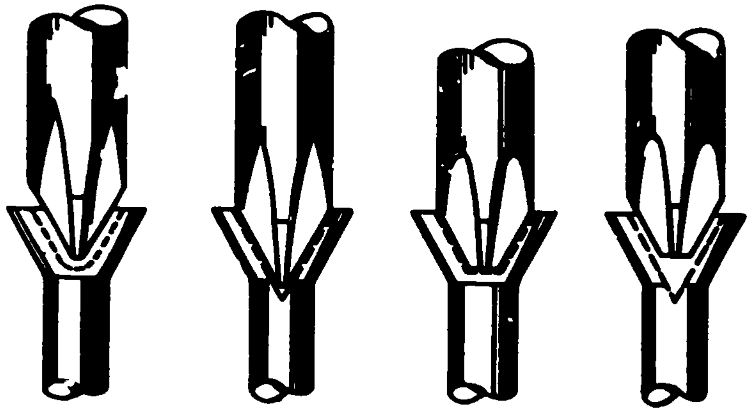
3. ______________________



4. Write the name of each part of the screwdriver in the picture below.



Study the drawing below and place the letters of the two cross point screwdrivers which are being used correctly in the space provided.

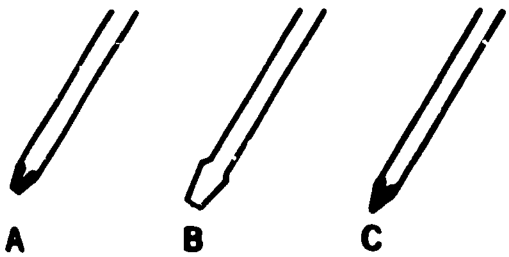


5.________ A B C D

6.________

FRAME 18. **REVIEW SCREWDRIVERS continued**

Match the screws illustrated on the left with the letter of the correct screwdriver on the right.



7. ______________________ 8. ______________________

/ / / / / / / / / / / / / / / / / / / /

1. Phillips crosspoint.

2. Reed and Prince crosspoint.

3. **Standard offset.**

4. a. shank b. handle c. **blade or tip.**

5. B.

6. C.

7. A.

8. C.

If you have answered all the questions on this section of the programmed text correctly, go on to the next frame. Raise your hand if additional information or clarification is needed.

FRAME 19. HAMMERS

A hammer is a tool consisting of a head and a handle. The good mechanic learns to select the correct hammer for the particular work at hand. Hammers are generally classified as "hard face" or "soft face" hammers. Each hammer has its own special use. Hard face hammers are made of steel. Soft face hammers have a face made of lead, plastic, leather, or rubber.

Use and Care of Hammers

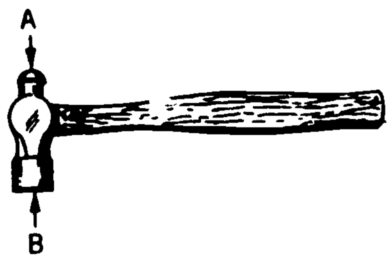
a. Do not use a hammer or mallet with a loose head.

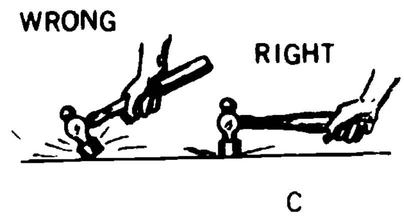
b. Replace worn handles.

c. Do not use the handle as a pry bar.

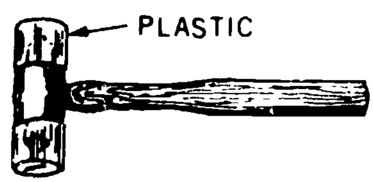
d. Use linseed oil to clean wood handles.

e. Use a solvent to clean the heads of steel hammers. (Prevents rust.)

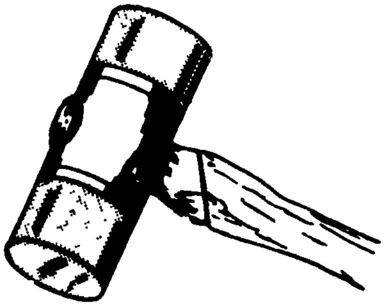




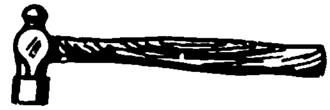
The ball peen hammer is the type most used by aircraft mechanics. It has a flat surface (B) on one end called the face and a round surface on the other end called the ball (A). Remember to grip the end of the handle and strike with the center of the face, as shown in (C). Hammers are used in areas where dents in the metal are not important and to provide the driving force for chisels and punches. They are sized according to the weight of the head and range from four ounces to 20 pounds in size.



A mallet usually has a replaceable soft face or tip made of lead, leather, rubber or plastic. Mallets are used where the finished product must be smooth (no nicks or dents in the metal). The size of a mallet is determined by the diameter of the face.



A



B

Match the hammers shown above to the nomenclatures below.

1. ___ Hammer, hand, machinist, ball peen.

2. ___ Hammer, hand, screw-in replaceable plastic face.

Mark each of the following statements as either true (T) or false (F) in the space provided.

3. ____ The size of the ball peen hammer is determined by the weight of the head.

4. ____ Hard face hammers are made of material such as leather, lead, plastic, or rubber.

/ /

1 B

2. A

3. True.

4. False. Hard face hammers are made of steel.

FRAME 21. PLIERS

Pliers are available in various types and sizes. They are primarily an extension to your hand and are used to hold material which the hand is not strong enough to grasp tightly. Pliers come in two types, adjustable and nonadjustable. They are not used as a replacement for wrenches. The adjustable pliers include slipjoint pliers and vise grips. Nonadjustable pliers inc chain long nose, flatnose, and diagonal side cutters.

Use and Care of Pliers

a. Do not use pliers to loosen nuts or bolts. Use only proper size wrenches.

b. Do not use plier handles as a pry bar.

c. Cover or hold the ends of safety wire or cotter pins when cutting.

d. Clean and oil pliers frequently.

Mark the following statements either true (T) or false (F) in the space provided.

___ If a wrench is not available, it is permissible to use pliers.

2. ___ An accident can be avoided by covering or holding the ends of cotter pins or safety wire when cutting them.

3. ___ Pliers are divided into two general types.

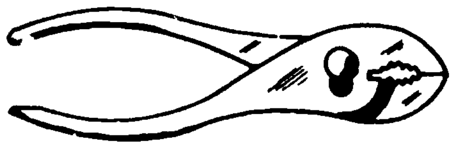
/ /

1. False. Pliers will round off the corners on nuts and bolts.

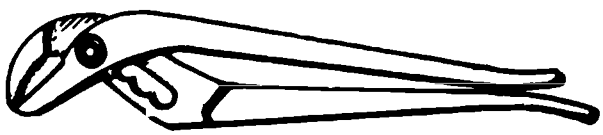
2. True. The ends might hit someone in the eye when cut or cause "foreign object damage."

3. True. They are divided into adjustable and nonadjustable jaws.

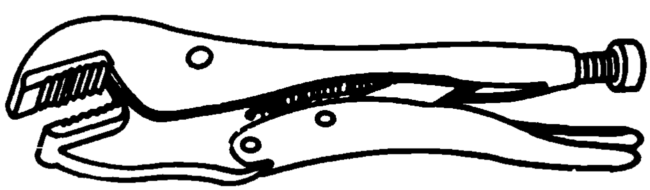
FRAME 22. ADJUSTABLE PLIERS



The most commonly used pliers are the slipjoint pliers, usually called "common pliers". They are used as a general purpose holding tool, and for bending pieces of metal or wire.



Water pump pliers were originally designed to tighten water pump packing gland nuts on cars in the 1920s. They are no longer needed for that purpose, but they are very effective as a "large capacity" holding tool.



Vise grip pliers have a locking device on one jaw. Once adjusted and locked, it is like putting an object in a small vise. This leaves your hands free for other work.

Mark the following statements as either true (T) or false (F) in the space provided.

1. ___ Common pliers are used for general purpose tasks, such as holding and bending pieces of metal or wire.

2. ___ Vise grip pliers can be used to hold two pieces of sheet metal together in preparation for drilling.

3. ___ Water pump pliers are used for holding large objects, such as pipes.

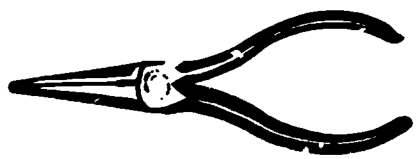
/ /

1. True.

2. True.

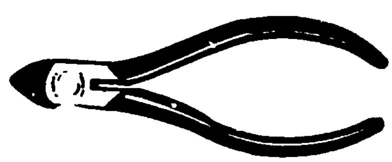
3. True.

FRAME 23. NON-ADJUSTABLE PLIERS



Chain long nose pliers, commonly called "needle nose pliers" have long jaws that come to a point. They are used for grasping small items in tight places where the fingers cannot reach, and to make delicate bends in thin pieces of metal.

Duck bill pliers have long, flat jaws and are designed to be used for pulling and twisting safety wire.



Diagonal side cutting pliers, commonly called "dikes" have jaws with sharp edges and are used for cutting safety wire or removing cotter pins.

Mark the following statements as either true (T) or false (F) in the space provided.

1. ____ Dikes are pliers that have sharp cutting jaws and are used for cutting small diameter wire (safety wire) and for cutting and pulling cotter pins.

2. ____ Needle nose pliers have long, slender jaws and are designed to reach into tight places where the fingers cannot be used.

3. ____ Duck bill pliers have long flat jaws and are designed for twisting and pulling safety wire.

/ / / / / / / / / / / / / / / / / / /

1. True.

2. True.

3. True.

FRAME 24. PUNCHES AND CHISELS

Chisels and punches are made in a variety of shapes to suit many different types of work. They are made from tempered steel and require care and precautions like other tools.

Use and Care of Punches and Chisels.

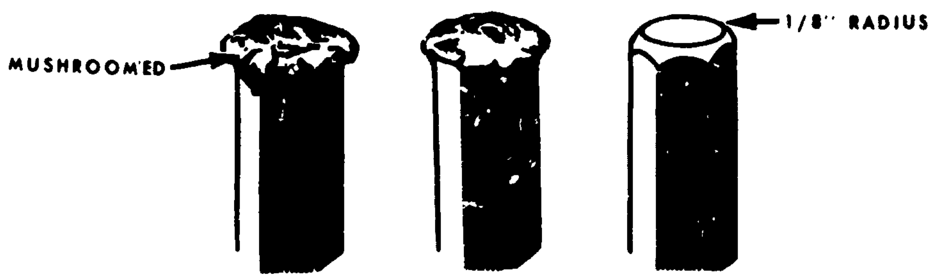
a. Do not use a dull chisel.

b. Use the correct punch when doing a job.

c. During sharpening, use safety apparel (face shield or goggles).

d. Use solvent for cleaning all tools, including punches and chisels.

e. Never use a chisel or punch that has a mushroom head.



The head on the left is badly mushroomed. The one in the center is slightly mushroomed. Both should be dressed until they are in the condition shown at the right.

Mark the following statements as either true (T) or false (F) in the space provided.

1. ___ It is proper to use a dull chisel to remove a nut.

2. ___ When sharpening a chisel, use a face shield or goggles.

3. ___ Mushroom headed chisels or punches should not be used.

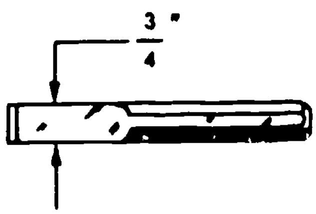
/ / / / / / / / / / / / / / / / / /

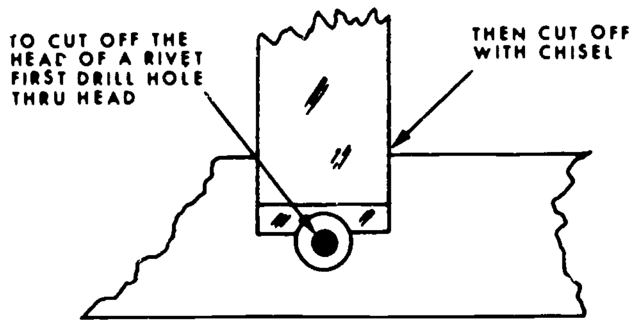
1. False. A dull chisel will cause chips to fly and possibly injure someone.

2. True. When you sharpen a chisel, use a face shield or goggles.

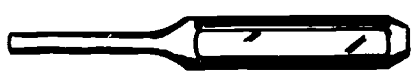
3. True. A chisel or punch in this condition should not be used because the bent edges are likely to break off and injure someone or cause "foreign object damage."

FRAME 25. **PUNCHES AND CHISELS** continued

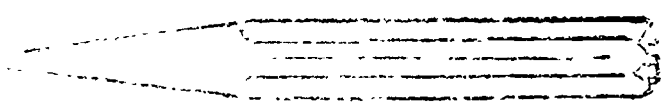




The size of a cold chisel is identified by the width of the blade. The cold chisel derives its name from the fact that it can be used to cut "cold metal". That is without first softening the metal by heating. They are ideally suited for removing the heads from rivets or cutting off stubborn bolts. The cold chisel is sometimes called a flat chisel.



The pin punch has a straight shank and is used to finish the job of driving rivets, bolts, or pins out of holes.



The drive or drift punch is used to start rivets, bolts, or pins out of holes.

Mark the following statements as either true (T) or false (F) in the space provided.

1. ___ **The size of a cold chisel is identified by the width of the blade.**

2. ___ **The pin punch has a thick tapered shank and is used to enlarge holes.**

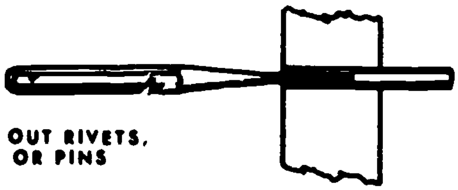
3. ___ The drift punch is used to finish driving rivets or pins out of holes.

//////////////////////

1. **True.** 2. **False.** 3. False

FRAME 26. REVIEW PUNCHES AND CHISELS.

Match the item listed in column B with the correct use in Column A.

COLUMN A	COLUMN B
 DRIVE OUT RIVETS, BOLTS OR PINS	
1. ____________	a. Chisel
 TO CUT OFF THE HEADS OF RIVETS	
2. ____________	b. Pin punch
	c. Drive punch

////////////////

1. b 2. a

FRAME 27. MEASURING TOOLS

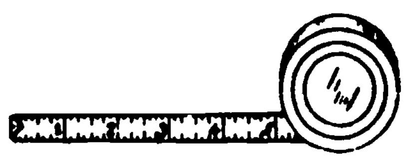
The Air Force has many types of measuring tools. Each type has a specific job. We will cover a few of the more common types used by the mechanic.

Use and Care of Measuring Devices

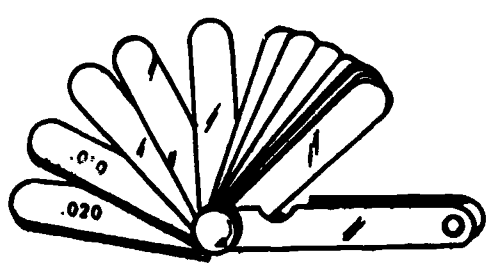
a. Keep all measuring tools clean. Oil lightly.

b. Turn in all tools that are not in good condition.

The simplest tool is the steel rule. Steel rules are made in varicus lengths, usually six or twelve inches. The smallest graduation on a steel rule will be 64ths of an inch.

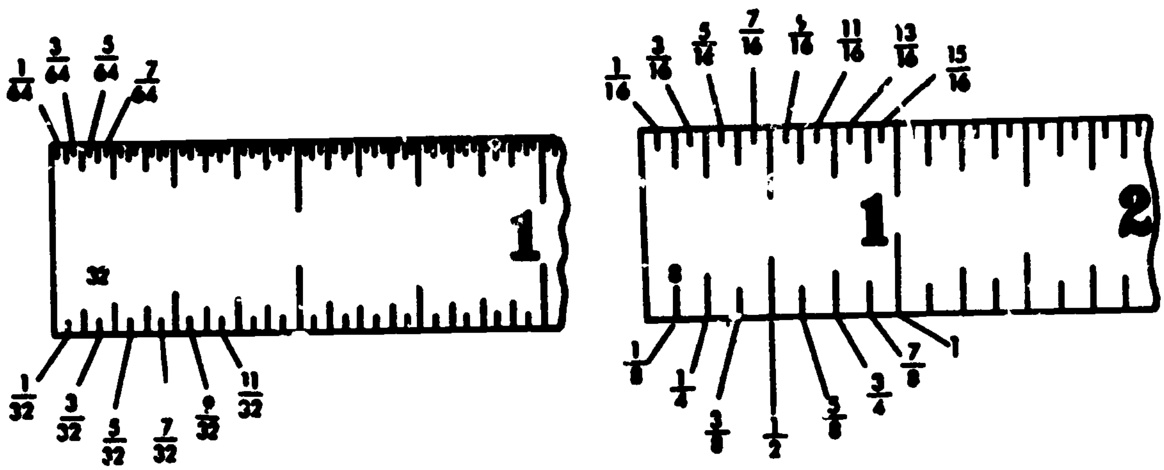


Another type of measuring device is the steel tape. They extend to 6, 8, 10 or 12 feet.



A thickness gage is used to measure the clearance (space) between two parts that fit very closely together. Each leaf of the thickness gage is marked to show its thickness in thousandths of an inch.

FRAME 28. REVIEW FOR MEASURING TOOLS



Using the above views, answer the following questions in the space provided.

1. ___ How many 64ths in 1/2 inch?

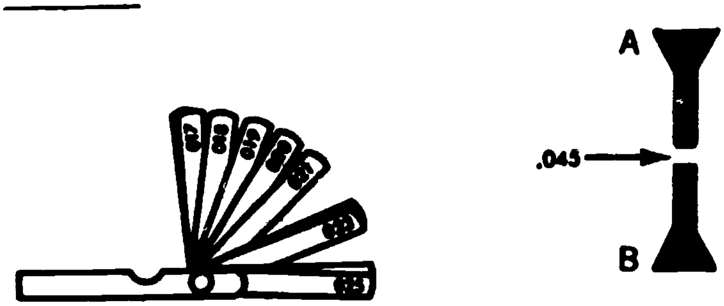
2. ___ How many 8ths in 3/4 inch?

3. ___ How many 16th in 3/8 inch?

4. ___ How many 32nds in 1/4 in

If you had to check the clearance below, which two leaves of the thickness gauge would you use?

5. ________ ________

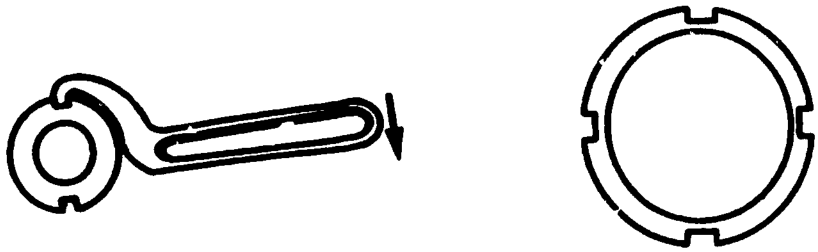


/ / / / / / / / / / / / / / / / / /

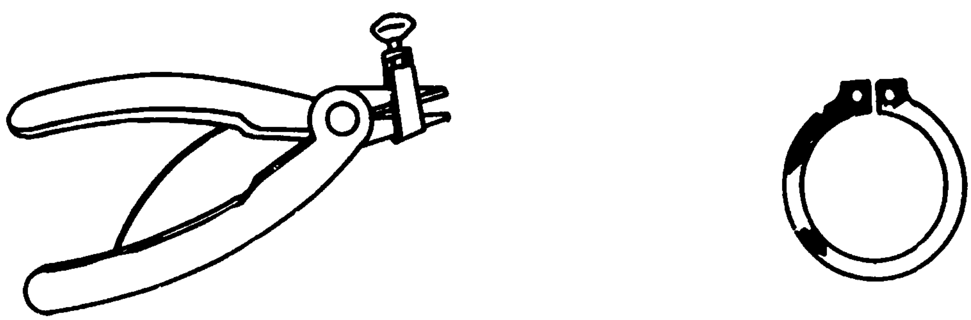
1. 32 2. 6 3. 6 4. 8 5. .022 and .023

FRAME 29. SPECIAL HANDTOOLS

Special tools are designed for specific purooses and can be checked out from the special tool section of your base.



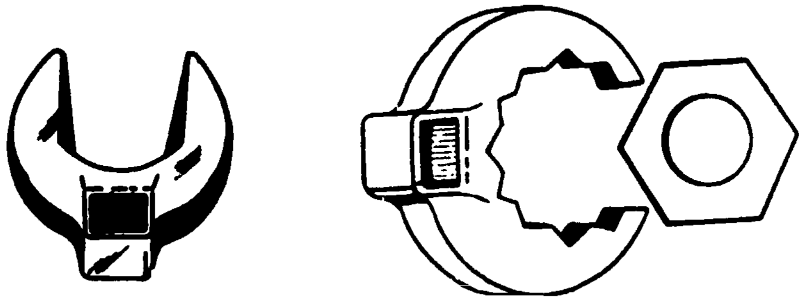
The spanner wrench (external) is made to fit round packing or gland type retaining nuts with lugs or slots in the outer surface, as shown above.



Snap ring extractors are made to slip into the holes in the ends of a snap ring and expand it to remove it, as shown above.

FRAME 30. MISCELLANEOUS HANDTOOLS

Miscellaneous handtools may or may not be issued as part of the mechanics' toolbox.



Another handy wrench for hard-to-reach places is the "crow's foot". This wrench has a female drive on one end and the same handles used with socket sets can be used. The crow's foot may be open end or box end type and is used to torque tubing nuts.

NO RESPONSE REQUIRED

FRAME 31. REVIEW

From memory, write the name of each tool in the space provided..

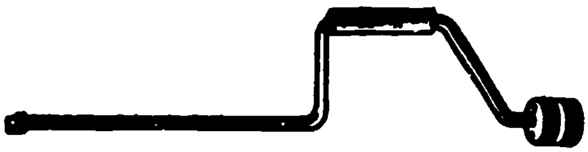
1. ______________________________

2. ______________________________

3. ______________________________

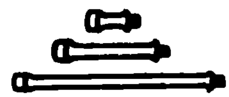
4. ______________________________

5. ______________________________

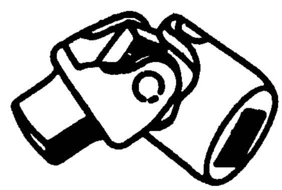


6. ______________________________

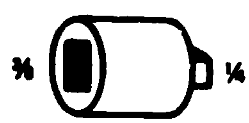
7. ______________________________



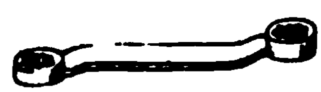
8. ______________________________



9. ______________________________

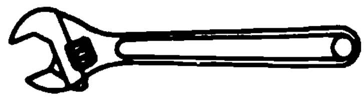


10. ______________________________



11. ______________________________

12. ______________________________



13. ______________________________

14. ______________________________

15. ______________________________

16. ______________________________

17. ______________________________

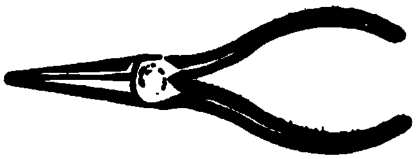
18. ______________________________

19. ______________________________

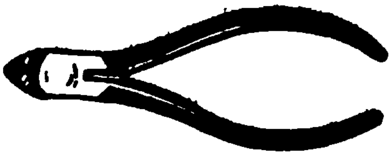
20. ______________________________

21. ______________________________

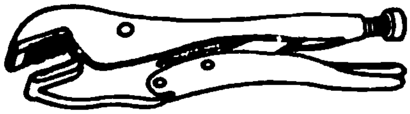
22. ______________________________



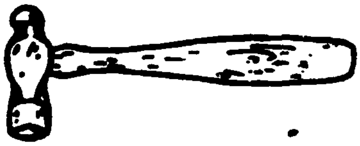
23. ______________________________



24. ______________________________



25. ______________________________

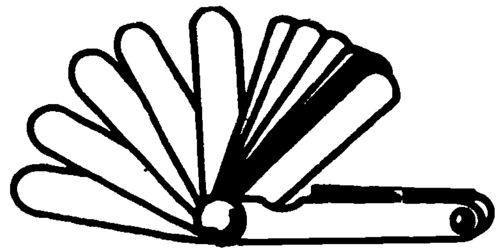


26. ______________________________

27. ______________________________

28. ______________________________

29. ______________________________



Mark the following statements as either true (T) or false (F) in the space provided.

30. ___ Before and after each job, the mechanic should inventory his tools.

31. ___ The mechanic is responsible for keeping his tools oiled and clean.

32. ___ Rags and excess parts should not be stored in the mechanic's toolbox.

33. ___ Aircraft mechanics are financially responsible for their tools.

34. ___ The three groups of components that make up a socket set are attachments, handles, and sockets.

35. ___ The term mushroom head applies to punches and chisels.

36. ___ Box end wrenches are offset 15° to prevent injury to your hand.

37. ___ The tool used for measuring clearance is the thickness gauge.

38. ___ The mechanic's first choice of wrenches would be the socket set.

39. ___ The hammer best suited to drive a chisel would be the ball peen.

40. ___ The Phillips screwdriver is used in cross slot screws having round corners.

41. ___ The open end wrench is used to remove nuts from tubing and hose assemblies.

42. ___ The adjustable jaw of the adjustable wrench should point in the direction of rotation.

43. ___ The hammer used for shaping metal, where metal damage would be critical, is the mallet.

44. ___ Duckbill pliers are used for twisting safety wire.

45. ___ The hinge handle is best used for breaking loose tight nuts and bolts.

46. ___ Diagonal side cutters are used to cut wire and remove cotter pins.

47. ___ Solvent is used to clean grease and dirt from handtools.

48. ___ Lost or missing tools may cause foreign object damage.

49. ___ The socket head setscrew wrench is used in internal wrenching bolts.

50. ___ The Reed and Prince screwdriver is used in screws having cross slots with square corners.

/ / / / / / / / / / / / / / / /

1. Deep well socket.

2. Shallow socket.

3. Ratchet handle.

4. Hinge handle.

5. Speed handle.

6. "T" handle.

7. Extension.

8. Universal.

9. Adapter.

10. Box end wrench.

11. Open end wrench.

12. Adjustable jaw wrench.

13. Allen or hex head.

14. Phillips screwdriver.

15. Standard (common) screwdriver.

16. Reed and Prince screwdriver.

17. Crosspoint offset screwdriver.

18. Standard (common) offset screwdriver.

19. Channel lock pliers.

20. **Slipjoint (common) pliers.**

21. **Flat nose (duckbill) pliers.**

22. **Chain long nose (needle nose) pliers.**

23. Diagonal cutting pliers (dikes).

24. **Vise grips.**

25. **Ball peen hammer.**

26. **Mallet.**

27. **Six inch steel rule.**

28. **Steel tape.**

29. **Thickness gauge.**

Questions 30 through 50 are all true.

If all of your answers in the last three frames are correct, you have completed the Programmed Text portion of this lesson. Raise your hand to let the instructor know you are finished.

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K-4904

WORKBOOK

3ABR42632-WB-~~104A~~ 110A

Technical Training

Jet Engine Mechanic

SAFETY DEVICES

14 August 1979

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3350 Technical Training Group
Chanute Air Force Base, Illinois

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Jet Engine Branch
Chanute AFB, Illinois

3ABR42632-WB-104A

SAFETY DEVICES

OBJECTIVES

When you have completed this workbook and your classroom instruction. you will be able to identify safety devices used on aircraft engines.

EQUIPMENT

	Basis of Issue
3ABR42632-SG-104A, 104C	1/student

PROCEDURE

Use the information presented in the classroom discussion, study guides, and aid from the instructor. Fill in the spaces provided with the correct information.

Use the following list of words to complete item 1.

external teeth	keyed	spacer	tab	spring
internal teeth	lock	split	tech order	

1. Washers

a. Types of washers

(1) Plain

(a) Used under ___________ washers to prevent damage to soft metals.

(b) Used as a ___________ for adjustments, like aligning a castellated nut to match a drilled hole in a bolt.

(2) Lockwashers

(a) There are many types of lockwashers but the three that are most commonly used are:

1 _________

2 _________ _________

3 _________ _________

Supersedes 3ABR42632-WB-102E, 7 June 1978.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-J - 2400; TTVSA - 1

(b) Lockwashers are used with plain nuts and have ________action.

(3) Special

(a) There are many different shapes and varieties of special washers and two of the most commonly used are the ____________ and ____________.

(b) Be sure to check the ________ ________ to see where special washers can be used.

Use the following list of words to complete item 2.

cotter pins   quick release   castle

2. Pins

a. Types of Pins

(1) ________ ________ are used to secure such items as nuts, bolts, screws, pins, and shafts. Cotter pins are used with drilled shank bolts, studs, and __________ nuts.

(2) ________________ pins are used where rapid removal is necessary. (Example: Jet engine maintenance stands.)

Use the following list of words and numbers to complete item 3.

2	confused	jewelry	tech order
3	copper	lug	tighten
4	cut	mutilated	together
6	dikes	overstressed	tools
24	duckbills	per inch	torque
across the head	end	size	twist
aluminum	FOD	size	twist
annealed	geometrical	strand	wire
around the head	hardware	strip	zinc

3. Safety Wire (Lockwire)

a. Safety wire is used to secure aircraft ____________ that has no other locking device.

b. Types of lockwire.

(1) ________ coated, soft steel wire is used on drilled head bolts, fillister screws, snap rings, and other similar items.

(2) _________ corrosion-resistant steel wire is used in the hot section of the engine. Most widely used type.

(3) ________ or _________ wire is very thin and is used as a seal to secure such things as safety switches and fire extinguishers.

Note: Steel and aluminum wire should not be _________.

c. Two methods of safety wiring.

(1) Double __________ methods.

(a) There are _________ ways of doing the double twist method.

(b) The two ways are:

1 __________ __________ ___________, where the wire is wrapped around the head of the bolt or screw.

2 __________ __________ ___________, where the wire is laid over the head of the bolt or screw.

(2) Single ___________ method.

(a) Use single strand only where specified in the

_____ ______________.

(b) Bolts are usually in a ____________ pattern.

d. Lockwiring electrical coupling nuts (cannon plugs).

(1) Properly ___________ cannon plugs.

(2) Use double _____________ method for lockwiring cannon plugs.

(a) Cannon plugs can be lockwired to a wire

_____________.

(b) Two cannon plugs can be lockwired ___________.

(3) Be careful not to ___________ out lockwire hole in cannon plug.

(4) Check tech order for proper lockwire ___________, procedures and illustrations.

e. Lockwire procedure.

(1) Remove all ____________.

(2) Select proper tools - they are __________ and __________ ___.

(3) Maximum or ________ units wired together.

(4) Maximum span of lockwire between tension points is __________ inches.

(5) Wire length not to exceed _________ inches.

(6) Check tech order for proper wire ___________.

(7) Lockwire must not be nicked, kinked, or __________.

(8) Duckbills to be used on the _____________ of the wire only.

(9) Lockwire must tend to ______________ at all times.

(10) Wire must be tight but not ___________________.

(11) 7 to 10 twists ___________ ____________ between the bolts.

(12) Pigtail should have at least ________ full turns and bent down or under.

(13) Place hand over _____________ when cutting.

(14) Always ____________ lockwire, never twist off.

(15) Place ____________ in proper container.

(16) Replace ___________ in tool box.

REVIEW QUESTIONS

1. The three types of washers are __________, ___________, and __________.

2. Plain washers are used under _____________ washers to prevent damage to soft metals.

3. ____________ washers may be used as spacers for adjustments when necessary.

4. ____________ washers use spring action as its locking feature.

5. Two types of special washers are _________ and ____________.

6. Quick release pins are used where __________ _________ is necessary.

7. ______________ pins are used to secure such items as bolts, nuts, screws, pins, and shafts.

8. ______________ is used to secure hardware items that have no other locking device.

9. List the three types of lockwire.

a. ________________________________

b. ________________________________

c. ________________________________

10. The two methods of lockwiring are ___________ _____________ and ____________ ______________.

11. Two ways of doing the double twist method is _______________ and ________________.

12. The _____________ ____________ method is used only where specified in the tech order.

13. Use the double twist method for lockwiring ______________ plugs.

14. Cannon plugs may be lockwired ____________ or to a wire __________.

15. Be very careful when lockwiring cannon plugs as not to strip out the lockwire ____________.

16. A maximum of ___________ units should be lockwired together.

17. Lockwire must not be ___________, _________, or ____________.

18. Lockwire should be tight but not ______________________.

19. The maximum length of safety wire you can use is _________ inches.

20. Seven to ten __________ ___________ ___________ is the desired number of twists between the bolts.

21. Steel and ____________ wire look very much alike and should not be confused.

22. Always check the __________ ____________ to find out what size lockwire the job requires.

23. _____________ wire is sometimes used instead of copper wire for safetying fire extinguishers, first aid kits, and other emergency equipment.

24. Care should be taken not to confuse __________ with aluminum wire.

25. Maximum ____________ of lockwire between tension points is 6 inches.

26. Always ___________ lockwire, never twist off.

27. ______________ should have at least 3 full turns and ___________ down or under.

28. Place your ____________ over the lockwire when cutting.

29. Remove all ____________ before starting to work.

30. The proper pliers to use for lockwiring is the ____________ and ______________.

31. Lockwire must ____________ to ___________ at all times.

32. ______________ pliers should be used on the end of the wire only.

33. Place FOD in proper _______________.

Use the following list of words to identify figures 1 through 12.

around the head	keyed washer	single strand method
across the head	external teeth	split washer
cotter pin	plain washer	spool of lockwire
double twist method	quick release pin	tab washer
internal teeth		

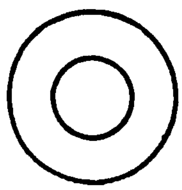

Figure 1.

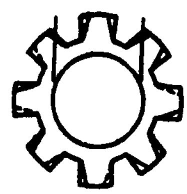

Figure 2.

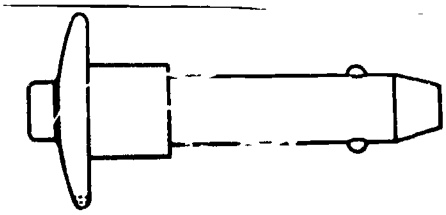

Figure 3.

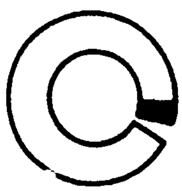

Figure 4.

Figure 5.

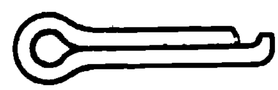

Figure 6.

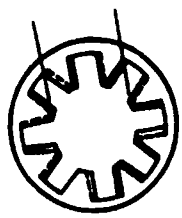

Figure 7.

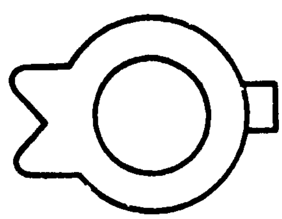

Figure 8.

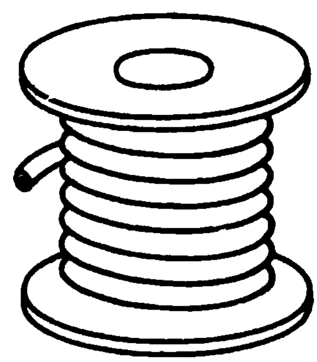

Figure 9.

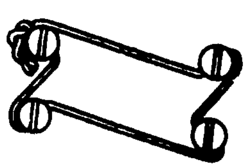

Figure 10.

Figure 11.

Figure 12.

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Chanute AFB, Illinois

3ABR43230-WB-102D
19 November 1974

TORQUE WRENCHES

OBJECTIVES

When you have completed this workbook, you will be able to:

1. State the purpose and proper use of torque wrenches.

2. State the method used for torque conversion.

EQUIPMENT

	Basis of Issue
3ABR43230-SG-103E	1/student

PROCEDURE

Use the information presented in the classroom presentation, discussion, study guide, and aid from the instructor. Fill in the spaces provided with the correct information.

1. Torque wrenches are used to obtain a predetermined ______________ value as prescribed in the technical orders and manuals.

2. Torque Conversions: 12 inch-pounds equal ______________ foot-pound.

a. To change:

(1) Foot-pounds to inch-pounds, you __________ by 12.

(2) Inch-pounds to foot-pounds, you __________ by 12.

b. Work the following problems:

(1) 60 foot-pounds equals __________ inch-pounds.

(2) 216 inch-pounds equals __________ foot-pounds.

(3) 576 inch-pounds equals __________ foot-pounds.

(4) 75 foot-pounds equals __________ inch-pounds.

This supersedes 3ABR43230-WS-102D, 21 March 1973. RGL: N/A
OPR: TAR
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TAR - 2800; TTOC - 2

Choose from these words to complete items 3 through 20.

bolts	fast	smooth
breakaway	jerky	steady
capacity	lock	techniques
color code tape	lowest	sixty
common tools	memory	torque
date	nuts	torque control
extension	overtorque	verified
smooth	release	overtorque

3. The most common type of torque wrench used in the Air Force is the ______________ type.

4. When the torque reaches a preset value, the handle will ______________ or breakaway approximately 15 degrees travel.

5. When the mechanic feels the handle release, he knows the proper ______________ has been reached.

6. Once the torque wrench has released <u>DO NOT PULL AGAIN</u>, not even to recheck the torque, as this will ______________ the bolt.

7. Unlock and rotate the grip to the desired torque setting on the shaft, then ______________ the grip in place.

8. Torque should be applied in a ______________ and ______________ motion to prevent overtightening.

9. With a ______________ or ______________ pull, you might not feel the breakaway action of the torque wrench and could easily ______________ the bolt or nut.

10. Torque control, as it is called, is the ability to apply torque in a ______________, steady motion.

11. Proper tightening of aircraft hardware is called ______________ ______________.

12. A good mechanic will not take torque control lightly, and will be familiar with correct torque application ______________ and procedures.

13. Torque wrenches are precision instruments and are not to be used as ______________ ______________.

14. <u>NEVER</u> back off ______________ or ______________ with a torque wrench.

15. Don't use a torque wrench to apply more force than the rated ______________ of the tool.

16. <u>NEVER</u> use an ______________ on the handle or grip end.

17. Before storing the torque wrench, return the handle to the _______________ setting on the shaft.

18. Torque wrenches should be _______________ every _______________ days or when dropped, and recalibrated if necessary.

19. Each time a torque wrench is verified, the _______________ and _______________ _______________ _______________ will be placed on the shaft.

20. Always check the technical order for correct torque values, NEVER RELY ON _______________.

QUESTIONS

1. You multiply by 12 to change __________ - __________ to __________ - __________.

2. Convert 780 inch-pounds to foot-pounds. Ans: __________

3. One foot-pound equals _______________ inch-pounds.

4. Convert 55 foot-pounds to inch-pounds. Ans: __________

5. The _______________ torque wrench releases when the torque reaches the setting on the wrench.

6. Never recheck _______________ as this will cause overtightening.

7. Torque should be applied in a _______________, _______________ motion.

8. Correct torque application techniques and procedures are called _______________ _______________.

9. Torque wrenches are precision instruments and are not to be used as common _______________.

10. Never go beyond the _______________ action of a torque wrench.

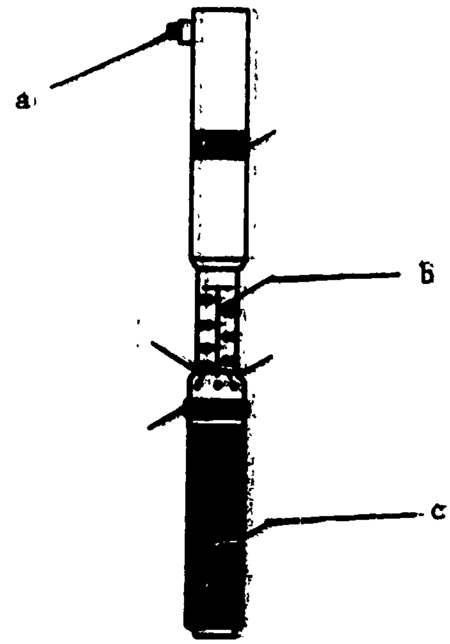
11. _______________ are not to be used on the handle or grip end.

12. Return the _______________ to the lowest setting before storing.

13. Torque wrenches should be calibrated or verified every _______________ days or when _______________.

14. What is placed on the shaft of torque wrenches to indicate when the next due date is for verification or calibration? Ans: _______________ and _______________ _______________ _______________

15. ________________ ________________ will always specify correct torque values.



16. Identify the three basic parts of the torque wrench.

a. ____________________

b. ____________________

c. ____________________

337

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-HO-110A
4 May 1983

HARDWARE

OBJECTIVE

Using handout, the identification and lockwiring trainer, and handtools, remove and install three nuts and bolts. Two of the three nuts and bolts must be removed and installed correctly with no more than one error allowed.

EQUIPMENT

	Basis of Issue
Trainer	1/student
Tools	

INSTRUCTIONS

Read this checklist thoroughly prior to starting.

PROCEDURE

1. Select proper tools.

2. Turn tools in correct direction.

3. Remove three nuts and bolts.

4. Reinstall three nuts and bolts.

5. Turn tools in correct direction (do not tighten the nut or bolt).

6. Keep safety in mind.

7. Secure tools after finishing.

Supersedes C3ABR42633-HO-110A, 18 November 1982.
OPR: 3350 TCHTG RGL: N/A
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3350 TCHTG/TTGU-B - 300; DAV - 1
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1108

Jet Engine Branch
Chanute AFB, Illinois

3ABR42632-WB-~~104B~~
3ABR42633-WB-~~104B~~
7 April 1980

AIRCRAFT AND ENGINE HARDWARE

OBJECTIVES

When you have completed this workbook and your classroom instruction, you will be able to identify and state the purpose of selected hardware items.

EQUIPMENT

	Basis of Issue
3ABR42632-SG-104A/3ABR42633-SG-104A	1/student

PROCEDURE

Use the information presented in the classroom presentation, discussion, study guide, and aid from the instructor. Fill in the spaces provided with the correct information.

1. Screws

a. A screw has a lower material strength than a

_______________________.

b. Generally speaking if you can use a ________________ or Allen wrench on it, its called a screw.

c. Four main groups of screws

(1) ________________ - Found in the framework of the aircraft.

(2) ________________ - Used where high material strength is not important.

(3) ________________ - Cut their own threads in the material.

(4) ________________ - Used to hold pulleys or gears on shafts.

Supersedes 3ABR43230-WB-102F, 1 November 1972.
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3350 TCHTG/TTGU-J - 3,300; TTVSA - 1

RGL: N/A

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2. Bolts

a. Bolts are stronger than _______ ____.

b. Available in many special designs as well as _______ shapes and designs.

c. Types of bolts used

(1) _______ -
Used throughout the aircraft frame and engine.

(2) _______ - -
The wrench goes inside the head of the bolt.

(3) _______ -
Fits the hole very tightly and used where there is vibration or load reversals.

(4) _______ -
Made for special applications.

d. When removing and replacing bolts it is important that you use _______ bolts.

e. Identification markings

(1) Bolts are marked with a code to identify their physical _______.

(2) Some examples of markings on bolts are:

(a) + _______ _______

(b) - _______ _______

(c) - - _______ _______

(3) Many bolts are marked with _______ _______ which indicates specific metals and alloys.

f. Bolt size is determined by:

(1) _______

(2) _______

(3) _______ _______ - _______

3. Nuts

a. Nuts are used to properly ______________ the bolted assembly.

b. Identification markings on nuts are the same as

______________.

c. Tightening of nuts and bolts

(1) Check the specific TO for proper ______________ value.

(2) Always use proper ______________ procedures when tightening nuts and bolts.

4. Studs

a. Studs are used to ______________ removable parts to castings made of soft metals.

b. Types of studs used are:

(1) ______________

(2) ______________

c. Studs can be ______________ or ______________ on the nut end.

5. Hoses

a. Hoses are used for making ______________ that move or subject to vibration.

b. Hoses will ______________ so the movement will not do any harm.

6. Tubing

a. Tubing is used to carry ______________ and

______________.

b. Types of tubing

(1) ______________ ______________ - Used in high pressure systems.

(2) ______________ ______________ - Used in low pressure systems.

c. Color coding for tubing

(1) Color coding on tubing aids in ___ ___________ identification.

(2) Most common colors used are:

(a) Red = ____________

(b) Yellow = ____________

(c) Blue & Yellow = ____________

(d) Red - Grey - Red = ____________ ____________

REVIEW QUESTIONS

1. Name the four main groups of screws

2. Which type of screw is used to secure a pulley to a shaft?

3. A sheetmetal screw is an example of a ____________

____________ screw.

4. If you can use a screwdriver or an ____________

____________ on the head, its generally called a screw.

5. Name the four types of bolts. ____________

____

____

6. ____________ have a higher material strength than a screw.

7. Which type of bolt is used where there is vibration or load reversals?

8. When you remove and replace a bolt make sure the

replacement bolt is a like ____________.

9. Allen wrenches are used on ____________ ____________ bolts.

10. Steel alloy bolts are marked with a ________ ______.

11. Aluminum alloy bolts are marked with a ____________.

12. Corrosion resistant steel bolts are marked with a

________________.

13. The size of a bolt is determined by the ______________,

________________, and ______________________________

________________.

14. Always check the TO for proper ________________ value on nuts and bolts.

15. Two types of studs used on engines are ______________

and ________ ________.

16. Connections that move or subject to vibration are joined

by ________________.

17. Two types of tubing used is ______________________

and ________________________________.

18. Color coding on tubing is used for rapid ______________.

19. Red color coding designates ________________ lines.

20. Blue and yellow color coding designates ______________ lines.

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-HO-110b
11 May 1983

TORQUE WRENCHES

OBJECTIVE

Using a Handout, trainer, and torque wrenches, torque three nuts/bolts. Two of the three nuts/bolts must be torqued correctly, with no more than one error allowed.

INSTRUCTIONS

Read this checklist thoroughly prior to starting.

PROCEDURES

1. Inspect for damage.
2. Check calibration date.
3. Set torque value (1/4 = 75 in. lbs, or 3/8 = 110 in lbs).
4. Torque bolt or nut to the torque valve.
5. Return torque setting to the lowest setting.
6. Place torque wrench in box, close lid.
7. Do not drop torque wrench during progress check.

Supersedes C3ABR42633-HO-110b, 29 October 1982.
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RGL: N/A
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Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-HO-110C
4 May 1983

LOCKWIRING

OBJECTIVE

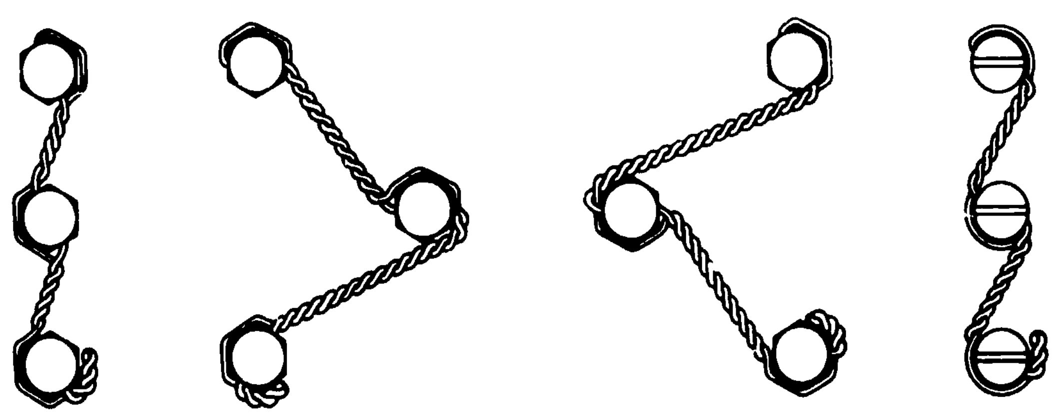
Using a handout, safetying devices, and trainer, safety three (3) bolts together, with no more than two errors allowed.

INSTRUCTIONS

Use this handout to determine the sequence in which you will perform this task. Refer to examples 1 through 4 as needed.

INFORMATION

1. Select proper tools.
2. Proper wire size.
3. Measure wire.
4. Lockwire must tend to tighten.
5. 8 to 10 twists per inch.
6. Pigtail-3-6 turns, bent down and under.
7. Place hand over wire when cutting.
8. Put FOD in proper container.
9. Replace tools.
10. Reinventory and secure tool box.



EXAMPLE 1 EXAMPLE 2 EXAMPLE 3 EXAMPLE 4

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STUDY GUIDE

3ABR42633-SG-201

Technical Training

Turboprop Propulsion Mechanic

TURBOPROP ENGINE OIL SYSTEM

3 January 1980

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

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Jet Engine Branch
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3ABR42633-SG-201

TURBOPROP ENGINE OIL SYSTEM

OBJECTIVE

After comp

After completing this study guide and your classroom instruction, you will be able to state the purpose, units, location, and operating principles of the T56 engine oil system.

INTRODUCTION

The purpose of the oil system is to cool, lubricate, and clean the oil wetted parts of the engine. The T56 engine oil system has parts located in the aircraft nacelle as well as on the engine. It is a dry sump type oil system with the oil tank being located in the aircraft nacelle.

INFORMATION

The T56 power section and reduction gear assembly have separate and independent oil systems which use a common airframe furnished oil tank. The power section contains an independent lubrication system with the exception of airframe furnished parts which are common to both the power section and reduction gear assembly.

PRESSURE OIL SYSTEM

Aircraft Mounted Major Units

Refer to figure 1 for the aircraft mounted major units. Although some of the items in figure 1 are not discussed in this study guide, study them so you will be able to identify them by their names.

OIL TANK. A stainless steel, nonself-sealing engine cil tank is located above the engine in the forward section of the nacelle. The tank is serviced through a scupper type f'ller, which has an overflow drain to direct excess oil overboard during servicing. A calibrated oil level bayonet gage is attached to the screw-type filler cap. Each oil tank has an oil capacity of 12 gallons, plus an additional 7.5 gallon air space, and provides for removal of air from the returned engine oil. The oil tank sump is located at the bottom of the tank. A drain valve in the bottom of the sump aids in draining the sump and engine oil tank.

OIL TANK PRESSURIZING VALVE. An engine cil tank pressurizing valve is used to pressurize the oil tank by controlling the flow of oil released air from the tank. The valve contains an air-operated poppet valve and a vacuum relief feature. The purpose ot the oil tank pressurizing valve is to keep the oil in the tank under pressure to ensure a continuous flow of oil to the power section and gearbox. The oil tank pressurizing valve vents into the overboard drain.

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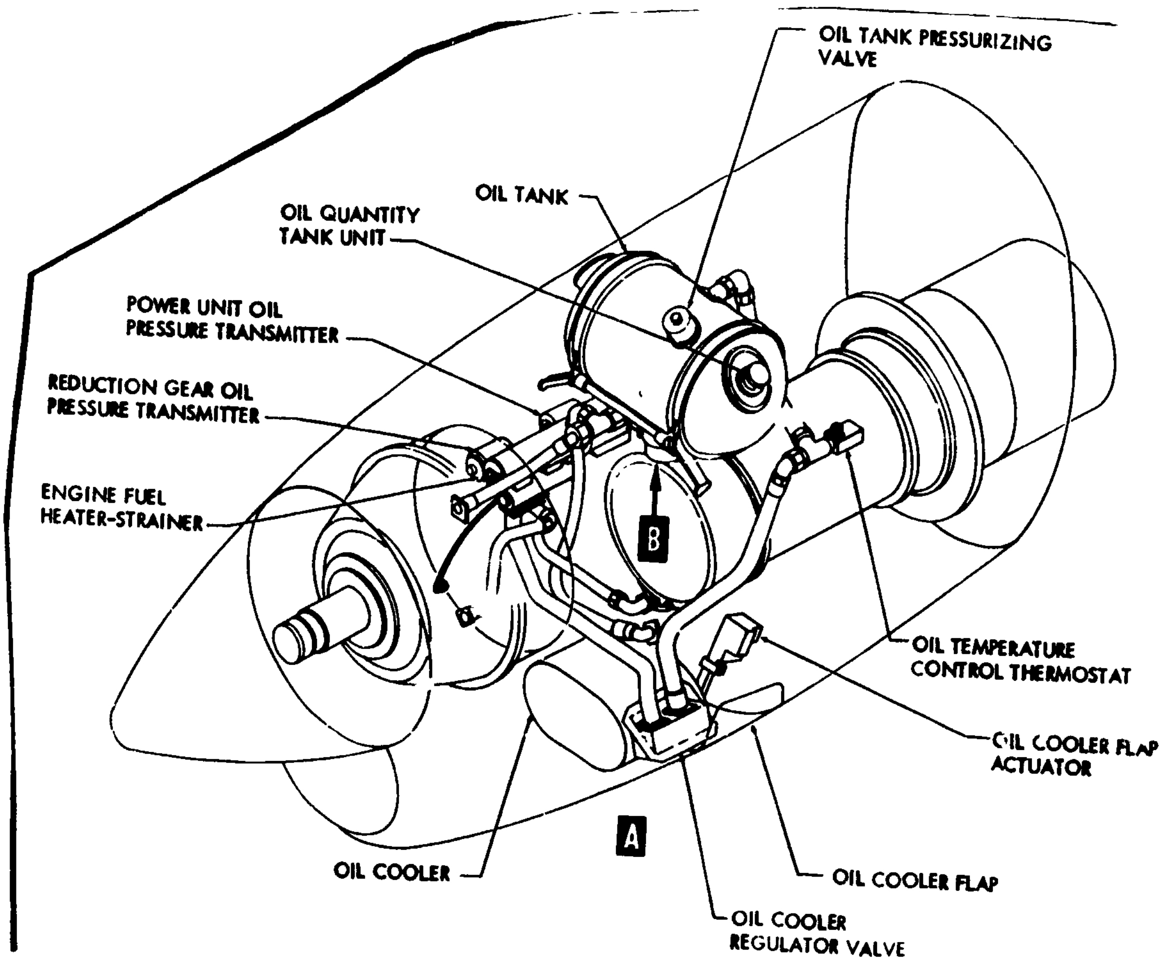

Figure 1. Engine Oil System Components Locations.

OIL SHUTOFF VALVE. A motor-operated oil tank sump gate type valve is attached to the oil sump. The valve is an energize-to-open, energize-to-close type with a manual override for servicing the valve. The open and closed positions are indicated on the valve. The valve receives power from the essential DC bus. Power passes through the normally closed contacts of the fire emergency handle to drive the oil shutoff valve motor and open the valve. When the fire emergency handle is pulled, power will drive the motor to close the oil shutoff valve.

OIL TEMPERATURE BULB. One resistance type oil temperature bulb is located in the engine oil tank outlet line on each of the four engines. The four oil temperature indicators on the engine instrument panel receive their power from the essential DC bus. One circuit breaker on the co-pilot's side circuit breaker panel protects each system.

ENGINE FUEL HEATER AND STRAINER. An engine fuel heater and strainer transfers engine oil heat to the fuel being supplied to the engine, to prevent icing of the fuel system parts. A thermostatically controlled bypass valve is located on the oil side of the heater core. It limits the temperature of the fuel to the engine by directing the oil supply either through or around the fuel heater.

OIL COOLER. The oil cooler is mounted in the lower portion of the engine nacelle and can be reached through the oil cooler access panel. The oil cooler radiator is elliptical in shape. It is made of aluminum alloy, a welded and braced shell assembly with a core equipped with tubes, heater plates and baffles which direct the flow of oil through the cooler, and a bypass jacket to serve as a warmup passage for the oil. The cooler has a bypass and cooler inlet port, a bypass outlet port, and a cooler outlet port. The cooling capacity of the oil cooler is governed by the flow of air through the core tubes. The flow is controlled by the position of the oil cooler flap. The oil cooler mounts the oil cooler regulator valve, which thermostatically regulates the temperature of the oil leaving the oil cooler and also provides high pressure surge protection of the cooler. The oil cooler drain can be reached by removing the oil cooler drain access cover. Two strap assemblies secure the oil cooler in position in the air duct.

OIL PRESSURE TRANSMITTER. Two oil pressure transmitters are located on each engine. A dual oil pressure indicator is located on the main instrument panel in the flight station to show transmitted pressures. One transmitter is connected to the reduction gear section of the engine and the other transmitter is connected to the power section.

Engine Mounted Major Units

Refer to figure 2 for the engine mounted major units of the oil system. Although some of the items in figure 2 are not discussed in this study guide, study them so you will be able to identify them by their names.

MAIN OIL PUMP. The main oil pump is mounted on the front of the accessory drive housing cover. The pressure element supplies all pressure oil to the power section and the scavenge element scavenges oil from the accessory drive housing. It is a two-element pump, (pressure element and scavenge element) driven by a common shaft. Both elements are spur gear type pumps with a capacity of 7 gallons per minute at 100% rpm.

PRESSURE REGULATING VALVE. The pressure regulating valve is located in the body of the main oil pump. Its purpose is to bypass oil from the filter outlet back to the pressure element inlet, and regulates filter outlet oil pressure to 50-60 psi. It is a poppet type valve which is always bypassing a certain amount of oil. It can be field adjusted to regulate filter outlet oil pressure to 50-60 psi.

OIL FILTER. The oil filter is housed in the cover of the accessory drive housing on the front right-hand side. The oil filter is an 11 wafer stack, 117 micron element. One micron is equal to .000039 millionths of an inch.

Reduction Gearbox Mounted Major Units

Refer to figure 3 for the reduction gearbox mounted major units. Although some of the items in figure 3 are not discussed in this study guide, study them so you will be able to identify them by their names.

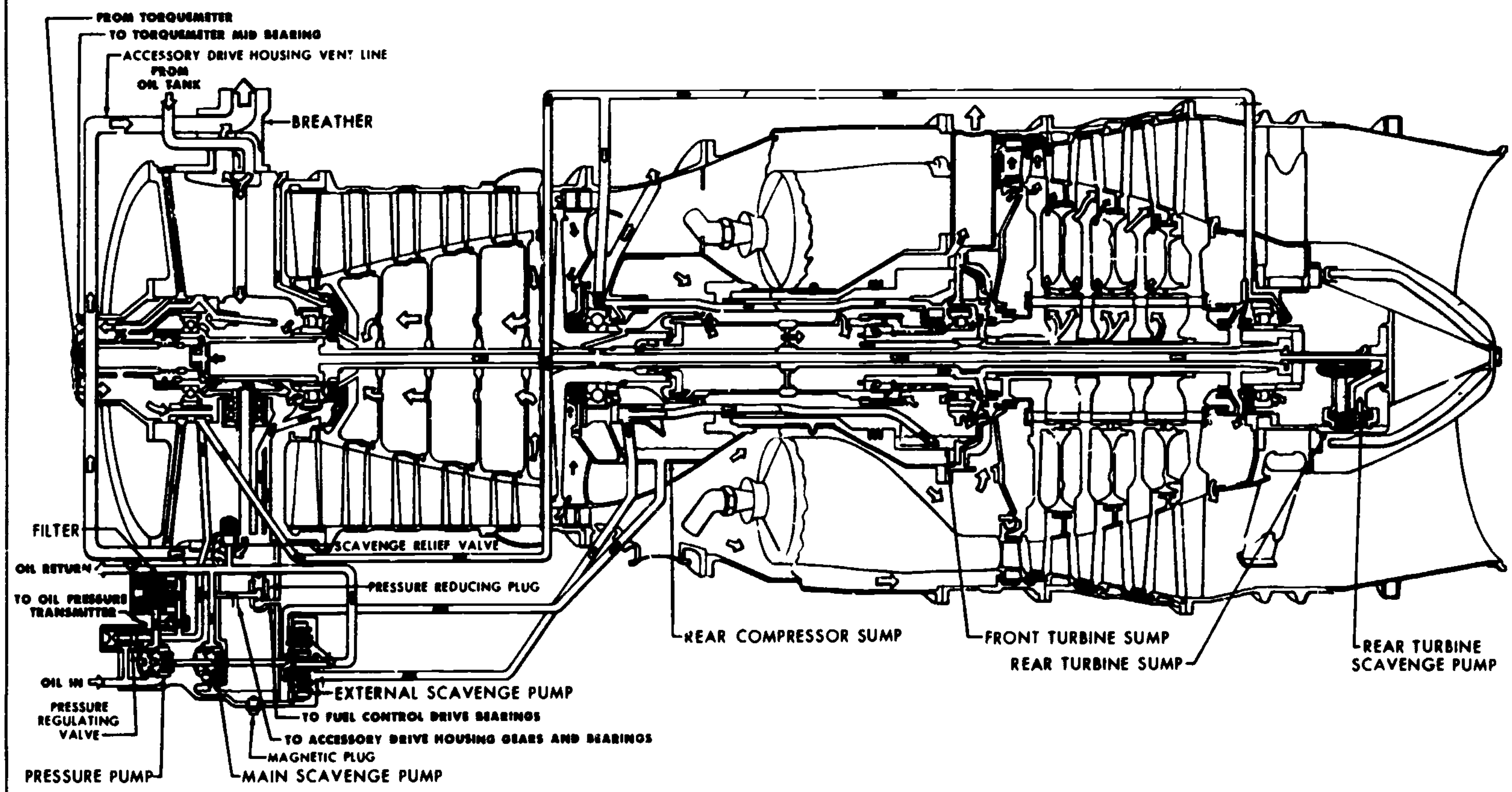

Figure 2. Power Section Oil System Schematic T-56 - A-7 and T56-A15.

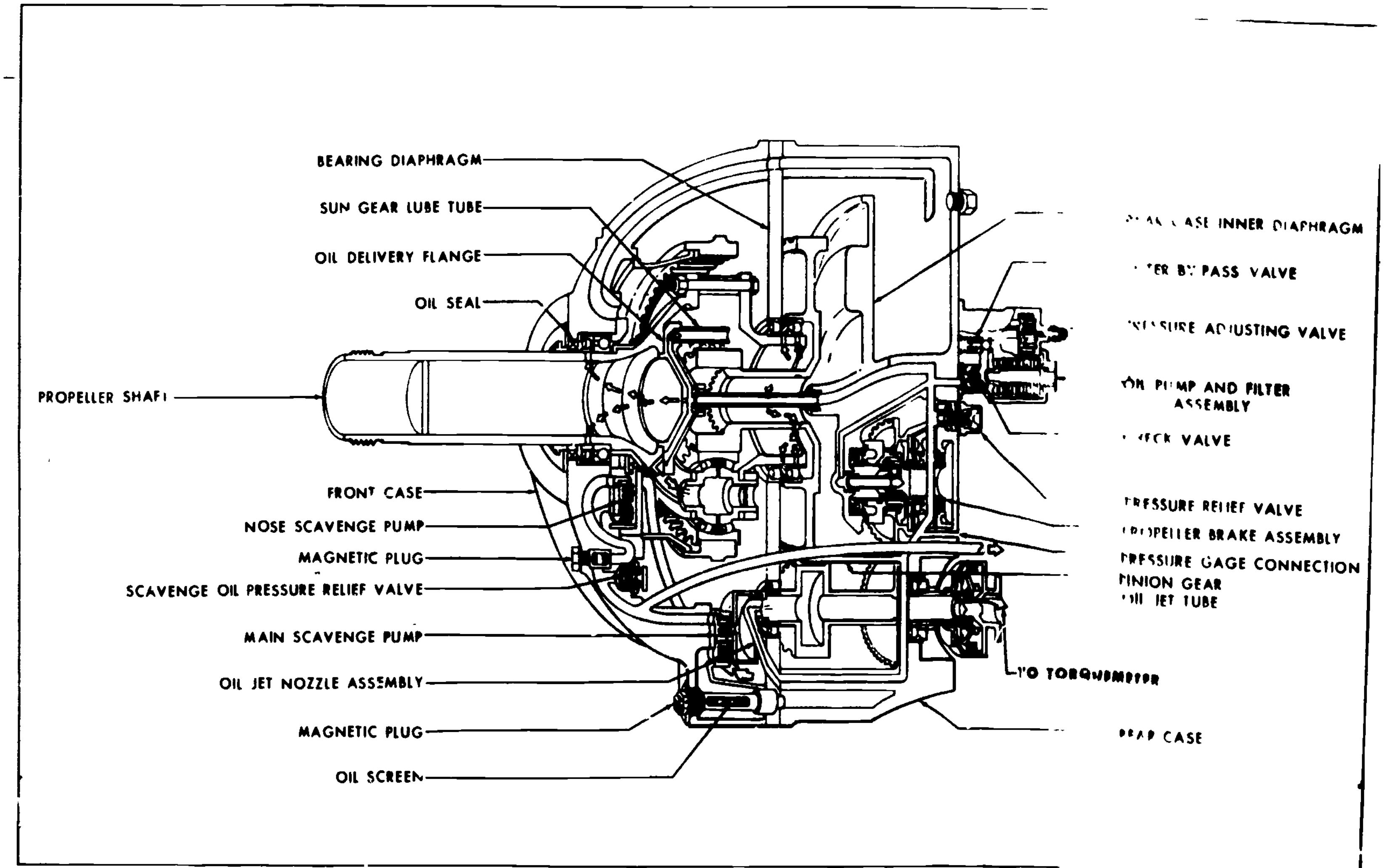

Figure 3. Reduction Gear Oil System Schematic for T56-A-7, -15 Engine (There are minor differences in -9 engines).

PRESSURE PUMP AND FILTER ASSEMBLY. The pressure pump and filter assembly is located on the upper side of the rear case. The pump is the spur gear type and the output capacity is 17.5 gallons per minute. The filter is a 13 wafer stack, 117 micron element, and incorporates a bypass valve set at 300 psid which functions if the filter becomes clogged.

SCAVENGE OIL SYSTEM

Refer to figures two and three as you study the following text.

Major Units

TURBINE REAR SCAVENGE PUMP. The turbine rear scavenge pump is mounted in the turbine scavenge oil pump support. Its purpose is to scavenge turbine rear bearing oil. It is the spur gear type driven by the bevel gear and the side gear on the rear scavenge oil pump drive gear shaft. The rear scavenge oil pump drive gear shaft splines into the turbine scavenge pump drive shaft coupling which furnishes the drive for the pump.

EXTERNAL SCAVENGE PUMP. The external scavenge pump is mounted on the center rear pad of the accessory drive housing and its purpose is to scavenge oil from the diffuser sump, combustion inner casing, and the turbine front bearing oil sump. It is the spur gear type; three gears and two elements. It picks up oil from the sump area by two tubes, one connected to each element. The external scavenge pump discharges into the scavenge discharge of the main pressure and scavenge pump mounted on front of accessory drive housing.

REDUCTION GEARBOX NOSE SCAVENGE PUMP. The nose scavenge pump is secured to the nose bearing plate and it scavenges oil during the nose-down flight attitude. The outlet of the nose scavenge pump has passageways that connects in with the outlet of the reduction gearbox main scavenge pump.

REDUCTION GEARBOX MAIN SCAVENGE PUMP. The main scavenge pump is secured to the forward case of the reduction gearbox. It scavenges oil during any normal flight attitude except nose-down. It is a spur gear type pump.

OIL FLOW

Refer to figures 1, 2, and 3 as you study the following text. Oil flow is gravity fed from the oil tank to the oil pumps on the engine and the gearbox. After the oil leaves the engine oil pump it passes through the filter. Once the oil leaves the filter it lubricates the necessary parts of the accessory housing and then on into the air inlet housing through a passage in the bottom vertical strut of the air inlet housing. The oil then passes through oil jets to lubricate the front compressor bearing, mid-torque bearing, and torque-to-reference shaft sleeve bearing. From the air inlet housing, oil passes through a drilled passage to an external compressor pressure oil tube assembly. Oil flows rearward through the compressor pressure oil tube and a "T" fitting divides the oil flow at the diffuser. A part of the oil will flow into the diffuser oil tube connection. At the 1 o'clock position of the diffuser, to an oil jet which sprays some of the oil onto the rear compressor bearing and some will be used to lubricate the turbine front bearing. The remainder of the oil will flow into the pressure oil tube aft of the spray shield to a tube mounting pad on the turbine rear bearing support through a double wall tube, which is threaded into the rear bearing oil seal. Oil flows through drilled passages in the oil seal, bearing support, and bearing cap.

The oil that is gravity fed to the oil pump of the reduction gearbox passes through the filter and on to lubricate the gears and bearings in the reduction gearbox.

Once the oil passes over the bearings and gears it has to be picked up and returned to the oil tank. This is the job of the scavenge oil system. This scavenge oil is picked up by the different scavenge pumps located in the engine and gearbox. Before the oil gets to the tank it passes through the fuel/oil heater to prevent icing of the fuel system. This oil is very hot from the friction created by the bearings and gears. This is the reason it passes through the oil cooler before being returned to the tank.

QUESTIONS

1. The purpose of the oil system is to ______________, ______________, and ________________ the oil-wetted parts of the engine.

2. The T56 engine oil system is a ____ ______________ sump type.

3. The capacity of the oil tank is _________ gallons, plus an additional ______________ gallons of air space.

4. The purpose of the fuel heater and strainer is to prevent ________ of the fuel system parts.

5. There are _______ oil pressure transmitters located on each engine.

6. The main oil pump is mounted on the _________ of the ____________ ____________ ______________ cover.

7. The oil pressure regulating valve can be field adjusted to regulate filter outlet oil pressure to ____ ________ psi.

8. The ___________ _____________ pump scavenges oil from the diffuser sump, combustion inner casing, and the turbine front bearing oil sump.

9. The reduction gearbox oil pressure pump is the _____________ __________ type.

10. The oil is fed to the oil pumps by ______________.

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WS-201
31 January 1984

TURBOPROP ENGINE OIL SYSTEM

OBJECTIVE

1. Without reference, identify facts relative to the Joint Oil Analysis Program (JOAP) program.

2. Given TO 1C-130B-2-4, identify principles about the operation of the oil system.

EQUIPMENT

	Basis of Issue
TO 1C-130B-2-4	1/student

INSTRUCTIONS

Complete the statements in section one without reference. Using TO 1C-130B-2-4, complete the statements in section two. Having completed the statements in section two, place the correct TO paragraph number in the blank space found at the end of each completed sentence.

Section 1. JOAP

1. The purpose of JOAP is to indicate how much ______________ particles are in the oil system.

2. The oil sample is taken from the ____________ in the sump.

Section 2. OIL SYSTEM

1. The tank is serviced through a _______________ - type filler, which has an _______________ _______________ to direct excess oil overboard during servicing. (Paragraph #______-__________)

2. The oil quantity transmitter on the engine oil tank ____________________ the indicator light circuit to ________________ when oil quantity in the engine oil tank drops to ____________________ (± 1.2) gallons. (Paragraph #______-_________)

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3. An engine oil tank pressurizing valve is used to

_______ ___ the _________ _________ by controlling

the flow of oil-released air from the _________. (Paragraph

#______-______)

4. If oil tempera e is lower than desired, the flap will

_________ to decrease the volume of _________ _________

through the cooler, and increase oil temperature. (Paragraph

#______-______)

5. A drilled par ge in the lower left-hand strut _________

oil from the _________ _________ to an external pad on the

air inlet housing. (Paragraph #______-______)

6. When a cold-engine start is made, the _________ _________

and _________ valve and the surge valve are open, and the guided

valve is closed. (Paragraph # ______-______)

7. The differential pressure indicator button does not necessarily

indicate that oil is by-passing the _________ since the _________

required to open the by-pass valve is _____ ___ than the pressure

required to extend the indicator button. (Paragraph #______ ______)

8. The thermostatic valve also contains a pressure relief valve

which prevents _________ oil pressure from damaging the cooler

by allowing _________ surges to flow directly to the outlet port.

9. The gear-type pressure pumps and scavenge pumps are installed

in the reduction gear housing and on the power unit to supply the force

for _________ the engine lubricant and maintaining the "______-

______" condition. (Paragraph #______-______)

10. The nose scavenge pump picks up oil which collects in the

_______ _________ front casing and pumps the oil to a common

_______ connected with the main scavenge pump. (Paragraph #______-______)

STUDY GUIDE/WORKBOOK
C3ABR42633-SW-~~207~~ 262

Technical Training

Turboprop Propulsion Mechanic

FUEL SYSTEMS

20 April 1982

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

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Maintenance Training Branch
Chanute AFB, Illinois

TURBOPROP ENGINE FUEL SYSTEM

OBJECTIVES

After completing this portion of the study guide/workbook and your classroom instruction, you will be able to identify the purpose and operating principles of the T56 engine fuel system.

INTRODUCTION

MAJOR UNITS OF THE FUEL SYSTEM

A separate fuel system is provided for each engine. The major units of the fuel system are a starting fuel enrichment system, dual fuel pump, low-pressure paper-element filter assembly, high pressure fuel filter assembly, fuel control, coordinator, electronic temperature datum control, temperature datum valve, fuel manifold and nozzles, and two burner drain valves. The fuel is delivered to the engine fuel systems in the nacelles by the fuel supply system within the aircraft wings.

OPERATION OF THE FUEL SYSTEM

Fuel is supplied by the aircraft fuel system to the inlet of the engine-driven fuel pump assembly. The fuel pump assembly consists of a boost pump and two spur gear type pumps. The gear type pumps may be placed in either series or parallel by an electrically operated paralleling valve located in the high pressure fuel filter assembly. The boost pump output is delivered to the low pressure fuel filter assembly which filters the fuel and delivers it to the high pressure fuel filter assembly, where it is directed to the inlets of the two gear type pumps. The output of the two gear pumps is filtered by the high pressure fuel filter. A pressure switch in the high pressure fuel filter assembly completes an electrical circuit to the fuel pump light in the cockpit to give a warning of a primary gear pump failure. Fuel leaving the high pressure fuel filter takes two paths. One path enters the fuel control and flows through the fuel metering section. Here the fuel volume is corrected to 120% of engine demand. This correction is for RPM, throttle, and air density variations. The second path enters the fuel control through the enrichment valve and bypasses the metering section. The latter path is used only during the initial phase of the starting cycle when the use of the enrichment system is selected by a manually positioned cockpit enrichment switch.

The fuel control delivers metered fuel to the temperature datum valve which provides further correction to the fuel flow. The temperature datum valve is a part of the electronic fuel trimming system and the fuel flow correction made by the temperature datum control. The electronic fuel trimming system compensates for variations in fuel density and BTU content. The temperature datum valve receives more fuel from the fuel control than it delivers to the fuel manifold and is always bypassing fuel. The amount of

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fuel bypassed is determined by the position of a bypass control needle which varies in response to an electrical signal from the temperature datum control amplifier. The amplifier determines this electrical signal by comparing a desired turbine inlet temperature signal to the actual turbine inlet temperature signal provided by a parallel circuit of 18 thermocouples located in the turbine inlet.

Fuel flow from the temperature datum valve is delivered to the fuel manifold through an aircraft furnished flowmeter. The fuel manifold distributes the fuel to six fuel nozzles which atomize and inject the fuel into the forward end of the six combustion liners. A drip valve located at the lowest point of the fuel manifold is used to drain the fuel manifold at engine shutdown. During the starting cycle, a solenoid is energized to close the drip valve. Fuel pressure holds the drip valve closed during normal operation. At engine shutdown, a spring opens the drip valve.

During an engine start, it is desirable to fill the fuel manifold rapidly so that an initial high pressure to the fuel nozzles will allow the nozzles to better atomize the fuel. This insures a better light-off during engine starts. The secondary and primary fuel pumps are placed in parallel during a start to insure sufficient fuel flow to fill the fuel manifold rapidly. If a start is not successful, additional fuel can be delivered to the fuel manifold on the next starting attempt by using the enrichment system. The enrichment system must be "armed" by the cockpit enrichment switch. If the enrichment system is "armed," the enrichment valve will open at 2200 rpm due to the speed sensitive control and ignition relay operation. When the pressure in the fuel manifold exceeds approximately 50 psi, a pressure switch connected to the fuel manifold opens an electrical circuit which will cause the enrichment valve to close. When the enrichment valve is open, fuel will flow through the enrichment valve to the upstream side of the fuel control cutoff valve. Functionally, the enrichment valve is in parallel with the metering section of the fuel control.

Fuel bypassed by the fuel control and temperature datum valve is returned to the fuel pump assembly by way of the high pressure fuel filter assembly. Any fuel leakage past the seals of the fuel pump assembly and fuel control is drained overboard through a common manifold.

QUESTIONS

1. What are the main units of the fuel system?

2. To what is the boost pump output fuel delivered to on the engine?

3. What completes an electrical circuit to the fuel pump light in the cockpit to give a warning of a primary gear pump failure?

4. What does the fuel control deliver fuel to?

5. What determines the amount of fuel bypassed by the temperature datum valve?

6. How many fuel nozzles and combustion liners are there on the T56 engine?

Project I

FUEL SYSTEM FLOW

OBJECTIVE

After completing this project of the study guide/workbook, you will be able to identify the purpose and operation of the fuel system components.

EQUIPMENT

TO 1C-130B-2-4, Organizational Maintenance Instructions
C3ABR42633-HO-100A/200/300A/400/500, C130E Hercules Training Manual/Power Plant

INFORMATION

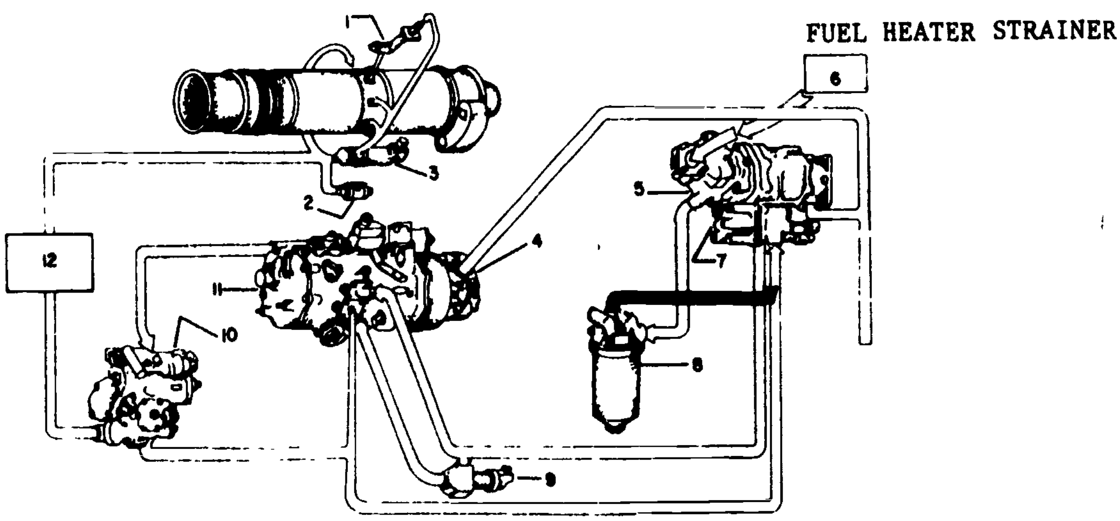


Figure 1. Fuel System Flow Schematic.

INSTRUCTIONS

Refer to HO-200, page II 8-3, to answer the following questions:

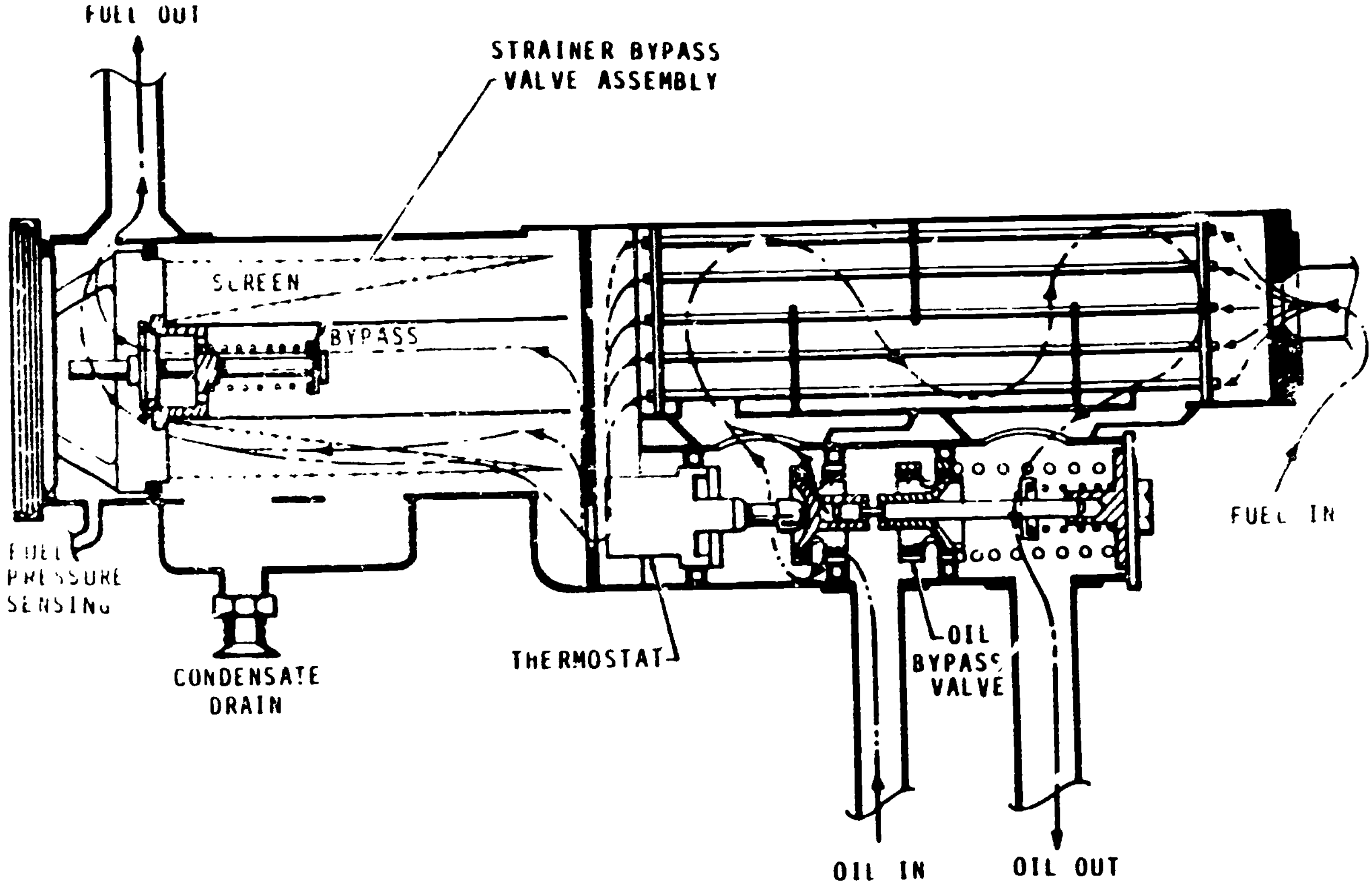
1. Fuel and Heater Strainer:

a. Purpose - In the heat exchanger, fuel is warmed to prevent ______ in the strainer.

b. Operation - The __________ passing over the tubes of the heat exchanger gives off heat that is absorbed by the fuel as it p ses through the inside of the heat exchanger tubes.

c. The temperature of the fuel at the outlet of the exchanger is a minimum of ______ °F.

2. Referring to page II 8-4, Fuel Heater and Strainer Assembly Flow Diagram, how many heat exchanger tubes are used? ________________



FUEL HEATER AND STRAINER ASSEMBLY FLOW DIAGRAM

Figure 2. Fuel Heater Strainer.

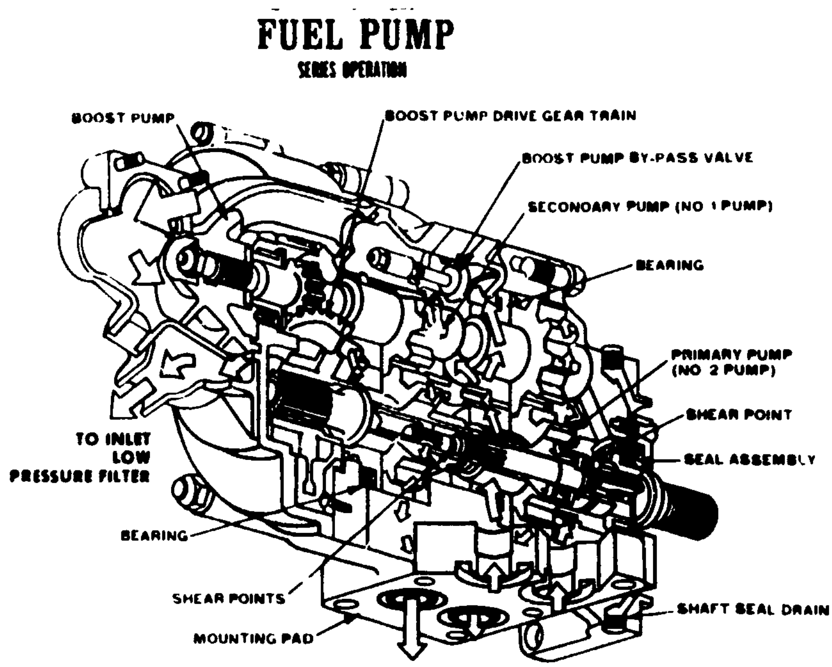


Figure 3. Dual Fuel Pump.

INSTRUCTIONS

Refer to page II 8-5 - 8-8 and TO 1C-130B-2-4, Section V, to answer the following questions:

1. The three element fuel pump contains a ______________, ______________ and a __________ ___, all housed in a common housing.

2. The capacity of the primary pump is _____% higher than the secondary pump.

3. Fuel from the centrifugal boost pump in the fuel pump assembly flows through the __________-__________ __________ __________ __________ to the gear type primary and secondary pumps.

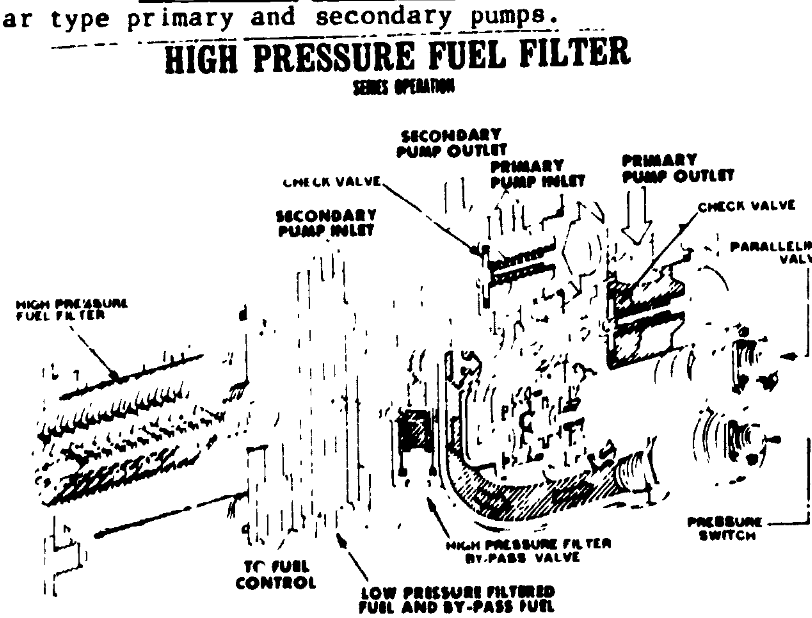


Figure 4. High Pressure Fuel Filter Assembly.

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4. The low-pressure fuel filter assembly contains a ____________ paper-element filter.

5. The low-pressure fuel filter is located _____________ the pump assembly and bypasses fuel at _____ psid if it becomes _________ or _________.

6. The high pressure fuel filter is mounted on the _________. A _________-disc filter element is located at the outlet of the _________ and _________ pumps.

7. A solenoid-operated pump _________ is mounted on the high pressure filter housing.

8. A fuel pressure switch located on the high pressure fuel filter housing closes when _________ pressure increases from _____ to _____ psi.

9. A pressure drop of _____ to _____ psi opens _________ bypass valve of the high pressure filter assembly in the event the filter becomes clogged.

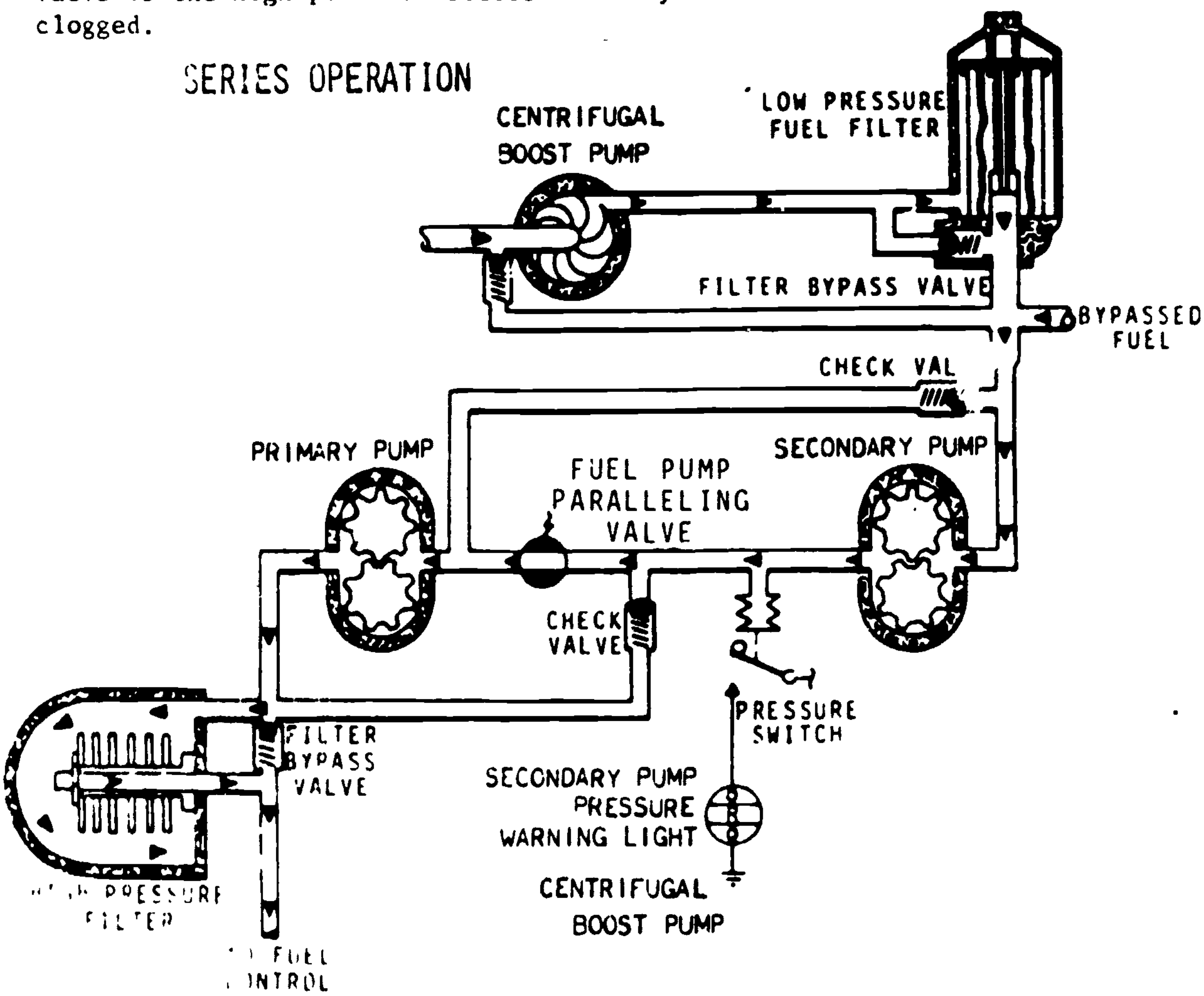

Figure 5. Series Operation.

10. During engine start, the fuel pumps are in _________ operation until engine speed reaches _____% rpm.

11. In series operation, fuel flow takes the following path from the centrifugal boost pump:

a.

b.

c.

d.

e.

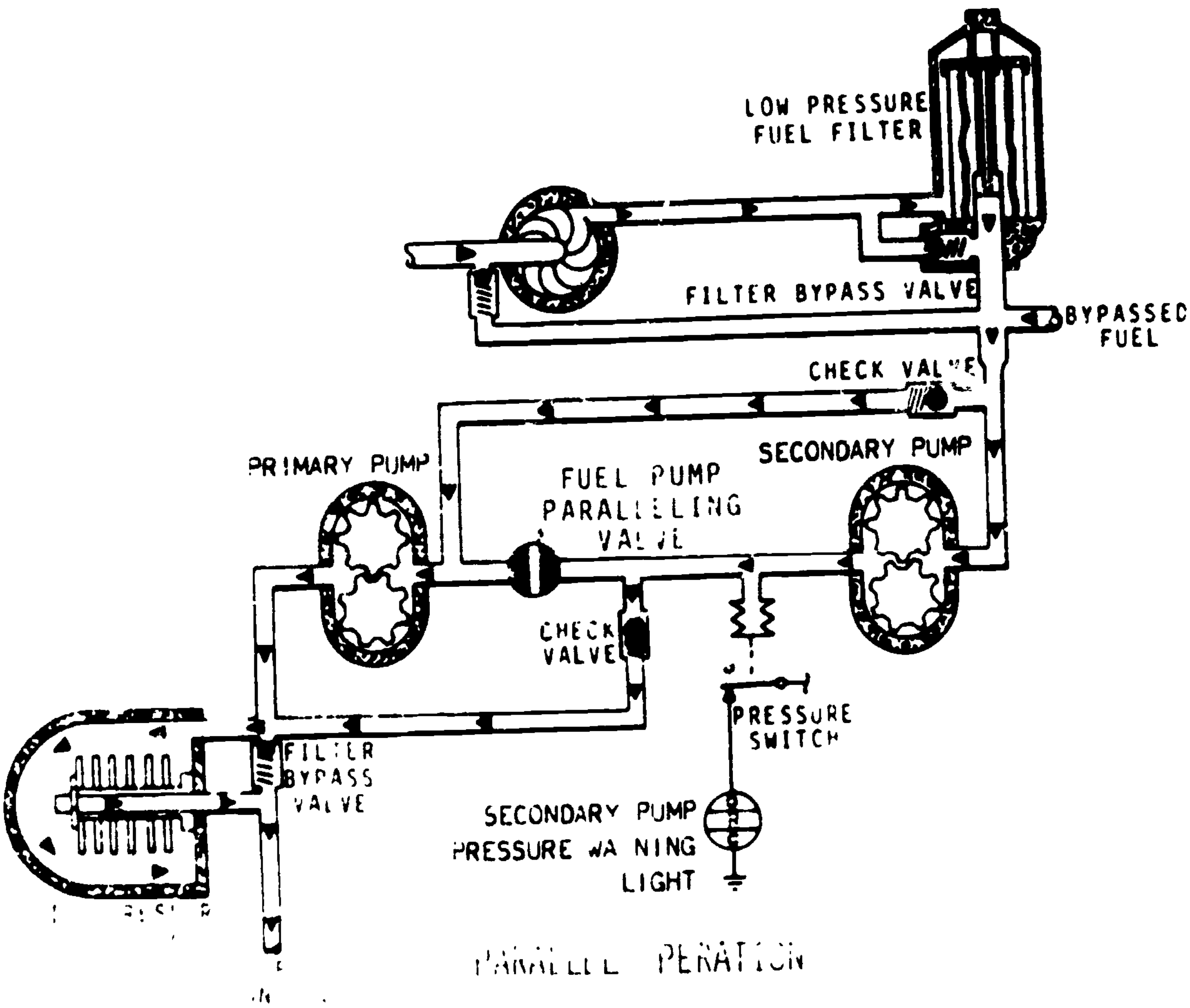

Figure 6. Parallel Operation.

12. When the engine speed reaches 16% speed, the __________ completes a circuit to energize the fuel pump __________ solenoid. The __________ actuates to place the __________ and __________ pumps in parallel.

13. When the engine speed reaches 65% speed, the __________ __________ deenergizes the fuel pump __________ solenoid.

14. The fuel pump paralleling valve at 65% returns to its normal position and places the fuel pumps in _________ operation.

15. Each pump has a separate fuel flow path in parallel operation. Name the components in the order in which fuel flows through each pump (see figure 6):

PRIMARY PUMP	SECONDARY PUMP
a.	a.
b.	b.
c.	c.
d.	d.
e.	e.

Project II

T56 ENGINE FUEL SYSTEM COMPONENTS

OBJECTIVES

When you have completed this project and your classroom instruction, using TOs 1C-130B-2-4 and 2J-T56-26, you will be able to remove, inspect and install selected fuel system components.

EQUIPMENT

	Basis of Issue
TO 1C-130B-2-4	1/student
TO 2J-T56-26	1/student

PROCEDURE

Using the applicable TOs, complete the following questions:

1. On which page and paragraph is the removal of the dual fuel pump located?

2. If there is evidence of fuel pump seal leakage, which tool is used to remove the seal?

3. What is the maximum allowable torque necessary to rotate the fuel pump to check starting torque?

4. If an ultrasonic cleaner is not available, what is used to clean the filter of the high-pressure fuel filter?

5. What component is removed before removing the fuel control?

6. If the flexible thermostat line is removed from the fuel control, what must be done with the fuel control?

7. Which paragraph and page covers installation of the fuel control?

8. In what TO, figure and page is the torque for the fuel control nuts found?

9. What must be done prior to removing the bolts which secure the TD valve?

10. In TO 1C-130B-2-4 the manifold drain valve is referred to as a __________ valve.

11. What type carbon solvent is used to clean the tip of the fuel nozzle?

12. What paragraph do you refer to for checking the fuel line connections pressure?

13. What page and paragraph covers installation of the fuel enrichment valve?

14. How much torque is required for the TD valve bolts?

FUEL CONTROL

1. The __________ __________ is the primary metering device in the fuel system.

2. The fuel control is designed to deliver __________ more fuel than the engine needs.

3. Since more fuel is available from the pumps than is needed, what happens to the excess fuel in the fuel control?

4. The __________ valve controls the amount of __________ __________ from the fuel control and is regulated by varying the __________ of the valve opening.

5. The operation of the fuel control is affected by atmospheric mechanical and hydraulic conditions. These conditions are as follows:

a.

b.

c.

d.

FUEL CONTROL SHUTOFF VALVE

1. This valve can be operated __________ or __________ to shut off fuel to the engine.

2. An externally mounted __________ __________ __________ is the primary means of opening and closing the valve.

3. The fuel control shutoff valve can be closed by activating one of the following:

a. Emergency __________ handle.

b. Condition lever to __________.

c. Condition lever to __________.

FUEL ENRICHMENT SYSTEM

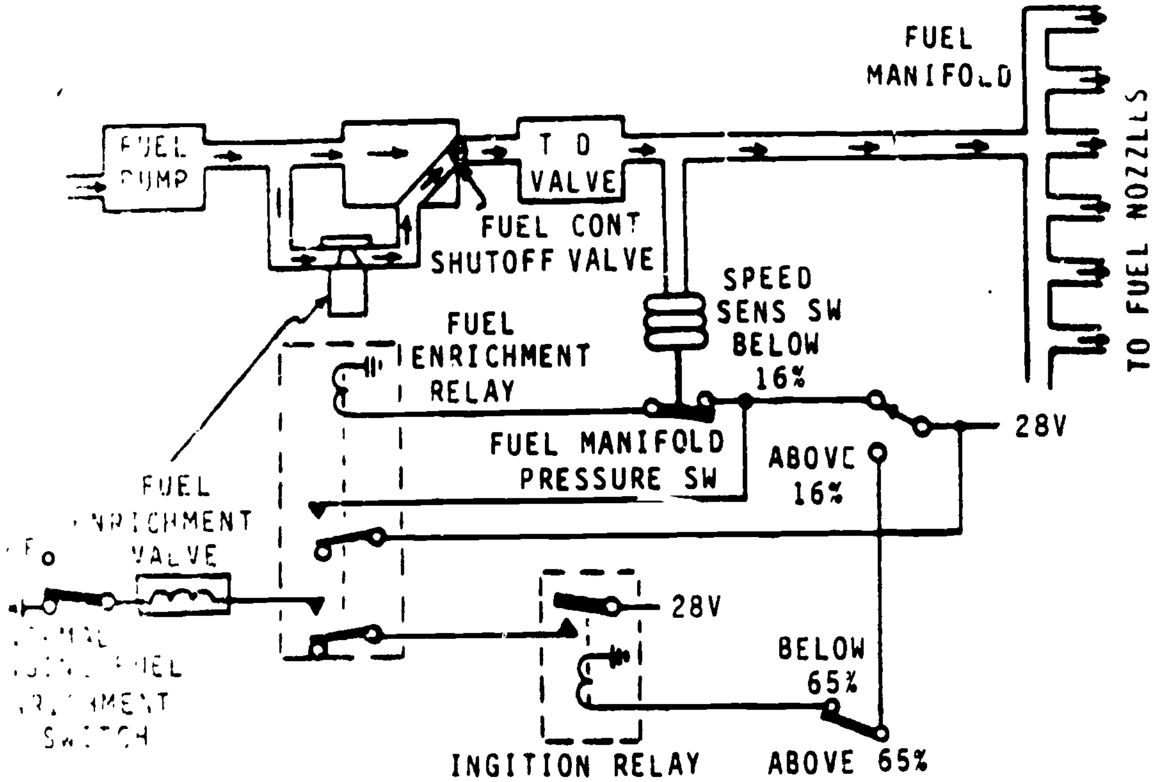

Figure 7. Fuel Enrichment Schematic.

1. The purpose of the enrichment system is to provide an increase in __________ and __________ during an engine start.

2. The circuit to the fuel enrichment valve is completed when the following events occur:

a. The engine fuel enrichment switch in the flight station is in __________.

b. Fuel pressure in the manifold is less than ______ psi.

3. How is the fuel enrichment system deenergized?

TEMPERATURE DATUM VALVE

1. With the use of the fuel control, fuel flow is scheduled to the TD valve at about ______ percent above normal engine __________ requirements.

2. The TD valve meters this fuel to keep __________ __________ __________ ( ) at a desired value.

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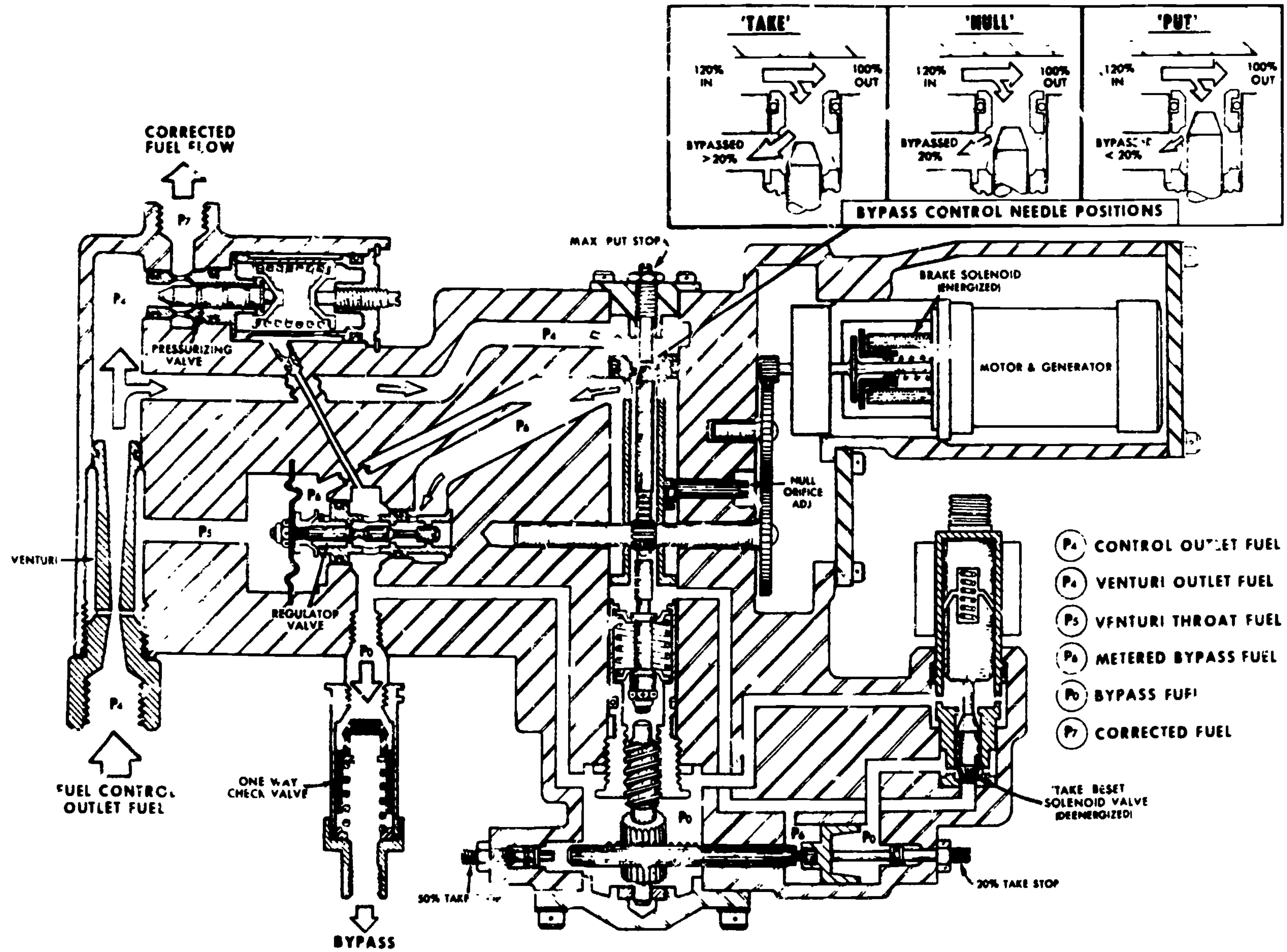

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Figure 8. TD Valve Diagram.

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FUEL FLOWMETER

1. The fuel flow transmitter _________ the amount of fuel flowing to the engine.

2. The indicator in the flight station shows fuel flow in _________ _________ flow.

FUEL MANIFOLD

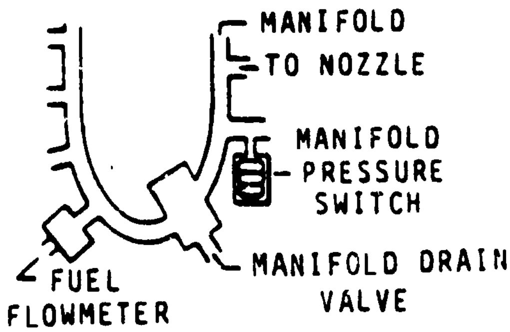

Figure 9. Fuel Manifold

With the aid of the technical order fill in the blanks to the following statements:

1. Fuel manifold

   a. Purpose - Distributes fuel to the fuel _________.

   b. Location - Around the _________ case.

2. Fuel manifold pressure switch

   a. Purpose - Used to _________ fuel enrichment when fuel pressure in the _________ reaches 50 psi.

   b. Location - On the compressor case at the _____ o'clock position; connected to the No. ______ fuel nozzle.

   c. Operation - Is spring loaded _________, fuel pressure _________.

3. Fuel nozzles

   a. Purpose - To _________ the fuel for efficient combustion.

   b. Location - Mounted to the _________ at the even clock positions and extending into the _________ chamber liners.

   c. Type - Single _________ duplex.

4. Burner drain valves

   a. Purpose - To drain excess _________ in the outer combustion case during an _________ start.

   b. Location - On forward and rear ends of the combustion case at the ______ o'clock position.

   c. Operation - Is _______ loaded open; air pressure _________.

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WS-202
8 November 1983

ENGINE FUEL SYSTEM

OBJECTIVE

After completing this worksheet, you will be able to:

With the aid of a technical order, identify principles about the operation of the fuel system.

EQUIPMENT

	Basis of Issue
TO 1C130B24	1/student

INSTRUCTIONS

Using TO 1C130B24, complete the following statements. Having completed the statements, place the correct TO paragraph number in the blank space found at the end of each completed sentence.

1. During engine operation, fuel flows from the ______________ supply system through a fuel heater-strainer to the ______________ ___ ______________ ______________ assembly. (Paragraph # _________-_________)

2. Fuel enters the fuel control inlet port and is ______________ by the ______________ valve. (Paragraph # _________-_________)

3. When pressure of the fuel to the engine is less than approximately _____ . _____ psi, the pressure-operated switch in the fuel pressure signal assembly will remain ______________ and cause the low pressure light on the the fuel control panel to go on. (Paragraph # _________-_________)

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4. When the valve (fuel enrichment valve) is energized, it opens the _______________ line and allows fuel from the high-pressure filter to enter the fuel control between the metering portion of the fuel control and the fuel control _______________ _______________. (Paragraph # _______-_______)

5. (In normal fuel flow), the fuel flows from the primary and secondary pumps through the high-pressure fuel filter assembly to the _______________ _______________. (Paragraph # __________-__________)

6. Each nozzle (fuel nozzle) consists of a body holder, a _______________ _______________, a filter screen spring, a check valve assembly, a _______________ _______________, an air shroud, and a nozzle body. (Paragraph # __________-__________)

7. The coordinator, mounted on the rear face of the fuel control, coordinates the _______________, the _______________ _______________ _______________ _______________, and the _______________ _______________. (Paragraph # __________-__________)

8. With the condition lever in "RUN" or "AIR START" position, engine RPM less than 16 percent, and fuel manifold pressure less than 50 psi, the fuel manifold pressure switch will be in its _______________ _______________ position, and the fuel enrichment relay will be _______________. (Paragraph # __________-__________)

9. The fuel is delivered to the engine fuel systems within the nacelles by the _______________ _______________ _______________ within the wing. (Paragraph # __________-__________)

10. Fuel from the centrifugal boost pump in the fuel pump assembly flows through the _______________-_______________ _______________ _______________ assembly to the gear-type primary and secondary pumps. (Paragraph # __________-__________)

STUDY GUIDE

C3ABR42633-SG-203

Technical Training

Turboprop Propulsion Mechanic

TEMPERATURE DATUM SYSTEM

1 November 1983

CHANUTE TECHNICAL TRAINING CENTER (ATC)
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C3ABR42633-SG-203
1 November 1983

TEMPERATURE DATUM SYSTEM

OBJECTIVES

1. ~~Given TO 1C-130B-2-4, identify facts about the arrangement of the temperature datum system.~~

2. Given TO 1C-130B-2-4, identify principles about the operation of the temperature datum system.

INTRODUCTION

The purpose of the T-56 engine temperature datum system (TD system) is to prevent the turbine section from getting too hot. A condition where the turbine is too hot is called an "overtemp" or overtemperature condition. The TD system prevents an overtemp condition by controlling the amount of fuel that flows through the six fuel nozzles. It is important to know that the TD system does not allow an overtemp condition.

In this study guide you will learn about the location and operation of the temperature datum system components.

INFORMATION

COMPONENT LOCATIONS

Thermocouples

Each T-56 engine has 18 thermocouples which fit over studs around the turbine inlet case. Three thermocouples fit into the aft end of each combustion liner. (See figure 1)

Coordinator

The coordinator connects to the aft end of the fuel control at the lower left side of the compressor case. Each engine has one coordinator. (See figure 1)

Temperature Datum Control Amplifier (TD Amp)

This amplifier is located in the top of the nacelle, behind the engine oil tank. Each engine has one TD amp. (See figure 1)

Temperature Datum Valve (TD Valve)

Each engine has one TD valve. This valve is located on the lower right side of the compressor case, behind the fuel pump housing. (See figure 1)

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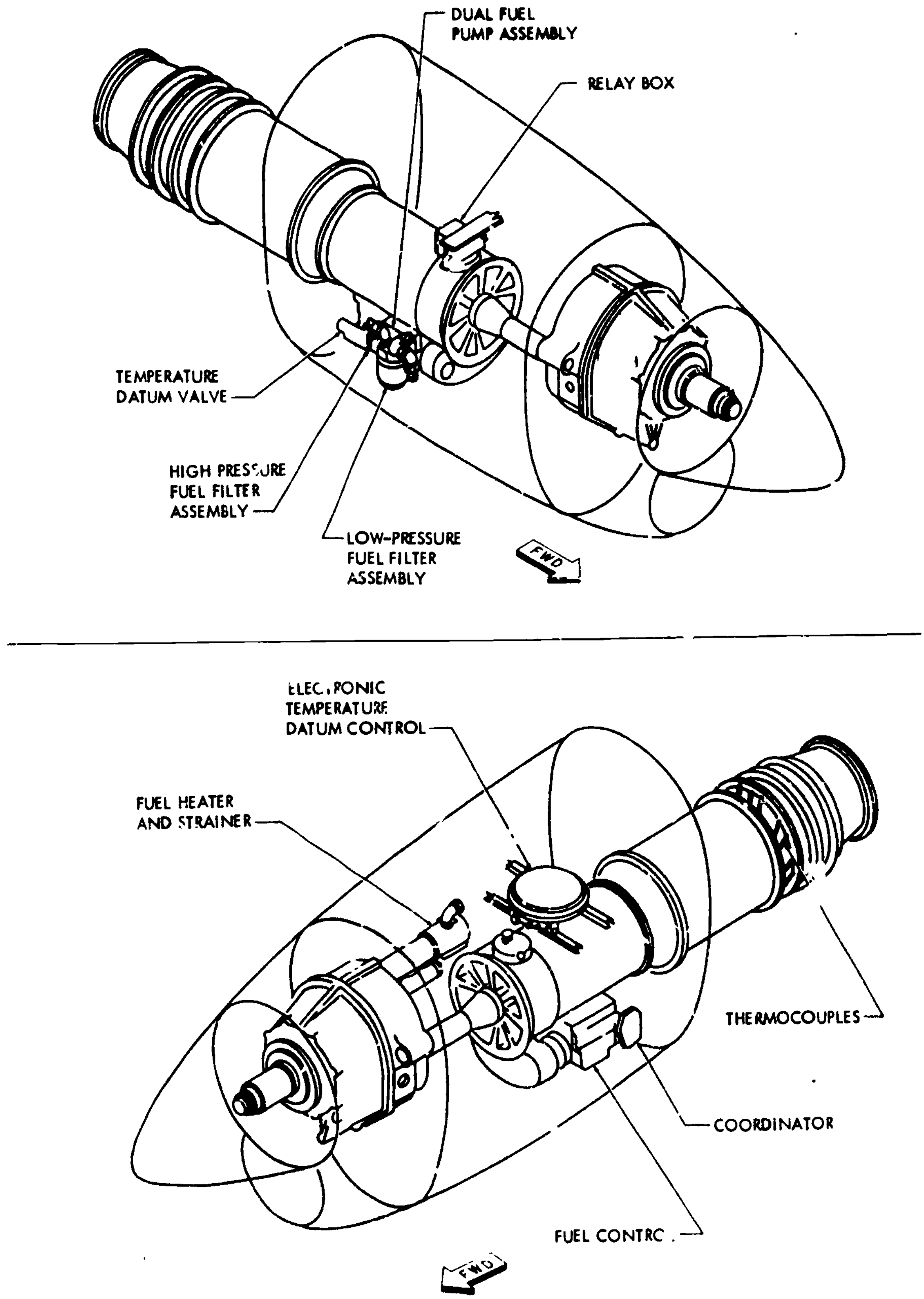

Figure 1. Temperature Datum System Component Location.

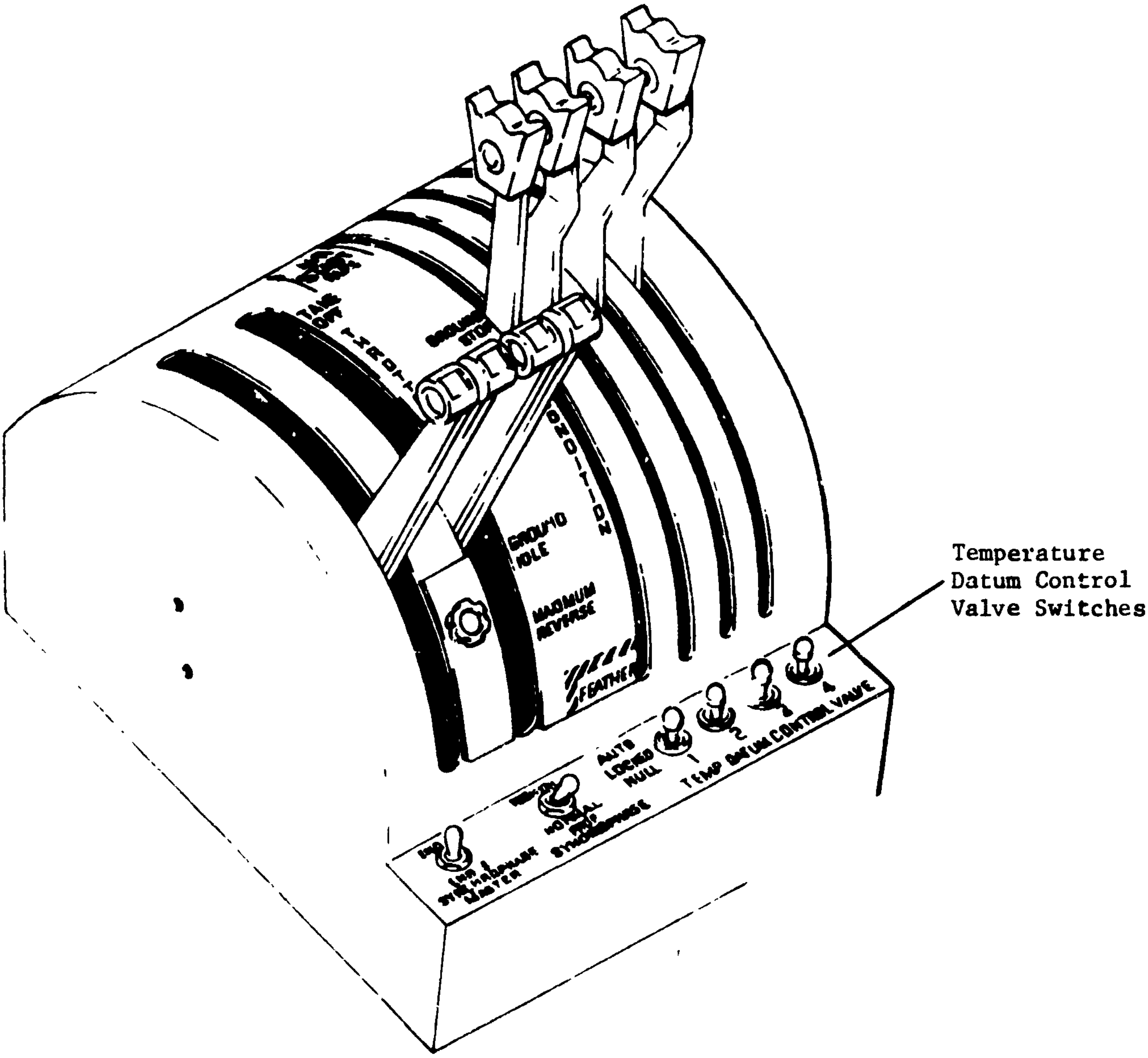

Figure 2. Throttle Quadrant Showing Temperature Datum Control Valve Switches.

Temperature Datum Control Valve Switches (TD Valve Switches)

There are four TD valve switches one for each engine. These are located on the power plant control pedestal (throttle quadrant), behind the four engine condition levers. (See figure 2)

~~Exercise 1~~

~~1. Where are the 18 thermocouples mounted on each engine?~~

~~2. How many temperature datum amplifiers and temperature datum valves are there for each engine.~~

~~Note: Check your answers with those found on the last page of this study guide.~~

SYSTEM OPERATION

Temperature Limiting Range

The temperature datum system controls the turbine inlet temperature in two ranges of operation. The first range is the temperature limiting range. The throttle lever angle (TLA) is below 65°. It is important to know that the TD system LIMITS turbine inlet temperature (TIT). This means that the TD system will not let the TIT get higher than a maximum temperature, such as during engine start.

Exercise 2

1. What are the limits of throttle lever angle in the temperature limiting range?

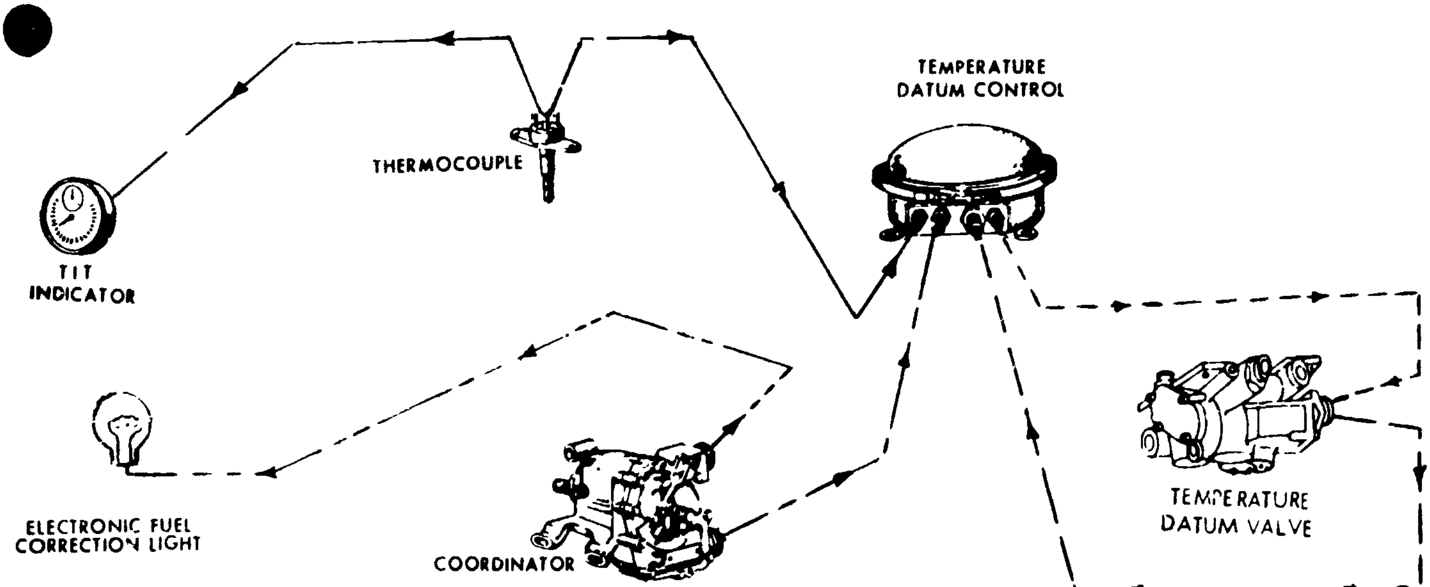

Figure 3. Temperature Datum System Operation Schematic.

THERMOCOUPLES. The thermocouples send an electrical signal to the TD amp and to the turbine inlet temperature indicator, in the cockpit, which indicates the ACTUAL TIT for that engine. (See figure 3)

COORDINATOR. (See figure 4) There are two electrical switches inside the coordinator, the 65° switch, and the 66° switch. Each switch is controlled by moving the throttle lever. When the throttle is below

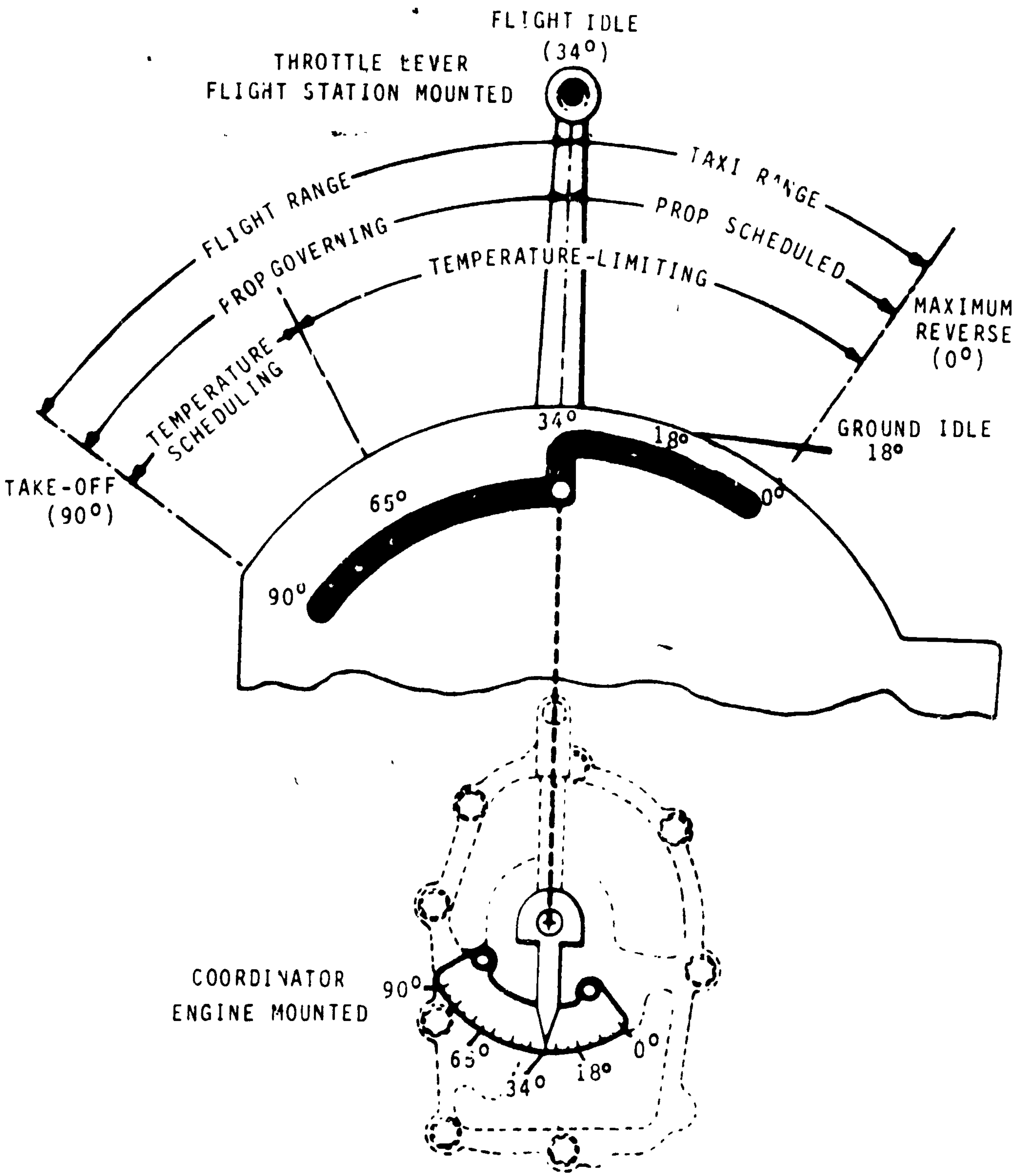

Figure 4. Throttle Position Schematic.

65°, the 65° switch tells the TD amp to operate in the temperature limiting range. The 66° switch turns on a fuel correction light on the pilot's instrument panel. The light tells the pilot that the TD system is operating in the temperature limiting range.

Exercise 2

1. What does the coordinator 65° switch do when the throttle is below 65° TLA?

TEMPERATURE DATUM CONTROL AMPLIFIER. In the limiting range the TD amp "limits" the TIT by changing the amount of fuel to the fuel nozzles. Every time the TD amp has to change the fuel flow, it sends a "take" signal to the TD valve and the TD valve will DECREASE the amount of fuel to the fuel nozzles. In the limiting range, the TD amp will only change the fuel flow by a "take" signal which means that the fuel will be taken away from the nozzles. Fuel will NEVER be added. Fuel is taken to prevent an "overtemp" condition during engine starting.

REMEMBER, THE PURPOSE OF THE TD SYSTEM IS TO PREVENT AN "OVERTEMP" CONDITION!

During engine start, the TD system can "take" up to 50% of the fuel during "start limit," 0%-94% rpm, and up to 20% of the fuel during "normal limit," above 94% rpm.

Exercise 3

1. In the temperature limiting range does the temperature datum control amplifier change fuel flow by increasing fuel or decreasing fuel?

2. In the "start limit" range how much fuel can the TD system "take"?

3. How much fuel can the TD valve "take" in the "normal limit" range?

TEMPERATURE DATUM VALVE. In the temperature limiting range, the TD valve is the part that changes the fuel flow to the fuel nozzles. Remember from studying the fuel system that fuel flows from the fuel control to the TD valve; then it flows to the fuel nozzles. The amount of fuel that leaves the TD valve is called the "corrected" fuel. The "corrected" fuel is the amount of fuel the engine needs to operate, but not to have an "overtemp" condition. The TD valve knows how much to correct the fuel flow because the TD amp sends an electric signal to a motor generator in the TD valve. The motor generator moves a bypass control needle. The bypass control needle will then "take" up to 50% of the fuel or 20% of the fuel. Remember, the TD amp tells the TD valve how much fuel to "take."

Exercise 4

1. Which component tells the TD valve how much fuel to "take"?

2. The bypass control needle can "take" up to two different amounts of fuel. What are these amounts?

Temperature Controlling Range

The engine will only run in the temperature controlling range if engine rpm is above 94% and the coordinator throttle lever angle (TLA) is above 65°. (See figure 4) The temperature controlling range is also called the scheduling range. Temperature controlling and temperature scheduling means the same thing. In this range of operation the temperature datum system will control the fuel in the engine to maintain a temperature scheduled by throttle position. When the pilot moves the throttle between 65°-90° TLA, the temperature datum system will change the scheduled temperature accordingly. Increasing the TLA will increase the fuel flow, TIT, and torque. Decreasing the TLA will decrease the fuel flow, TIT, and torque.

Exercise 5

1. What must the engine rpm and TLA be set at for the engine to operate in the temperature controlling range?

2. The temperature controlling range is also known as the temperature ______________ __________________.

THERMOCOUPLES. The 18 thermocouples do the same thing in both ranges of operation -- they send an electrical signal to the TD amp and the TIT indicator.

COORDINATOR. The coordinator is connected to the throttle by cables. If you push the throttle toward "take off," you increase the TLA toward 90°. If you pull the throttle back, you decrease the TLA toward 65°. When the throttle is moved forward, above 65°, the 65° switch in the coordinator tells the TD amp to operate in the controlling range, and the 66° switch turns off the fuel correction light. Inside the coordinator is a potentiometer. This is an electrical unit that senses throttle movement by the pilot between 65°-90° TLA. When the throttle is moved, the potentiometer sends a voltage signal to the TD amp.

TEMPERATURE DATUM CONTROL AMPLIFIER. A voltage signal from the coordinator potentiometer tells the TD amp it must either increase or decrease the engine TIT. Remember, the TD amp both increases and decreases the TIT by signaling the TD valve to correct the fuel flow as the fuel leaves the TD valve. It is important to know that the TD valve will only correct the fuel flow by electrical signals from the TD amp.

Exercise 6

1. How is the coordinator connected to the throttle?

2. Which coo. nator component signals the TD amp to increase or decrease TIT?

3. Which component corrects fuel flow when signaled by the TD amp?

TEMPERATURE DATUM VALVE. In the temperature controlling range, the TD valve corrects fuel flow by increasing, known as "put," and decreasing, known as "take." This is different than in the limiting range where the

TD valve could only take fuel. In the controlling range, the TD valve can "put" up to 20% fuel or "take" up to 20% of the fuel. Remember, this is done to maintain a certain TIT that is requested by the pilot when he/she moves the throttle between 65°-90° TLA.

Exercise 7

1. How does the TD valve correct fuel flow in the temperature controlling range?

TEMPERATURE DATUM VALVE SWITCHES. So far in this study guide we have talked about the temperature datum system controlling TIT by using electrical signals. What might happen if something went wrong in the electrical system? The engine might "overtemp."

The temperature datum valve switches help control the electrical part of the TD system. There is one switch for each engine and each has three positions: NULL, AUTO, LOCKED. (See figure 2)

The NULL position removes AC electrical power from the TD amp. Now, there is no protection to prevent an "overtemp" condition. The pilot will have to prevent an "overtemp" condition by moving the throttle back toward 65° TLA.

The AUTO position of the switch lets the TD system correct the fuel flow automatically to maintain TIT. There is also protection for the engine to prevent an "overtemp" condition. The normal engine operation is with the TD valve switch in the AUTO position.

Operation of the TD valve switch in the LOCKED position will give the engine "overtemp" protection, and the bypass control needle in the TD valve will not move from the position it is in. This means that, if the needle is in a "put" position or a "take" position, it will stay there. It will not move unless there is an "overtemp" condition.

The LOCKED position is used during precision flying so all the engines put out the same power. If the engines on one wing put out more power than those on the other wing, the aircraft will pull to the right or to the left. This would make landing more difficult.

Exercise 8

1. Which TD valve switch position removes AC power from the TD amp?

2. Which switch position is used for normal engine operation?

3. The locked position is used for what?

SUMMARY

Remember that the purpose of the temperature datum system is to prevent an "overtemp" condition and to maintain the temperature of the turbine section. The system does this by controlling the fuel flow from the TD valve to the fuel nozzles. Also, remember the TD valve will not "correct" the fuel flow unless signaled to by the TD amp.

ANSWERS TO EXERCISES

~~Exercise 1~~

1. [redacted]
2. [redacted]

~~Exercise 2~~

1. [redacted]

~~Exercise 3~~

1. [redacted]

~~Exercise 4~~

1. [redacted]
2. [redacted]
3. [redacted]

~~Exercise 5~~

1. [redacted]
2. [redacted]

~~Exercise 6~~

1. [redacted]
2. [redacted]

~~Exercise 7~~

1. [redacted]
2. [redacted]
3. [redacted]

~~Exerci 8~~

1. [redacted]

~~Exercise 9~~

1. [redacted]
2. [redacted]
3. [redacted]

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633 000-WS-203
26 July 1984

TEMPERATURE DATUM SYSTEM

OBJECTIVES

Given TO 1C-130B-2-4, identify principles about the operation of the temperature datum system.

EQUIPMENT

	Basis of Issue
TO 1C-130B-2-4	1/student

PROCEDURE

Using only TO 1C-130B-2-4, fill in the spaces with the correct information pertaining to the temperature datum system. At the end of each statement is a space for you to put the paragraph number. This will be filled in to insure that you can locate the correct information in the technical order.

OPERATION

1. If the temperature datum control valve switch is not placed in the "LOCKED" position before moving the throttle below 66° degrees, the temperature control system will be transferred from ____________ ____________ to ____________ ____________.

(Paragraph # ________ - ________)

2. At engine speeds below 94 percent rpm, the valve can decrease the normal fuel flow to the ____________ by ____________ percent.

(Paragraph # ________ - ________)

3. The datum control senses differences between the ________ and the ____________ turbine inlet temperatures at the ____________ ____________ ____________. (Paragraph # ________ - ________)

4. The 18 indicating system thermocouples are connected in ____________ by the ____________ ____________ ____________ ____________ assembly. (Paragraph # ________ - ________)

5. On the temperature datum control valve switches, the switch positions are "________", "____________", and "________".

(Paragraph # ______ - ________)

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C3ABR42633-WS-204
23 February 1984

ENGINE STARTING SYSTEM

OBJECTIVE

After completing this heet, you will be able to:

With the aid of a technical order, identify facts about the operation of the starter system.

EQUIPMENT

	Basis of Issue
TO 1C-130B-2-4	1/student

INSTRUCTIONS

Using TO 1C-130B-2-4, complete the following statements. Having completed the statements, place the correct TO paragraph number in the blank space found at the end of each completed sentence.

1. The starting cycle is controlled from the engine __________ __________ ______________. (Paragraph # ____-________)

2. The starter duty cycle is as follows: __________ minute ON, ________ minute OFF, ________ minute ON, ________ OFF, ________ minute ON, _________ minutes OFF. (Paragraph #_____-_______)

3. Air supply to the starter is routed through a combinati. __________ _____ _____ and ______________ ______________ in the inlet duct to the starter. (Paragraph #______-_______)

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TURBOPROP ENGINE STARTER AND IGNITION SYSTEMS

OBJECTIVE

After completing this study guide and your classroom instruction, you will be able to identify principles about the operation of the starting and ignition system.

INTRODUCTION

Like the automobile engine, the aircraft engine has a starter and ignition system. The air turbine starter is geared to the engine to rotate the engine compressor during the starting cycle. The starter can be operated with compressed air supplied from the gas turbine compressor (GTC), another operating engine on the aircraft, or an external source of air. Once the engine is energized and supplied with a fuel-air mixture, ignition is necessary. The ignition system ignites the fuel-air mixture in the combustion chambers and shuts off automatically when the engine accelerates to a predetermined speed (RPM).

Figure 1. Engine Start Panel.

INFORMATION

STARTER SYSTEM

Starter Switches

The engine ground start switches (see figure 1) are located on the engine starting panel on the overhead control panel. Each switch is used to open the starter control valve to permit operation of the starter. The switch button is pushed in manually, then a holding coil holds the button in. At the same time, the starter control valve is energized open. A red light in the button glows as long as the button is held in. When the engine accelerates to a preset speed, the centrifugal cutout switch in the starter is actuated open to

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cause the starter control valve to close and the starter switch (button) to be released, causing the light to go out. The button can be pulled manually at any time to discontinue starter operation.

Starter

Each engine is equipped with a pneumatic starting system. The starter (see figure 2) is designed to rotate the compressor fast enough to provide sufficient air to support combustion and to cool the engine. The starter is geared to the engine through the reduction gear assembly and obtains air through the bleed air manifold. Air may be supplied to the bleed air manifold by the gas turbine compressor, another operating engine or an external air source (MA-1A).

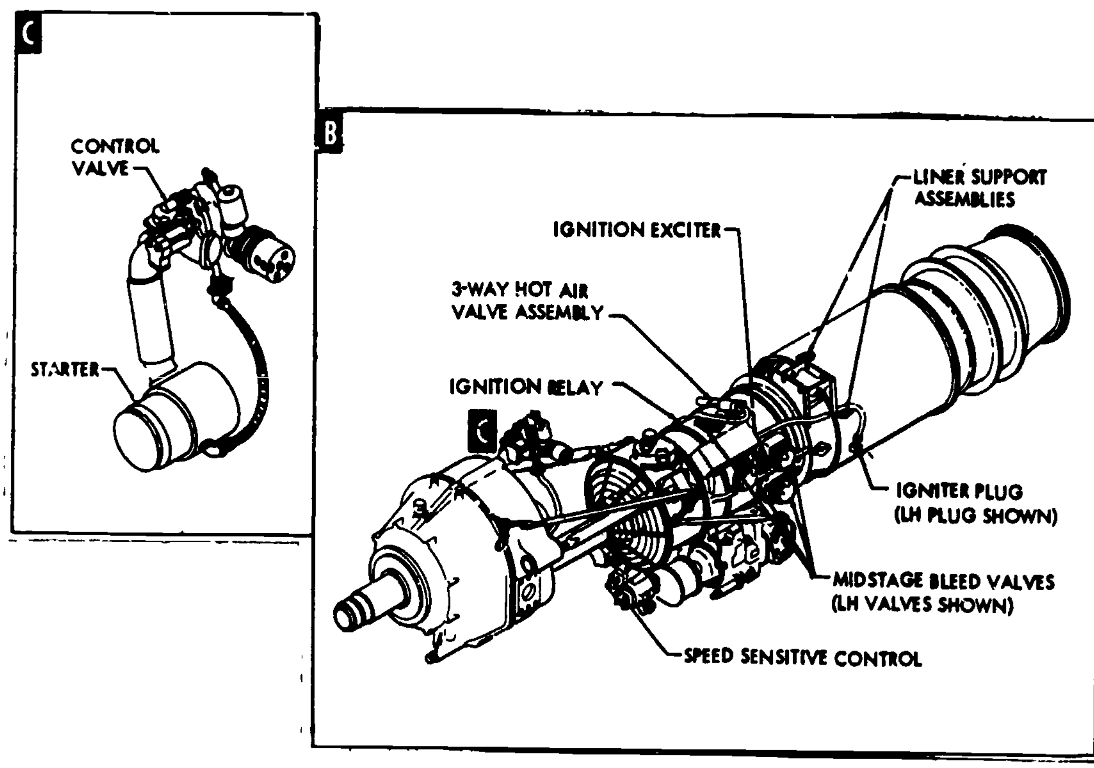

Figure 2. Engine Starting System Components Locations.

Starter Control Valve

The starter control valve controls the flow of bleed air to the starter (see figure 2). It is a combination air shutoff and regulator valve. This valve is located in the starter air inlet duct. This valve is energized open during the engine starting cycle and is deenergized closed automatically by the centrifugal cutout switch or manually by pulling the starter switch (button).

Three-Way Hot Air Valve Assembly

A three-way, solenoid-operated valve is provided to control the closing of the compressor midstage bleed valves. The valve is mounted to the top of the engine compressor section. It receives air pressure from the compressor's 14th stage. The solenoid is energized during the engine starting cycle to close the three-way hot air valve. This cuts off the supply of air from the 14th stage and permits the midstage valve to open (see figure 2).

IGNITION SYSTEM

The purpose of the ignition system is to supply a current which fires the spark igniters in the combustion chambers. Ignition occurs automatically during the starting cycle and continues until the engine is turning fast enough to sustain combustion of the fuel. The ignition system is a high voltage, condenser-discharge type. Units of the system consist of an ignition relay, a speed sensitive control, an ignition exciter, and two spark igniters (see figure 2).

Ignition Relay

The ignition relay is a normally open relay mounted on the upper compressor housing. It is energized by the speed sensitive control during the starting cycle when the engine reaches 16% rpm. It is deenergized by the speed sensitive control when the engine reaches 65% rpm. When energized, it completes circuits to the ignition exciter, which fires the spark igniters; to the fuel manifold drain valve solenoid, which closes the drain valve; to the paralleling valve, which parallels the fuel pumps; and to the fuel enrichment relay, which energizes the fuel enrichment valve solenoid (providing the fuel enrichment switch on the engine start panel is in the normal position). When deenergized, the ignition relay breaks these circuits and they return to their deenergized condition (see figure 2).

Igniter Exciter

The ignition exciter receives 28-volts DC from the ignition relay and steps it up to high voltage required by the spark igniters to ignite the fuel air mixture during the engine start cycle (see figure 2).

Spark Igniters

The engine uses only two spark igniters. They are located in combustion chambers two and five. Flame is supplied to the four other chambers by crossover tubes (see figure 2).

SUMMARY

Compressed air causes the starter to rotate the compressor rotor bringing air into the engine. The engine-driven fuel pump sends fuel under pressure to the manifold. At a predetermined speed, the drip valve closes and fuel enters the combustion chambers. At this same instant, the ignition relay closes and the spark ignites the fuel-air mixture in the combustion chambers; the mass expands and turns the turbine wheels on its way out of the engine. The energy derived from the hot gases rotating the turbine wheels assists the starter in turning the compressor rotor faster. At a predetermined engine speed, the starter and ignition systems are cut off by the engine speed sensing control and the engine is started.

QUESTIONS

1. What is the indication when the engine ground start switches are energized?

2. Where is the pneumatic starter located?

3. What controls the bleed air to the pneumatic starter?

4. Where does the pneumatic starter obtain its air source?

5. What component completes the circuit to the igniter exciter?

6. Where are the spark igniters located?

7. How are the combustion chambers without igniter plugs fired?

8. Where is the ignition relay located?

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WS-205
6 December 1982

ENGINE IGNITION SYSTEM

OBJECTIVE

After completing this worksheet, you will be able to:

With the aid of a technical order, identify facts about the operation of the ignition system 2 out of 3 times correctly.

EQUIPMENT

	Basis of Issue
TO 1C-130B-2-4	1/student

PROCEDURE

Using Technical Order 1C-130B-2-4, complete the following statements. After you have completed the statements, place the correct technical order paragraph number in the space provided at the end of each statement.

1. The ignition exciter supplies high voltage to the ______________ ______________ for ignition of engine ______________. (Paragraph ____-____)

2. High voltage to the igniter plugs is supplied by the ____________ ____________ during the starting cycle. (Paragraph ____-____)

3. The ignition relay is energized by the speed-sensitive control during the starting cycle when the engine reaches ____________ ____________ speed. (Paragraph ____-____)

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4 January 1980

TURBOPROP COMPRESSOR BLEED SYSTEM

OBJECTIVES

After completing this study guide and your classroom instruction, you will be able to state the [redacted], [redacted], [redacted], [redacted] operating principles of the T56 engine compressor bleed system.

INTRODUCTION

There are two types of bleed air systems used on C-130 aircraft. One is the pneumatic bleed air system which is used to supply air to the various systems on the aircraft that require an air supply. The other is the compressor bleed system used to prevent surges and stalls during acceleration of the engine. This system is sometimes referred to as the acceleration bleed system.

INFORMATION

PNEUMATIC BLEED AIR SYSTEMS

The engine bleed air system consists of high pressure ducts and valves which conduct compressed air to pneumatically operated systems of the aircraft.

Three different sources are provided for a supply of compressed air to the pneumatic systems. When any or all of the engines are running, the supply of bleed air is taken from the compressor diffuser section of the engine. When on the ground with the engines shut down, the supply may come from the onboard gas turbine compressor (GTC) or from an external source. A more detailed description can be found in TO 1C-130B-2-10, C-130B Utility Systems. The power plant related penumatically operated systems on the C-130 aircraft which use bleed air are:

1. Engine starting system
2. Nacelle preheat system
3. Engine air inlet and oil cooler scoop anti-icing system

COMPRESSOR STALLS

When designing a compressor, engineers must consider a condition known as a "compressor stall." A compressor stall occurs when the airflow through the compressor breaks down or is interrupted. A compressor surge is a stage of stall. The severity of a stall depends upon the area involved - whether one stage, several stages, or the entire compressor is involved.

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During a stall, the rotor blades cannot move sufficient air rearward to support combustion. Stalls are most likely to occur during rapid acceleration, as during a start. Then, the amount of air needed is more than the compressor output. Extra fuel is added to accelerate the turbine. Should the fuel be added too rapidly, the pressure in the combustion chambers will exceed compressor discharge pressure, thus causing the air to reverse flow momentarily. If this flow reversal is momentary, a surge results, or if the reversal is prolonged, a stall will result. Failure to stop a surge or stall by retarding the throttle may severely damage an engine.

Several methods are in use which help prevent stalls and surges. On the T56 engine, compressor bleed valves are used. The use of these bleed valves allows the engine to accelerate more rapidly. These valves open above 16% engine rpm and remain open until 94% engine rpm, allowing a more stable airflow through the engine, which permits the addition of more fuel during acceleration. Since the T56 engine is a constant speed engine, once it reaches design speed (13,820 rpm), it is not subject to acceleration stalls.

COMPRESSOR BLEED SYSTEM

Acceleration bleed valves are installed on the 5th and 10th stages of the compressor. These valves unload excess air from the compressor during starting and acceleration and in this way help prevent compressor stalls.

The eight valves discharge the air into sheet metal collectors which duct the bleed air aft of the engine firewall. This hot bleed air is a fire hazard so it must be vented to a fireproof area. These bleed valves open above 16% rpm and close above 94% rpm. A speed sensitive valve, mounted on the front of the accessory case, controls the opening of the acceleration bleed valves. This speed sensitive valve is controlled by flyweights. Below 13,000 rpm, the top sides of the bleed valves are vented to atmosphere through the speed sensitive valve. Since atmospheric pressure is less than 5th and 10th stage air pressure. the greater pressure holds the valves open. Above 13,000 rpm, the flyweights will move the speed sensitive, closing the vent to atmosphere and opening the top sides of the bleed valves to 14th stage pressure. This 14th stage air is carried from the diffuser to the speed sensitive valve by an external line.

QUESTIONS

1. What are the two types of bleed air systems used on C-130 aircraft?

2. Where is bleed air taken from the engine to supply air to the aircraft pneumatic systems?

3. What is a compressor stall?

4. What is the difference between a stall and a surge?

5. What is used on the T56 engine to help prevent stalls?

6. What controls the opening of the compressor bleed valves?

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WS-206
12 January 1983

BLEED AIR SYSTEM

OBJECTIVE

After completing this worksheet, you will be able to identify principles about the operation of the bleed air system.

EQUIPMENT

	Basis of Issue
TO 1C-130B-2-4	1/student
TO 1C-130B-2-10	1/student

INSTRUCTIONS

Using TO 1C-130B-2-4, complete the first statement.

Using TO 1C-130B-2-10, complete the next two statements. At the end of the statements, in the place provided, write in the page and paragraph number where the information is found.

INFORMATION

1. At 94 percent rpm, the speed sensitive valve opens and allows __________ __________ from the 14th stage to __________ the compressor bleed valves and stop compressor unloading. (Page ______ para ________)

2. Switches for the four engine __________ __________ valves are on the __________ __________ control panel at the top of the pilot's __________ __________. (Page _______ para _______)

3. There are __________ possible sources of compressed air: the __________ themselves, the __________ __________ __________ in the left hand wheel well, or a mobile __________ __________ __________ externally connected to the __________. (Page ______ para _______)

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STUDY GUIDE
3ABR42633-SG-~~214~~
207

Technical Training

Turboprop Propulsion Mechanic

PROPELLER AND ENGINE ANTI-ICING AND DEICING SYSTEMS

28 April 1980

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

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PROPELLER AND ENGINE ANTI-ICING AND DEICING SYSTEMS

OBJECTIVE

After completing this study guide and your classroom instruction, you will be able to explain the purpose, operation, and arrangement of the propeller and engine anti-icing and deicing systems.

INTRODUCTION

The engine and propeller anti-icing and deicing systems are used on the C-130 aircraft to prevent the buildup of ice on the T56 engine compressor inlet housing, engine intake scoop, oil cooler intake scoop, and torquemeter housing shroud. The propeller system uses the anti-icing and deicing to prevent or remove ice formations on the outside of the propeller assembly. Without this system on an aircraft, severe damage could occur to the aircraft and engine.

INFORMATION

In this study guide, we will discuss the engine and propeller anti-icing and deicing system parts, purposes, operation, and their arrangement.

ENGINE ANTI-ICING SYSTEM

The T56 engine anti-icing system shown in figure 1 is very important to you as a turboprop engine and propeller mechanic. This anti-icing system's primary purpose is to prevent ice formation on the engine intake scoop, oil cooler intake scoop, the eight radial struts of the air inlet housing assembly, and the lower half of the torquemeter housing shroud. The formation of ice in the engine intake can cause severe damage to the engine compressor section. The engine anti-icing system is incorporated in the engine to prevent ice from forming in the air intake area.

The engine anti-icing system controls are located in the aircraft cockpit, on the overhead panel, figure 2. The main control for this system is the engine/propeller master anti-icing control switch. On the same panel there are four individual switches for operating each engine anti-icing solenoid valve. To operate this system, the engine/propeller anti-icing master switch can be placed in three positions. These positions are manual, automatic, and reset. In order for the anti-icing master switch to operate in the automatic mode of operation, the master switch must be pushed up to the RESET position and allowed to return to the automatic position. Then the switches for the engine inlet air ducts must be placed in the ON position. After these two

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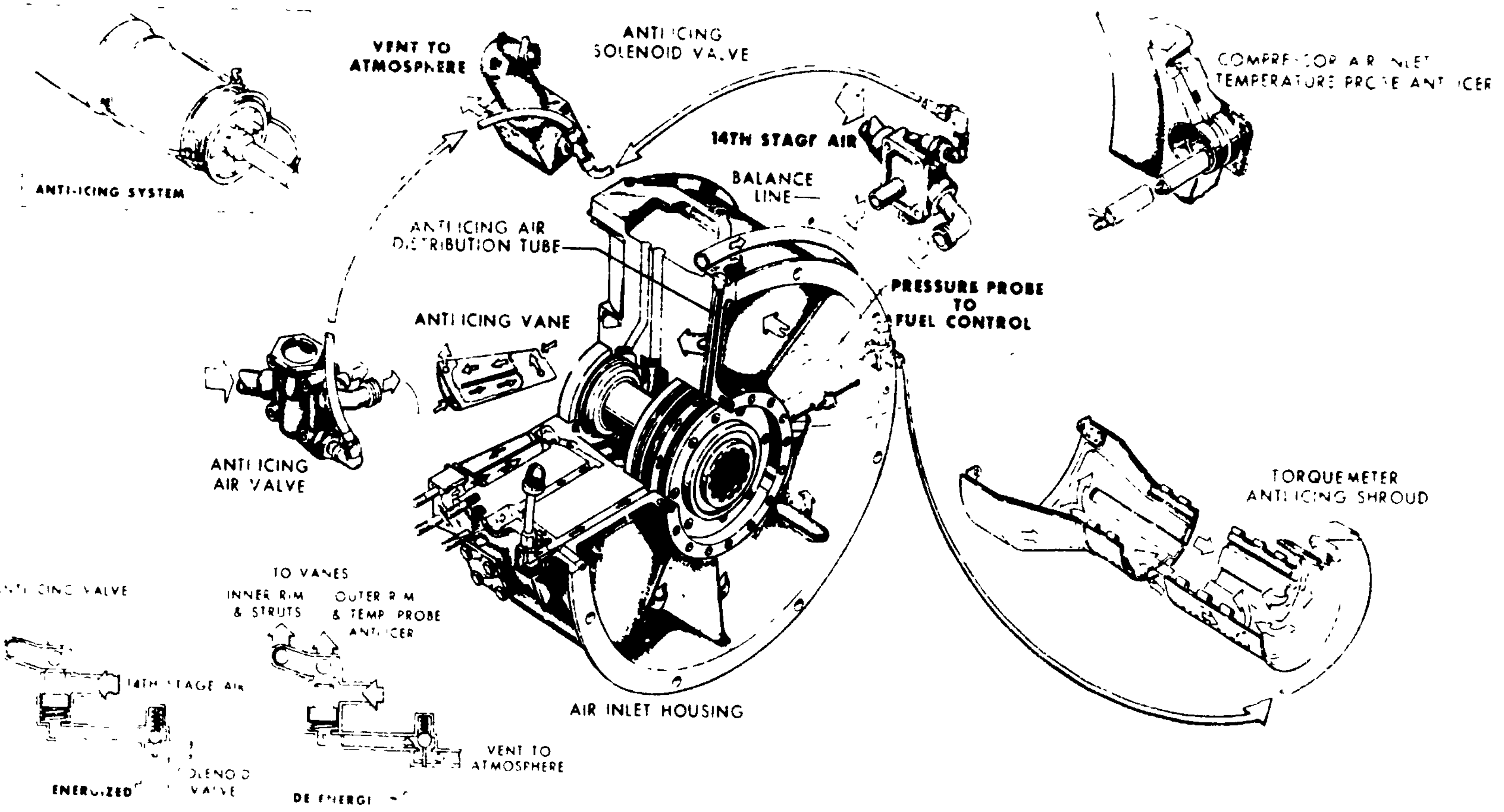

Figure 1. Engine Anti-Icing System.

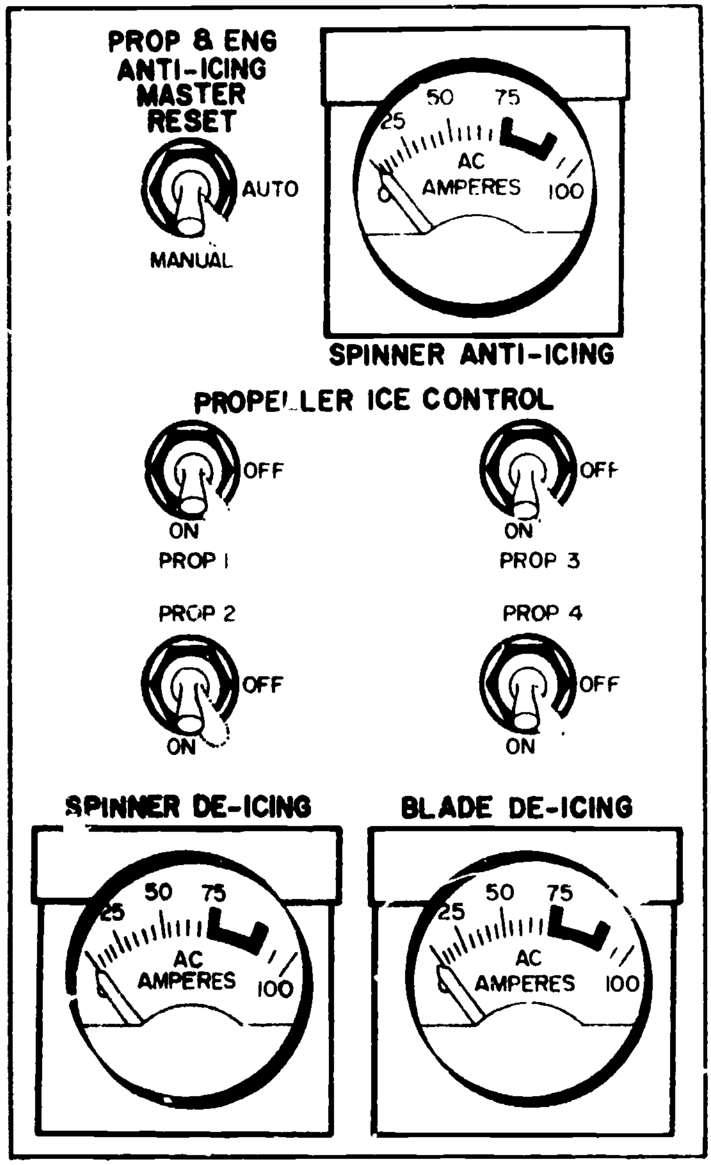

Figure 2. Anti-Icing Control Panel.

switches have been activated, they will complete an electrical circuit to the ice detector system. There are ice detector probes, located in the four engine intakes, but only No. 2 and No. 3 are operational. These ice detector probes can "feel" the presence of ice accumulating on their outside. When ice is detected, the probes will automatically complete a circuit to energize the anti-icing system. After the ice detector probes have energized the system, the power section mounted anti-icing solenoid and QEC kit mounted anti-icing solenoid valve will be de-energized to the open position, thus allowing hot air from the engine diffuser to be routed to the engine air inlet housing area, intake scoop, and oil cooler intake scoop. The anti-icing solenoid valve and anti-icing solenoid are energized to the closed position and de-energized to the open position.

After the anti-icing solenoid valve has been de-energized, the hot compressor air is routed from the engine compressor diffuser bleed air ports, on the 14th stage compressor, to the anti-icing air valves. There are two anti-icing air valves on the T56 engine and these are mounted on the air inlet housing at the three and nine o'clock positions. The air valves are connected to the diffuser bleed air ports and the anti-icing solenoid valve by metal air tubes. When the hot compressor air has reached the two air valves, it is then routed through the air inlet housing to five areas of the engine. These areas are:

1. Air inlet housign struts (8).
2. Compressor air inlet guide vanes.
3. Compressor air inlet temperature probe.
4. Compressor inlet pressure probe.
5. Lower half of the torquemeter housing shroud.

The compressor diffuser assembly will also send hot air to the nacelle air intake and the oil cooler air scoop to prevent ice formation on these parts. The hot air is routed to the bleed air manifold, located on the right side of the nacelle, to the intake scoop and oil cooler scoop. On the compressor diffuser there are air bleed ports located on the outside of the 14th stage compressor, which are connected to ducting which is connected to the bleed air manifold, then to ducting which is directly connected to the nacelle intake and oil cooler scoop. This portion of the anti-icing system is operated by the same switches mentioned in the previous paragraphs. (See figure 1.)

PROPELLER ANTI-ICING AND DEICING SYSTEM

The propeller anti-icing and deicing system is different from the engine anti-icing system. We discussed that the engine anti-icing system uses hot compressor air to prevent a buildup of ice. The propeller assembly uses electrical current to operate the anti-icing and deicing system. The anti-icing portion of the system is to prevent ice formation on certain parts of the propeller and the deicing portion is to remove the ice that has accumulated on the propeller. We will discuss each part of this system and the complete operation of the propeller anti-icing and deicing system.

The propeller anti-icing and deicing system is operated by the same switch as the engine anti-icing system. To operate the system you must place the engine/propeller anti-icing master switch to either the auto or manual position. Then the four propeller ice control switches must be placed in the ON position. This action will complete an electrical circuit to the propeller deicing timer, spinner anti-icing relays, and the deicing relays. The propeller deicing timer is used to control the heating cycle for propeller deicing only, but the deicing timer is also connected to the ice detector probes located on the engine. The deicing timer has a set cycle, it is activated for a 15-second heating period, and a 45-second cooling period, this heating cycle is the same for all four propellers. The heating cycle will be switched from one propeller to the next

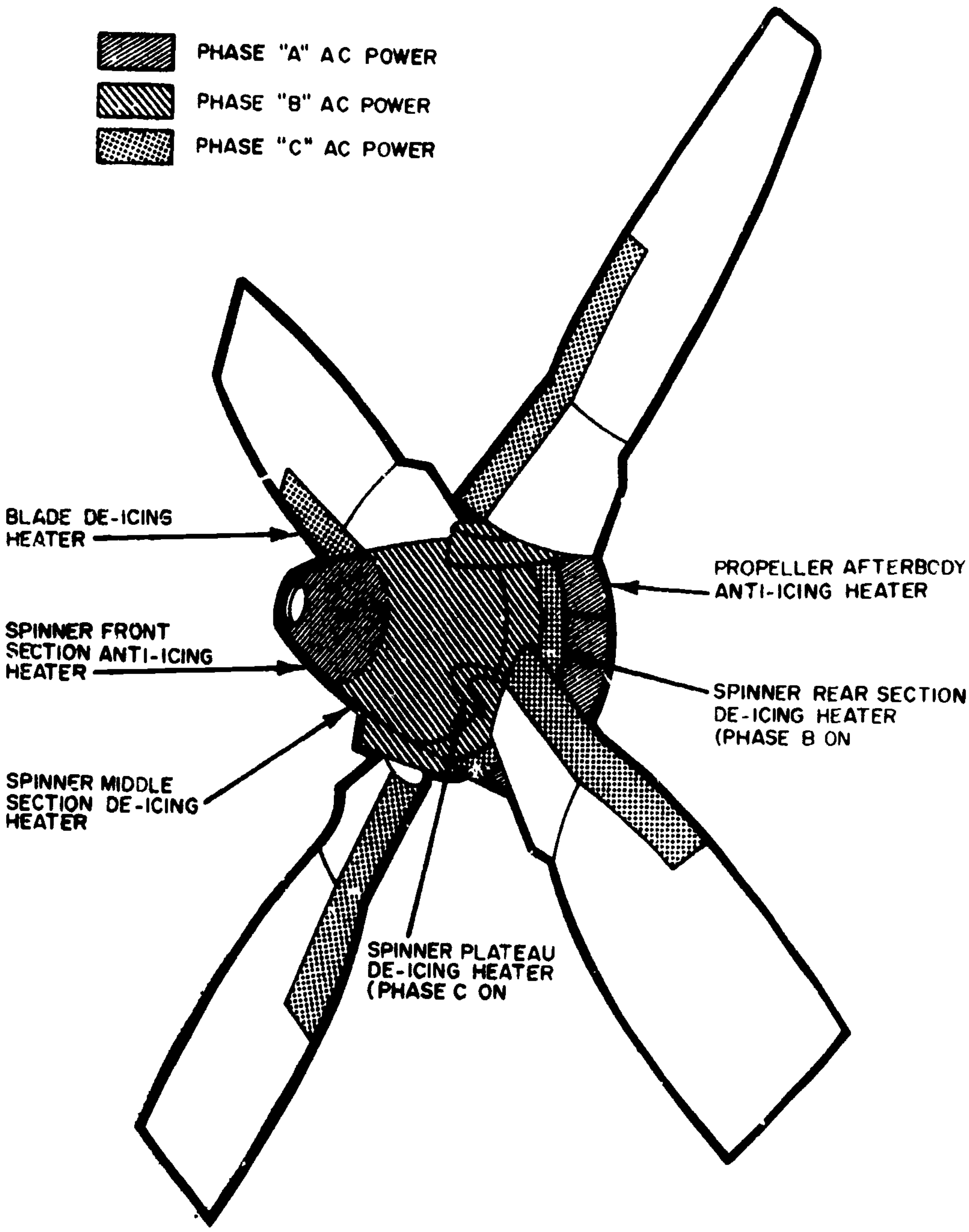

Figure 3. Propeller Anti-Icing and Deicing System.

propeller in the sequence of propeller numbers one, two, three, and four. This system uses alternating current (AC) for both the anti-icing and deicing portions.

The first part of the propeller assembly we will discuss is the brush block assembly. The brush block is mounted on the propeller control assembly. Its purpose is to transfer electrical current from the stationary part (nonrotating) to the rotating part of the propeller assembly. The brush block is constructed with four rows of carbon brushes, with three carbon brushes on a single row. These brushes transfer the electrical current to the rotating part.

The rotating part is the deicer contact ring holder assembly. The brushes on the brush block mate with four copper sliprings on the deicer contact ring holder. The four copper sliprings have a specific purpose: the outside ring is for anti-icing only, this ring is for "D" phase AC voltage; the second ring from the outside is for blade and the back half of the rear spinner deicing only, this ring is for "C" phase AC voltage; the third ring is for front spinner and front half of the rear spinner deicing only, this ring is for "B" phase AC voltage; and the inside ring is for ground for the anti-icing and deicing system, this ring is for "A" phase. The deicer contact ring holder transfers the electrical power to the blade deicing heater (deicing boot) by four contact brush assemblies mounted on the deicer contact ring holder. These contact brush assemblies directly contact two blade sliprings on the blade shank for deicing of the propeller blade only. Then the deicer contact ring holder assembly is connected to the rear spinner assembly by connector straps. These connector straps transfer the electrical power to the rear spinner and front (nose) spinner for either anti-icing or deicing of these assemblies. The rear spinner has the capability of being deiced only. The front (nose) spinner uses both anti-icing and deicing, the first seven inches of the nose spinner is for anti-icing only, and the remainder of this assembly is deiced. The propeller afterbody assemblies are connected by electrical leads from the brush block assembly to four terminal bolts on the afterbody mounting bracket, and the afterbodies are connected to these terminal bolts by electrical bonding straps. The afterbody has anti-icing only. (See figure 3.)

The propeller anti-icing and deicing system has three ammeters located on the overhead panel in the cockpit to indicate the current draw being used by the propeller assembly. One of these ammeters is for spinner anti-icing, the other two are for either blade deicing or spinner deicing. (See figure 2.)

The maximum allowable current draw for anti-icing is from 16 to 21 amps and the maximum allowable current draw for deicing is from 65 to 90 amps per propeller assembly.

SUMMARY

The engine and propeller anti-icing and deicing system are of major importance to the turboprop mechanic, the complete system is to eliminate the possibility of icing conditions affecting the operation of both the engine and propeller. This system can be operated in either the automatic or manual modes of operation.

QUESTIONS

1. What is the purpose of the engine anti-icing solenoid valve?

2. What is the part which is used to operate the anti-icing or deicing system?

3. What are the four areas of the engine that hot air is directed?

4. What is the purpose of the engine anti-icing system?

5. What are the areas of the spinner that are anti-iced?

6. What are the areas of the propeller that are deiced?

7. What is the cycle of the deicing timer?

8. What is the purpose of the deicer contact ring holder?

9. Which slipring carries electrical current for blade and rear spinner deicing?

10. Which heating elements have power cycled to them by the deicing timer?

11. What is the maximum allowable amperage draw for deicing and anti-icing?

12. What part sends hot air for nacelle intake and oil cooler air scoops for anti-icing?

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WS-207
26 January 1984

ENGINE ANTI-ICING SYSTEM

OBJECTIVE

After completing this worksheet, you will be able to:

Given TO 1C-130B-2-10, identify principles about the operation of the anti-icing system.

EQUIPMENT

	Basis of Issue
TO 1C-130B-2-10	1/student

PROCEDURE

Using Technical Order 1C-130P 2-10, complete the following statements. After you have completed the statements, place the correct technical order paragraph number in the space provided at the end of each statement.

1. Anti-icing air is directed from the compressor diffuser forward through ______________ tubes located along the compressor to the power unit anti-icing air valve assemblies; then, through ______________ ______________, to the air inlet struts, the inlet guide vane assembly torquemeter anti-icing shroud, the compressor inlet pressure probe, and the fuel control thermostatic probe. (Paragraph ____-____)

2. The actuated relay closes circuits to energize all four scoop ______________-______________ ______________ and all four ______________ ______________-______________ ______________. (Paragraph ____-____)

3. Both manual and automatic controls, selected by a PROP AND ENGINE ANTI-ICING MASTER switch, are provided for the ______________-______________ ______________. (Paragraph ____-____)

Supersedes C3ABR42633-WS-207, 6 December 1982.
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C3ABR42633-WS-208
30 January 1984

ENGINE INDICATING SYSTEM

OBJECTIVE

After completing this worksheet, you will be able to:

Given TO 1C-130B-1 and TO 1C-130B-2-6, identify principles about the operation of engine indicating systems.

EQUIPMENT

	Basis of Issue
TO 1C-130B-1	1/student
TO 1C-130B-2-6	1/student

PROCEDURE

Using TO 1C-130B-1, complete the first three statements. After you have completed the statements, place the correct technical order page number in the space provided at the end of each statement.

Using TO 1C-130B-2-6, complete the last three statements. At the end of the statements is a space for the technical order paragraph number.

1. Each indicator registers temperature in degrees ______________ and contains a vernier scale graduated in ______________.
(Page ____-____)

2. Each of the four torquemeters indicates torque in ______-______, and can indicate either ______________ or ______________ torque.
(Page ____-____)

3. The four oil temperature gages indicate oil temperature in the engine ______________ ______________ lines. (Page ____-____)

4. A tachometer system is provided for each engine to measure the ______________ ______________. (Paragraph ____-____)

5. Low-level limit switches in the four tank units are connected in ______________ with the warning light so operation of any one of the switches completes a ______________ to ______________ the ______________.
(Paragraph ____-____)

6. The synchronous-type fuel pressure indicating system measures the ______________ ______________ of the ______________ ______________ ______________. (Paragraph ____-____)

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OPR: 3350 TCHTG
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Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WS-209
5 December 1983

FIRE WARNING SYSTEM

OBJECTIVE

When you have completed this worksheet, you will be able to:

Identify principles about the operation of the fire warning system.

EQUIPMENT

	Basis of Issue
TO 1C-130B-1	1/student

INSTRUCTIONS

Using TO 1C-130B-1, complete the following statements.

1. The purpose of the fire warning system is ____________________

____

2. Each of the fire engine detection systems consists of a ______

________________ __________________________, ________________, and

________________ ________________________ in the fire emergency handle for each engine.

3. When high temperature is detected the __________________ unit initiates a __________________________ to the indicator lights.

4. The indicator lights give a __________________________________ when activated.

5. A test ____________________ is provided to test operation of each _________________________ and _____________________________.

6. How many positions does the agent discharge switch have?

____

Supersedes C3ABR42633-WS-209, 7 October 1982.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 350; DAV - 1

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Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WS-210
7 November 1983

OVERHEAT WARNING SYSTEM

OBJECTIVE

When you have completed this worksheet, you will be able to:

With the aid of a T.O. identify facts about the operation of the overheat warning system.

EQUIPMENT

	Basis of Issue
TO 1C-130B-1	1/student

INSTRUCTIONS

Using TO 1C-130B-1, complete the following statements

Section I

NACELLE OVERHEAT WARNING SYSTEM

1. The purpose of the nacelle overheat warning system is to warn the pilot of an ______________ condition in the area around the engine ______________.

2. The nacelle overheat warning system consists of ______________ detectors connected in ______________ to a loop.

3. The fenwal setting at which the detector lights will give an overheat warning is approximately ______________ °F.

4. There are ______________ numbered nacelle overheat warning ______________.

5. The test switch ______________ checks detector continuity or operation.

6. How is a nacelle overheat condition indicated to the pilot?

____

____.

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SECTION II

TURBINE OVERHEAT WARNING SYSTEM

1. The turbine overheat warning system for each engine consists of four ____________ detector units, a ____________, and ____________ ____________.

2. A turbine overheat condition is indicated by ____________ ____________.

3. The system operates when turbine temperature rises to ______°F.

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Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WS-211
8 November 1983

NEGATIVE TORQUE SIGNAL SYSTEM

OBJECTIVE

Given TOs 1C-130B-1 and 1C-130B-2-4, identify principles about the operation of the negative torque signal system.

EQUIPMENT

	Basis of Issue
TO 1C-130B-1	1/student
TO 1C-130B-2-4	1/student

INSTRUCTIONS

Use TO 1C-130B-1 to complete the first statement. Use TO 1C-130B-2-4 to complete the second and third statements. Fill in the blank space at the end of each statement with the paragraph number that identifies the location of the information required to complete these three statements.

1. Normal operation of the NTS system does not commit the propeller to feather. However, a ______________ NTS system may completely ______________ the propeller or cause engine to ______________ ______________ ______________.
(Paragraph # ________-________________)

2. The signal mechanism transmits the motion of the ______________ ______________ through linkages to the propeller, which moves toward ______________ position until blade angle increases enough to relieve the negative torque condition. (Paragraph # _______-___________)

3. When the negative torque signal exceeds a __________ __________, at the power unit, the reaction generated by the helical splines __________ the force of opposing springs and the ring gear pushes an actuator rod through the front of the ____________ ________________ front case.
(Paragraph # ________-_____________)

Supersedes C3ABR42633-WS-211, 10 December 1982.
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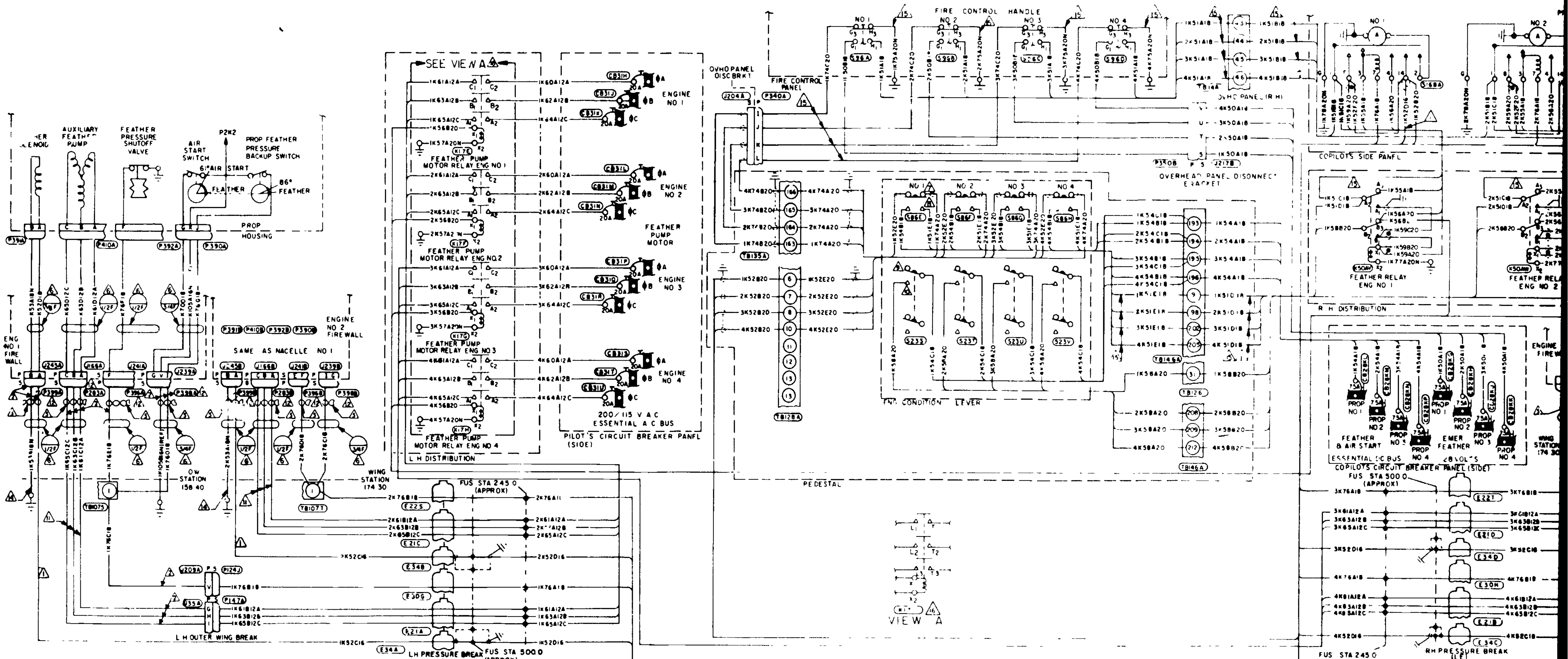
Jet Engine Branch
Chanute AFB, Illinois

PROPELLER FEATHER AND AIR START CONTROL

Use and study this handout as directed by your instructor



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3350 TCHTG/TTGU-J - 1200; TTVSA - 1

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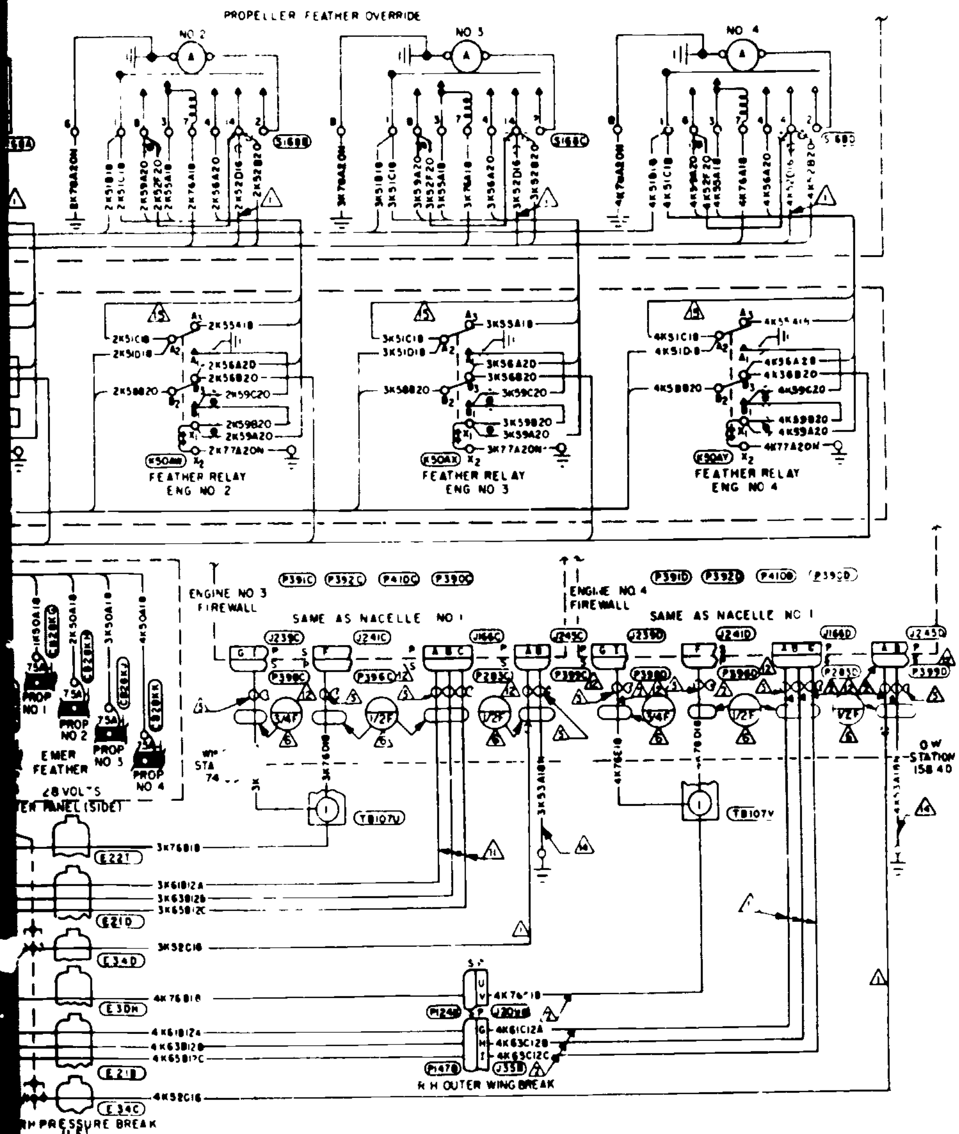

NOTE

1. THIS WIRE TO BE ROUTED SEPARATELY.
2. WIRES & CONNECTORS PART OF REGULATED ASSY.
3. FOR ITEM IDENTIFICATION SEE ITEM LIST, TABLE 1-1.
4. ALL WIRES ON THIS DIAGRAM MUST BE KEPT A MINIMUM OF SIX INCHES FROM SENSITIVE WIRES.
5. ALL WIRES IN THIS CONDUIT TO BE TWISTED 2 TO 3 TURNS PER FOOT AND TWIST TO EXTEND A MINIMUM OF ONE FOOT BEYOND CONDUIT.
6. ALL WIRES IN THIS CONDUIT TUBE COVERED WITH GENCOTE NO. 135 TYPE 564 ASBESTOS SLEEVING, GENERAL PLASTIC CORP, PATTERSON, NEW JERSEY.
7. THIS SWITCH POSITION IS FOR CONDITION LEVER IN AIR START, RUN & GRD STOP.
8. THIS SWITCH POSITION IS FOR CONDITION LEVER IN FEATHER.
9. THIS SWITCH POSITION IS FOR CONDITION LEVER IN RUN, GRD STOP & FEATHER.
10. THIS SWITCH POSITION IS FOR CONDITION LEVER IN AIR START.
11. WIRE TO BE PE 400 (PACKARD ELECTRIC WARREN, OHIO).
12. SAFETY WIRE THIS PLUG, INSTALL LS7289-1 RED DOT DECAL ON ADJACENT STRUCTURE.
13. INSTALL WIRES PER MIL-W-5088.
14. PROVIDE SEPARATE GROUNDS.
15. ENTIRE LENGTH TO BE ENCLOSED IN VINYL TUBING.
16. ALL WIRES SHOWN ON TERM. C1, B1, A1 ON MS24192D1 ARE TERMINATED ON TERM L1, L2, L3 RESPECTIVELY ON AN3339-1 RELAY. ALL WIRES SHOWN ON TERMINALS C2, B2, A2 ON MS24192D1 RELAY ARE TERMINATED ON TERMINALS T1, T2, T3 RESPECTIVELY ON AN3339-1 RELAY.

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-HO-212b
8 November 1983

INSPECTION OF IGNITION SYSTEM COMPONENTS

OBJECTIVE

Given handout and working in a group, inspect ignition system components.

INSTRUCTIONS

Using handout, inspect the ignition system components.

PROCEDURE

1. Speed Sensitive Control

   a. Inspection of electrical connector for

      (1) corrosion

      (2) bent or broken prongs

      (3) stripped or cross-threaded

   b. Inspection of mating surfaces for nicks, scratches, etc.

   c. Inspection of shaft for excessive wear.

   d. Visual inspection for general condition.

2. Ignition Exciter

   a. Visual inspection for general condition.

   b. Inspection of electrical connectors for

      (1) corrosion

      (2) bent or broken prongs

      (3) stripped or cross-threaded

   c. Inspection of mounting studs.

Supersedes C3ABR42633-HO-212b, 20 December 1982.
OPR: 3350 TCHTG
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3. Ignition Relay

   a. Inspection of body for general condition.

   b. Inspection of mounting bracket for cracks.

   c. Inspection of electrical connector for

      (1) corrosion

      (2) bent or broken prongs

      (3) stripped or cross-threaded

4. Igniter Plugs

   a. Inspection for general condition.

   b. Inspection of mounting surfaces.

   c. Inspection of igniter leads for

      (1) corrosion

      (2) wear

      (3) stripped or cross-threaded

ANTI-ICING SYSTEM COMPONENT REMOVAL

OBJECTIVE

Given a handout and working in a group, remove anti-icing system components.

INSTRUCTION

The following are step-by-step instructions on anti-icing system component removal.

PROCEDURE

1. Anti-icing solenoid valve

   a. Disconnect electrical connector from the solenoid.

   b. Disconnect the solenoid-to-air valve air lines at the solenoid.

   c. Remove the two bolts that secure the solenoid to its mounting bracket.

   d. Remove the solenoid.

2. Anti-icing air valve

   a. Disconnect the solenoid-to-air valve air line at the air valve.

   b. Remove the four bolts that secure the air valve to the air inlet housing.

   c. Pull the air valve away from the air inlet housing.

   d. Pull the air valve off of the 14th stage air tube.

Supersedes C3ABR42633-HO-212e, 6 December 1982
OPR: 3350 TCHTG
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Chanute AFB, Illinois

C3ABR42633-HO-212f
8 November 1983

INSPECTION OF BLEED AIR SYSTEM COMPONENTS AND ENGINE PLUMBING

OBJECTIVE

Given handout, and working in a group, inspect bleed air system components, including engine plumbing.

INSTRUCTIONS

Using this handout, inspect bleed air system components according to steps given below.

PROCEDURE

1. Speed sensitive valve

   a. Inspect fittings for stripped threads.

   b. Inspect both mating surfaces for nicks, scratches, etc.

   c. Inspect shaft splines for excessive wear.

2. Compressor bleed valves

   a. Inspect bleed valve fittings for stripped threads.

   b. Inspect each valve for freedom of movement.

   c. Inspect air lines for chafing.

3. Speed sensitive valve filter

   a. Inspect filter for contamination.

   b. Inspect fittings for stripped threads.

Supersedes C3ABR42633-HO-212h, 10 December 1982.
OPR: 3350 TCHTG
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Chanute AFB, Illinois

C3ABR42633-HO-212g
8 November 1983

INSPECT ANTI-ICING SYSTEM COMPONENTS

OBJECTIVE

Given handout and working in a group, inspect anti-icing system components.

INSTRUCTIONS

Use this handout for inspecting the anti-icing components.

PROCEDURE

1. Anti-icing solenoid valve

   a. Inspection of electrical connector for

      (1) corrosion.

      (2, bent or broken prongs.

      (3) stripped or cross-threaded.

   b. Inspection of the body

      (1) fittings stripped or cross-threaded.

      (2) cracks.

2. Anti-icing air valve

   a. Inspection of the body for corrosion.

   b. Inspection of openings for obstructions.

   c. Inspection of fittings for stripped or cross-threaded.

Supersedes C3ABR42633-HO-212g, 10 December 1982.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 350; DAV - 1

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INSTALL ANTI-ICING SYSTEM COMPONENTS

OBJECTIVE

Given a handout and working in a group, install anti-icing system components.

INFORMATION

The following are step-by-step instructions on anti-icing system component installation.

PROCEDURE

1. Anti-icing solenoid valve

a. Install the anti-icing solenoid valve on the bracket and torque the bolts.

b. Connect the air lines from the anti-icing air valves.

c. Connect the electrical to lead to the solenoid valve.

2. Anti-icing air valve

a. Install the anti-icing air valves onto the air inlet housing by inserting the two air passages into the air inlet housing.

b. Connect the 14th stage air line.

c. Connect the solenoid-to-air valve air line.

Supersedes C3ABR42633-HO-2121, 10 December 1982.
OPR: 3350 TCHTG
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3350 TCHTG/TTGU-B - 350; DAV - 1

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-HO-212m
10 December 1982

INSPECTION OF OIL SYSTEM AND ACCESSORY DRIVE HOUSING

OBJECTIVE

Given TO 2J-T56-26, handout, and working in a group, inspect oil system components including accessory drive housing with no more than 3 procedural errors allowed.

INSTRUCTIONS

The following are step-by-step instructions on inspection of the oil system and accessory drive housing.

PROCEDURE

1. Power section main and scavenge oil pump.

   a. Inspect mating surfaces for nicks, scratches, etc.

   b. Inspect shaft splines for excessive wear.

2. External scavenge oil pump.

   a. Inspect mating surfaces for nicks, scratches, etc.

   b. Inspect hose fittings for stripped threads.

   c. Inspect shaft splines for excessive wear.

3. Power section oil filter

   a. Inspect mating surfaces for nicks, scratches, etc.

   b. Inspect filter element for damage and obstructions.

4. Accessory drive housing

   a. Inspect all mating surfaces for nicks, scratches, etc.

   b. Inspect shaft splines for excessive wear.

   c. Inspect all studs for stripped threads, being bent or damaged.

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3350 TCHTG/TTGU-B - 200; DAV - 1

RGL: N/A

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Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-HO-212n
8 November 1983

INSPECTION OF FUEL SYSTEM COMPONENTS

OBJECTIVE

Given handout, and working in a group, inspect fuel system components including fuel manifold and nozzles.

INSTRUCTIONS

Using this handout, follow the step-by-step procedures for inspecting the fuel system components.

PROCEDURE

1. Fuel enrichment valve

   a. General visual inspection for

      (1) cracks.

      (2) obstructions.

      (3) fittings for stripped or cross-threaded.

   b. Inspection of electrical connector for

      (1) corrosion.

      (2) bent or broken prongs.

      (3) stripped or cross-threaded.

2. Dual fuel pump

   a. General visual inspection for

      (1) fittings stripped or cross-threaded.

      (2) both mounting surfaces for nicks, scratches, etc.

      (3) hoses for cracks, worn and fire sleeving.

      (4) shaft splines for excessive wear.

Supersedes C3ABR42633-HO-212n, 10 December 1982.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 350; DAV - 1

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b. Inspection of electrical connections

(1) corrosion.

(2) bent or broken prongs.

(3) stripped or cross-threaded.

3. High pressure fuel filter

a. Inspection of surfaces for nicks, scratches, etc.

b. Inspection of fuel filter for damage and obstructions.

4. Fuel control

a. General visual inspection for

(1) fittings stripped or cross-threaded.

(2) both mounting surfaces for nicks, scratches, etc.

(3) shaft splines for excessive wear.

(4) broken permanent safety wire.

(5) hoses for wear, cracks, and firesleeving.

(6) mechanical linkage worn, missing cotter pins, and broken safety wire.

b. Inspection of electrical connector for

(1) corrosion.

(2) bent or broken prongs.

(3) stripped or cross-threaded.

5. Coordinator

a. General visual inspection for

(1) cracks.

(2) corrosion.

(3) mechanical linkage worn, missing cotter pins, and broken safety wire.

b. Inspection of electrical connections for

(1) corrosion.

(2) bent or broken prongs.

(3) stripped or cross-threaded.

6. Fuel manifold

a. Inspection for worn or cracked firesleeving.

b. Stripped or cross-threaded fittings.

7. Fuel manifold drain valve

a. Visual inspection for cracks and stripped fittings

b. Inspection of electrical connector for

(1) corrosion.

(2) bent or broken prongs.

(3) stripped or cross-threaded.

c. Inspection of mounting bracket for cracks.

8. Fuel nozzles

a. Inspection of air shroud for correct assembly.

b. Inspection of shroud face for cracks.

c. Inspection for obstructions.

d. Inspection for stripped or cross-threaded fittings.

INSPECTION OF TEMPERATURE DATUM SYSTEM COMPONENTS

OBJECTIVE

Given handout and working in a group, inspect temperature datum system components with no more than 3 procedural errors allowed.

INSTRUCTIONS

Using this handout, inspect the temperature datum system components.

PROCEDURE

1. Temperature Datum Valve

   a. Visual inspection for cracks.

   b. Inspection of fittings for being stripped or cross-threaded.

   c. Inspection of permanent safety wire being broken.

   d. Inspection of electrical connectors for
      (1) corrosion.
      (2) bent or broken prongs.
      (3) stripped or cross-threaded.

   e. Inspection of mounting bracket for cracks.

   f. Inspection of hoses for being worn and cracked firesleeving.

2. Thermocouples

   a. Inspection of studs having movement or bent.

   b. Inspection for cracks.

   c. Inspection of probe for
      (1) wear.
      (2) inlet holes for elongation.
      (3) burning.
      (4) bending.

   d. Inspection of mating surfaces for nicks, scratches, etc.

Supersedes C3ABR42633-HO-2120, 29 December 1982. RGL: N/A
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 300; DAV - 1
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Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-HO-212p
7 November 1983

CORROSION CONTROL

OBJECTIVE

Given handout and working in a group, apply corrosion control procedures to engine accessories.

INSTRUCTIONS

Using handout apply corrosion control procedures to engine accessories.

PROCEDURES

Note: * - simulated steps.

*1. Safety Precautions

a. Prevent breathing of toxic vapors.

b. Prevent absorption through the skin.

c. Prevent ingestion or swallowing.

d. Prevent skin irritation.

*2. Clean engine accessory using chemical method

a. Spray or wipe down with PD-680.

b. Rinse immediately.

c. Let air dry.

3. Practical Method of Corrosion Treatment

a. Protect accessory surfaces by applying a film of lubricating oil.

4. Cap open lines with plastic or metal covers

Supersedes C3ABR42633-HO-212p, 20 December 1982
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 200; DAV - 1

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STUDY GUIDE/WORKBOOK
C3ABR42633-SW-213

Technical Training

Turboprop Propulsion Mechanic

MAINTENANCE DOCUMENTATION

15 March 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE

DO NOT USE ON THE JOB

MAINTENANCE DOCUMENTATION

PROJECT 1. DOCUMENTING REMOVAL OF ASTERISKED ITEMS

OBJECTIVE

Given TO 00-20-2-4 and TO 1C-130A-06, document removal of selected engine accessories on AFTO Form 349 (figure 1) and AFTO Form 350 (figure 2).

EQUIPMENT

	Basis of Issue
TO 00-20-2-4	1/student
TO 1C-130A-06	1/student

PROCEDURE

Use TO 00-20-2-4, page 2-7, table 2-2, rule 1, and TO 1C-130A-06. This involves removal of an asterisked item and replacement is not accomplished concurrently. Column C shows what blocks in the AFTO Form 349 will be documented. NOTE: If this were a dispatch form you would be required to fill in blocks 7, 9, 17, and 18. Local management does not require you to fill in blocks 14, 15, and 16, but they do require you to fill in blocks 26 and 27. Block 6 will always reflect time for item identified in block 3.

Refer to table 2-2 and use Section 3 to identify what information is to be placed into each of the blocks.

INFORMATION

1. You and two others in your crew are assigned the in-shop on equipment task of removing the power section oil pump, due to external oil leakage. You are working on an engine that was removed due to a failure or malfunction. The oil leak was found after the engine was brought to your shop. Your crew started removal at 0600 hours and stopped at 0900 hours. At 0800 hours, one of your crewmembers went to a hospital appointment and didn't come back. The item removed is not sent to RPC and a demand has not been made on supply for a new part. The item removed is serially controlled and no operating time is required.

Note: Complete forms as asterisk items.

2. Power section oil pump

(1) P/N 6789851

(2) S/N 0617A

(3) NSN 2910-00-361-4567

Supersedes C3ABR42633-SW-211, 10 May 1983.
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 150; DAV - 1

MAINTENANCE DATA COLLECTION RECORD

OMB NO 21-R0227

1. JOB CONTROL NO.	2. WORKCENTER	3. I.D. NO./SERIAL NO.	4. MDS	5. EQ/CL	6. TIME	PRI	8. SORTIE NO.	9. LOCATION
CJD								

10. ENG. TIME	11. ENGINE I.D.	12. INST ENG TIME	13. INST. ENG. I.D	14.	15.	16.	17. TIME SPC RFO	18. JOB STD.

19. FSC	20. PART NUMBER	21. SER. NO./OPER. TIME	22. TAG NO	23. INST. ITEM PART NO.	24 SERIAL NUMBER	25 OPER. TIME

ACT. LINE	A TYPE MAINT	B COMP POS	C WORK UNIT CODE	D ACTION TAKEN	E WHEN DISC	F HOW MAL	G UNITS	H START HOUR	I STOP DAY	I STOP HOUR	CREW SIZE	K CAT LAB	L CMD ACT ID	M SCH CODE	N EMPLOYEE NUMBER
1															
2															
3															
4															
5															

26. DISCREPANCY

27. CORRECTIVE ACTION

28 RECORDS ACTION

AFTO FORM MAY 75 349 PREVIOUS E... IS OBSOLETE.

☆USGPO: 1976 — 657-708/9017 Region 5-11

Figure 1.

3. General information for completing figures 1 and 2.

(1) JCN _ _ _ 3750

(2) W/C T3230

(3) SRD - XGK

(4) Engine data

(a) Model and series T56-A-7B

(b) Serial #AE-101774

(c) ID #TX1774

(d) Engine time 3452:62

AFTO FORM 350
JAN 82

PREVIOUS EDITION
WILL BE USED

OMB NO. 0701-0014

REPARABLE ITEM PROCESSING TAG

1. JOB CONTROL NO. CJD | 2. ID / SERIAL NO. | 3. TM | 3A. SRD | 4. WHEN DISC

5. HOW MAL | 6. MDS | 7. WORK UNIT CODE | 8. ITEM OPER TIME | 9. QTY

10. FSC | 11. PART NUMBER

12. SERIAL NUMBER | 13. SUPPLY DOCUMENT NUMBER

14. DISCREPANCY

15. SHOP USE ONLY

15A. CMD / ACT ID | 15B. ACTION TAKEN

TAG NO. 980131 AFTO 350 PT. I

16. SUPPLY DOCUMENT NUMBER

17. NOMENCLATURE

18. PART NUMBER

19. NSN

20. [illegible] | [illegible] | [illegible] USE ONLY

TAG NO. 980131

Figure 2.

BEST COPY AVAILABLE

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MAINTENANCE DATA COLLECTION RECORD

OM [illegible] 21 [illegible]

1. JOB CONTROL NO.	2. WORKCENTER	3. I.D. NO./SERIAL NO.	4. MDS	5. EQ/CL	6. TIME	7 PRI	8 SORTIE NO	9 LOCATION
CJD								

10. ENG. TIME	11. ENGINE I.D.	12 INST ENG TIME	13. INST. ENG. I.D	14	15.	16.	17 [illegible] SPC REQ	18 JOB STD

19. FSC	20. PART NUMBER	21. SER. NO./OPER. TIME	22. TAG NO.	23. INST ITEM PART NO.	24. SERIAL NUMBER	25 [illegible]

ACT. LINE	A TYPE MAINT	B COMP POS	C WORK UNIT CODE	D ACTION TAKEN	E WHEN DISC	F HOW MAL	G UNITS	H START HOUR	I STOP DAY	I STOP HOUR	J CREW SIZE	K CAT LAB	L CMD ACT ID	M SCH CODE	N EMPLOYEE NUMBER
1															
2															
3															
4															
5															

26 DISCREPANCY

27. CORRECTIVE ACTION

28 RECORDS ACTION

AFTO FORM MAY 75 349 PREVIOUS EDITION IS OBSOLETE. ☆USGPO: 1976 — 657-708/9017 Region 5

Figure 3.

PROJECT 2. DOCUMENTING INSPECTION OF ASTERISKED ITEMS

OBJECTIVE

Given TO 00-20-2-4 and TO 1C-130A-06, document inspection of selected engine accessories on AFTO Form 349 (figure 3).

PROCEDURE

Use TO 00-20-2-4, Section 3, to document the inspection of the ignition exciter.

Note: If this were a dispatch form, you would be required to fill in blocks 7, 9, 17, and 18. Local management does not require you to fill in blocks 14, 15, 16, but they do require you to fill in blocks 26 and 27.

INFORMATION

1. You have been given the in-shop on equipment task of inspecting the ignition exciter that was removed to facilitate compressor maintenance. You began work at 0900 hours and finished at 0930 hours.

Note: The item is serially controlled and you did NOT remove, replace or install the ignition exciter.

2. Ignition exciter

(1) P/N 6805230

(2) S/N 0617B

(3) NSN 2910-00-482-7146

3. General information

(1) _ _ _ 3749

(2) W/C T3230

(3) Engine data

(a) Model and series T56-A-7B

(b) Serial #AE-101774

(c) ID #TX1774

MAINTENANCE DATA COLLECTION RECORD

OMB NO. 21-R0227

1. JOB CONTROL NO.	2. WORKCENTER	3. I.D. NO./SERIAL NO.	4. MDS	5. EQ/CL	6 TIME	7. PRI	8 SORTIE NO	9. LOCATION
CJD								

10. ENG. TIME	11. ENGINE I.D.	12. INST ENG TIME	13. INST. ENG. I.D.	14.	15.	16.	17. TIME SPC REQ	18. JOB STD.

19. FSC	20. PART NUMBER	21. SER. NO./OPER. TIME	22. TAG NO.	23. INST. ITEM PART NO.	24. SERIAL NUMBER	25. OPER. TIME
						1009

ACT. LINE	A TYPE MAINT	B COMP POS	C WORK UNIT CODE	D ACTION TAKEN	E WHEN DISC	F HOW MAL	G UNITS	H START HOUR	I STOP DAY	I STOP HOUR	J CREW SIZE	K CAT LAB	L CMD ACT ID	M SCH CODE	N EMPLOYEE NUMBER
1															
2															
3															
4															
5															

26 DISCREPANCY

27. CORRECTIVE ACTION

29 RECORDS ACTION

AFTO FORM MAY 75 349 PREVIOUS EDITION IS OBSOLETE. ☆USGPO: 1976 — 657-708/9017 Region 5

Figure 4.

PROJECT 3. DOCUMENTING INSTALLATION OF ASTERISKED ITEMS

OBJECTIVE

Given TO 00-20-2-4 and TO 1C-130A-06, document installation of selected engine accessories on AFTO Form 349, figure 4.

PROCEDURE

Use TO 00-20-2-4, page 2-7, table 2-2, rule 3. This involves installation of an asterisked item accomplished separately from removal. Column C shows what blocks in AFTO Form 349 will be documented. NOTE: If this were a dispatch form, you would be required to fill in blocks 7, 9, 17, and 18. Local management does not require you to fill in blocks 14, 15, and 16, but they do require you to fill in blocks 26 and 27. Block 6 will always reflect time for item identified in block 3.

Refer to table 2-2 and use Section 3 to identify what information is to be placed into each of the blocks.

INFORMATION

1. You are one other person in your crew are assigned the unscheduled in-shop, on-equipment task of installing the coordinator control which was removed to facilitate compressor maintenance. You started at 1200 hours and you accomplished the task at 1600 hours.

2. Coordinator control

(1) P/N 6815900

(2) S/N C0026

(3) NSN 2910-00-457-12

3. General information

(1) JCN _ _ _ 3709

(2) W/C T3230

(3) Engine data

(a) Model and series T56-A-7B

(b) Serial #AE-101774

(c) ID #TX1774

MAINTENANCE DATA COLLECTION RECORD

OMB NO. 21-R0227

1. JOB CONTROL NO.	2. WORKCENTER	3. I.D. NO./SERIAL NO.	4. MDS	5. EQ/CL	6 TIME	7. PRI	8. SORTIE NO.	9. LOCATION
CJD								

10. ENG. TIME	11. ENGINE I.D.	12. INST ENG TIME	13. INST. ENG. I.D.	14.	15.	16.	17. TIME SPC REQ	18. JOB STD.

19. FSC	20. PART NUMBER	21. SER. NO./OPER. TIME	22. TAG NO.	23. INST. ITEM PART NO.	24. SERIAL NUMBER	25. OPER. TIME

ACT. LINE	A TYPE MAINT	B COMP POS	C WORK UNIT CODE	D ACTION TAKEN	E WHEN DISC	F HOW MAL	G UNITS	H START HOUR	I STOP DAY	I STOP HOUR	J CREW SIZE	K CAT LAB	L CMD ACT ID	M SCH CODE	N EMPLOYEE NUMBER
1															
2															
3															
4															
5															

26. DISCREPANCY

27. CORRECTIVE ACTION

28 RECORDS ACTION

AFTO FORM MAY 76 349 PREVIOUS EDITION IS OBSOLETE.

☆USGPO: 1976 — 657-708/9017 Region 5-11

Figure 5.

PROJECT 4. DOCUMENTING REMOVAL, INSPECTING AND INSTALLINC OF AN ASTERISKED ITEM ON ONE AFTO FORM 349

OBJECTIVE

Given TO 00-20-2-4 and TO 1C-130A-06, document removal, inspection, and installation of a selected engine accessory on an AFTO Form 349 (figure 5).

PROCEDURE

Use TO 00-20-2-4 and TO 1C-130A-06 to document the removal, inspection, and installation of the fuel control. NOTE: This is not a dispatch form so you do not have to fill in blocks 7, 9, 17, and 18. Local management does not require you to fill in blocks 14, 15, 16, but they do require you to fill in blocks 26 and 27. Block 6 will always reflect time for item identified in block 3.

INFORMATION

1. You and one other member in your crew have been given the in-shop, on-equipment unscheduled task of removing, inspecting, and installing a fuel control that is suspected of having worn shaft splines. The engine was removed to facilitate turbine maintenance due to an overheat and flame out. You started the job at 0700 hours and finished at 1400 hours. You went to

lunch between 1100 and 1200 hours and it took you two hours to do each part of the task. The fuel control was not set to RPC and a demand has not been made on supply for a new fuel control. The item is serially controlled and no operating time is required.

2. Fuel control

   (a) P/N 330043-7

   (b) S/N 172371

   (c) FSC 2910

3. General information

   (a) JCN _ _ _ 3750

   (b) W/C T3230

   (c) Engine data

      (1) Model T56-A-7A

      (2) Serial #AE 01774

      (3) ID #TX 1774

      (4) Time 3147.3

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WB-215
13 March 1984

PROPELLER TECHNICAL PUBLICATIONS

OBJECTIVES

1. Given TO 1C-130B-2-11, locate basic propeller information.
2. Given TO 3H1-18-2, locate basic propeller information.
3. Given TO 3H1-18-4, locate basic information and components of the propeller system.

EQUIPMENT

	Basis of Issue
TO 1C-130B-2-11	1/student
TO 3H1-18-2	1/student
TO 3H1-18-4	1/student

PROCEDURE

Follow the directions given for each section.

SECTION 1

DIRECTIONS

Use TO 1C-130B-2-11 to complete the following statements.

1. What is the basic issue date of this technical order? ____________

2. How many sections does the table of contents list in this technical order? __________

3. The title of Section I is ____.

4. On what page would you find general information about the propeller? __________

5. What is the title of the illustration on page 1-4? _______________ __________________________________

6. What is the title of Section II? ________________________________

7. On what page does the description and operation of the propeller start? __________

8. According to the table of contents for Section II (on page 2-1), on what page should you find information about control drive bracket installation? __________

OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 400; DAV - 1

Designed for ATC Course Use. Do Not Use on the Job.

9. The title of Section III is ______________________________.

10. Page ________ contains information on adjustment of the propeller hydraulic system.

11. What is the title of illustration 3-4? ______________________________

12. What is the title of Section IV? ______________________________

13. On what page does the operational checkout for the propeller control system start? __________

14. What page is Table 4-3 on? __________

15. According to the alphabetical index, what page is the following information located on?

a. Governing Speed Adjustment ________

b. Reindexing ________

c. Valve Housing Replacement ________

d. Tachometer Test Panel ________

SECTION 2

DIRECTIONS

Use TO 3H1-18-2 to complete the following statements.

1. What are the model numbers for the propellers covered in this manual? ______________________________

2. What section in this technical order covers the major characteristics of the propeller? ______________

3. The title of the illustration on page 1-3 is ______________________________.

4. What is the title of Section II? ______________________________

5. What page contains instructions for initial servicing? ____________

6. On what page is illustration 2-12 found? __________

7. The title of Section III is ______________________________.

8. According to the tool list on page 3-1, what is the nomenclature of the tool in figure 3-11? ______________________________

9. Section ______ is called "Check-out and Analysis."

10. What page contains the instructions for testing the valve housing assembly? ________

11. The title of Section V is ______________________________ ______.

12. Instructions for spinner and afterbody repair are found on page ________.

13. What is the title of illustration number 4-8? ____________________ ______________________________________

14. What is the title of Section VI? ______________________________

15. According to the index on page 6-1, on what page does the different data sheets for propeller model 54H60-91/PT21403 start? ________

SECTION 3

DIRECTIONS

Use TO 3H1-18-4 to complete the following statements.

1. List the figure/index and part numbers for the following component description:

Figure/Index	Part Number	Description
________	________	Piston, servo (low-pitch stop assembly)
________	________	Ring, stop (dome assembly)
________	________	Valve, shuttle (pitchlock regulator assembly)

2. Which figure covers the dome assembly? ________

3. List the figure and index numbers for the following part numbers:

Part Numbers	Figure/Index
AN150407	________
HS9380	________
548537	________
SWE84036	________
69494R245	________
740313-3	________
MS16562-99	________

STUDY GUIDE
3ABR42633-SG-209

SG 216

Technical Training

Turboprop Propulsion Mechanic

PROPELLER FUNDAMENTALS

5 February 1980

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

PROPELLER FUNDAMENTALS

OBJECTIVE

After completing this study guide and your classroom instruction, you will be able to explain basic facts about propeller constructional features, operating principles, and functions.

INTRODUCTION

Early airplanes used fixed pitch propellers. Then, with the passing of time, adjustable propellers were developed. Some of the propellers had to be adjusted on the ground. Others had a hydraulic or electrical system which allowed the pilot to change the blade angles in flight.

The changing of blade angles is to keep with such changes as air density and aircraft attitude. This allows the engine to operate more efficiently.

Next the constant speed propeller was developed. This type of propeller could sense an off speed condition of the engine. An off speed is when the engine drives the propeller too fast or when the propeller drives the engine. It would then automatically change the blade angles to keep the engine rpm constant.

Today's turbopropeller is more accurate and sensitive than propellers have been. This is necessary because of the close control that must be maintained on the high speed turboprop engines.

As you can see, the propeller has evolved from a fixed pitch to a complicated device. It takes well trained men to repair and maintain these propellers.

PURPOSE OF A PROPELLER

OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-J - 200; TTVSA - 1

Propeller blade tips are required to be painted so the mechanic can identify the plane of rotation. One good safety practice to observe is to stay clear of the turning propeller. Always consider the area in front as well as the rear of the propeller as a danger area.

The purpose of the propeller is to convert engine power into forward or reverse thrust. It must also load the engine and thus control its speed. The propeller blades can be considered a series of rotating airfoils.

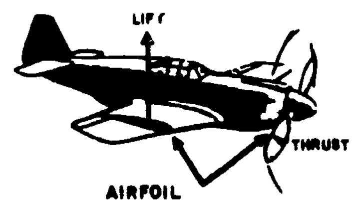

Figure 1. Airfoils.

The thrust of a propeller is developed in the same manner as lift on a wing. In fact, propeller thrust is nothing more than lift directed forward rather than upward. See figure 1.

The propeller blades are held at the center of rotation by a hub. The hub is attached to the propeller shaft. As the shaft is driven by the engine, the propeller turns and thrust is developed.

As an airfoil passes through the air, air pressures are present and acting on the airfoil.

Bernoulli's principle explains how these air pressures behave. Bernoulli was an Italian who performed many experiments dealing with velocity and pressure of fluid which includes air. Through his experiments, Bernoulli proved the following principle:

As a velocity of a fluid across a surface increases, pressure on that surface decreases. As velocity decreases, pressure increases. Now, let's apply this principle to a moving airfoil.

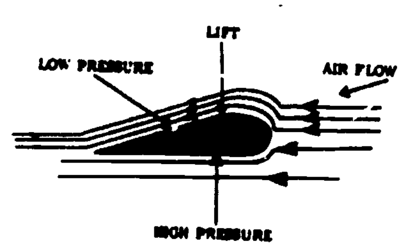

Figure 2. Airflow Over an Airfoil.

Refer to figure 2. You can see that as the air flows over the airfoil the flow over the curved or cambered portion must travel farther and faster than the flow across the flat portion. This increase in velocity causes a decrease in pressure on the curved portion. As a result, the airfoil moves toward the low pressure area. In the case of the wing, it would be up (lift), and on the propeller blade it would be forward (thrust).

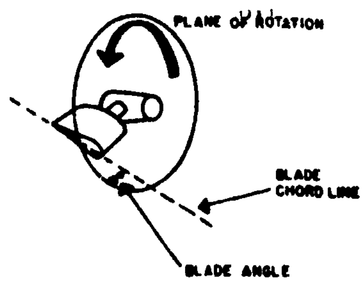

Figure 3. Blade Angle.

For a propeller to produce a desired amount of thrust the blades must be set at a specific angle. This blade angle is the angle between the chord of the blade and the plane of rotation. See figure 3.

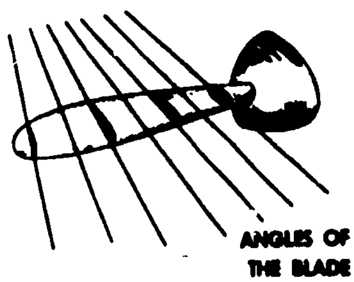

Figure 4. Variation in blade Angles.

In order for the propeller to operate properly, the blade angle must vary along the length of the blade. See figure 4. The reason for this variation is that the propeller operates like a screw. It advances at the same time that it rotates. These two motions acting upon any section of the blade cause that point to follow a spiral path through the air. See figure 5. That is, a point on a section near the tip of the blade will trace a large spiral. A point on a section near the shank of the blade will trace a smaller spiral. If these spiral paths are to be traced with the various propeller blade sections at their most effective angle, then each individual airfoil section must be designed and constructed so that their angles become gradually less toward the tip of the blade and greater toward the shank of the blade. This gradual change of the blade angles is called a pitch distribution.

NOMENCLATURE AND TERMS

You will be required to know certain terms and theory that pertain to propellers. It is also necessary that you know the names of various parts of a propeller. The following is a list of propeller terms and nomenclature.

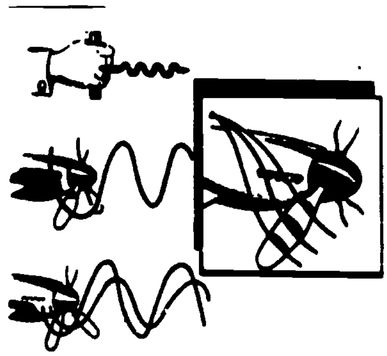

Figure 5. Action of Propeller Blade.

Propeller Hub - That part of the propeller that retains the blades.

Pitch Change Mechanism - Provides the force required to accomplish blade angle change.

Blade Angle - The angle between the chord line of the blade and the plane of rotation.

Chord Line of Blade - An imaginary line drawn through the blade from the leading edge to the trailing edge. It is perpendicular to the center of the blade.

Center Line of Blade - An imaginary line drawn through the center of a blade from tip to butt. It is used when laying off blade stations. It is the longitudinal axis of the blades.

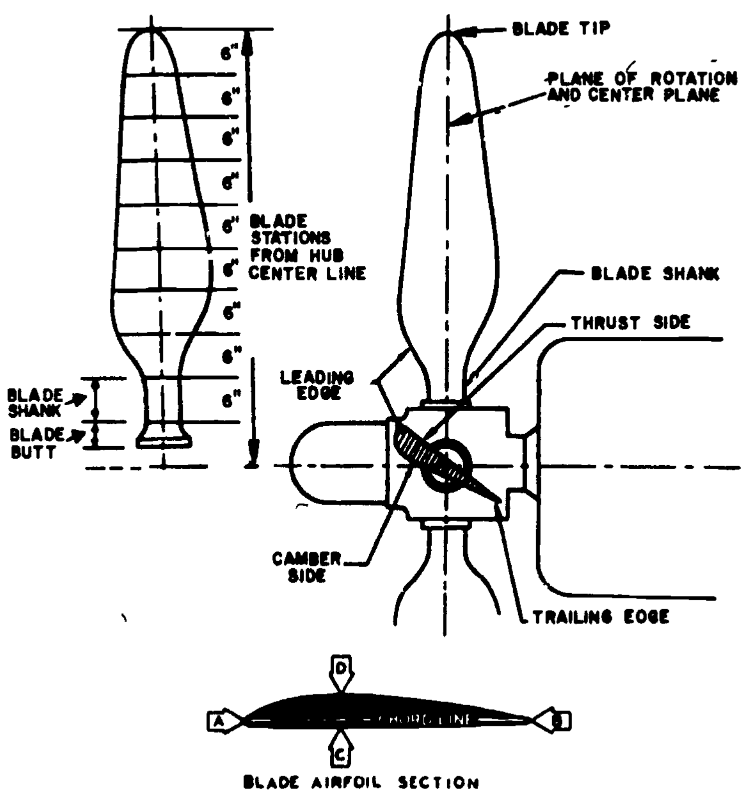

Figure 6. Blade Terms.

Blade Stations - Designated distance on the blade as measured from the hub center. It is common practice to designate these stations at 6-inch intervals. See figure 6.

Blade Track - When similar points on all blades of a propeller follow in the same plane of rotation.

Blade Data - Contains blade drawing number; serial number: high angle; low angle; feather angle; reverse blade angle; reference station for measuring blade angle. This information is located on the cambered side of the blade between the 12-24 inch station.

Revolutions Per Minute (RPM) - The number of complete turns an object makes in one minute of time.

Thrust Side - The side of a propeller blade which is usually flat or nearly so.

Camber Side - The curved side of a propeller blade.

Leading Edge - The edge of the blade that strikes the air first.

Trailing Edge - The edge of the propeller blade opposite the leading edge.

Blade Shank - The thick rounded part of the blade.

Blade Butt - The portion of the blade that extends into the hub or barrel.

Blade Tip - The outer extremity of the blade.

Blade Cuff (Fairing) - A molding placed on the blade shank to extend the blade airfoil to the propeller hub.

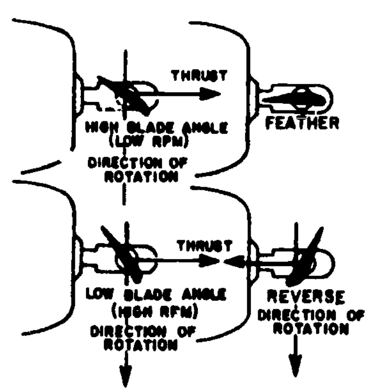

Figure 7. Position of Propeller Blade at Different Angles.

Low blade angle is the lowest angle that the blades of a propeller can be set and still effectively produce forward thrust for a given aircraft. See figure 7.

High blade angle is the highest angle that the blades of a propeller [illegible] set to operate in the automatic constant speed operations. See figure 7.

Feathered blade angle is the angle at which the blades are streamlined to the line of flight. This will prevent propeller windmilling and reduce drag on the aircraft. See figure 7.

Reverse blade angle is the position the blades assume for reverse thrust. This will slow the aircraft down after it has landed. See figure 7.

TYPES OF PROPELLERS

There are two general types of propellers; noncontrollable and controllable.

Noncontrollable Propellers

The noncontrollable propeller cannot change blade angle during flight. On some of the noncontrollable propellers the blade angle can be changed on the ground. This type of propeller is used on low horsepower engines.

Controllable Propellers

These propeller blade angles can be changed during flight. They are used on medium or high horsepower engines. Controllable propellers can be broken down into two categories; two position propellers and automatically controlled propellers.

Two Position. These propellers have a mechanical device whereby the pilot can select either a high or a low blade angle.

Automatically Controlled. These propellers are fully automatic and are controlled by a governing device. The blades of these propellers will automatically change angle to maintain the selected rpm of the engine. This is the most widely used propeller in the Air Force today.

The turboprop is one of the most recent developments in propellers. As you learned in the first part of this study guide, the turboprop is used on a turboprop engine.

PROPELLER FORCES AND STRESSES

Equally important in blade design are the stresses set up within the rotating propeller by the forces acting on it. When the propeller is rotating at high speeds, it is subject to three general types of stresses; tensile, torsional, and bending.

Figure 8. Centrifugal Force (Tensile).

Tensile: Tensile stresses are created by centrifugal force acting on the propeller blade as shown in figure 8. To make this clearer, suppose a weight is whirled at the end of a string. The pull on the weight outward supplies what is known as centrifugal force created by the whirling motion of the propellers has a tendency to pull the blades from the hub. This force or pull is equal to approximately 50 tons per blade on a medium size propeller.

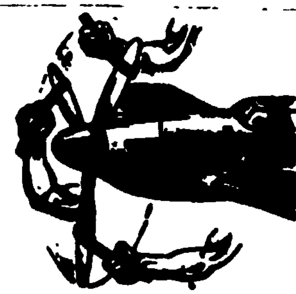

Figure 9. Centrifugal Twisting Moment.

Torsional: Torsional stress is caused by a force called Centrifugal Twisting Moment (CTM). This force constantly tries to twist the blades to a zero blade angle or flat pitch. CTM is present at all times during propeller rotation. See figure 9.

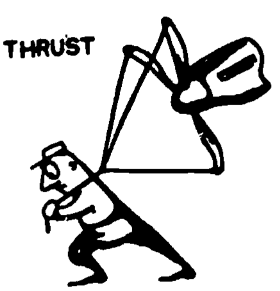

Figure 10. Bending Stress.

Bending: Bending stress is created by thrust. The forward pull of the propeller tends to bend the blades forward as shown in figure 10. This stress is counteracted by centrifugal force acting on the blades. The thrust face tends to bend the blades forward. The tremendous centrifugal force pulling out on each blade tends to hold it straight.

PROPELLER MODEL NUMBERS

Propellers are identified by their model numbers. Each character or designator that makes up the model numbers represents specific information. The chart in figure 11 shows a Hamilton (the manufacturer of the propeller) propeller model number and the meaning of each of the designators.

	5	4	H	60	91			
54H60-91	New Series of Propeller (Turboprop) & Major Modifications	Number of Blades	Blade Shank Size and Type of Blade Metal	Propeller Shaft Size (Size 60)	Minor Modifications			

Figure 11. Propeller Model Numbers.

BLADE DRAWING NUMBERS

As in the propeller model numbers, the blades are also identified by a number. This number is called a blade drawing number.

Hamilton

A	7111	C	2
Blade has a molded cuff on the shank	Represents the basic design of the blade	Blade has all parts such as deicing heater, bushing, slip ring.	Number of inches removed from original diameter.

Figure 12. Propeller Blade Designations (Blade Drawing Number).

The chart illustrated in figure 12 lists a typical propel'.er blade drawing number. It also shows the meaning of each of the designators.

SUMMARY

In this study guide a ɔrief mention was made of the fundamental theory that applies to propellers. Terms such as lea*d*ing edge, blade angle, blade tip, etc., are very important. You ould do well to learn these terms and know what they mean.

Also listed were some of the stresses that are constantly acting on the rotating propeller. These forces have a definite affect on the propeller operation.

The types of propellers listed gives you an idea of the progress made in the development of the propeller. The turbopropeller is now the latest type and more information on it will be given to you later on in the course.

QUESTIONS

1. What does the number 60 represent in the propeller model number 54H60-91?

2. What is the purpose of the propeller?

3. Define the term "blade angle."

4. Define Bernoulli's principle.

5. Name two general types of propellers.

6. What is meant by torsional stress?

7. Name three forces that act on a rotating propeller.

8. What is the purpose of the pitch change mechanism?

9. When and why is the reversing operation of a propeller used?

10. Why is the blade angle at the tip less than the angle midway of the blade?

Main-enance Training Branch
Chanute AFB, Illinois

C3ABR42633-WB-216
20 January 1984

PROPELLER FUNDAMENTALS

OBJECTIVE

After completing this workbook and your classroom instruction, you will be able to identify facts about propeller constructional features and operation.

EQUIPMENT

	Basis of Issue
TO 1C-130B-2-11	1/student
TO 3H1-18-2	1/student

INFORMATION

Using TOs 1C-130B-2-11 and 3H1-18-2, correctly fill in the blanks for each section. Follow the procedures given for each section.

SECTION I. CONSTRUCTIONAL FEATURES

PROCEDURE

Using TOs 1C-130B-2-11 and 3H1-18-2, complete the following statements. At the end, fill in the page and paragraph number.

1. The blade shank is hollowed to lighten the blade and to provide for

_______________ _______________ _______________.

(Page _____-_____) (Para _____-_____)

2. List the main parts of the dome assembly. _______________,

_______________, _______________, _______________,

and _______________.

(Page _____-_____) (Para _____-_____)

3. Gears on the _______________ cam mesh with _______________

_______________ segments on each blade.

(Page _____-_____) (Para _____-_____)

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4. The propeller control assembly is a ________________ unit mounted on the rear ________________ ________________ ________________. A ________________ ________________ ________________ mounted on the engine keeps the control assembly from ________________.

(Page ____-____) (Para ____-____)

5. List the three parts of the spinner assembly. ________________, ________________, and ________________.

(Page ____-____) (Para ____-____)

6. What is the index number for the blade micro adjusting ring?

__ ________________

(Page ____-____) (Para ____-____)

7. What component within the dome shell s ports the low pitch stop assembly? ________________ ________________ ________________

(Page ____-____) (Para ____-____)

8. The blade bushing is secured to the blade butt by two ________________ ________________ and two ________________ ________________ ________________.

(Page ____-____) (Para ____-____)

SECTION II. OPERATION

PROCEDURE

Using TO 3H1-18-2 and TO 1C-130B-2-11, complete the following statements. At the end, fill in the page and paragraph number. Some questions refer to a figure number.

1. List the main functions of the propeller barrel assembly.

a. ________________________________

b. ________________________________

c. ________________________________

(Page ____-____) (Para ____-____)

2. What is installed between the mating sections of the barrel halves to prevent fluid leakage? ______________________________

(Page ____-____) (Para ____-____)

3. What component provides for small angle adjustment between the blade gear segment and the blade? ______________________________

(Page ____-____) (Para ____-____)

4. Which propeller blade has a beta gear segment to deliver blade angle signals to the control? ______________________________

(Page ____-____) (Para ____-____)

5. The dome assembly contains the ______________ for changing ______________________________.

(Page ____-____) (Para ____-____)

6. What type of oil pressure, acting on a servo piston in the low pitch stop lever assembly, releases the low pitch stop setting toward reverse pitch? ______________________________

____

(Page ____-____) (Para ____-____)

7. The purpose of the pitchlock regulator assembly is to ______________ ______________ of the engine propeller unit.

(Page ____-____) (Para ____-____)

8. List two functions of the hub mounting bulkhead assembly.

a. ______________________________

b. ______________________________

(Page ____-____) (Para ____-____)

C3ABR42633-SW-217A
2 February 1984

THE NEGATIVE TORQUE SYSTEM

OBJECTIVE

After completing this study guide/workbook, you will be able to, without references, identify fact. out the arrangement and operation of the negative torque signal system.

EQUIPMENT

	Basis of Issue
HO-200	1/student

SECTION I

INSTRUCTIONS

Using the following information, read, memorize, and answer the questions at the end of this section.

INTRODUCTION

The negative torque system (NTS) involves both the propeller and engine. The reduction gearbox (RGB) is the link between the engine and propeller, thus negative torque is sensed in the RGB and transferred to the propeller by means of a plunger and bracket lever assembly. The bracket and lever assembly then sends the mechanical signal to the NTS actuator rod on the valve housing cover that sends the signal to the valve housing components.

ARRANGEMENT

The NTS plunger is located in the front case of the RGB. Mounted at the 10 o'clock position on the RGB is the NTS bracket and lever assembly which is located over the plunger (when viewing the engine from the front). The NTS actuator rod is located on the valve housing cover and makes contact with the lever assembly when an NTS condition exists. The feather valve linkage is the next part in the system which is located on the valve housing. However, there is a manual feather cam located on the alpha shaft of the valve housing that controls this linkage in the ground range The feather valve, feather actuating valve, NTS linkage switch, and feather valve linkage switch are all located in the valve housing. The feather valve linkage has the job of shifting the feather valve and feather actuating valve, also actuating the NTS linkage and feather valve linkage switches. These switches complete circuits for the NTS and feather valve lights which are located on the co-pilot's side panel. These lights are controlled by a switch that is located on the co-pilot's side panel which has three positions: feather valve, normal, and NTS.

OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 350; DAV - 1

SUMMARY

As a turboprop mechanic, you will be troubleshooting and replacing components in the NTS system.

Knowing the arrangement of this system is very important for quick fixes and safe operation. The information that you have just read will help you in performing your job on this system.

QUESTIONS

1. Where is the NTS plunger located?

2. How many components of the NTS system are located in the valve housing?

3. What are the names of the components which are located in the valve housing of the NTS system?

4. What is mounted over the RGB plunger?

5. At what clock position and where is the bracket and lever assembly located?

6. The NTS actuator rod is located on the ______________.

7. Where are the feather valve lights located?

8. Where are the NTS check lights located?

9. Where is the manual feather cam located?

SECTION II

While reading HO-200 (pages 13-29 through 13-31), fill in the blanks with the appropriate information.

1. Negative torque is developed when _________ _________ _________ _________ _________ _________ _________ _________.

2. With a negative torque condition on an engine, an _________ _________ of _________ results.

3. The easiest way to _________ the propeller is to _________ the air load by _________ the blade angle.

4. The _________ _________ has a negative torque system to increase the blade angle.

5. The _________ _________ meters fluid to drive the propeller blades _________ _________ until the _________ _________ condition is relieved.

6. The _________ _________ _________ _________ _________ retracts and allows the propeller to resume _________ operation.

7. When the throttle is moved below _________ _________, the _________ _________ _________ on the alpha shaft rotates.

8. A negative torque condition _________ results in an increase in propeller _________ _________ in the _________ or _________ range.

PROGRAMMED TEXT

C3ABR42633-PT-218

Technical Training

Turboprop Propulsion Mechanic

MULTIMETERS
(PSM-37)

13 January 1984

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

Designed for ATC Course Use.

Do Not Use on the Job. RGL: 9.6

FOREWORD

This programmed text was prepared for use in Course 3ABR42633, Turboprop Propulsion Mechanic. The material has been validated with thirty (30) students from the subject course. Ninety percent of the students achieved the objectives as stated. The average time to complete this programmed text was 5 hours and 30 minutes.

OBJECTIVES

After completing this program test, you will be able to identify the parts of the PSM-37 multimeter, and the correct procedures for using it.

INSTRUCTIONS

This programmed text presents information in small steps called "frames." Carefully study the written material and/or diagram in each frame until you are satisfied that you understand its contents. Each frame requires you to respond to the information in some way. For example, you may be required to select the true statements or insert a correct answer. Specific instructions are provided in each frame. After you have made your response, compare your answers with the answers given two frames over. The answers will be located at the bottom of the page. If you are correct, go on to the next frame. If you are incorrect, study the frame again and correct your mistakes before continuing. If you still can't understand your mistake, ask your instructor for assistance. Read carefully, select the correct answer and DO NOT HURRY.

INTRODUCTION

In the inspection, maintenance, and operation of aircraft electrical equipment you will often have to measure voltages, currents, and resistance. In electrical work, one or more of the following methods are commonly used to determine if the circuits on an aircraft are operating properly:

1. Measure the amount of current flowing in a circuit.

2. Determine the difference in potential between two points in a circuit.

3. Measure circuit continuity and total or partial circuit resistance.

The multimeter has been designed as a multipurpose instrument that can measure AC/DC voltages, resistances, and DC current flow. There are a number of multimeters in use by the Air Force. You will learn to use the PSM-37 multimeters in this PT.

Supersedes 3ABR42633-PT-216, 25 March 1981.
OPR: 3350 TCHTG
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3350 TCHTG/TTGU-B - 350; DAV - 1

Frame 1

This fr ~e summarizes the s fety precautions that must be observed when using the PSM-37 to test circuits.

1. The PSM-37 should never be handled carelessly. Aside from being expensive, it is sensitive and delicate. Don't abuse it.

2. When measuring voltage and current, start your check with the range switch set on "1000". Then move it to a lower setting if necessary. Then turn it to a range higher than that applied to the circuit after making the check. This way the meter will be ready for the next check.

3. Never connect the ohmmeter to a circuit that has power on it.

4. When used as a voltmeter, connect it in "parallel" with the voltage drop being checked.

5. When measuring DC voltage and current, be sure to observe polarity when connecting the meter to the circuit. Note if the meter needle moves left on the scale, either reverse meter leads on the circuit or turn the polarity switch to the other DC position.

6. When used as an ammeter, connect it in "series" with the portion of the circuit being checked.

7. Before connecting the meter to a circuit, make sure it is set up for the valu to be measured. (AC or DC volts and amps, or ohms)

8. Periodically check the strength of the internal battery. Accomplish this by zeroing the ohmmeter on each of the range switch settings. If it does not zero on all settings, the battery needs to be replaced.

9. Store the meter with the switches in the following positions: POLARITY switch "OFF", RANGE switch "1,000", and FUNCTION switch VOLTS 20 KΩ/V. These positions give the meter some protection if the next person forgets to check the meter before placing it in a circuit.

NO RESPONSE REQUIRED, GO ON TO THE NEXT FRAME.

Frame 2

The multimeter taught in this PT is the PSM-37 multimeter. The PSM-37 can be used to check alternating current (AC), direct current (DC), AC and DC voltage, and resistance. The maximum value of each that this meter can measure is given in the chart shown below.

Units	Without A Lead Adapter	With Adapter
Voltage	0-1000 Volts	0-5000 volts
Current	0-1 amp	0-10 amps
Resistance	0-100 Megohms	No Adapter

List the Five Functions of the PSM-37

1. ____________________

2. ____________________

3. ____________________

4. ____________________

5. ____________________

In order for you to make volts, amps and ohms tests with the PSM-37 multimeter, you must know where all of the controls are found and what they do. We will tell you about each of them in the next few frames. As we talk of them, find them on your meter to check your knowledge of their location.

NO RESPONSE REQUIRED

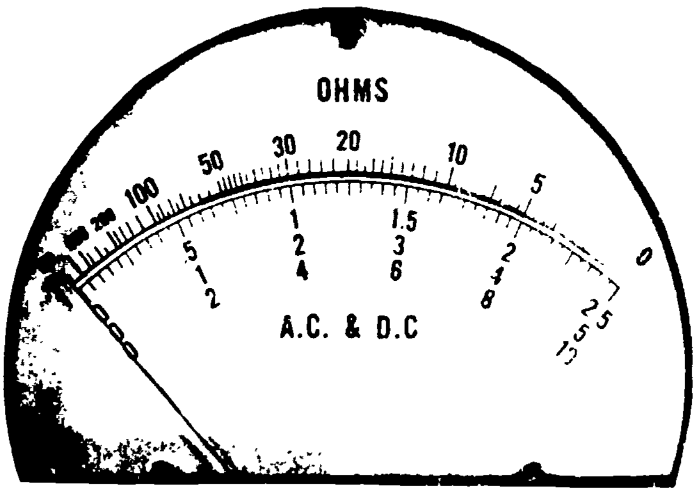
Frame 4

The meter face shows the values that you are measuring. It is made up of two scales, OHMS and AC and DC.

The green OHMs scale is used when you make a resistance test. It is read from right to left. Look at your meter; you will see a wide green area on the OHMS scale from 5-60. The reason for this is to show the part of the scale where the most accurate readings can be made. In later frames you will find it extremely important to take readings in this wide green area for the most accurate range.

The black AC & DC scale is used when you make a voltage or current test of circuits. The values of the scales will be volts when measuring voltage and milliamperes (MA) when you test for current. By now you should have seen that there are three sets of numbers below the black scale. You will be told more about these later.

The meter needle (pointer) points to the value of volts, milliamperes or ohms being measured.



Match the statement or function in Column B with the names to which they relate in Column A by placing the letter of the Column B items beside the numbers of the Column A items.

Column A	Column B
____1. OHMS scale	a. Read left to right and evenly marked.
____2. AC & DC scale	b. Moves to indicate the valued being measured.
____3. Needle	c. Ranges from zero (0) to infinity (∞)
____4. Most accurate ohms	d. Displays values being measured.
	e. 0 to 60.
	f. 5 to 60.

Answers to Frame 2:

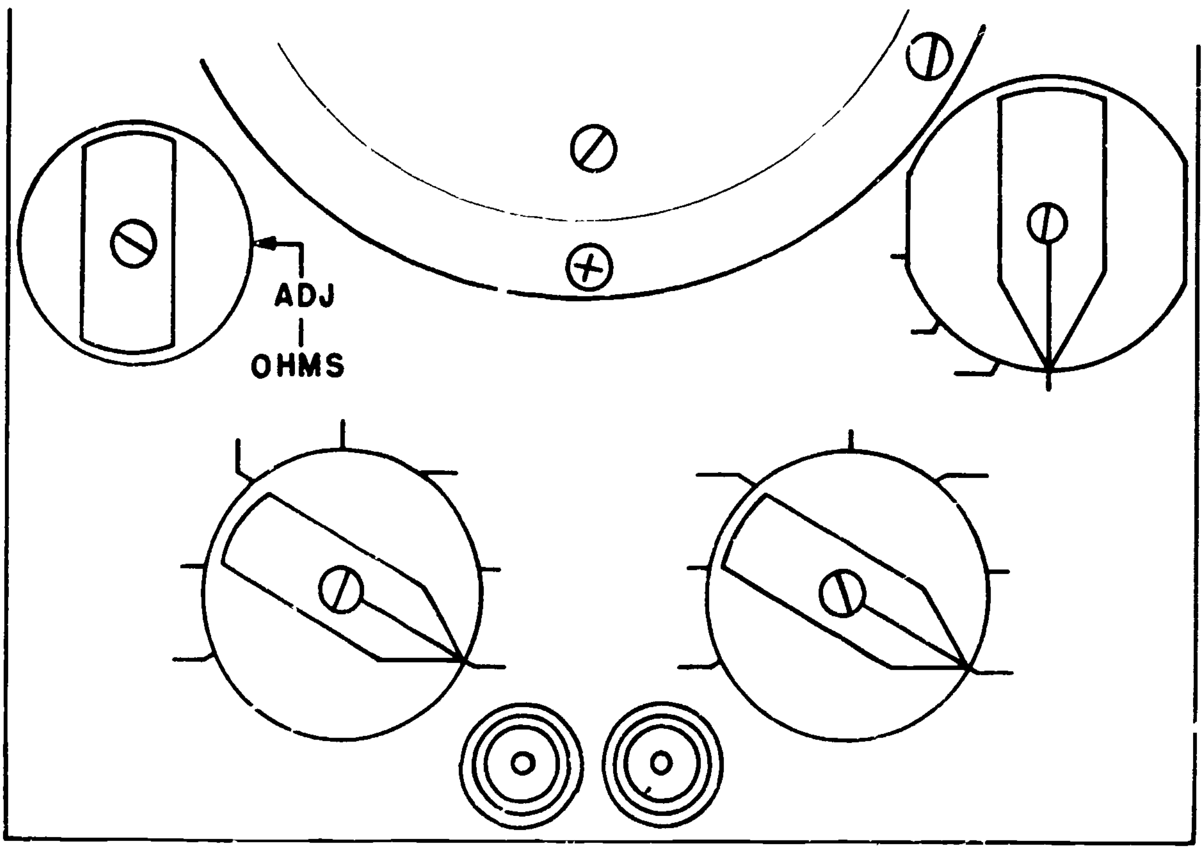
1. AC voltage, 2. DC voltage, 3. AC current, 4. DC current

5. Resistance. (Answers may be given in any order.)

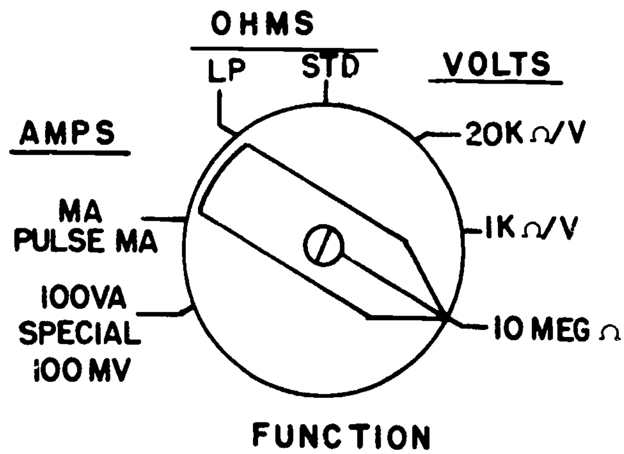
Frame 5

The OHMS ADJUST knob is found at the center and to the left of the meter front and is marked ADJ. It is used to compensate for the aging of the batteries that are in the meter. It is turned to make the needle line up on the "0" on the ohms scale, before you make a resistance check.

NO RESPONSE REQUIRED



The FUNCTION switch can be seen in the lower left on the meter front. It is used to set the meter up to test for AMPS, OHMS, or VOLTS. It has seven positions. The ones that you will have to use the most are the "MA" position for current checks, "LP" and "STD" for resistance checks, and "20KΩ/V" for voltage checks. The "LP" position on ohms has a low power output for use when testing solid state devices and very small values or resistance (0 to 60Ω). The "STD" is used for all other ohms checks.



Place a checkmark (✓) beside each true statement.

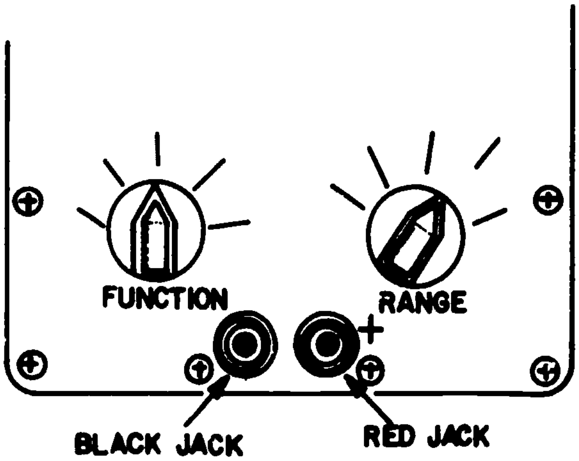
____1. To set the meter for measuring voltage, you would turn the function switch to one of the voltage settings.

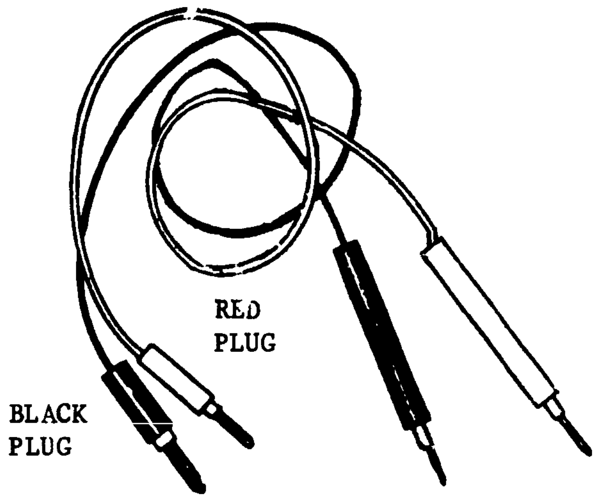
____2. The "STD" position of the function switch is for measuring low powered components.

Answers to Frame 4: 1. c, 2. a, 3. b, 4. f

Frame 7

The test jacks are found at the bottom center of the meter front. The red one is the positive jack and is marked with a + . The black jack is negative and is not marked. The two jacks give a connection point for the meter leads. There are two meter leads; one red and one black. The red lead will always be placed in the positive side of the circuit and the black in the negative. Be sure that you match the color of the lead with the color of the jack. If you reverse the leads, the meter may be damaged when it is connected to a live circuit (one that has power applied). Refer to the diagram below.





Complete the following statement(s) by choosing the correct word or words and record them on the response sheet.

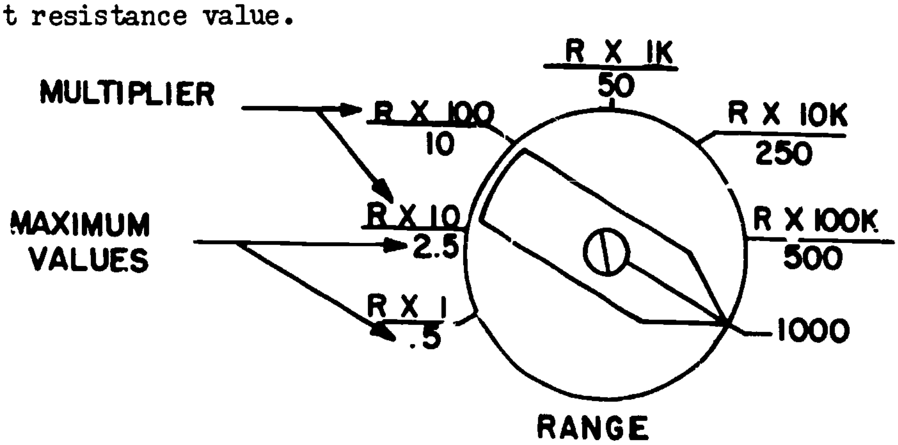
1. The red lead is____________ (negative/positive) and is connected to the____________ (red/black) meter jack. The __________(red/black) negative lead is connected to the ___________(red/black) meter jack.

The RANGE switch is found in the lower right corner of the meter front and is marked RANGE. It is used to set the maximum values of voltage and current to be measured or, the multiplier for the resistance checks. The maximum range settings are those numbers below the lines. The multipliers are the R X numbers above the line. The position of the range switch relates one of three things to the operator:

1. The maximum <u>voltage</u> that the meter can measure at that particular range setting. Set the function selector to the volts - 10 Meg position and the range switch to the 10 position. The meter will measure a maximum of 10 volts.

2. The maximum <u>current</u> that the meter can measure at that particular range setting. Set the function selector to AMPS - MA and the range switch to 500. The meter is capable of measuring a maximum of 500 ma (one-half of an amp).

3. The <u>multiplier</u> of the ohmic (resistance) value that the meter is reading. Set the function selector to the OHMS - STD position and the range switch to R X 1K. Multiply the meter reading by 1000 to get the correct resistance value.



Place a checkmark (✓) beside the true statement (s)

____1. The range switch means the maximum voltage the meter will measure on the OHMS function.

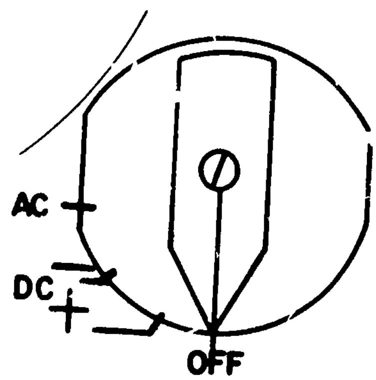
____2. While the PSM-37 is set to AMPS - MA, the range switch tells the operator the maximum current the meter is capable of measuring at that setting.

____3. With the RANGE switch in the R X 10K/250 setting, the operator would multiply the OHMS scale readings by 10,000.

Answers to Frame 6: ✓1. ____2.

Frame 9

The polarity switch turns the multimeter on and off, and sets the meter to test DC+, DC-, or AC. The + and - signs mean the polarity that must be applied to the red test lead when you make DC measurements so that the meter pointer will move up scale to the right. If the pointer moves to the left, just change the polarity switch to the other DC setting or reverse the test leads in the circuit. When you make OHMS checks, the + or - will mean the output polarity of the red test lead. The shape of the polarity switch knob will not allow the cover for the meter to be put on unless the switch is in the off position.



Complete the following statements by placing the correct word(s) in the blank spaces.

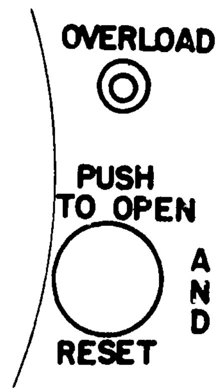
1. When a negative voltage is applied to the red lead, the polarity switch must be turned to the __________ position.

2. The meter polarity switch would be turned to ________ position when measuring alternating current.

3. If the meter needle moves to the left of the "0" on AC & DC scale, the ________ switch must be turned to the opposite DC position.

Answers to Frame 7: 1. positive, red, black, black

The OVERLOAD indicator, and the PUSH TO OPEN AND RESET control are both a part of the overload protection circuit. A red shaft will show in the overload indicator when the meter has been overloaded. To reset the meter for normal use, just take the meter leads out of the circuit, and push the "push to open and reset" control. The red shaft will retract and stay that way when you let go of the button, if the overload circuit breaker has been reset the right way. The next step is to set the meter to a higher range so that it will not be overloaded again. Now the meter is ready for use. The push to open and reset control should be pushed in when you change the range or function switch setting and you do not take the test leads from the circuit.

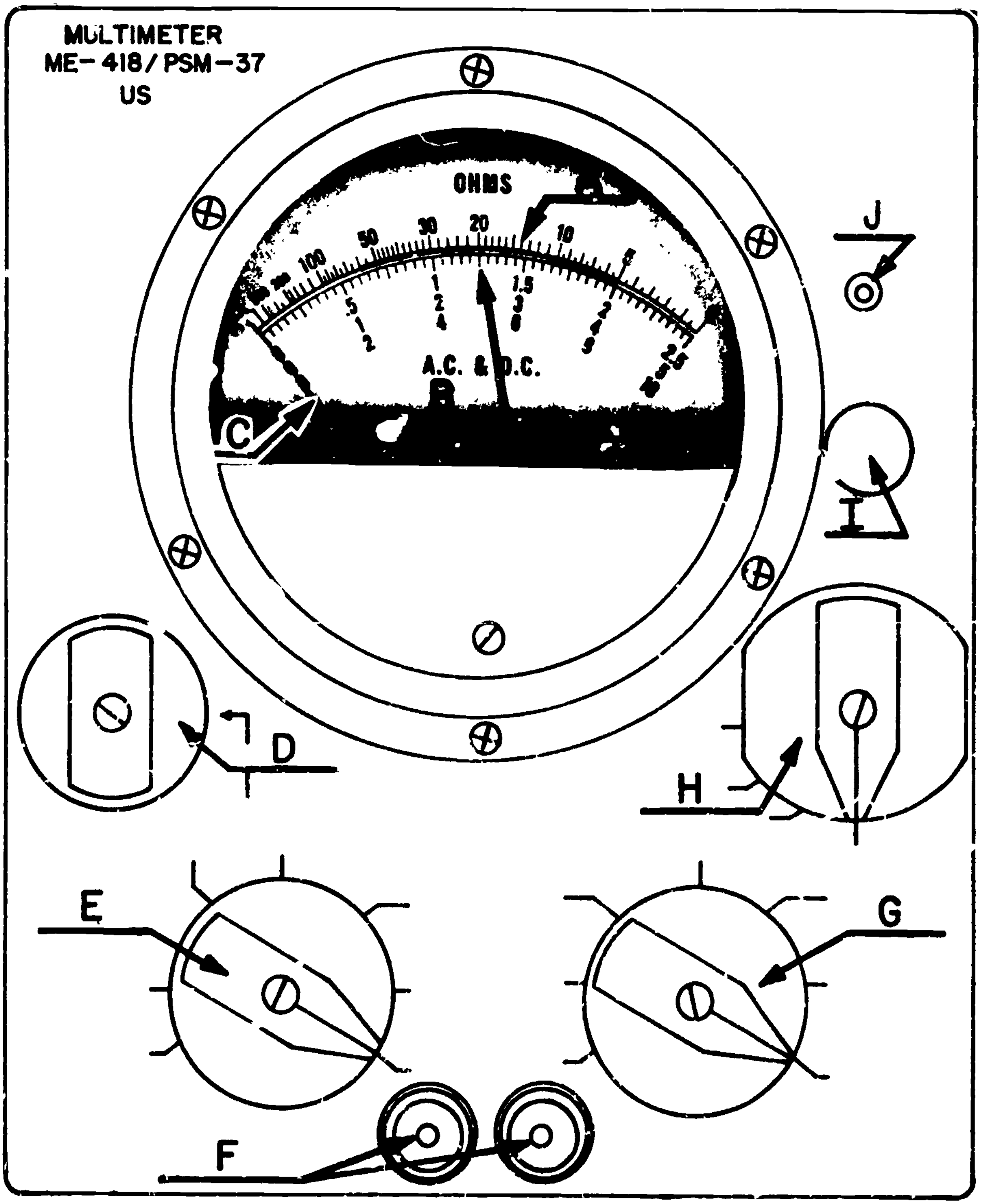


Complete the statements below by filling in the blank spaces with the correct answers.

1. If too much voltage or current is applied to the meter, the ____ ________ indicator will have a __________ shaft appear in it.

2. After removing the meter from a circuit due to an overload, you must push in the ____ _____ button.

Answers to Frame 8: ____1. ✓2. ✓3.



This illustration is to be used with the meter controls and function exercise on the next page.

The following exercise checks your knowledge of the meter control names, location and functions. Use the illustration of the meter on the preceding page to select the letter that corresponds to the name of that control. Place the letter you chose from the illustration in the "Meter Letter" column. Then match up the function of the controls in the "Function" column with the name of the control in the "Name" column. Place your letter choice in the "Function Letter" column.

Name	Meter Letter	Function Letter
1. Needle (Pointer)	C	(b)
2. OHMS (Green)	____	( )
3. OHMS Adj.	____	( )
4. Test jacks	____	( )
5. Function switch	____	( )
6. Polarity switch	____	( )
7. PRESS TO OPEN and RESET	____	( )
8. AC & DC	____	( )
9. Overload	____	( )
10. Range Switch	____	( )

Functions

(a) scale used to indicate voltage or current readings.

(b) aligns with the scale to indicate value measured.

(c) hook-up point for leads.

(d) used to break meter input circuit and reset overload protector.

(e) used to "zero" the pointer on OHMS scale.

(f) determines if meter measures OHMS, VOLTS, or AMPS.

(g) used to select the type of current or voltage to be applied to the meter.

(h) indicates values in OHMS.

(i) determines maximum value to be measured or multiplier for ohms.

(j) indicates excessive power has been applied to PSM-37.

Answers to Frame 9:

1. DC-, 2. AC, 3. Polarity

Frame 12

Look at the face of the PSM-37 meter in front of you. The AC & DC scales are printed in black. On the lower left side of the meter face you will find the FUNCTION switch. It has three VOLTS positions. While in this block we will have you use the 20KΩ/V position. The only difference between the three positions is in circuit loading and this will be explained in more detail later in the course. On the lower right side of the meter face is the RANGE switch. This switch is very important since it is used to select the maximum range the meter can measure in volts and current. If you select the wrong range, you could cause damage to the meter.

Look at the AC & DC scale. You will notice that there are three sets of numbers. In the space below, write the range for each set of numbers. The first one has been done for you.

Top Scale: Numbers range from 0 to 2.5.

Middle Scale: Numbers range from _____ to _____.

Bottom Scale: Numbers range from _____ to _____.

Answers to Frame 10: 1. overload, red 2. Push to open and reset

The number to the far right of each scale shows the maximum deflection of the meter's needle. The values of these numbers (2.5, 5, and 10) will depend on where the range switch is set. There are seven ways to set the range switch: .5, 2.5, 10, 50, 250, 500, and 1,000. These numbers show the highest value which can be read with the meter for any of the settings of the range switch. For example, if the range switch was set at 250, the maximum value that could be checked with the meter would be 250. This value may be in volts or milliamps as determined by the function switch. If more than 250 were applied to the meter, it might be damaged.

Fill in the blanks with the correct number.

1. If the range switch is set at 50, the maximum voltage that can be measured would be ___________.

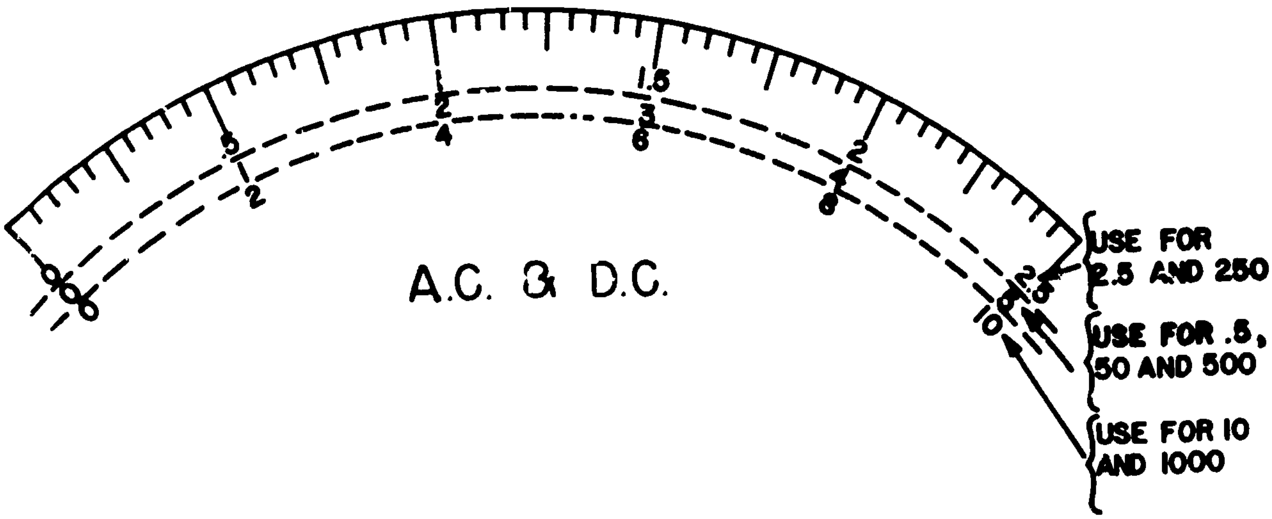
2. If the range switch is set at 2.5, the maximum voltage that can be measured would be ___________.

3. If you wanted to measure a voltage, the value which would be between 250V and 500V, the RANGE switch would have to be set at the _________ position.

Answers to Frame 11: 1. C (b) 2. A (h) 3. D (e) 4. F (c) 5. E (f) 6. H (g) 7. I (d) 8. B (a) 9. J (j) 10. G (i)

Frame 14

Since there are seven ways to set the range switch and only three different scales, each scale is used by several range positions. The 2.5 and 250 range switch positions use the top scale (0-2.5). The .5, 50, and 500 ranges use the middle scale (0-5). The 10-100 range use the bottom scale (0-10). Do not try to memorize these as they are easy to figure out. The first digit of the ranges that use the 0-5 scale is a 5. The first digit of the ranges that use the 0-2.5 scale is a 2. The first digit of the ranges that use the 0-10 scale is a 1.



Place either 0-2.5 or 0-5, or 0-10 in the spaces provided to indicate the scale that would be used for each of the range switch settings. The first one has already been done for you.

Range Switch Set at		Scale Used
.5	a.	0-5
2.5	b.	________
10	c.	________
50	d.	________
250	e.	________
500	f.	________
1000	g.	________

Answers to Frame 12: 0 to 5 0 to 10

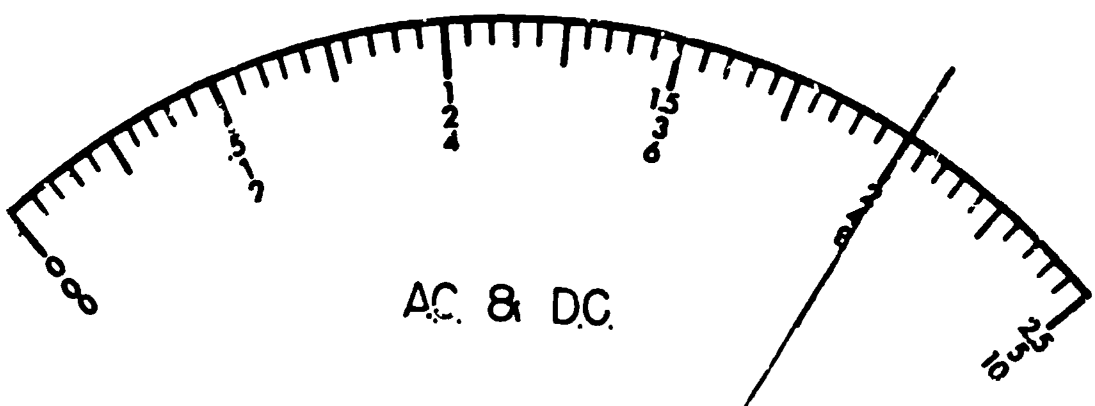
In the last frame you learned how to choose the right scale for each range position. With the RANGE switch set on 50, the readings are read from the 0-5 scale. Since the meter can now only read a maximum of 50,the number 5 will mean 50. The 4 will mean 40, the 3 will mean 30, and so on. Notice that the changing of 5 to 50 resulted in the maximum number on the scale matching the RANGE switch position, and the other numbers change by the same amount (multiplied by 10). The way you determine the value of the maximum number on the scale is by changing the maximum number on the scale to match the RANGE switch position. Example: The range position of 250 uses the 0-2.5 scale. The 2.5 will now mean 250, the 2 will mean 200, the 1.5 will mean 150, and so on.

For all the exercises below, the POLARITY switch is set on DC+, the FUNCTION switch is set on VOLTS 20KΩ/V. What is the voltage indicated on each of the following scales for each of the RANGE switch positions? The first one is completed for you.

1. Use figure A.

   a. 50 range __40V DC__ c. 500 range________

   b. 1000 range ________ d. .5 range__________



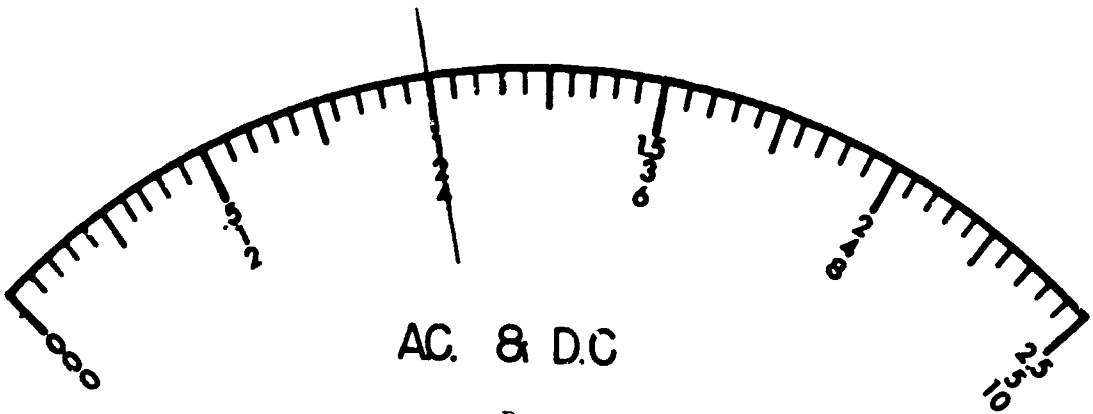
A.

Frame 15 (Cont'd)

2. Use figure B.

a. 2.5 range ________   c. 250 range ________

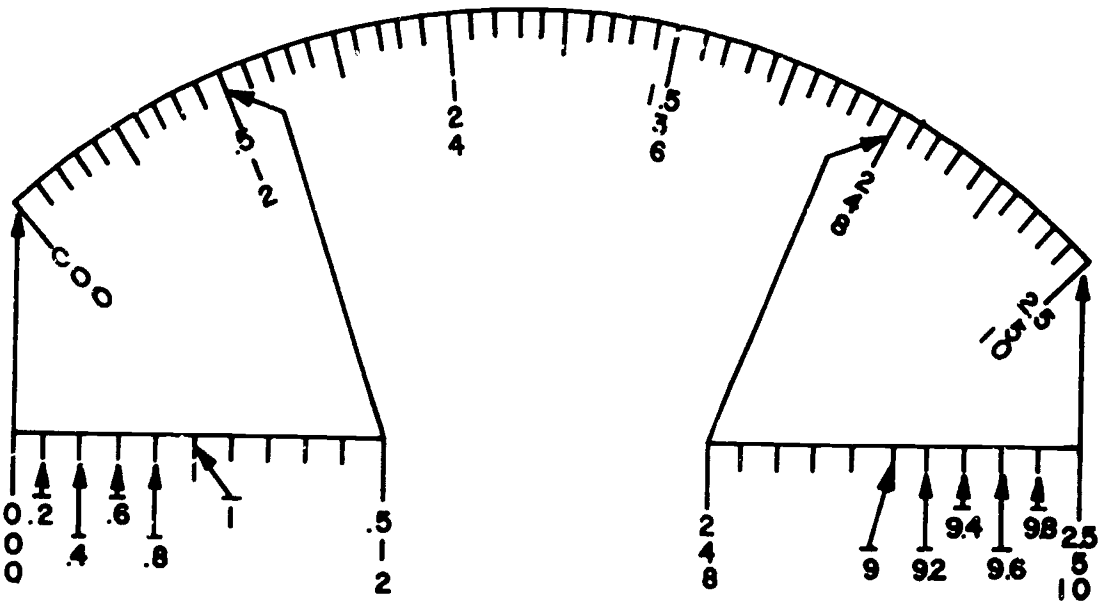
b. 10 range ________   d. .5 range ________



B.

Answers to Frame 13: 1. 50V 2. 2.5V 3. 500V

The maximum value of each scale is determined by the position of the RANGE switch. With the RANGE switch at the 10 range, the 0-10 scale was read as is, Max 10. The difficulty in reading the scale comes when the needle stops on one of the small marks between the numbers. To find the value of each mark on the scale, divide the RANGE switch position by 50. Example: RANGE switch in 10 range, divide 10 by 50 to get .2. Each marking on the 0-10 scale is worth .2 points a piece. See figure A below. When you start at zero, you would count the marks, 0, .2, .4, .6, .8, 1 - - - - - - - - 9.2, 9.4, 9.6, 9.8, 10. You use the same procedure to find the value of the small mark for each of the RANGE switch positions. The reason we use 50 as the denominator is there are 50 marks along the AC & DC scale. Since the scale is linear (evenly spaced and marked), you can use the 50 as the denominator on all range positions and scales.



Frame 16 (Cont'd)

PROBLEM 1

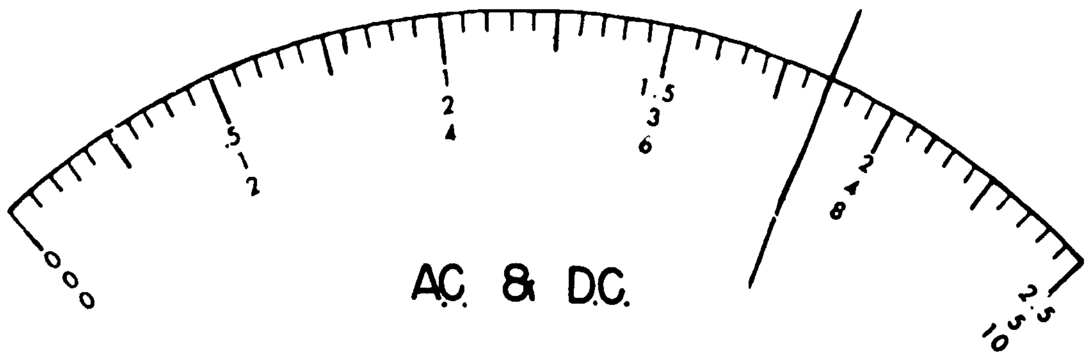
Fill in the blanks with the appropriate response for the scale used and the value of each black mark on the scale. The first one is accomplished for you.

Range Switch Set At	Scale Used	Value of Each Mark
.5	0-5	.01
2.5	a. ________	b. ________
10	c. ________	d. ________
50	e. ________	f. ________
250	g. ________	h. ________
500	i. ________	j. ________
1000	k. ________	l. ________

Answers to Frame 14: b. 0-2.5 c. 0-10 d. 0-5

e. 0-2.5 f. 0-5 g. 0-10

The following exercise is to insure your ability to interpret meter indications in various RANGE switch positions, and check your ability to determine the value of each mark on the meter scales. Fill in the correct answer in the appropriate space for each of the following items. Number one is completed for you.



Range Switch Set At	Value Indicated
1. .5	.37
2. 2.5	
3. 10	
4. 50	
5. 250	
6. 500	
7. 1000	

Answers to Frame 15: 1. b. 800V DC c. 400V DC d. .4V DC

2. a. 1V DC b. 4V DC c. 100V DC d. .2V DC

Frame 18

You now know how to read the scales and its values, with the range switch set in any of the ranges. What you have learned will be true even if the meter is measuring AC or DC voltage or current. In the next few frames you will learn how to set the meter up to read DC volts, AC volts, DC current and AC current. It is important that you know the positions of the three switches, so you can tell what the meter is reading. The switches are: The POLARITY switch to tell if you are measuring + or - DC or AC volts, or current; the FUNCTION switch to tell if you are measuring voltage (VOLTS position), resistance (OHMS position), or current (AMPS position); the RANGE switch to tell you the maximum value and scale to be used for the readings.

Place a checkmark (✓) beside the true statement(s).

____1. To measure OHMS, the polarity switch would be on either DC position, the function switch to OHMS, and the range switch to appropriate R X position.

____2. To measure a 30 volt battery, the polarity switch would be in +DC, the FUNCTION switch to VOLTS, and the RANGE switch to R X 1K/50 position.

Answers to Frame 16: a. 0-2.5 b. .05 c. 0-10 d. .2

e. 0-5 f. 1. g. 0-2.5 h. 5. i. 0-5 j. 10

k. 0-10 l. 20

When you want to read DC voltage it is important to have the meter set up right. The FUNCTION switch set to VOLTS (in school, 20KΩ/V position); the POLARITY switch set to the polarity of the voltage applied to the RED test lead; (Note: In most cases, this will be positive and the polarity switch will be set at "DC+".) the RANGE switch will be set to the value of the voltage to be read. For example, if the voltage to be read is 8 volts DC, the RANGE switch would be set at 10. It is important to keep in mind the range switch sets the maximum value can read; so, set the RANGE switch above the value to be read. When you want to read an <u>unknown</u> voltage, start with the range switch at the <u>highest</u> value. Then, turn the RANGE switch to a lower setting until the meter shows a voltage value. This procedure is a good practice to follow, regardless of what you are measuring.

Fill in the blanks with the correct switch position. For practice, set your meter up to measure the voltage in problem number one.

1. If you knew that you were going to measure approximately 120 volts DC, the RANGE switch would be set at ______, the POLARITY switch set at DC+ and the FUNCTION switch set at ______.

2. If you didn't know the approximate value of the voltage that you were measuring, you would use the ______ range first.

3. A negative voltage polarity is applied to the RED test lead, the POLARITY switch would be set at ______.

Answers to Frame 17: 2. 1.85 3. 7.4 4. 37 5. 185

6. 370 7. 740

Frame 20

When you use a voltmeter, you have to be sure the readings are as true as you can get them. Always choose the RANGE switch position which will cause the meter needle to move as close to a full scale reading as you can. For example, you could read 2 volts DC on the PSM-37 in front of you by setting the RANGE switch on 10 and read the voltage value off the bottom scale (0-10). But, it would be better if you set the RANGE switch to 2.5 and read the voltage on the top scale (0-2.5). By doing this, you can get more needle deflection than if you had set the RANGE switch on 10.

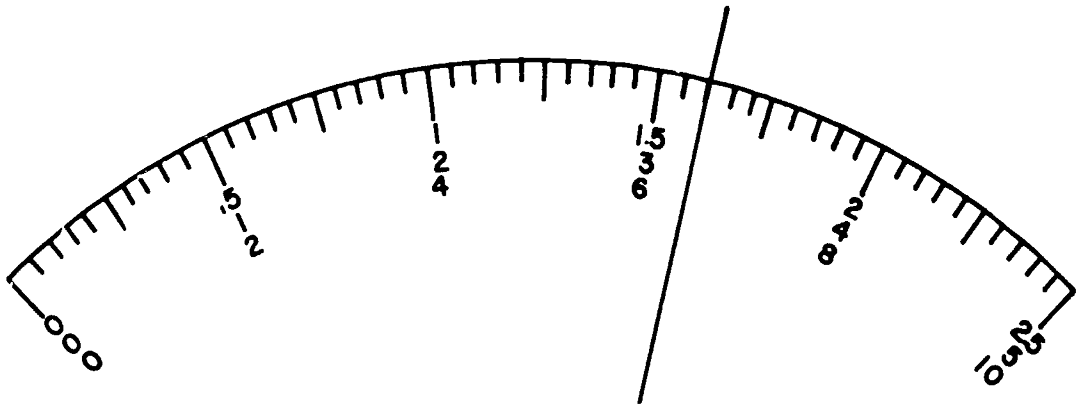
Fill in the blanks with the correct positions.

1. Look at the meter in front of you. If you were going to measure approximately 300V, you would have to set the range switch at ________ to get the most accurate reading.

2. If you wanted to accurately measure 30V, you would have to set the range switch at __________.

Answers to Frame 18: ✓ 1. ✓ 2.

1. Fill in the correct answers in the appropriate spaces for the meter scales shown below. The FUNCTION switch is set at VOLTS (20 KΩ/V), and POLARITY switch is set at DC+.



Range Switch Setting	Indication
a. .5	________
b. 2.5	________
c. 10	________
d. 50	________
e. 250	________
f. 500	________
g. 1000	________

2. For each of the following voltages, indicate on the blank, the range that should be used to obtain the most accurate readings.

Voltage	Range Switch Setting
a. .15	____________
b. 1.5	____________

Frame 21 (Cont'd)

c. 15 ______

d. 150 ______

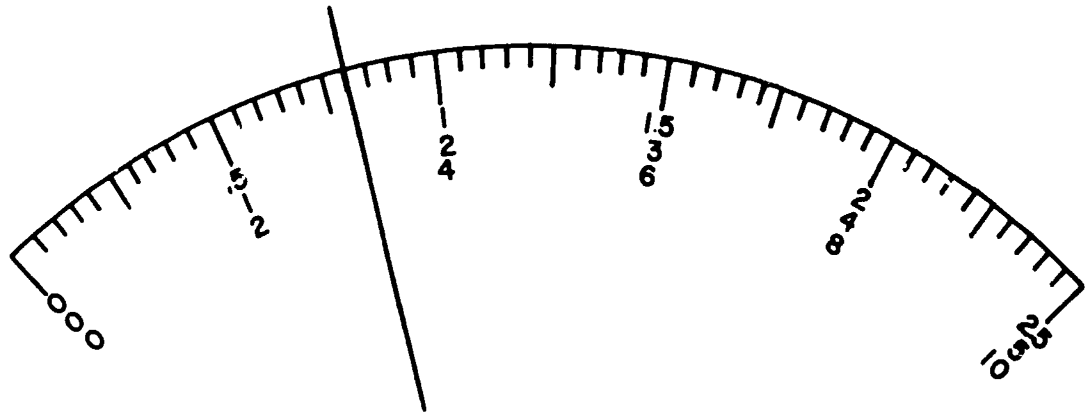
e. 750 ______

Answers to Frame 19: 1. 250, VOLTS (20 KΩ/V) 2. 1000 (highest)

3. DC-

28

Fill in the correct answer in the appriopriate spaces for each of the following items. The FUNCTION switch is set at volts (20KΩ/V) and the POLARITY switch is set at DC+.

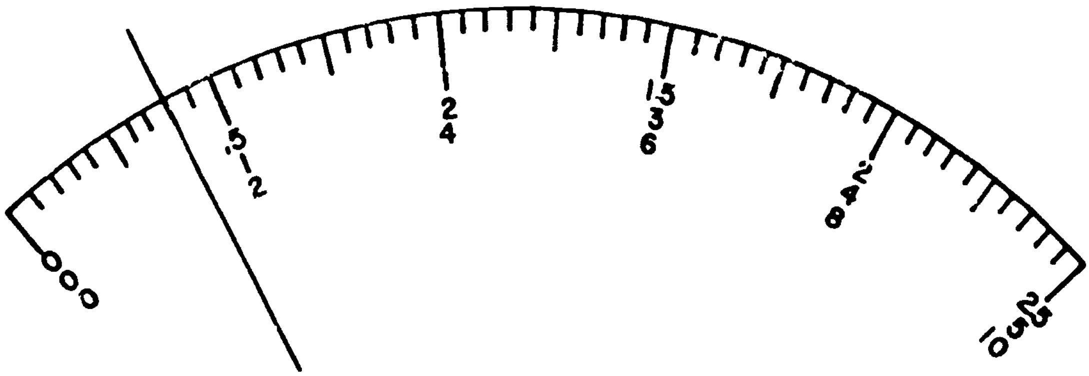


Range Switch Set At	Voltage Indicated
1. .5	________
2. 2.5	________
3. 10	________
4. 50	________
5. 250	________
6. 500	________
7. 1000	________

Answers to Frame 20: 1. 500 2. 50

Frame 23

Fill in the correct answer in the appropriate spaces for each of the following items (the FUNCTION switch is set at volts 20KΩ/V) and the POLARITY switch at DC+.

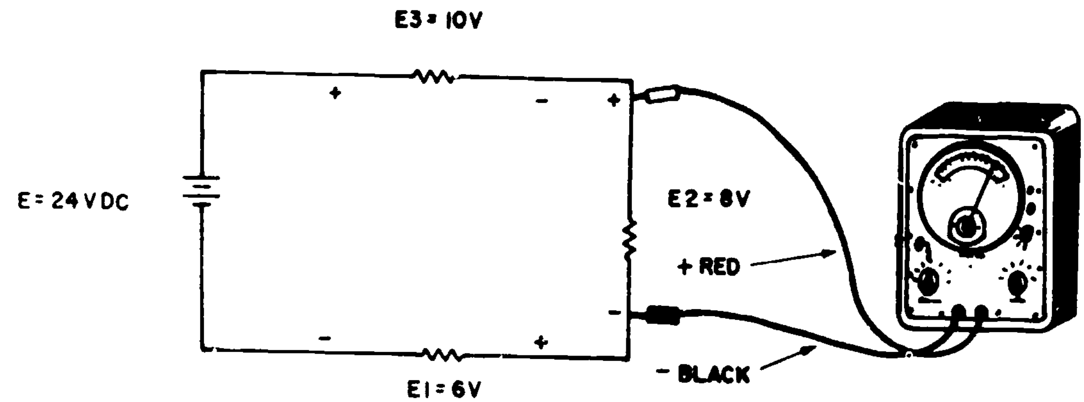


Range Switch Set At	Voltage Indicated
1. .5	__________
2. 2.5	__________
3. 10	__________
4. 50	__________
5. 250	__________
6. 500	__________
7. 1000	__________

Answers to Frame 21: 1. a. .32 b. 1.6 c. 6.4 d. 32 e. 160 f. 320 g. 640 2. a. .5 b. 2.5 c. 50 d. 250 e. 1000

When you test for the voltage of a DC circuit you <u>must</u> watch the polarity of the voltage drop before you place the test leads in the circuit. Once you know the polarity, place the black lead of the voltmeter to negative and the red lead to positive. The meter must be connected <u>across</u> (<u>in parallel</u> with) the component being measured, as shown in the diagram below. If you place the meter or leads in some other manner, you will have a wrong reading. Plus, it could cause damage to the meter.

Note: Another thing that is important before you test for DC voltage, is that you should have your PSM-37 set up for the polarity value and the type of voltage that you will test.



The voltmeter is connected in parallel with R2.

Select the correct word and place it in the blank space to complete statements one, two, and three. For item four, fill in the blanks with the correct position of the switches.

1. When using the PSM-37 as a voltmeter, you would connect the meter in __________ (series/parallel) with the voltage to be measured.

2. If the meter is connected in series when making voltage checks, the readings will be __________ (accurate/inaccurate).

3. To measure the voltage E3 in the circuit above, the red lead will be placed on the __________ (right/left) of the resistor and the black lead on the _________ (other/same) end of the resistor.

4. Set your PSM-37 to measure the voltage E1 in the circuit above. The range switch position is ____________, the polarity switch position is ______________, and the function switch is set at ______________.

Answers to Frame 22: 1. .16 2. .8 3. 3.2 4. 16 5. 80 6. 160 7. 320

Answers to Frame 23: 1. .08 2. .4 3. 1.6 4. 8V 5. 40 6. 80 7. 160

You have now taken a reading at TP-A. The procedures will be the same for the other test points. However, before moving your positive lead to a different test point, set the RANGE switch back to the 50 position. Then, work down to the most accurate range for each test point.

For each of the following DC VOLTAGE test points indicate on the blank the amount of voltage that the meter is reading.

Position Number 1

A. ________	F. ________
B. ________	G. ________
C. ________	H. ________
D. ________	I. ________
E. ________	J. ________

Check your answers for A-E before continuing to F.

As you complete each of the following steps place a check on the blank by the number of the step.

_____1. Turn the DC VOLTAGE SWITCH on the voltage, current, and resistance readings trainer to the "OFF" position.

_____2. Turn both the TRAINER POWER PANEL SWITCH and the 28V DC POWER PANEL SWITCH on the workbench to the "OFF" position.

_____3. Turn the POLARITY switch on your PSM-37 to the "OFF" position.

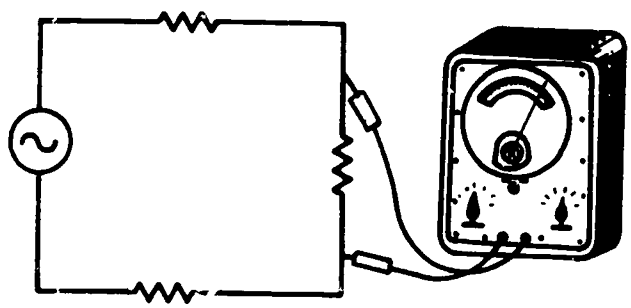
Answers to Frame 24: 1. parallel 2. inaccurate 3. left, other

4. 10, DC+, VOLTS

Frame 26

When you use the PSM-37 to measure the volts in an AC circuit it is used the same way as for DC circuits. The one difference is you <u>do not</u> need to observe polarity since AC means alternating current; a current that will first flow in one direction and then it will flow in the opposite direction.

To use the PSM-37 as an AC voltmeter, you must set the controls up properly; plus, you must place the meter in parallel with the voltage that you will test.



Meter in PARALLEL TO
measure AC voltage drop

Place a checkmark (✓) beside the true statement(s).

____1. You must observe polarity when measuring volts in an AC circuit.

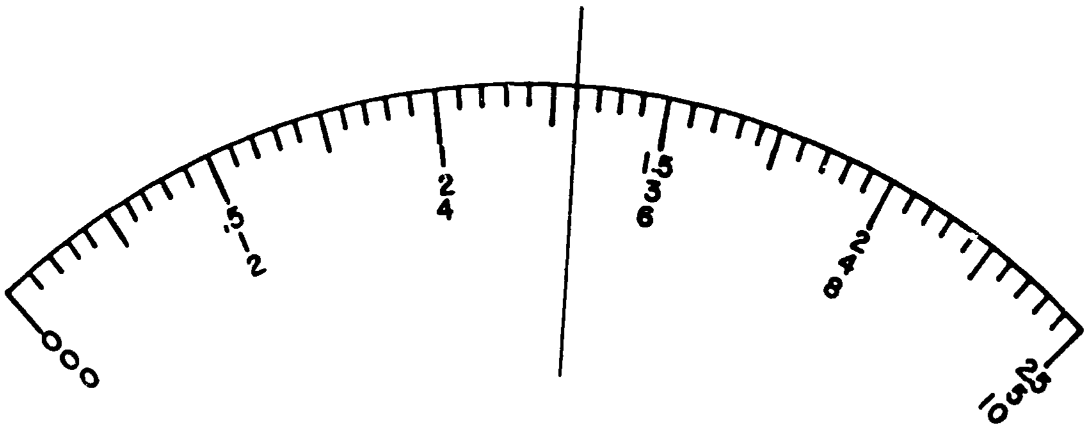
____2. An ammeter is connected in series to measure voltage in an AC circuit.

The way that you read AC voltage is much the same as for reading DC volts. The only change is that you set the POLARITY switch to the AC position. You see that the POLARITY switch must be set to match the type of voltage or current that you will measure. Since AC stands for alternating current, the meter leads have no set polarity while measuring AC.

Place the correct answer in the spaces for the following exercise. For practice, set your meter up to measure the voltage value in problem number one.

1. To measure 240 volts AC, turn the POLARITY switch to _______, the RANGE switch to ________, the FUNCTION switch to ______ and take the readings from the 0 to _______ scale.

2. Use the meter scale below to complete items a and b. Use your meter and knowledge to complete item c.



a. Range switch at 50. Voltage indicated _____V AC.

b. Range switch at 250. Voltage indicated _____V AC.

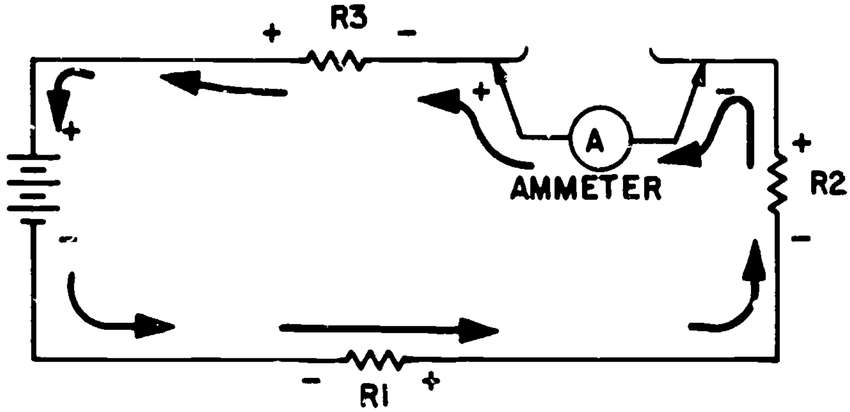
c. Range switch at _____ Voltage indicated 5.2V AC.

Answers to Frame 25:

a.	1.15V	f.	0V
b.	20V	g.	11V
c.	9V	h.	3.6V
d.	24V	i.	2.8V
e.	18V	j.	.35V

Frame 28

To measure current flow, the meter must be connected in series in the circuit. When you connect it in series the same current that flows through the circuit is the same that flows through the PSM-37. Do not place an ammeter in parallel to measure current. If you do, the meter can be damaged or the reading you take will be inaccurate and low. The circuit below shows you an ammeter that is properly placed in a DC circuit.



Place a checkmark (✓) beside the true statement(s).

____1. The ammeter must be connected in series with the circuit component being checked.

____2. To accurately measure current, the same current must flow through both the meter and the circuit component being checked.

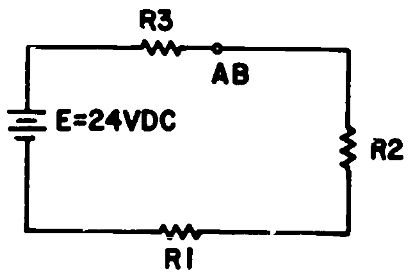
____3. If the PSM-37 is connected in parallel to measure current, the readings would be inaccurate and low.

Answers to Frame 26: ____1. ____2.

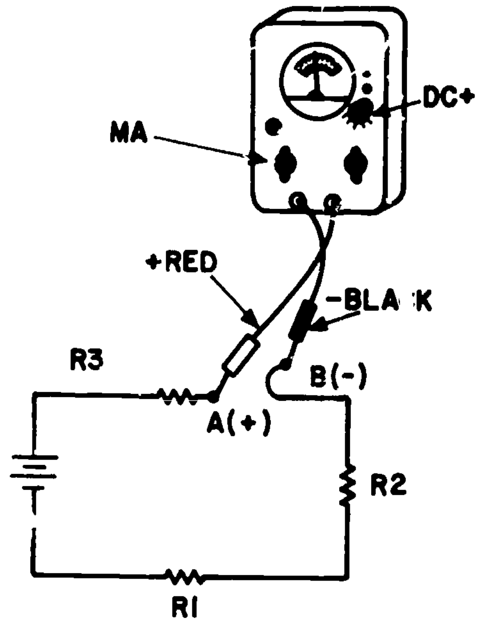
Answers to Frame 27: 1. AC, 250, VOLTS, 2.5

2. a. 26V AC b. 130V AC c. 10

Study the two diagrams for a few moments before reading the rest of this frame.



"CIRCUIT A"



"CIRCUIT B"

To connect an ammeter in a circuit to test current flow, the circuit must be broken. Notice in circuit A that there is a point marked AB. In circuit B this point has been separated to form - - points "A" and "B". Since point "A" is connected to the plus (+) post of the battery through R3, point "A" is positive (+); point "B" is connected to the minus (-) post of the battery through R1 and R2 so it is negative (-). Remember, this circuit has DC volts applied. You must observe the polarity of the points to which the meter is connected.

The red test lead will be connected to point "A" and the black test lead connected to point "B". The circuit current now leaves the minus side of the battery, goes through R1, R2, in the black lead, through the meter, out the red lead, through R3 and back to the plus post of the battery.

Caution: Turn power "off" to the circuit when connecting and disconnecting an ammeter in and out of a circuit.

Place the correct answer in the blank space provided, to complete the following statement(s).

1. Before the PSM-37 can be used to test circuit current, the circuit must be __________ and the meter placed in ________ with the circuit.

2. Set your PSM-37 up to measure 29 MA DC.

   The position of the switches are:

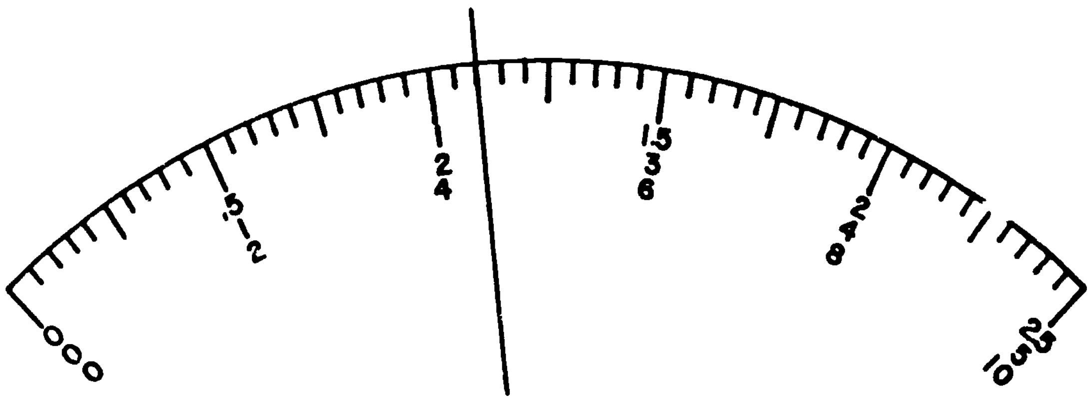
   a. Range switch __________.

   b. Function switch __________.

   c. Polarity switch __________.

You use the same scales to read current as you used to read volts. To measure DC milliamperes (MA) set the POLARITY switch to the DC+, set the FUNCTION switch to "MA/PULSE MA", and set the RANGE switch to the value that you wish to measure. The PSM-37 can read up to 1000 MA which is the same as one ampere.

Fill in the correct answer in the appropriate space for the following items.



1. FUNCTION switch set at AMPS, MA position.

   a. RANGE switch set at 1,000. Current indication is ____MA.

   b. RANGE switch set at 500. Current indication is ____MA.

   c. RANGE switch set at 250. Current indication is ____MA.

   d. RANGE switch set at 10. Current indication is ____MA.

Answers to Frame 28: ✓1. ✓2. ✓3.

Frame 30 (Cont'd)

2. Set your meter up to measure 22 MA DC.

   a. The RANGE switch setting is ______.

   b. The POLARITY switch setting is ______.

   c. The FUNCTION switch setting is ______.

We stated earlier that 1,000 milliamps is equal to one amp. Thus, two amps is equal to 2,000 milliamps and .6 amp is equal to 600 milliamps. Let's see why!

$$2 \text{ amps} \times \frac{1{,}000 \text{ ma}}{1 \text{ amp}} = 2{,}000 \text{ ma}$$

$$.6 \text{ amp} \times \frac{1{,}000 \text{ ma}}{1 \text{ amp}} = 600 \text{ ma}$$

Fill in the blanks with the correct number.

1. 6 amps = _____ ma
2. .1 amp = _____ ma
3. .25 amp = _____ ma
4. 5 amps = _____ ma
5. .5 amp = _____ ma
6. .05 amp = _____ ma

Answers to Frame 29: 1. broken, series 2. a. 50 b. AMPS-MA c. DC+

Frame 32

In the last frame you learned how to convert amps to milliamps. In this frame you will learn how to convert milliamps to amps. For example, 2,000 ma is equal to two amps and 600 ma is equal to .6 amp. Let's see why!

$$2{,}000 \text{ ma} \times \frac{1 \text{ amp}}{1{,}000 \text{ ma}} = \frac{2{,}000}{1{,}000} = 2 \text{ amps}$$

$$600 \text{ ma} \times \frac{1 \text{ amp}}{1{,}000 \text{ ma}} = \frac{600}{1{,}000} = .6 \text{ amp}$$

Fill in the blanks with the correct number.

1. 6,000 ma = ____ a
2. 100 ma = ____ a
3. 250 ma = ____ a
4. 5,000 ma = ____ a
5. 500 ma = ____ a
6. 50 ma = ____ a

Answers to Frame 30: 1. a. 440MA, b. 220MA, c. 110MA, d. 4.4 MA.
2. a. 50 b. DC+ c. AMPS MA.

When you use the PSM-37 as a milliameter, you will start on the highest range (1000) of the RANGE switch and work the switch down to the most accurate range. You should always push in on the PUSH TO OPEN and RESET button when you change the RANGE switch. This will cut down the chance of harm to the meter when measuring current. You should note that the most accurate reading on the AC & DC scale will be made when the needle moves as far right on the scale as it can, and still not go past the end of the scale.

Fill in the blanks below with the most accurate range switch position for each of the readings given. You may refer to your PSM-37 for a list of the ranges.

READINGS	RANGE	READINGS	RANCE
1. 40 MA	______	4. 225 MA	______
2. 400 MA	______	5. 11 MA	______
3. 4 MA	______	6. 60C MA	______

Answers to Frame 31:

	1. 6,000	4. 5,000
	2. 100	5. 500
	3. 250	6. 50

Frame 34

The difference in the way that you set up the meter for <u>measuring AC current</u> rather than DC, is the way you set the POLARITY switch. To read AC, the POLARITY switch is set in the AC position.

Fill in the blanks with the correct response.

1. Using your PSM-37, set the controls up to measure 150 MA AC.

   a. FUNCTION switch position is ________.

   b. RANGE switch position is ________.

   c. POLARITY switch position is ________.

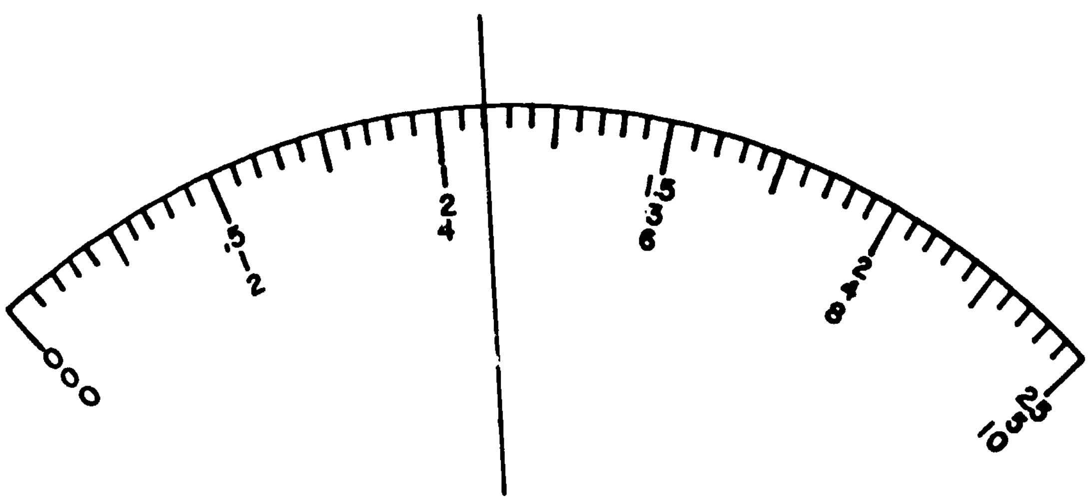
2. Using the meter scale below and your meter, fill in the blanks below with either the RANGE switch position or the indicated MA reading.

   a. Range switch at 1,000. Current indication is ____MA.

   b. Range switch at 500. Current indication is ____MA.

   c. Range switch at ____. Current indicated is 110 MA.

   d. Range switch at ____. Current indicated is 22 MA.



Answers to Frame 32: 1. 6, 2. .1, 3. .25, 4. 5, 5. .5, 6. .05

Answers to Frame 33: 1. <u>50</u> 2. <u>500</u> 3. <u>10</u> 4. <u>250</u> 5. <u>50</u> 6. <u>1,000</u>

The PSM-37 meter is built to measure many OHMS values. A look at the meter in front of you shows that there are six (6) positions for the ohmmeter function. They are R X 1, R X 10, R X 100, R X 1K, R X 10K and R X 100K. To measure resistance, the POLARITY switch must be turned to one of the DC positions (usually DC+); the RANGE switch must be set to one of the six positions listed above and the function switch must be set on OHMS. The OHMS position used in this block will be the STD position. (NOTE: The LP position is for testing low power devices and is used with the R X 1 position of the RANGE switch.) To measure resistance accurately, the ohmmeter must first be "zeroed". You zero the meter by touching the ends of the leads together with the meter set as you were told above. The meter needle should move to the zero end of the ohms scale. Note that the OHMS scale is GREEN. If the needle does not go all the way to zero, or goes past, then turn the OHMS ADJ knob. Turn the knob to bring the needle in line over the "zero" on the OHMS scale. When the test leads are separated the needle should go back to the left end of the OHMS scale, over the infinity (∞) mark.

Use your PSM-37 and zero the ohmmeter in the R X 10 through R X 100K range positions.

> Note: The PSM-37 meter should not need to be rezeroed on each of the RANGE switch positions. Once zeroed, the meter should stay zeroed through all resistance range positions.

If your meter will not zero on any of the ranges, push the "Push to Open and Reset" button. If your meter still will not zero, ask your instructor for help.

Place a checkmark (✔) beside the true statement(s)

_____1. With the function switch in OHMS STD and RANGE switch in R X 1, the meter can be zeroed on OHMS. (Use your meter and test this statement.)

_____2. The readings are taken from the green scale of the PSM-37 when the function switch is in the OHMS function.

_____3. The PSM-37 meter needs only to be zeroed when you first start to use it as an ohmmeter.

_____4. The zero mark for OHMS is on the left side of the OHMS scale.

Frame 36

The OHMS (green) scale is probably the most easy to read. The value of each mark on the scale stays the same for each position of the RANGE switch. For example, the numbers on the OHMS scale will always be the same value; 5, 10, 20, 30, and so on. The range switch is what determines what you multiply these numbers by to get the resistance reading of what you are measuring. This will be covered in the next frame.

You will not have much trouble with reading the meter when the meter's needle comes to rest on one of the larger marks which are numbered, or when the needle comes to rest halfway between any two numbered marks. The hard part comes when the needle comes to rest on a small mark or between s 11 marks. To find the small mark values follow these steps:

1. First step, note the two numbered values which the needle is resting between.

2. Subtract the smaller value from the larger value.

3. Count the number of divisions (blank spaces) between the two numbers.

4. Divide the value you got in step two by the number of divisions counted in step three.

5. You now have the value of one division on the scale you are using.

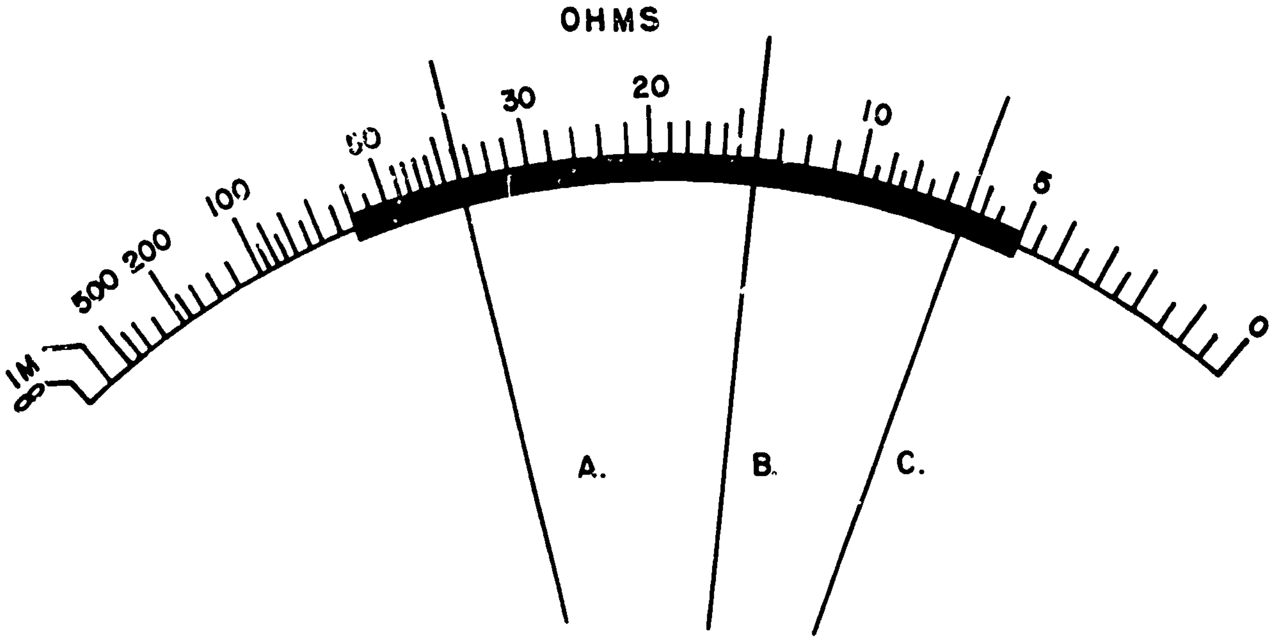
6. Add up the number of divisions your needle is from the lowest value you noted in step one.

7. The last step i- to add the total value of the summed divisions in step six to the lowest number value to get the proper reading.

As an example of the procedure outlined above, we will go through the complete procedure for the value indicated by pointer A in the figure on the next page.

Answers to Frame 34: 1. a. AMPS-MA b. 250 c. AC

2. a. 440 MA b. 220 MA c. 250 d. 50



1. Needle is resting between 30 and 50.

2. Subtract 30 from 50 you get 20.

3. Count 10 divisions between 30 and 50.

4. Divide 20 (from step 2) by 10 to get 2.

5. One division is equal to 2.

6. The lowest value is 30 and the needle is four divisions to left of this value.

7. Multiply 4 times 2 to get 8; add 8 to 30 to get 38.

Using the figure above, complete the following by filling in the blank with the correct response.

1. Needle B is indicating ______________________.

2. Needle C is indicating ______________________.

3. Each division mark between 20 and 30 is equal to __________.

4. Each division mark between 50 and 100 is equal to __________.

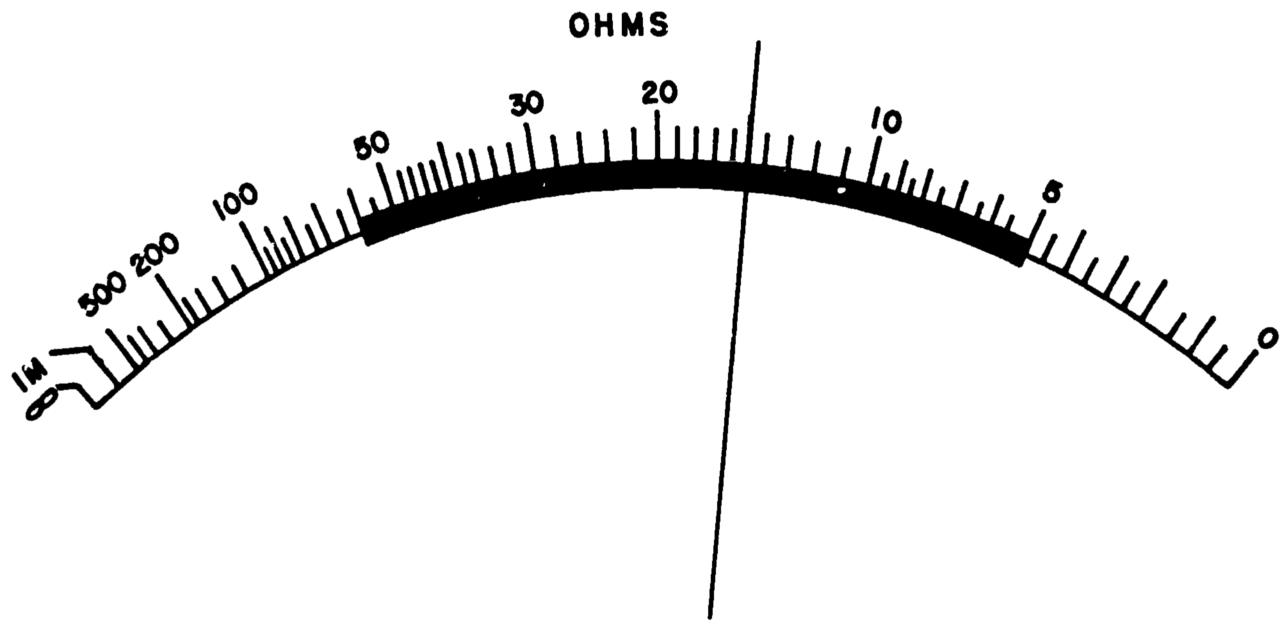
Frame 37

The illustration below shows the ohmmeter scale of the PSM-37. When measuring resistance in the R X 1 range, it is read just as is shown by the needle on the OHMS scale. With the RANGE switch in any of the other R X positions you would multiply the resistance reading (R) times the number at the R X position.

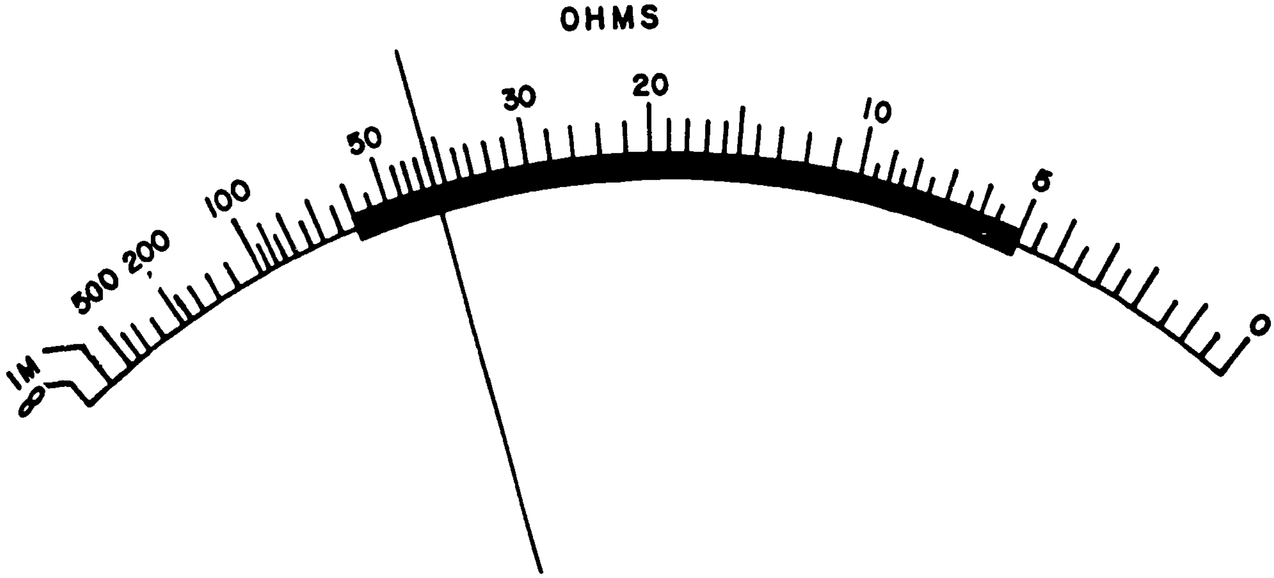
Example: In the R X 10 position the needle stops at the 30 mark on the OHMS scale. You would take 30 times 10. The ohmic value you have measured is 300 ohms. In the R X 100 position it would be 30 times 100, which equals 3000 ohms.

What resistance is indicated in each of the ohmmeter scales below?

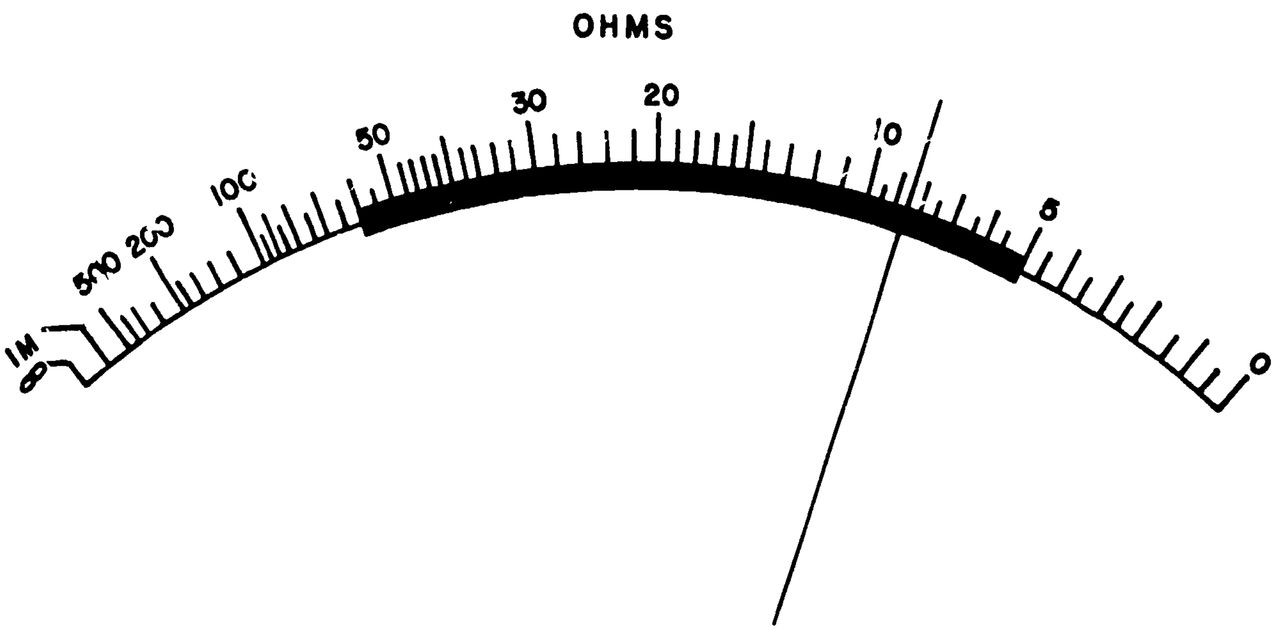
1. R X 10 = ______________



2. R X 10K = ___________

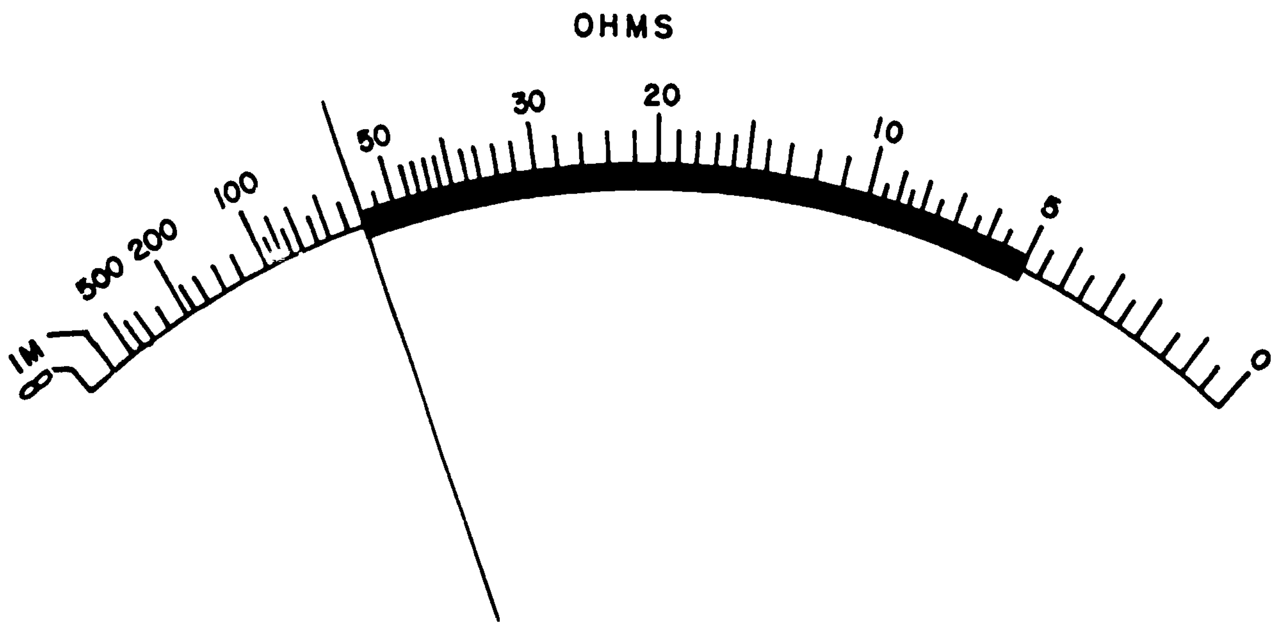


3. R X 1K - ___________



Frame 37 (Cont)

4. R X 1 = ____________________



Answers to Frame 35: ____1. ✓2. ✓3. ____4.

The range to be used in measuring any resistance that you do not know depends on the ohmic value of the unknown resistance. Let us say that the R X 1 range of the PSM-37 is being used and that the unknown resistance that you have is more than 2,000 ohms. In this case the resistance is too great to move the pointer away from infinity (∞). The RANGE switch would then have to be set to the R X 10 position. If this was done and the needle still did not move, then you would have to use the R X 100 range, and so on. If the needle still does not move when you use the R X 10K range, you have a resistance that is too high to measure with the PSM-37. This is commonly referred to as an infinite amount of resistance and is represented by "∞".

Note: To be sure no problem exists with the meter, check to see if the meter will zero in all resistance range positions.

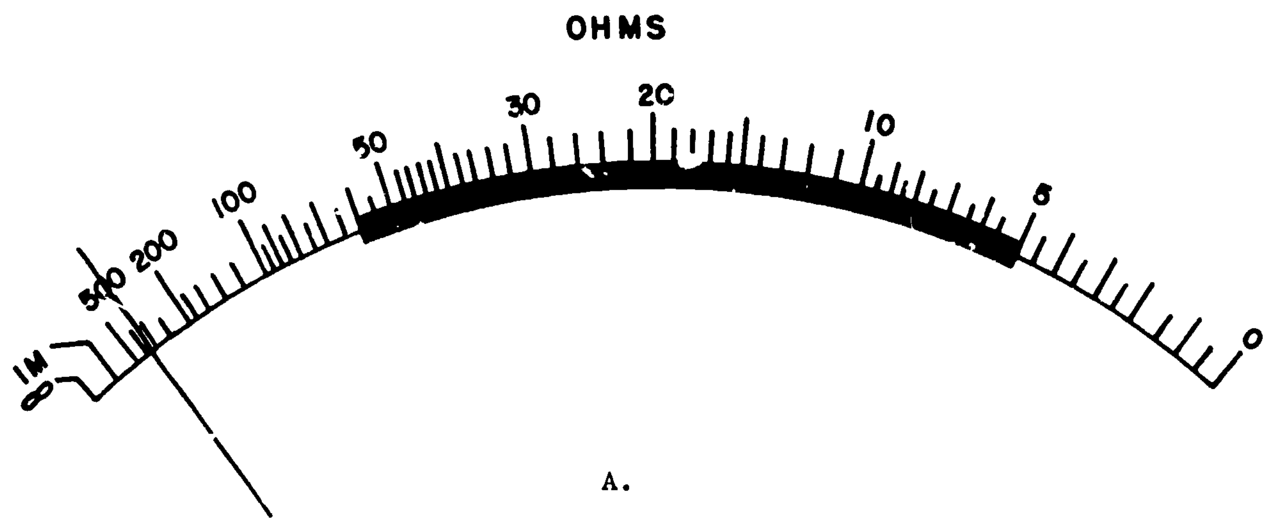
Place a checkmark (✔) beside the true statement(s).

_____1. A resistance reading of ∞ is the same as one of 0 ohms.

_____2. When testing resistance, if the needle of the ohmmeter doesn't move, it is indicating infinity (∞).

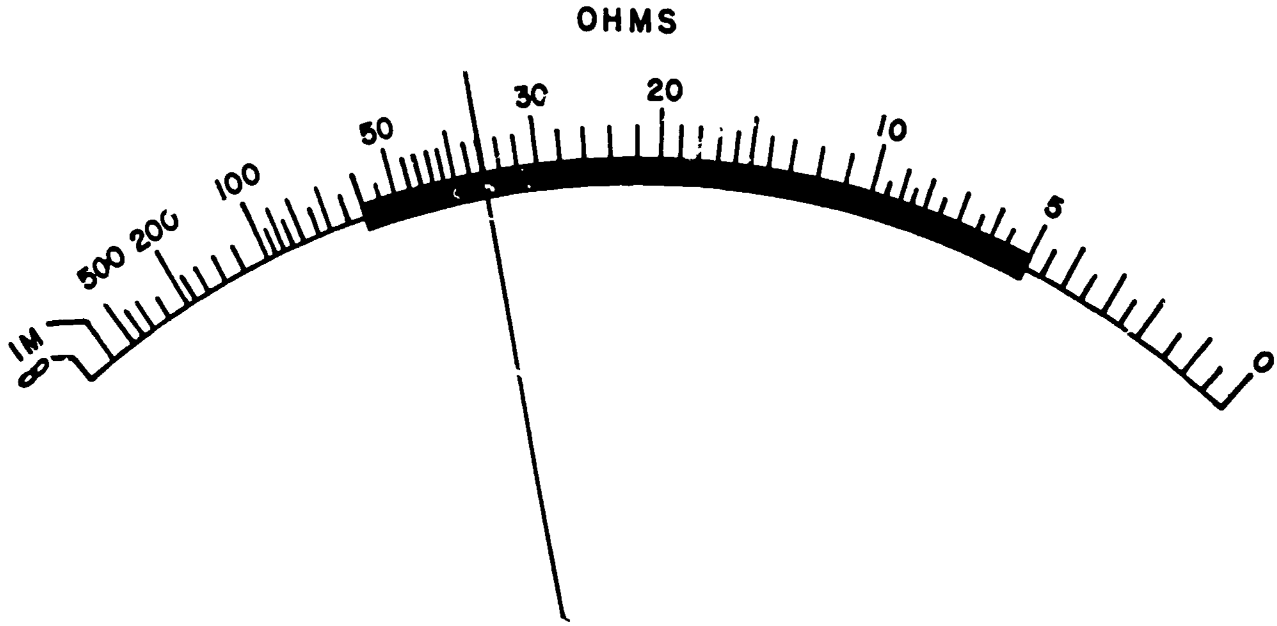
Answers to Frame 36: 1. 14 2. 6.5 3. 2 4. 5

When you use the PSM-37 to check ohms, set the RANGE switch to a position where the needle rests in the wide green area of the OHMS scale. Try not to take the readings from any other part of the scale, if it is possible. We need to do this because the ohmmeter is less accurate from 0 to 5 and 60 to ∞. In example A, a resistor with an ohmic value of 360 ohms is being measure with the range switch in the R X 1 range. The meter needle is between the 300 to 400 marks, a difference of 100 ohms. Since the operator is forced to guess at the reading, a large margin for error can exist.

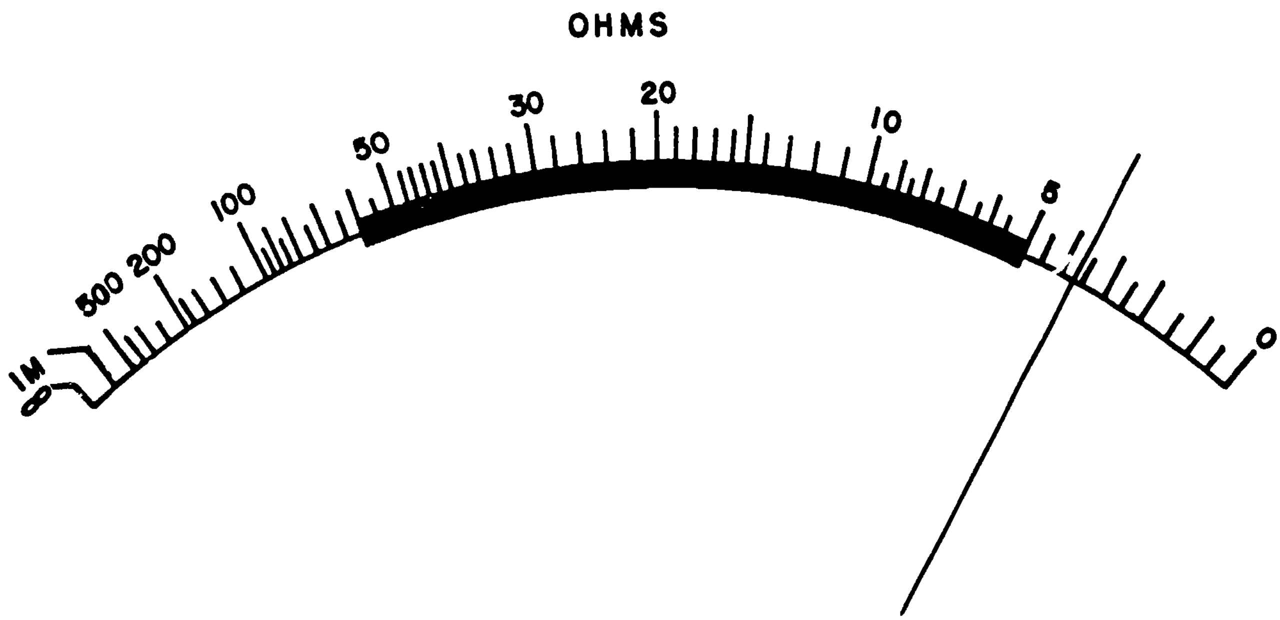


A.

Example B shows the same resistance measured using the R X 10 range. Even though the operator must multiply the scale reading by 10, the reading is more accurate because each mark in this area of the scale is 20 ohms (marks are 2 points each times 10, equals 20). Then, the margin for error is reduced.

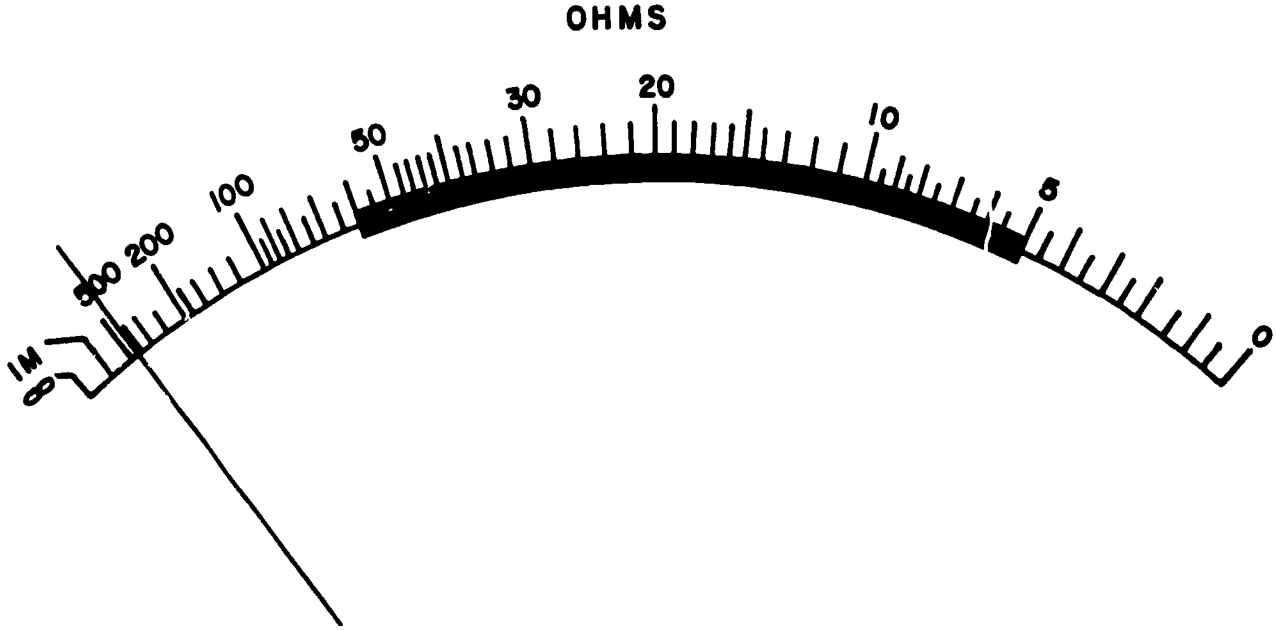


Example C shows a 360 ohm resistance reading on the R X 100 range. In this case you must multiply the scale reading by 100. The measurement is less accurate than B because each mark is worth 50 ohms (.5 X 100 equals 50). The margin for error is increased.



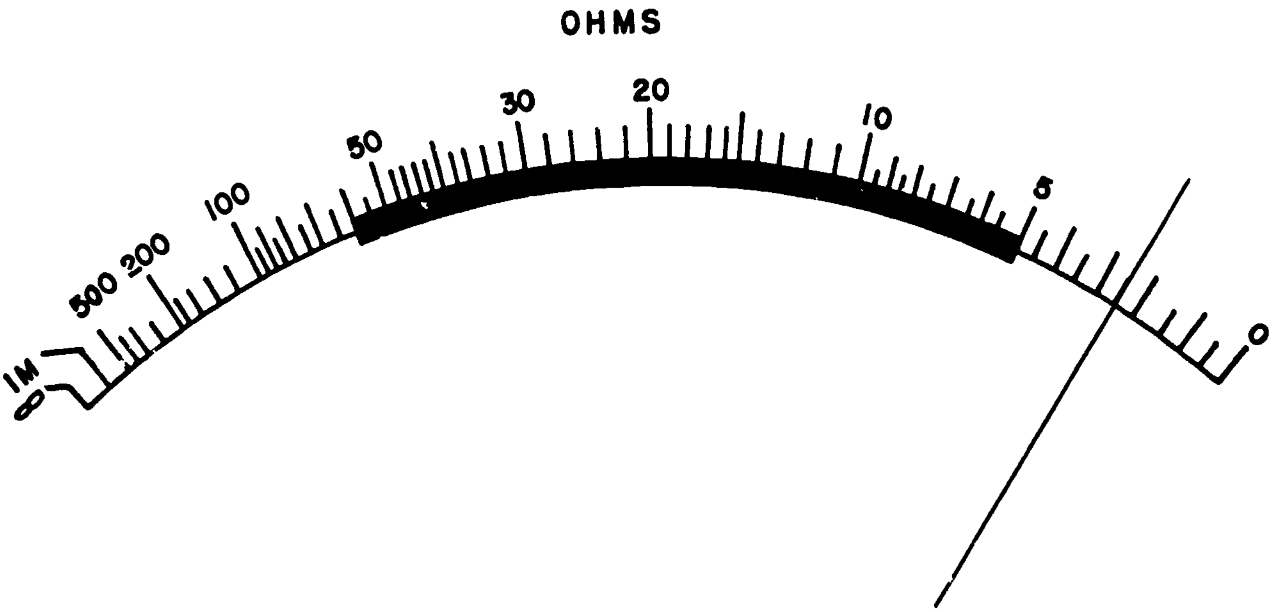
Study the ohmmeter scales shown below. Find out if the resistance is being read by the most accurate range. If the right range is used write "OK" in the blank next to that scale. If the right range is not used, write the range which should be used.

1. 480 ohms, R X 1 range ____________.

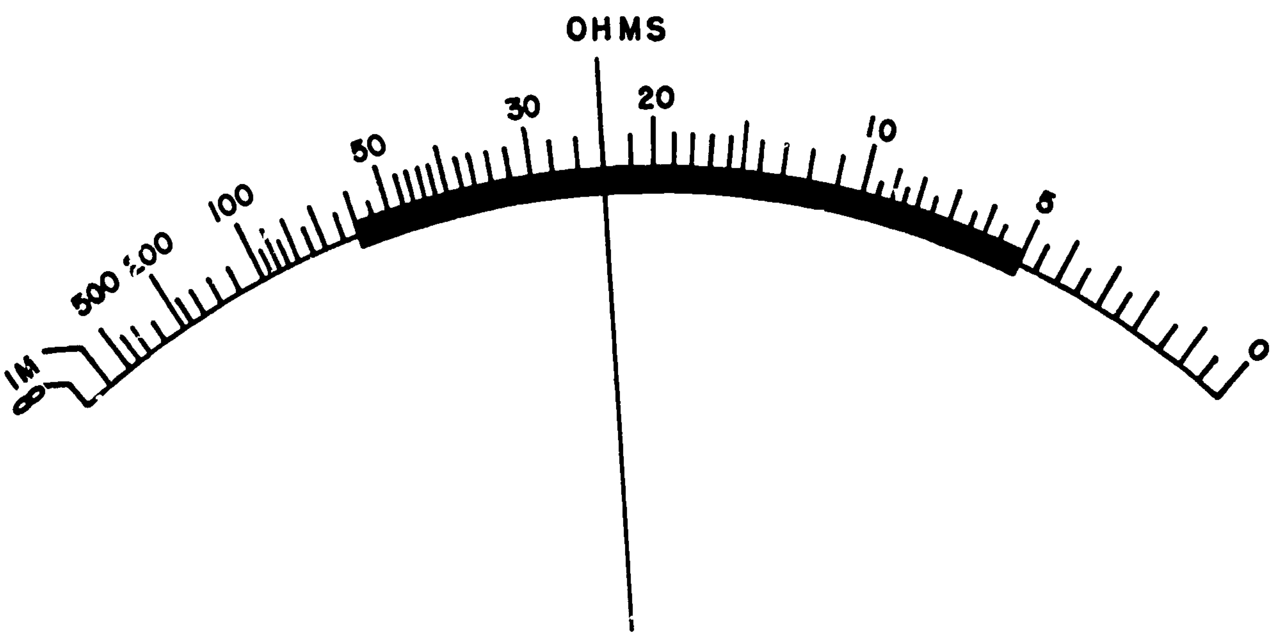


Frame 39 (Cont'd)

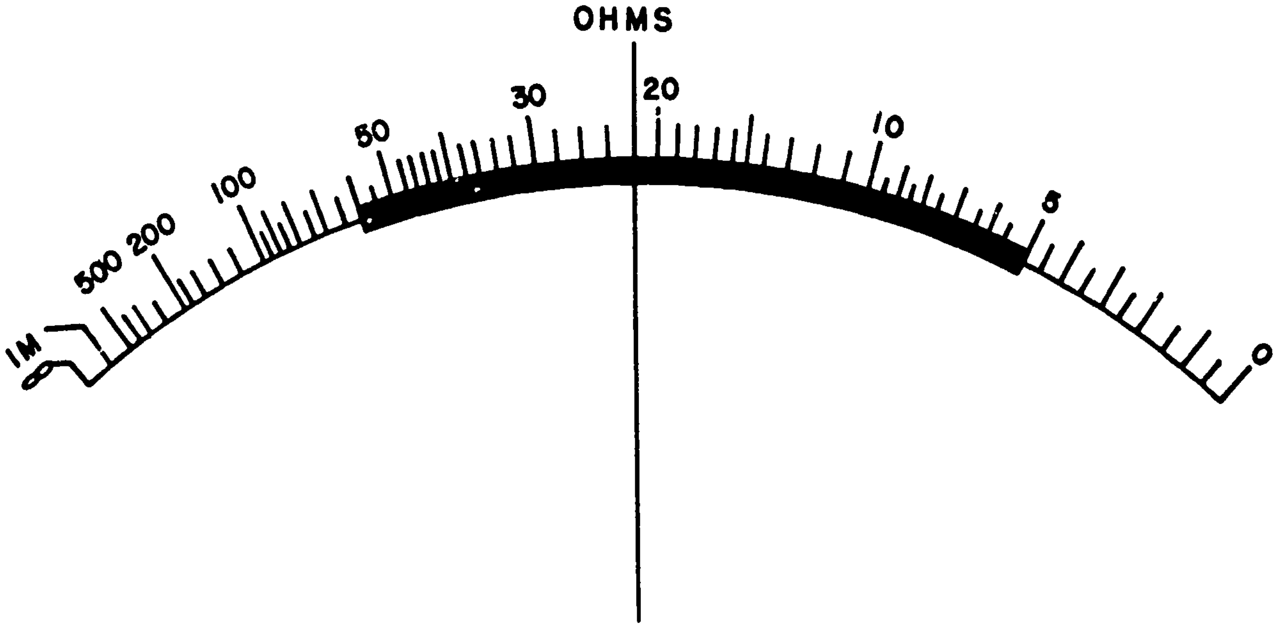
2. 25 ohms, R X 10 range ______________.



3. 240 ohms, R X 10 range ______________.



4. 2200 ohms, R X 100 __________.



Answers to Frame 37: 1. 150 2. 420,000 3. 8,500

4. 60

Frame 40

There is an important safety precaution that you must follow when you use the ohmmeter functions of the PSM-37. Do not hook an ohmmeter to a live circuit (one that has power applied); be sure that no power is applied to the circuit. The parts in the meter need very little current to work. They could be easily damaged if the meter were to be hooked to a live circuit. There is a small battery in the PSM-37 that gives us the current required to operate the meter in the ohms function. Another thing to remember is that the ohmmeter must be "zeroed" before you make your first ohms test. Think back; to zero the meter you first set the multimeter up for measuring resistance. The POLARITY switch should be set on DC+, the FUNCTION switch should be set on OHMS-STD, and the RANGE switch on RX10. Touch the two lead tips together. The needle should move to the right and zero over the 0 on the ohms scale. If it does not, turn the ohms ADJ knob until it does. If the needle does not move at all, press the "push to Open and Reset" button. If it still will not zero, ask the instructor for assistance.

Place a checkmark (✓) beside the true statement(s).

_____ 1. The ohmmeter function of the PSM-37 requires current from the circuit being checked to operate.

_____ 2. The ohmmeter is zeroed before use to insure accuracy.

_____ 3. If the pointer can not be adjusted to zero on the ohms scale, this means that the internal battery is weak.

Check the correct answer.

4. If an ohmmeter is connected to a circuit with power on, which of the following would most likely occur?

____ a. The reading would be accurate.

____ b. The circuit would be damaged.

____ c. The ohmmeter would be damaged.

Answers to Frame 38: ____ 1. ✓ 2.

After the ohms adj knob has been adjusted, the needle should stop at "0". This means that here is no resistance to current flow. Keep in mind that the meter lead tips must be touching each other or be in contact with a common conductor. If the needle stops to the left of "0", there is some opposition to the flow of current. If the needle only moves part of the way toward "0", there is resistance being measured. If the needle does not move at all, a great (infinite ∞) amount of opposition to the flow of current is present. We refer to each of these conditions by different terms. First, a "0" reading means that there is continuity (no resistance), in the circuit. A reading which will cause the needle to move, but to stop short of "0", means that there is resistance in the circuit. If the needle does not move at all, an open circuit is indicated, or the meter is at infinity "∞" and the resistance is either too large to be measured on that scale, or by that meter.

Place a checkmark (✓) beside the true statement(s).

____1. Continuity refers to the amount of resistance in an open circuit.

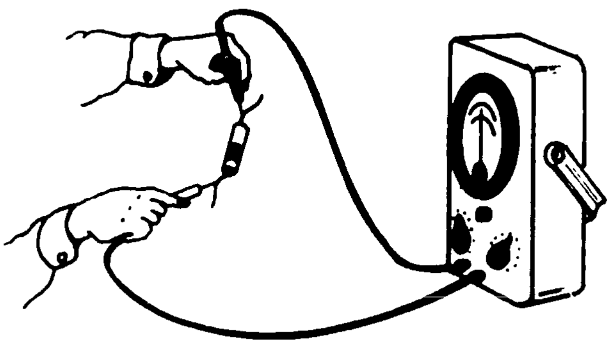
____2. A resistance that is too large to measure is referred to as infinity.

____3. When the pointer is reading a value other than "0", this means some resistance is present in the component being checked.

Answers to Frame 39: 1. R X 10 2. R X 1 3. OK 4. OK

Frame 42

The figure shows one test lead is placed to one side of the resistor. The other lead is placed to the other side of the resistor. When you make a resistance check on a component of a circuit, the component must be isolated (disconnected) from the rest of the circuit. This can be done in three ways: First, totally remove the resistor and test it out of the circuit; second, disconnect one end of the component to be tested from the circuit; third, is to take out the wire (conductor) leading up to one end of the component that you will test. In all three cases, the battery power from the meter will only have one path to flow through; that is, through the component being tested. If you do not isolate the part being checked, your ohms reading will be inaccurate.



Place a checkmark (✓) beside the true statement(s).

____1. The component being checked with an ohmmeter does not have to be isolated from the rest of the circuit.

____2. The ohmmeter must never be used to check the resistance of a circuit that has power on it.

____3. The manner in which the ohmmeter is connected to the component being checked is similar to the way the voltmeter is connected.

Answers to Frame 40: ___1. ✓ 2. ✓ 3. c 4.

If you check a high ohms resistor on a low R X range, the needle may not move off "∞" mark. Turn the range switch up range until the needle stops in the wide green area of the OHMS scale. Then take the reading times (X) the range switch position. This will give you the value of the resistor under test. Witn the range switch in a high RX position and meter leads hooked to a low ohms resistor, the needle may move to "0". In this case, turn the range switch down range. When the needle stops between the 5 and 60 of the ohms scale, take the reading. Multiply the reading times the range position to get the value of the resistor.

Place a checkmark (✓) beside the true statement(s).

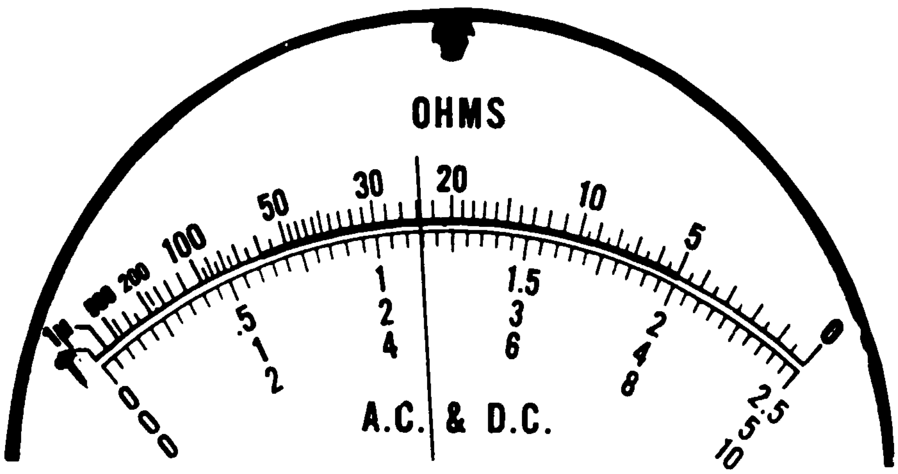
____1. With the ohmmeter on RX 100 and connected to a 10 ohm resistor, the needle will not move off "∞" mark.

____2. With the PSM-37 set up on the R X 1 range and connected to a 2500 ohms resistor, the needle will move to 25 on the ohms scale.

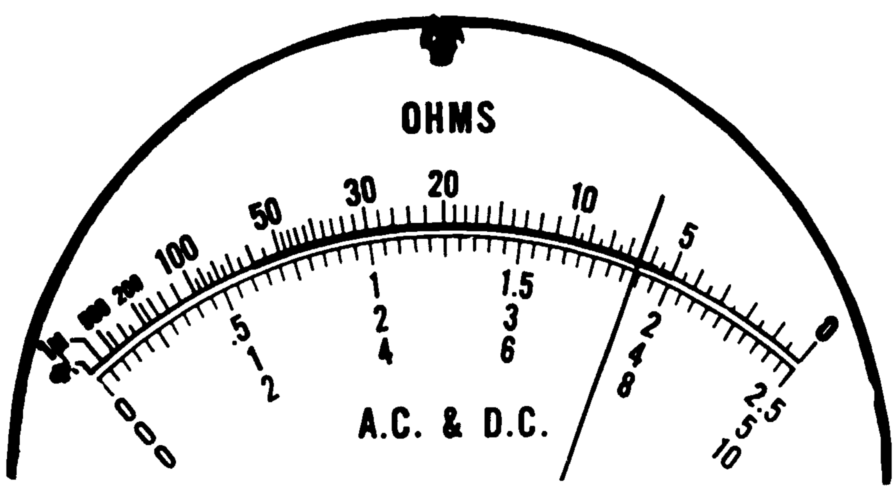
Answers to Frame 41: ____1. ✓ 2. ✓ 3.

Frame 44

In this frame you will be given one of the two meter faces shown and the position of the polarity, function, and range switches. You will be required to provide the proper reading of the meter.



Meter #1.



Meter #2.

These are the meter faces that you will use. The exercise that you are to fill out is on the next page.

Fill in the blanks with the proper meter readings. Be sure to use the meter referred to for each of the control settings. PLUS, indicate in your answer if the value is V DC, V AC, MA DC, MA AC, or OHMS.

	METER NUMBER	FUNCTION Sw SETTING	RANGE Sw SETTING	POLARITY Sw SETTING	PROPER READING
1.	1	VOLTS	50	DC+	23V DC
2.	2	VOLTS	250	AC	______
3.	2	OHMS-STD	R X 100	DC+	______
4.	1	VOLTS	10	AC	______
5.	2	VOLTS	.5	AC	______
6.	1	OHMS-STD	R X 1K	DC+	______
7.	1	AMPS-MA	50	AC	______
8.	2	VOLTS	2.5	AC	______
9.	1	OHMS-LP	R X 1	DC+	______
10.	2	AMPS-MA	10	AC	______
11.	2	OHMS-STD	R X 10	DC+	______
12.	1	AMPS-MA	250	DC+	______

Answers to Frame 42: ______1. ___✓___2. ___✓___3.

Frame 45

This frame summarizes the safety precautions that must be observed when using the PSM-37 to test circuits.

1. The PSM-37 should never be handled carelessly. Aside from being expensive, it is sensitive and delicate. Don't abuse it.

2. When measuring voltage and current, start your check with the range switch set on "1000". Then move it to a lower setting if necessary. Then turn it to a range higher than that applied to the circuit after making the check. This way the meter will be ready for the next check.

3. Never connect the ohmmeter to a circuit that has power on it.

4. When used as a voltmeter, connect it in "parallel" with the voltage drop being checked.

5. When measuring DC voltage and current, be sure to observe polarity when connecting the meter to the circuit. Note if the meter needle moves left on the scale, either reverse meter leads on the circuit or turn the polarity switch to the other DC position.

6. When used as an ammeter, connect it in "series" with the portion of the circuit being checked.

7. Before connecting the meter to a circuit, make sure it is set up for the values to be measured. (AC or DC volts and amps, or ohms)

8. Periodically check the strength of the internal battery. Accomplish this by zeroing the ohmmeter on each of the range switch settings. If it does not zero on all settings, the battery needs to be replaced.

9. Store the meter with the switches in the following positions: POLARITY switch "OFF", RANGE switch "1,000", and FUNCTION switch VOLTS 20 KΩ/V. These positions give the meter some protection if the next person forgets to check the meter before placing it in a circuit.

NO RESPONSE REQUIRED, GO ON TO THE NEXT FRAME.

Answers to Frame 43: _____1. _____2

Complete the following statements by entering the missing word(s) on the blank spaces provided.

1. When using the PSM-37 to measure a voltage of 34 volts DC, you will set the function selector to the (a) __________ position, the range switch to the (b) __________ position, and the polarity switch to the (c) __________ position. The reading will be taken from the 0 to (d) __________ scale.

2. When using the PSM-37 to measure .008 amps DC, you will move the function switch to (a) __________, polarity switch to (b) __________, and range switch to (c) ____________. The reading will be taken from the 0 to (d) __________ scale.

3. When measuring 210 volts AC, you will move the function switch to the (a) __________ position, polarity switch to (b) ____ _____, and range switch to (c) __________. Your readings will be taken from the 0 to (d) __________ scale.

4. When using the PSM-37 as an ohmmeter you will take the readings from the (a) __________ (color) scale. The function switch must be set to the (b) ____________ position when making resistance checks. Now assume you are checking a resistor; you have the range switch set to R X 1K and the pointer stops at 21 on the OHMS scale. The reading of 21 is multiplied by (c) __________ and the value of the resistor is (d) __________ ohms.

Place a "T" in the blank space beside each tr statement.

_____5. The ohmmeter readings will be most accurate when the readings are taken when the pointer is stopped in the wide green area of the ohms scale.

_____6. When measuring voltage, the meter must be connected in series with the component being checked.

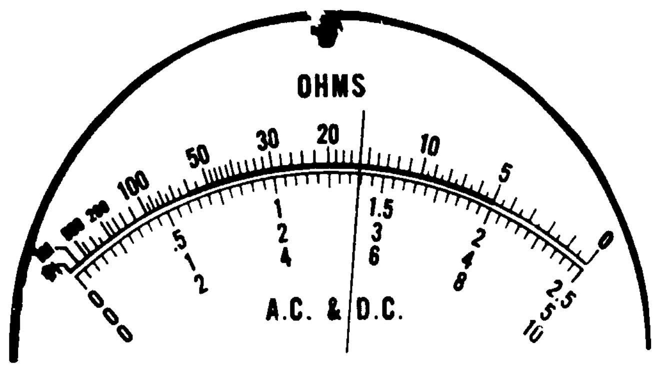
_____7. If the ohmmeter is not "zeroed" properly, you will get inaccurate readings.

_____8. A DC ammeter must be connected in series with the component being checked and you must observe polarity when connecting the leads.

Match the items in the right-hand column to their correct statement in the left-hand column. Enter your letter answers in the space provided.

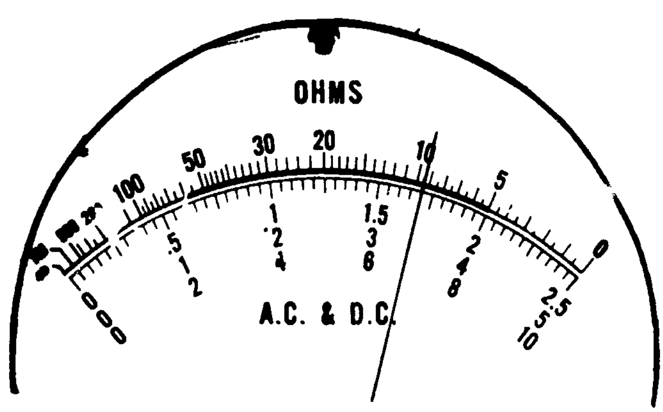
___9. An indication of zero ohms.	A. Black test lead
___10. Determine whether the meter measures ohms, volts or milliamps.	B. Press to Open and Reset Button
___11. Is always connected to the positive point of a DC circuit.	C. Continuity
___12. An unmeasurable large resistance.	D. PSM-37
___13. Provides current in the ohms function only.	E. Red test lead
___14. Used to make the pointer of the ohmmeter read exactly "O".	F. Range switch
___15. Used to measure AC and DC current and voltage, plus resistance.	G. External switch
___16. Is always connected to the negative point of the circuit.	H. Function switch
___17. Determines the meters maximum voltages and current or multiplier for resistance readings.	I. Internal battery
___18. Protects the meter from overload and can be used to break the input circuit to the meter.	J. Infinity
	K. Ohms Adj knob
	L. Red indicator

19. The function switch is set on VOLTS and the polarity switch is on AC. Use the meter face below to obtain the readings for the range switch positions given in the chart below the meter face.



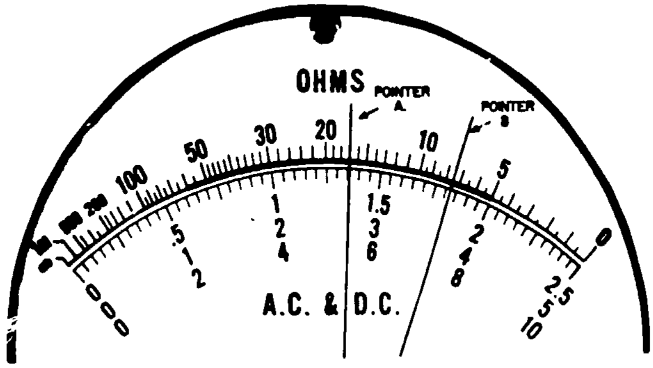
RANGE SW. →	.5	10	50	250
READINGS →				

20. The function switch is set to AMPS-MA and the polarity switch is set to DC+. Use the meter face below to obtain the readings for the range switch position given in the chart below the meter face.



RANGE SW. →	2.5	10	500	1000
READINGS →				

21. The function switch is set to ohms and the polarity switch to DC+. Use the meter face below to obtain the readings for the range switch positions given in the chart below the meter face. Enter pointer A readings in line one and pointer B in line two.

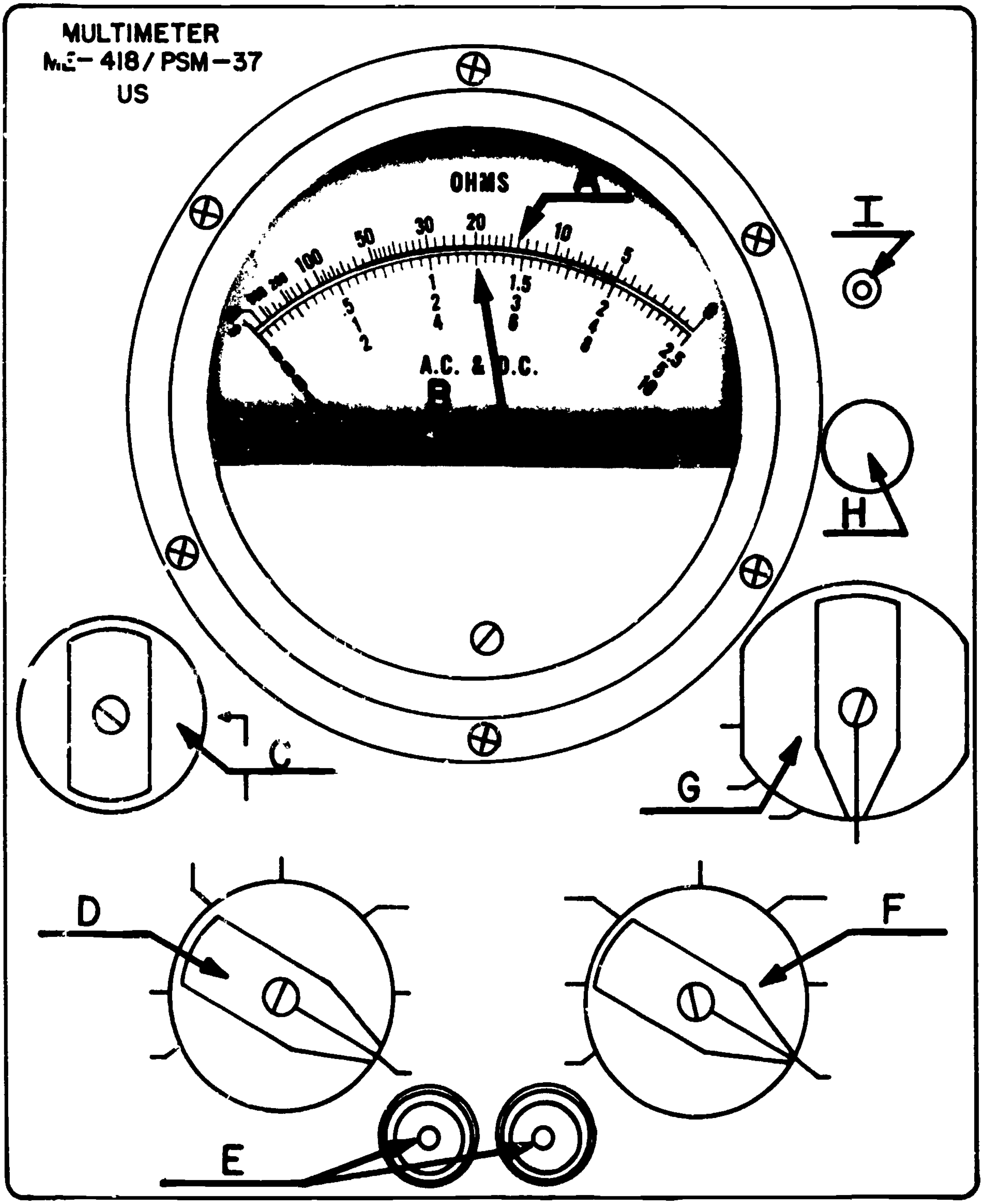


RANGE SW. →	RX10	RX1K	RX100K
POINTER "A"			
POINTER "B"			

22. Using the illustration of the complete PSM-37 meter on the next page, match the names of the controls and scales in Column A with the letter that corresponds to that item from the illustration. Place your letter answers in the space provided in Column B.

Column A	Column B
a. Overload	______
b. Polarity switch	______
c. Function switch	______
d. Ohms - Adj	______
e. Ohms (Green)	______
f. AC & DC	______
g. Push to Open and Reset	______
h. Test Jacks	______
i. Range switch	______

22. Continued. This illustration is to be used in conjunction with item 22, matching exercise of meter controls and scales.



Answers to Frame 44: 23V DC 2. 190V AC 3. 650Ω 4. 4.6V AC

5. .37V AC 6. 24,000Ω 7. 23 MA AC 8. 1.9V AC 9. 24Ω

10. 7.4 MA AC 11. 65Ω 12. 115 MA DC

Answers to Frame 46:

1. (A) Volts
   (B) 50
   (C) DC+
   (D) 5
2. (A) AMPS-MA
   (B) DC+
   (C) 10
   (D) 10
3. (A) Volts
   (B) AC
   (C) 250
   (D) 2.5
4. (A) Green
   (B) Ohms
   (C) 1000
   (D) 21,000
5. T
6. F
7. T
8. T
9. C
10. H
11. E
12. J
13. I
14. K
15. D
16. A
17. F
18. B

Answers to Frame 46 (Cont'd)

19.

.5	10	50	250
.28VAC	5.6VAC	28 VDC	140VAC

20.

2.5	10	500	1000
1.7MA DC	6.8MA DC	340MA DC	680 MA DC

21.

RX10	RX1K	RX100K
170	17,000	1,700,000
75	7500	750,000

22. a. I f. B

b. G g. H

c. D h. E

d. C i. F

e. A

If you missed any of these items, turn to the part(s) of this PT which covered the item tested. If you still do not fully understand that item, ask your instructor for assistance. You should now be ready to test on this Programmed Text.

STUDY GUIDE

3ABR42633-~~SG-211~~

3AAR42673-~~SG-403~~

SG-218

Technical Training

Turboprop Propulsion Mechanic/Technician

ELECTRICAL SAFETY AND THE MAINTENANCE MAN

7 October 1981

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ELECTRICAL SAFETY AND THE MAINTENANCE MAN

INTRODUCTION

Numerous maintenance articles written by experienced maintenance personnel or by engineers, well qualified in their fields, are printed in aviation magazines and publications. These articles contain maintenance information, techniques, reasons or causes of Air Force maintenance problems. They are written to inform Air Force personnel of the problem and its solution. It is hoped that this information will be of value to you if you should encounter the same or similar problems.

Since you will be on the job shortly and may be confronted with these problems, we feel that you could benefit from reading some of these articles along with the study guides issued to you. The content of the article in this handout is directly related to the subjects you will study. This article has been taken from Aerospace safety magazine and is informative in nature and should not be interpreted as being a regulation, technical order or directive in nature; however, it will be well for you to observe the safety practices given in this article.

INFORMATION

You will be working on electrical circuits on the C-130 aircraft. This study guide contains safety procedures for working on electrical circuits.

ELECTRICITY-SAFETY-AND THE MAINTENANCE MAN

If you have ever passed close to a high-tension power transmission line on a rainy day, a quiet pause near one of the support poles or towers would serve to make those "Danger--High Voltage" signs more meaningful. There is a hissing, buzzing, crackling sound from the wires where they pass over the insulators that sets the hair on end across the back of your neck--it sounds menacing, as it should. We've been taught, as part of our early training in this era of technology, to stay away from bare wires, especially those marked "High Voltage." We've seen movies with electric switchboards in submarines or the laboratories of "mad scientists" turning into fireworks displays as they overloaded or shorted out. In short, we are conditioned to think of high voltage electricity as dangerous, something to be treated with great respect even while we put it to work for us.

Of course, all this is true; if we are to stay alive, continuous caution is vital when we work around power stations, transmission lines, or distribution networks with high voltage potential. But most of the

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time, most of us deal with "low voltage" electrical equipment which operates on power stepped down by transformers from high voltage sources that are safely removed, we believe, from our work stations. We think that because the "high voltage" menace stops at the transformer station, or at the outside of the hangar, we are safe from electric shock--all we're exposed to is 220 or 110 volts alternating current, something we live with every day around the hangar or the house, something the wife can use to wash clothes or vacuum-clean the rugs. So each day, someone who feels "safe," someone who is complacent about "harmless low voltage" is injured or killed because he didn't obey the most fundamental rule for working safely with electricity--"Never allow your body to offer a path for current flow." Because it is current flowing through the body, not voltage, that determines the severity of an electric shock.

When the body is in a position to offer a path for the flow of current, the amount of current which will flow depends upon only two factors--the resistance offered by the body, and the voltage available to push current through that resistance. We often hear of cases where low voltage proved to be a killer because the resistance of the victim's body was low enough to allow heavy current flow through vital organs, or to cause fatal internal burns. On the other hand, some people have escaped the hazards of higher voltage shock solely because their bodies offered too much resistance to current flow. Since resistance is so important to survival, we should find out how it varies in the human body, and what effect these variations may have in prevention of electrical shock.

RESISTANCE VERSUS VOLTAGE

Figure 1 illustrates how resistance to current flow through the surface of the skin can vary according to circumstances. Careful study of this chart should leave you with the knowledge that you can exercise control over the total amount of resistance to shock when you touch a source of electrical potential. For example, if you keep your skin dry and if while grounded you touch the source lightly with your fingertip (only one-half of a square inch), the resistance to current flow may be as high as 400,000 ohms, and you probably will not feel even the slightest tingle of the shock sensation. But the chart shows much different resistance values on the "WET" side.

To demonstrate this, let's say you've been working hard on a hot day in the unventilated insides of your airplane, and you're sweating heavily. When you grasp anything fully with a wet hand, the increased contact area (up to 15 square inches) combines with the increased conductivity of the moist skin to lower your resistance at the area of contact to as little as 1000 ohms. Should the object you're grasping be a source of electrical potential like the metal case of a defective and improperly grounded electric drill motor, current will flow through your hand, arm or body at the instant you touch another object at ground potential. The shock could be very severe or perhaps fatal, even if the voltage is relatively "low," as you can see by looking at figure 2. For example, at 100 volts of 60-cycle alternating current and only 1000 ohms resistance, the current flow in most circumstances could be more than 100 milliamperes, and you couldn't let go or even move a muscle

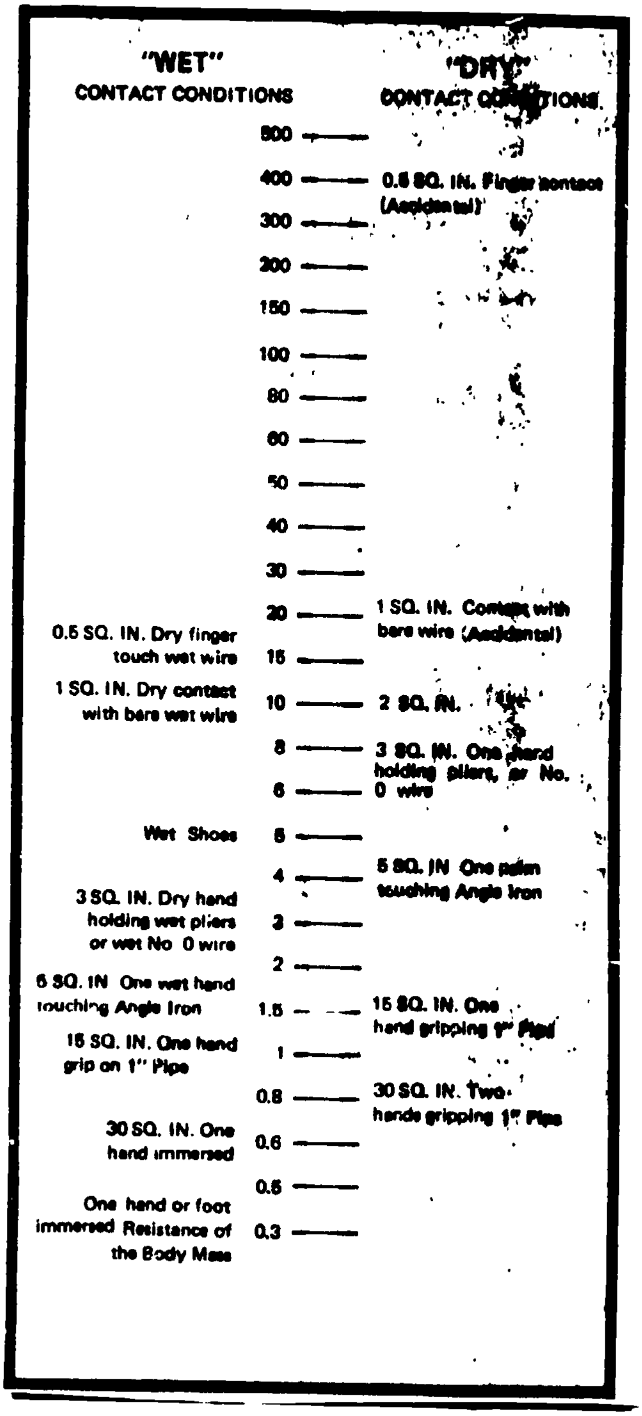


Figure 1. Variable Resistance of Typical Boyd Contacts.

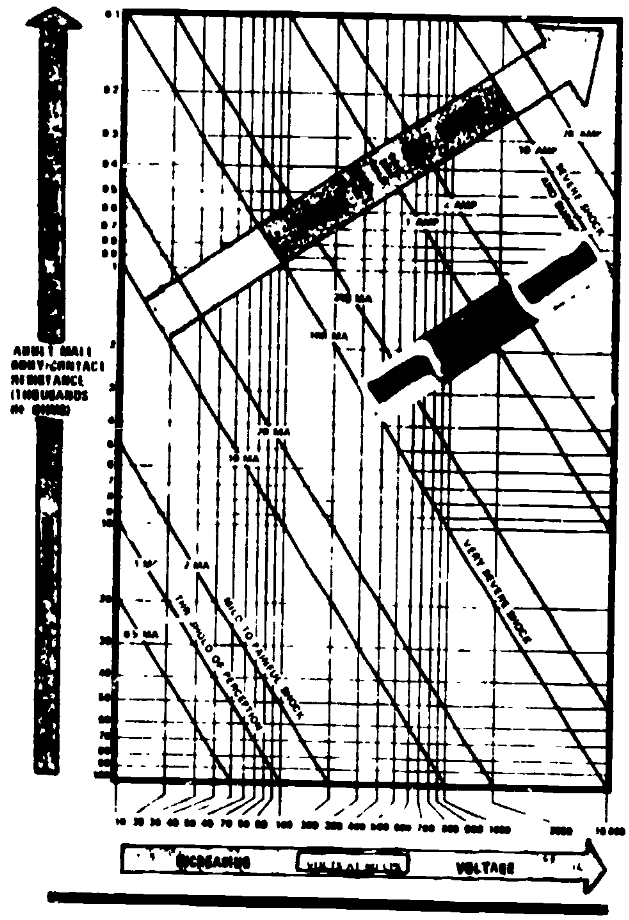


Figure 2. Electric Shock Hazard--Adult Males.

while the current continued to surge through your body. It takes only one-tenth this much current flow (10 milliamperes) to "freeze" your muscles and thus keep your body in the circuit until it is deenergized.

HOW RESISTANCE VARIES. Having looked at the illustrations and the big numbers along the scales, you may still feel that you wouldn't risk much from shock hazards in the type of work you do or the kind of equipment you normally work with. But you should have learned by now, at least, that the resistance of the human body cannot be relied upon to prevent a fatal shock from 115-volt or even lower voltage circuits. And this is because of the extreme variations in body resistance, almost all of them confined to the external area.

The internal resistance of the body is relatively constant and relatively low. We are all, inside of us, about 85 per cent water, an excellent and low impedance conductor. Conditions under the inner layers of the skin stay just about the same all the time, so that to find the causes for the variables in body resistance we must look at the skin, and what's in it and on it.

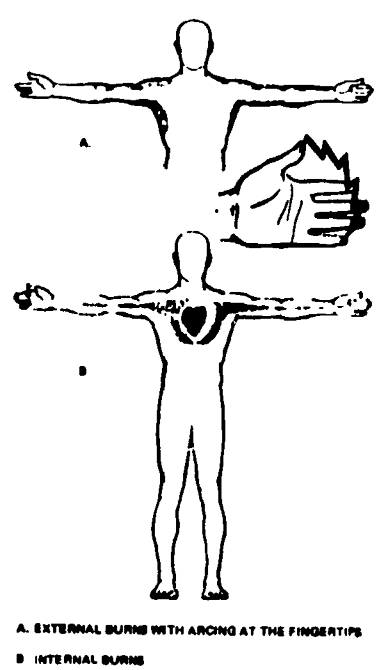


Figure 3. Electrical Burns From Over 2 Ampere Current.

Body skin is made up of two major layers. You already know that dry skin has relatively high resistance, especially if it is thick, such as in the area of a callous. But the inner layer of skin is naturally moist, due to the contact with body fluids, so resistance to current flow falls off rapidly if the inner layers are exposed, or if body fluids come closer to the surface, as when a blister forms. And blisters do form in seconds, from localized heating when current flows either along the surface of the skin or through a portion of the body, as shown in figure 3. The effect is cumulative--current flow through skin resistance causes heating, the heating brings moisture to the surface, blisters full of fluid lower the resistance even further, so the current flow increases, producing still more heat, etc. Your total body resistance might be pretty high to begin with, before you suffer a shock. Then as the skin resistance goes down, your total body resistance decays rapidly. An the longer it continues, as shown in this example, the worse it gets. In three seconds, while your internal resistance stays constant at only 300 ohms, your skin resistance plunges from 2000 ohms down to 200 ohms, while current flow zooms from 50 milliamperes to 230 MA. And all this time you can't let go to stop the vicious circle from completing itself.

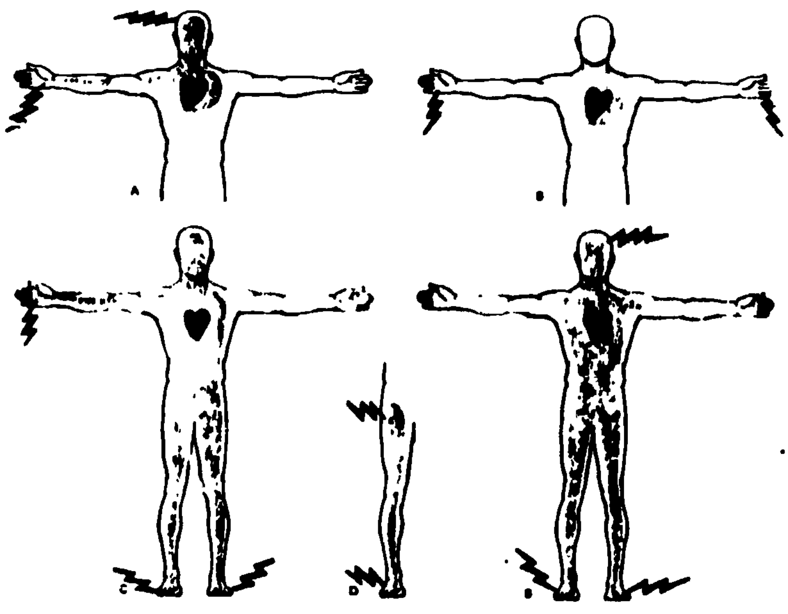


Figure 4. Current Path in Five Basic Types of Shock.

Two hundred thirty milliamperes of current flowing through your body through the region of the heart is well within the band of current flows (marked on our chart in figure 2) labeled "SURE DEATH"--the area where the heart stops pumping and just trembles ineffectually (ventricular fibrillation). Naturally, the effect of current flow on your body varies not only with its intensity but also with the path it follows. Figure 4 shows the five major flow paths through the body and the areas, shaded in red, that are affected most by the damage resulting from the shock.

EFFECTS OF SHOCK

To get an idea of the effects of so-called "low-voltage" shock, let's see what happens when 60-cycle alternating current at 110 volts passes through a man from hand-to-hand or hand-to-foot. As current flow gradually increases, the following effects become apparent:

1 to 8 MILLIAMPERES--a sensation of shock, not very painful. A man can still let go because muscle control is not lost.

8 to 15 MILLIAMPERES--painful shock, but still he can let go. The hazard up through this amount of current flow often comes from the so-called "fright reaction" or recoil when the shock occurs. Men have fallen from ladders and other high locations, or have bumped their heads hard enough to cause unconsciousness, increasing the possibility of remaining in the path of current flow, prolonging the exposure.

15 to 20 MILLIAMPERES--loss of muscle control begins, and the man cannot let go in spite of the painful shock. At 25 MA he will be "frozen" to the point of contact.

20 to 50 MILLIAMPERES--severe muscle contractions include those muscles controlling breathing. In addition to difficulty in breathing, the victim may be "knocked out."

50 to 75 MILLIAMPERES--almost certain unconsciousness.

75 to 100 MILLIAMPERES--as current nears 100 MA, the man is almost certain to die. Ventricular fibrillation sets in, the heart no longer circulates blood in the body, and even after the current is cut off, no pulse can be detected. Artificial respiration should be attempted, but unless a trained physician or a doctor can restore the natural rhythmic action of the heart by massage or controlled electrical shock treatment using special equipment usually found only in hospitals, it's almost impossible to save the victim's life. Usually the maximum time limit for resumption of natural heart function under these circumstances is about six minutes.

0.20 to 2 AMPERES--this intensity of flow will paralyze the nerves near the diaphragm or the nerve centers at the base of the brain. Breathing will be cut off.

2 AMPERES and over--the man will suffer severe burns due to "frying" of the body fluids and to external arcing at the point of contact. In addition, internal burns of the slow healing type will also occur. This latter fact might seem academic under the circumstances, but a peculiar thing sometimes happens when flows of above 10 AMPS occur for very short periods. The severe muscle contractions the man experiences may prevent ventricular fibrillation, and after release, if proper first aid is administered soon enough, he might survive if the heart picks up its regular pumping rhythm again.

The tabulation above is a general guide only. Naturally there will be variations due to individual circumstances. The physical condition of the victim may be a factor. But the important thing to remember is that fewer low voltage shock victims can be revived than those receiving 1000 volts or more.

SUMMING UP

With the foregoing facts in mind, we can do a summing-up exercise in relatively few words. Although we must be aware of the many variables in cases of electrical shock and the hazards which cause them, we can make some general statements which apply to almost all circumstances.

- If your body becomes part of a circuit, either as the load or as the conductor and the load, you will get an electrical shock.

- Your body will become part of the circuit if you come in contact with both a source of potential and a ground while your total resistance is low enough to allow a flow of current.

- Current flow is what kills or injures you--voltage only pushes the current through your body resistance.

- Direct current (DC) is generally considered to carry less shock hazard than alternating current (AC) for a given voltage, but it is likely to burn more severely since the arcs from DC are more persistent than those of AC.

- Body resistance is highly variable, principally because of changes in skin resistance from one body area to another due to thickness and amount of moisture on the surface.

- Electrical energy sources (AC or DC) operating with an open circuit potential of 30 volts or more with a capability of delivering 2.5 milliamperes or more into a short circuit are hazardous to you.

- Low voltage (less than 600 volts) can be more dangerous to you than high voltage. Accurate statistics show that 62 per cent of victims recovered after being knocked out by potentials over 1000 volts; for lower voltages, only 39 percent recovered.

- The seriousness of electrical shock depends on the balance between several factors--the voltage, the body resistance, the amount of current flow and its path through the body, the duration of contact and the condition of the body organs in the current path.

- The most hazardous currents are those in the frequency range from 20 to 100 cycles per second (cps). Currents of higher frequencies are less hazardous because they tend to flow on the surface of conductors rather than through the conductors themselves. High frequency current will cause electrical shock but to a lesser extent for a specific current value.

- The current required to operate just one 100-watt light bulb is eight to ten times the amount that is needed to kill you.

SAFETY PRECAUTIONS

There are a number of safety precautions you can take to minimize the degree of exposure and the potential for being on the receiving end of an electrical shock. Some of these precautions involve the equipment you work with--others have to do with your attitude toward your work and your interest in safe working conditions. Let's tick off some of the most time-tested precautions in both areas, as they apply to the mechanic or technician working either on the airplane or at the bench in the hangar or shops.

SAFE PRACTICES. Start with good housekeeping in your work area. Keep it clear of clutter, stray wires, solder drops, unusable spare parts and unoccupied people.

1. Don't work on energized circuits. If you can possibly avoid it, don't touch a live circuit anywhere. Of course, some of us must work on energized circuits to do our jobs, but in such cases we should be properly trained and always know for sure what voltages and frequencies we are involved with.

2. Avoid working alone. When using electrical equipment, if you can work with or around someone else, you are safer, especially if he knows how to turn off the power, how to get help in an emergency, and how to apply artificial respiration.

3. Follow the Technical Manual. Safe procedures for all the technical operations are contained in your approved technical publications. Follow them, and if there is a checklist for your particular operation, USE IT. Don't depend on your memory, and don't try to take short cuts.

4. Rig power cables properly. Never use portable cords or other equipment in such a way that a male plug can be energized except when it is in a receptacle. When connecting a motor or other equipment to a power source, first make sure that the switch or circuit breaker is open at the source. Then connect the cord or cable to the equipment you are going to use, and work back toward the power source with dead cable in your hands, making the connection to the source your next-to-last move. Your last move, then should be to turn on the switch or close the circuit breaker while watching to see if there is any evidence of overheating or arcing in the supply cable or the equipment itself. NEVER CONNECT TO A POWER SOURCE FIRST. NEVER MAKE INTERMEDIATE CONNECTIONS UNLESS THE POWER IS OFF.

5. Keep yourself and your equipment dry. Moisture is your enemy when you work with electricity.

6. Make sure that grounding is proper and complete. Most electrical industrial equipment comes with carefully designed grounding provisions. Most cords use three or four-wire cable to ensure your safety by providing a built-in low-resistance path to ground in case of a short circuit. Don't guess about this. If there is any doubt in your mind about the condition or function of any electrical equipment you may have to use, get help from authorized and trained personnel instead of taking a chance.

Grounding is one of the ways we prvent injury from electricity (the other is insulation). Adequate grounding of all non-current-carrying parts of electrical equipment which could become accidentally energized will help to keep you from "frying" when using such simple tools as a drill motor, or such complex ones as an electronic bench test set.

7. Be familiar with first aid procedures. If your buddy is not so careful as you, your knowledge may save his life.

8. Use the right tool for the job. Don't overload or abuse electrical equipment or circuits beyond their capacity. Don't try to "fool" the circuit by using a fuse heavier than the one authorized, or by "bridging" a burned out fuse with heavier conducting material. Don't replace fuses by hand on live circuits; use a fuse puller.

9. Use safety lights in closed or fume-laden areas. Whenever you work in a closed area or in a place where volatile fumes could collect, use only approved, sealed safety lights and explosion-proof equipment. Some explosions in the past haven't killed anyone, but those present were electrocuted by the bare wires whipping around as a result of the big boom.

10. If someone else becomes a shock victim, don't join him. Don't become part of the circuit yourself. Turn off the power or manipulate the wires or the victim with something you're SURE is a non-conductor (some rubber items are pretty good conductors). As soon as you can touch him safely, apply artificial respiration. Speed is essential--in 600 cases studied, 70 percent recovered when artificial respiration was applied within three minutes. Another minute of delay reduced the figure to 58 percent. Five minutes are too long--the chances are slim.

WORKING WITH 400 CYCLE AC

400 cycle AC electricity HURTS! Ask the mechanic who has been careless, he'll tell you for certain. For removal and installation purposes on the aircraft there is no problem (unless you forget to pull the proper circuit breakers). However, overhauling components on the bench is quite a different matter. Usually it is necessary in the case of actuators, valves, relays, and so forth, to apply power to the component for adjustment/test purposes. In days gone by, when almost all components were powered by 28 volts DC, working with power applied presented very little danger. However, with the introduction of jet aircraft and the switch to 115-volts, 400 cycle AC, it's a different story. A mistake now presents a danger that could possibly be fatal.

Extreme care must be exercised during bench adjustments. Turn the switch on your power supply OFF if at all possible while making any adjustment. Be certain that no part of your body is in contact with a possible ground return.

One further word concerning the bench power supply. There are two types in common use at the present time. There are two types in common use at the present time. The latest model employs an "above-ground" transformer and protects the operator from possible feedback through a metal bench or a damp floor. The older model does not afford this protection. It is possible to have full voltage standing between either test lead and any surrounding metal objects. Remember: If you must move a power supply, check it with a voltmeter after inserting the wall plug. This will eliminate that moment of surprise (115/220 volts AC, 400 cycle lightning bolt!)

QUESTIONS

1. What is the danger involved while working on electrical circuits?

2. What will be the effect of electricity on your body with you wearing wet clothing?

3. What will be the effect of electrical current flowing through the human skin?

4. How many milliamperes of current flowing through your body, in the region of the heart, will cause sure death?

5. What is the frequency range of the most dangerous currents?

6. What is the main safety precaution to prevent electrical shock while working on electrical circuits or equipment?

7. What are the two types of electricity that are used on an aircraft?

8. Why is it important to make sure that all equipment is properly grounded prior to working on electrical equipment?

9. Why is knowledge of first aid procedures important to you as an aircraft mechanic?

10. Why should you never connect a power cord to a power source first?

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-HO-218A
29 November 1982

USE OF MULTIMETER (VOLTAGE)

OBJECTIVE

Given a multimeter and trainer, measure a voltage with ± 3 volts of instructors reading with no more than 2 procedural errors allowed.

INSTRUCTIONS

Read the following carefully prior to starting as these are the steps that you will be evaluated on.

PROCEDURE

Step 1. Follow ALL safety precautions.

a. Remove all jewelry.

b. Metal framed glasses WILL NOT BE WORN.

c. Insure a dry environment.

d. Insure all equipment is in satisfactory condition.

Step 2. Turn meter ON - use power and polarity switch (DC +, DC -, or AC)

Step 3. Select proper function - VOLTS

Step 4. Select proper range

a. Use lowest possible range for taking reading

b. WHEN SYSTEM VOLTAGE IS UNKNOWN

(1) Start on highest meter range.

(2) Turn range switch down until on the lowest range that reading will fit on.

Note: Ask instructor what points in circuit to measure between.

Step 5. Place test probes at proper points in circuit.

a. Connect meter in parallel across component to measure voltage. For example, refer to figure 1.

OPR 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 200; DAV - 1

RCL: N/A

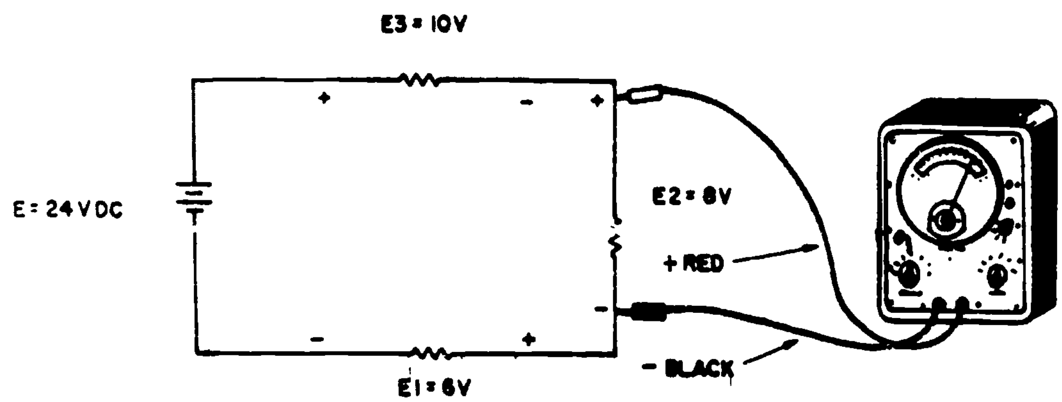


Figure 1.

(1) RED probe on positive side of component

(2) BLACK probe on negative side of component

Step 6. Obtain a reading within ± volts of instructors reading.

* Record reading ____________ v

Note: 1. Steps 1 and 6 must be accomplished correctly.

2. On steps 2 through 5 there are two procedural errors allowed.

USE OF MULTIMETER (RESISTANCE)

OBJECTIVE

Given a multimeter and trainer, measure a resistance within ± 10 ohms of instructors reading with no more than 3 procedural errors allowed.

INSTRUCTIONS

Read the following carefully prior to starting as these are the steps that you will be evaluated on.

PROCEDURE

Step 1. Follow ALL safety precautions.

a. Remove all jewelry.

b. Metal framed glasses WILL NOT BE WORN.

c. Insure a dry environment.

d. Insure all equipment is in satisfactory condition

Step 2. Insure circuit power is OFF - failure to perform this step will damage the meter.

Step 3. Turn meter ON - use power and polarity switch (DC + or DC -)

Step 4. Select proper function - OHMS.

Step 5. Select proper range -

a. Select range so that reading is taken from the lower part of scale (0-50).

b. To obtain resistance, multiply reading by number indicated on range switch.

Step 6. Zero meter

a. Place range switch in one of the positions RX10 through RX100.

b. Touch the two test probes together.

OPR 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 200; DAV - 1

RGL: N/A

c. Zero by adjusting the OHMS ADJUST knob until needle rests on the ohm scale zero.

Note: Ask instructor what points in circuit to measure.

Step 7. Place test probes at proper points in circuit.

a. Connect the meter in SERIES with the portion of the circuit to be measured.

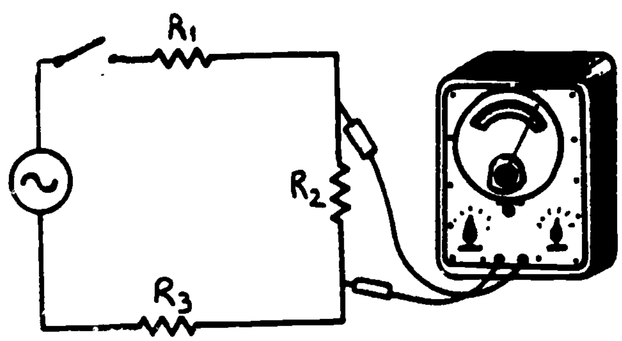


Figure 2.

b. For example, refer to figure 1.

Note: Ensure that circuit power is turned OFF, and that resistor R_1 is connected in series to the meter.

Step 8. Obtain a reading within ± 10 ohms of instructors reading.

* Record reading __________ Ω

Note: 1 Steps 1, 2, and 8 MUST be accomplished correctly.

2. On steps 3 through 7, there are 3 errors allowed.

541

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-HO-220
6 December 1982

UNIVERSAL PROTRACTOR

OBJECTIVE

Given a universal protractor and handout, measure 1 blade angle within ± .5 degrees of instructors reading, with no more than 3 procedural errors allowed.

INSTRUCTIONS

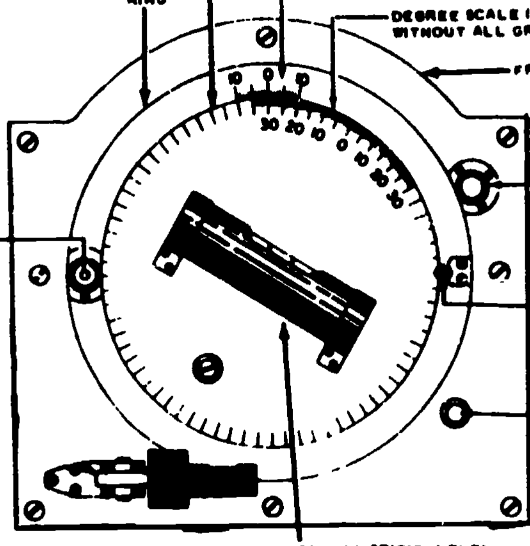


Figure 1.

The following is a list of the steps that you will be evaluated on and an explanation of each step (refer to figure 1 for location of parts).

PROCEDURE

Step 1: Observe all safety precautions.

a. Remove all jewelry.

b. When climbing up and down maintenance stand

(1) the front of your body will face the stand.

(2) your hands will be free of any tools and other materials.

OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 200; DAV - 1

RGL: N/A

Designed for ATC Course Use. Do Not Use on the Job.

Step 2: Zero protractor correctly

a. Engage the disk-to-ring lock

Note: Zeros on disk and ring scales must be lined up.

b. Disengage the ring-to-frame lock.

c. Place the protractor against a flat surface on the propeller dome or barrel so it faces the tip of the blade to be measured.

(1) The edge of the protractor that is against the propeller MUST be flat.

(2) There should be 2 flat edges of the protractor parallel to the propeller plane of rotation.

d. Using ring adjuster, rotate ring and disk until the bubble in the center spirit level is centered.

e. Using ring-to-frame lock, lock the ring in place.

Step 3: Install template correctly

a. Determine which side of the protractor the template goes on.

(1) Place protractor in same position on the propeller used for zeroing.

(2) Template goes on the flat edge that is parallel to the plane of rotation and is farthest from the barrel assembly.

b. Install template on that edge of protractor so that the "L" shaped end will hook on blade trailing edge when protractor faces blade tip.

Step 4: Place template on blade correctly

a. Place template on blade at reference station (yellow mark) so that

(1) "L" shaped end hooks on blade trailing edge.

(2) protractor faces blade tip.

Step 5: Turn disk to center bubble in center spirit level.

a. Disengage disk-to-ring lock.

b. Rotate disk using disk adjuster until bubble in center spirit level is centered.

Step 6: Obtain a reading within ± .5 degrees of instructors reading.

a. How to read protractor

(1) Determine the "whole" degree reading.

(a) Read the number on the degree (disk) scale that lines up with the zero on the vernier (ring) scale.

(b) If the zero is between 2 numbers, the lowest number is your "whole" degree reading.

(2) Determine the "tenths" of a degree reading.

(a) Read the number on the vernier (ring) scale that best lines up with any line on the degree (disk) scale.

(b) If degree scale is read from left to right, read the vernier scale from left to ight and vice versa.

(3) Add the 2 readings together to obtain final reading.

b. What is yc r final reading? ____________________

SG222

STUDY GUIDE
3ABR42633-~~80-213~~

Technical Training

Turboprop Propulsion Mechanic

SOLDERING ELECTRICAL CONNECTIONS

27 February 1980

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

SOLDERING ELECTRICAL CONNECTIONS

OBJECTIVES

After completing this study guide and your classroom instruction, you will be able to state the purpose and procedure for soldering electrical connectors.

INTRODUCTION

The ability to understand and know the correct procedures for soldering electrical connectors and the equipment required to complete the job with safety in mind first of all, is of utmost importance to you as a turboprop propulsion mechanic.

INFORMATION

This study guide contains the necessary information to correctly solder electrical connections and the definition of terms that pertain to soldering procedures.

SOLDERING

Repair and replacement of electrical parts sometimes includes soldering of the wire terminal ends. AN connectors also may have the individual wires soldered in place. The proper methods used in soldering are described below.

Soldering is a relatively simple task. Still, something must be known about the tools to use and the material to be soldered. Also, you must know about solder that is being used and the specific procedures to follow when soldering. If not, the soldered connection may break loose or form an electrical connection that will not conduct electricity. You, as a repairman, may be called upon to repair electrical connections. It may be attaching new terminals on wires or connecting electrical wires to an AN connector. A bad connection on an electrical circuit of an aircraft system could cause serious damage. Your knowledge of soldering is important whether you are performing the repair or inspecting the completed job.

Facility

The worker is responsible for maintaining soldering areas in a clean, orderly condition. Smoking, eating, or drinking at the work stations is not permitted.

OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-J - 200; TTVSA - 1

The soldering area shall have a controlled environment which limits entry of contamination. It should have a temperature of 75° ± 10°F with a relative humidity of 25% minimum to 60% maximum. Lighting should be a minimum of 100-foot candles on the surface being soldered. Where required control conditions cannot be met, special care should be taken to maintain the quality of solder connections.

Solvents

Solvents shall be nonconductive and noncorrosive, and shall not dissolve or degrade the quality of parts or materials. Solvents shall be properly labeled and maintained in a clean and uncontaminated condition. Those showing evidence of contamination or decomposition shall not be used.

CAUTION: Flux or solvents shall not be used in any manner which will carry to or deposit residue on contact surfaces such as those in switches or connectors.

The following solvents are acceptable when properly used for cleaning before or after soldering:

1. Ethyl alcohol, ACS grade, 99.5% or 95% by volume.
2. Isopropyl alcohol, best commercial grade, 99% pure.
3. Trichlorotrifluoroethane, clear, 99.8% pure.
4. Any mixtures of the above.
5. 1,1,1-Trichloroethane, Federal Specification O-T-620.
6. Deionized water; however, care shall be used to ensure that proper drying is accomplished immediately after its use.

CAUTION: Sonic or ultrasonic vibration shall not be used as a method for cleaning electrical or electronic parts or assemblies unless it has been demonstrated that the reliability of the parts or assemblies will not be degraded by the process to be used.

Thermal Shunts

Thermal shunts (also called heat sinks or heat dissipator clamps) shall be used to absorb heat from part leads or wire where necessary to protect parts, insulating materials, and/or previously completed connections from damage during soldering operations. Care shall be taken in the selection, application and removal of thermal shunts to avoid damage to conductors, components, parts, insulation, or associated solder connections.

Flux

Have you ever watched metal change color as it heats? This is due to oxides forming on the metal face. This oxide prevents the solder from making a good bond with the metal. To remove the effects of the oxide, a flux is needed. The flux acts to cut the coating of oxide and permits a firm bond between the solder and the metal. Numerous types of flux are used in soldering. Some of the more common are zinc chloride, ammonium chloride, hydrochloric acid and rosin.

Solder

There are many kinds of solder in use. Solder is made of a combination of tin and lead. Some of the ratios are 40% tin and 60% lead, 50% tin and 50% lead, 60% tin and 40% lead. Solder having a higher tin content makes somewhat stronger bonds. For electrical work, solder in wire form with rosin flux in the core is most commonly used. Be sure to look on the spool--it must be a rosin core for electrical work. An acid core solder will corrode the connections and cause trouble.

Preparation of Conductors

INSULATION REMOVAL. Stripping machines or handtools used to remove conductor insulation shall be of the correct size and in current adjustment and/or calibration.

DAMAGE TO INSULATION. After insulation removal, the remaining conductor insulation shall not exhibit any damage such as nicks, cuts, crushing, or charring. Conductors with damaged insulation shall not be used. Slight discoloration from thermal stripping is acceptable.

DAMAGE TO CONDUCTORS. After removal of the conductor insulation, the conductor shall not be nicked, cut, scraped, or otherwise damaged. Part leads and other conductors which have been reduced in cross-section area shall not be used. Damaged wires shall not be used.

WIRE LAY. The lay of wire strands shall be restored as nearly as possible to the original lay if disturbed. Contact with bare fingers shall be avoided; however, if contact is made, the wire shall be cleaned with an approved solvent prior to further processing.

Soldering Procedures

Soldering tools or coppers, figure 1, come in various sizes and shapes. The one selected will depend upon the size of the job as well as working space. The soldering tip or iron must be designed to give up its heat rapidly. It must channel this heat directly into the working area. Any heat delivered out of the immediate vicinity of the joint is wasted. Some jobs, where a larger area is to be heated, require a flat surfaced tip; for other cases, an AN connector, for example, you'll need a small four faced or pointed tip. Some tools require 28V DC; others work on 115V AC.

Perhaps you'll be lucky enough to have one of the quick heating electric irons in the shop. These are like transformers molded to fit the hand. They have a high current output fitted

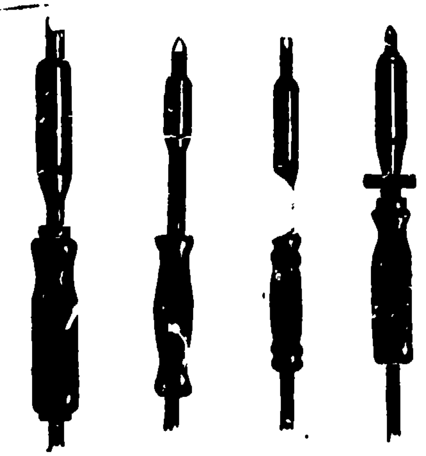


Figure 1. Soldering Coppers.

Figure 2. Solder Gun.

to a replaceable tip. These soldering "guns" usually have a trigger switch which has two posi ons. Pull back just a little and you have enough heat for the ordinary job. E rt enough force to pull the trigger back a little farther and more heat is available. A soldering gun is shown in figure 2.

Remember that soldering guns are not made for continuous service. They are made for spot work and heat in a matter of seconds. If you try to keep them in constant operation, the transformer won't last. The tips will soon fail.

Once you've chosen a gun of the right wattage, and tip of the correct shape, you're in business. But there is still another fact to remember--the best tool in the shop is worthless in the hands of a man who can't use it. A tip may have plenty of heating area, but the energy will be wasted in space unless you hold the tool correctly. Bring as much of the heating area into use as possible. Remember that heat rises, so hold the iron under the work to be soldered, not over it.

We have been emphasizing the need for getting heat to the work area. This is the reason for your first step in soldering--tinning the soldering tip. Oxides have an insulating effect and tend to block the heat flow. File or sand the working surface of the tip free of any discoloration. See figure 3. There is no need to be heavy handed about this task; simply remove the surface coat of oxides. If you use a file, take care to make a flat stroke; keep the tip shape the same.

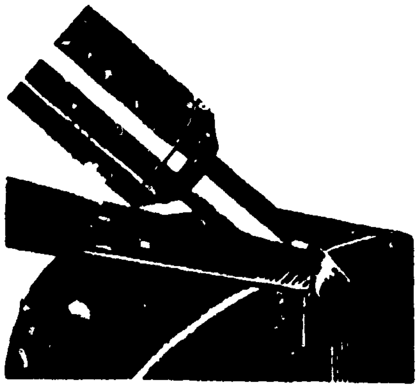


Figure 3. Preparing Tip Surfaces.

After the face has been cleaned and heated, rosin cored solder should be applied until there is a bright, shiny, surface of solder. The excess solder is wiped off with a damp rag. See figure 4.

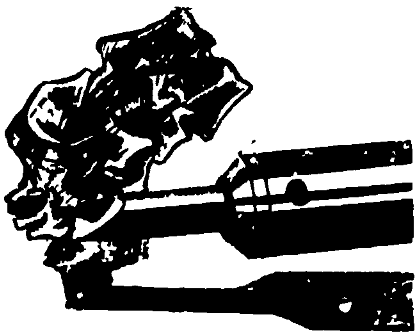


Figure 4. Wiping the Tinning Job.

This is known as tinning the soldering iron. Without this tinning, oxide builds up on the tip, preventing the transmission of heat. Proper tinning is the keynote to successful soldering; any time during your work that solder begins to show burning and oxidation, the heat is being transferred too slowly. You should re-tin immediately. By all means don't flip the iron, or throw the hot solder into space, injury to nearby personnel may result.

Surfaces for soldering must be free of oil, grease, paints, etc., or solder will not stick. Surfaces should be cleaned with sandpaper, emery cloth, or file and then wiped clean. The work must be as carefully cleaned as the tool itself. It is then sanded and shaped to the exact appearance of the finished job.

Solder is not intended to furnish a great deal of mechanical strength, but it does surprisingly well. Once cleaning and forming have been completed, you will save time by applying a thin coating of solder to each piece.

Now the pieces should be joined together. The soldering tip is held underneath them if at all possible. Since heat rises, the action will be much more efficient in this position. When using rosin cored solder, you should keep the solder in contact with the work itself, and not with the iron. See figure 5. If

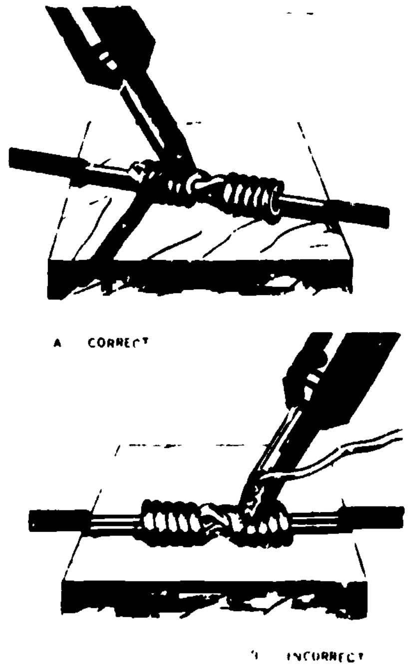


Figure 5. Applying Cored Solder.

you allow the rosin to drip down over the whole surface of the tip, it will break down before it strikes the work area--its fluxing ability will be largely destroyed.

Some men try to hold the work with one hand and the iron with the other; consequently, the part isn't steady when the solder passes from the liquid state to the solid form. A slight movement at this moment will cause a weak place which will soon break. A vise or some other clamping device, to hold the work, should be used.

The best jobs have a thin film of solder. Strangely, these thin films are stronger than "blobs." When soldering terminals, try for a rounded effect. Sharp points in electrical work may cause shorts.

Signs of a "<u>cold joint</u>" may be recognized by its dirty-grey, grainy texture. Cold joints are either caused by not properly heating the metal to be soldered, or by improper cleaning and tinning.

Don't let the iron become too hot. If it does, the solder will flow too freely, and show oxidization colors. Heating should be stopped when the tip shows a blue color.

Inspection

Each soldered connection shall be visually inspected. Inspection shall be aided by magnification appropriate to the size of connections between 4X and 10X magnification. Additional magnification shall be used as necessary to resolve suspected anomal defects. Parts and conductors shall not be physically disturbed to aid in detection.

Acceptance Criteria

An acceptable solder connection will be characterized by:

1. Clean, smooth, bright, undisturbed surface.

2. Solder fillet between wire or lead and termination as described herein.

3. Contour of wire sufficiently visible to determine the presence of the direction of the bend and the terminating end of the wire.

4. Complete wetting.

5. Proper amount and distribution of solder.

Rejection Criteria

The following are some characteristics of unsatisfactory solder condition of which is cause for rejection:

1. Conductors and Parts:

   a. Damaged, crushed, cracked, charred, or melted insulation.

   b. Improper insulation clearance.

   c. Improper tinning.

   d. Separation of wire strands.

   e. Part improperly supported or positioned.

   f. Part marking not visible.

   g. Part damaged.

   h. Loose conductors.

   i. Cut, nicked, stretched, or scraped leads or wires.

   j. Flux residue or other contaminations.

   k. Improper wrap or stress relief.

   l. Spliced conductors.

2. Solder Connections:

   a. Cold joint.

   b. Overheated granular joint.

   c. Fractured joint.

   d. Improperly bonded joint.

   e. Pitted or porous joint.

   f. Excessive solder.

   g. Insufficient solder.

   h. Splattering of flux or solder on adjacent areas.

   i. Rosin solder connection.

j. Unclean connection (e.g., lint, flux, dirt, etc).

k. Dewetting.

Remember, a neat job means only one thing. The solder must have melted quickly; flowed into and around the union; then frozen into place without air bubbles, oxides, carbon particles or other foreign matter. Any impurity weakens a joint and builds up electrical resistance.

SUMMARY

Improper soldering techniques can cause damaged equipment and unsafe conditions. The mechanic should know that flux is used to prevent oxides from forming. These would prevent the solder from making a good bond with the metal. Various soldering tools are available to properly accomplish each job. You should know the procedures for preparing the material to be soldered. You should know the steps to be followed during soldering. Then with practice, you can do a soldering job that will be safe and dependable.

DEFINITIONS

The following definitions apply to terms used in this study guide.

Blister - Delamination in distinct local areas.

Bridging - A build-up of solder or conformal coating between parts, part leads and/or base substrate forming an elevated path (see fillet).

Cold Solder Joint - Unsatisfactory connection resulting from dewetting or movement of conductor during cooling and frequently exhibiting an abrupt rise of the solder from the surface being soldered. These usually appear frosty and granular.

Conduction Soldering - Method of soldering which employs a soldering iron for transfer of heat to the soldering area.

Conductor - A lead or wire, solid or stranded, or printed wiring path serving as an electrical interconnection between terminations.

Connection - An electrical termination.

Cracked Solder Joint - A soldered connection which has fractured or broken within the solder.

Dewetting - The condition in a soldered area in which the liquid solder has not adhered intimately, characterized by an abrupt boundary between solder and conductor, or solder and terminal/termination area.

Disturbed Solder Joint - Unsatisfactory connection resulting from relative motion between the conductor and termination during solidification of the solder.

Electrical Component - An assembly of one or more electronic/ electrical parts that may be disassembled or separated without destruction of designed use, e.g., printed wiring assembly.

Excessive Solder Joint - Unsatisfactory connection wherein the solder obscures the configuration of the connection.

Fractured Solder Joint - A joint showing evidence of cracking.

Joint - A solder joint; a termination.

Overheated Joints - An unsatisfactory solder joint, characterized by rough solder surface.

Part - One piece, or two or more pieces joined together which are not normally subject to disassembly without destruction of designed use.

Part Lead - The conductor, solid or stranded, attached to a part.

Porous Solder Joint - A joint having a grainy or gritty surface.

Pits - Small holes or sharp depressions in the surface of the solder.

Repair - Operations performed on a nonconforming article to place it in usable c tion.

Resistance Soldering - Method of soldering by passing a current between two electrodes through the area to be soldered.

Rework - The reprocessing of articles or material that will make it conform to drawing specification or contract.

Rosin Solder Joint - Unsatisfactory connection which has entrapped rosin flux.

Solder - A nonferrous, fusible metallic alloy used to join metallic surfaces.

Solder Icicle - A cone shaped peak or sharp point of solder usually formed by the premature cooling and solidification of solder upon removal of the heat source.

Solder Joint - A termination.

Soldering - The process of joining metallic surfaces through the use of solder without direct fusion of the base metals.

Terminal - A tie point device used for making electrical connections.

Termination - The point at which electrical conductors are joined.

Thermal Shunt - A device with good heat dissipation characteristics used to conduct heat away from an a cle being soldered.

Tinning - The coating of a surface with a uniform layer of solder.

Wetting - Flow and adhesion of a liquid to a solid surface, characterized by smooth, even edges.

QUESTIONS

1. What is the indication of a cold soldered joint?

2. Why does the repairman need to know how to solder properly?

3. What is the purpose of the flux?

4. Why should a soldering iron be tinned?

5. When soldering, why should the surface be cleaned?

6. Why shouldn't the soldering iron be "flipped" to remove the excess solder?

7. What type of core should the solder contain for electrical work? Why?

8. What is the indication that the soldering iron tip is too hot?

9. What determines which soldering iron to use?

10. What do the numbers 60/40 on a spool of solder tell you?

11. Why is it important to have a controlled environment for soldering?

12. Why do we use solvents in soldering?

13. What is meant by wire lay?

14. What characterizes an overheated solder joint?

15. Is the use of a five power (5X) magnification allowed for inspection of soldering?

16. Should soldering coppers be held above or below the item being soldered? Explain why.

17. Who is responsible for keeping the soldering work area clean?

18. Why is lighting so important in soldering?

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-HO-222a
6 January 1983

SOLDERING

OBJECTIVE

Given a soldering iron, electrical connectors, and a handout, solder one electrical connection with no more than three procedural errors allowed.

INSTRUCTIONS

Using handout, solder one electrical connection.

PROCEDURE

1. Safety precautions:
   a. Do not flip solder.
   b. Inspect electrical cord.
   c. Inspect soldering iron.
   d. Use eye protection.
   e. Do not wear metal frame glasses.
   f. Remove all jewelry.
2. Cleaning of soldering iron:
   a. Proper use of file for making a flat stroke.
   b. Proper regulation of heat.
3. Tinning of soldering iron:
   a. Insure a bright, shiny surface.
   b. Excess wiped off with damp rag.
4. Preparation of wire:
   a. Remove insulation by use of wire strippers.
   b. Properly tin exposed wire.
5. Preparation of connector:
   a. Remove excess old solder.
   b. Surfaces free of oil, grease, paints, etc.
6. Insure no old solder -- look for dirty-gray, grainy texture.
7. Inspection (visual):
   a. Clean, smooth, bright, undisturbed surface.
   b. Proper amount and distribution of solder.
   c. Complete wetting.
   d. Sufficiently visible to determine bend direction and terminating wire end.

OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 200; DAV - 1

RCL: N/A

Designed for ATC Course Use. Do Not Use on the Job.

PROPELLER CONTROL ASSEMBLY

OBJECTIVE

After completing this workbook and your classroom instruction, you will be able to trace the flow of hydraulic fluid on schematic diagrams for governing, feather, and reverse operations.

EQUIPMENT

	Basis of Issue
Colored pencils	1 set/student

PROCEDURE

Using colored pencils, trace the following conditions on the diagrams (figures 1, 2, 3, and 4, located in the back of this workbook).

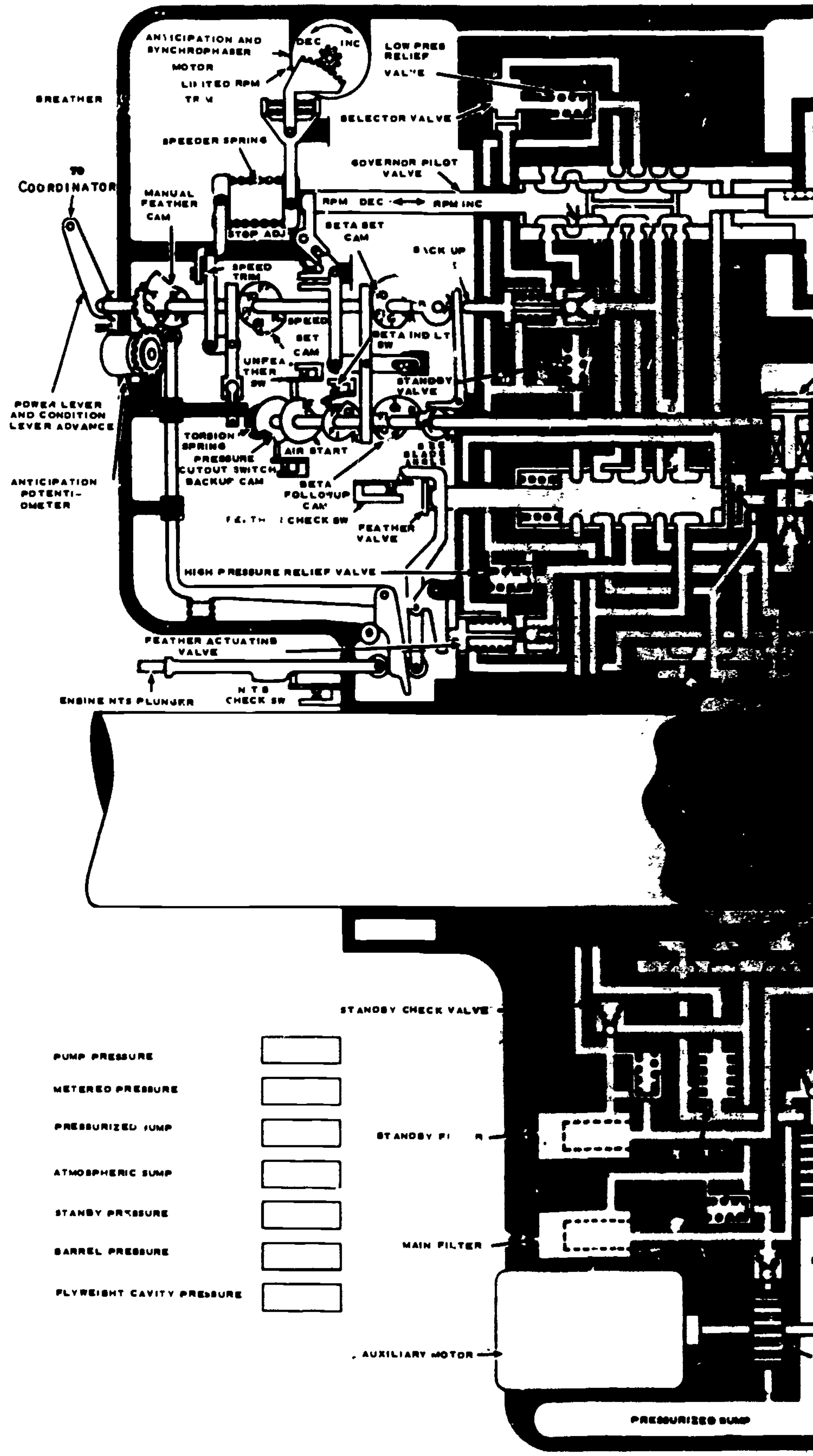
1. Onspeed

2. Underspeed

3. Feather

4. Reverse

OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-J - 600; TTVSA - 1



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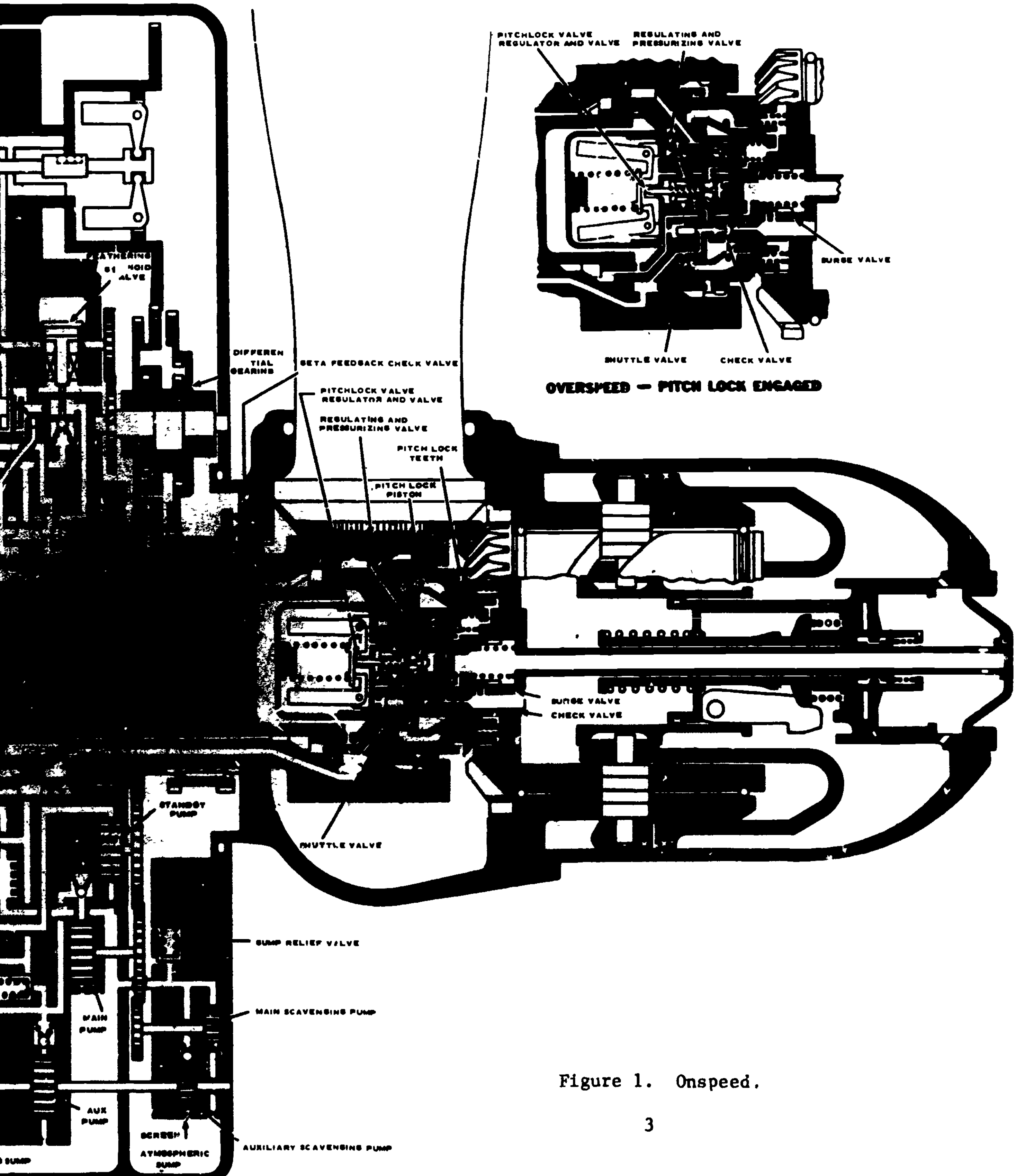
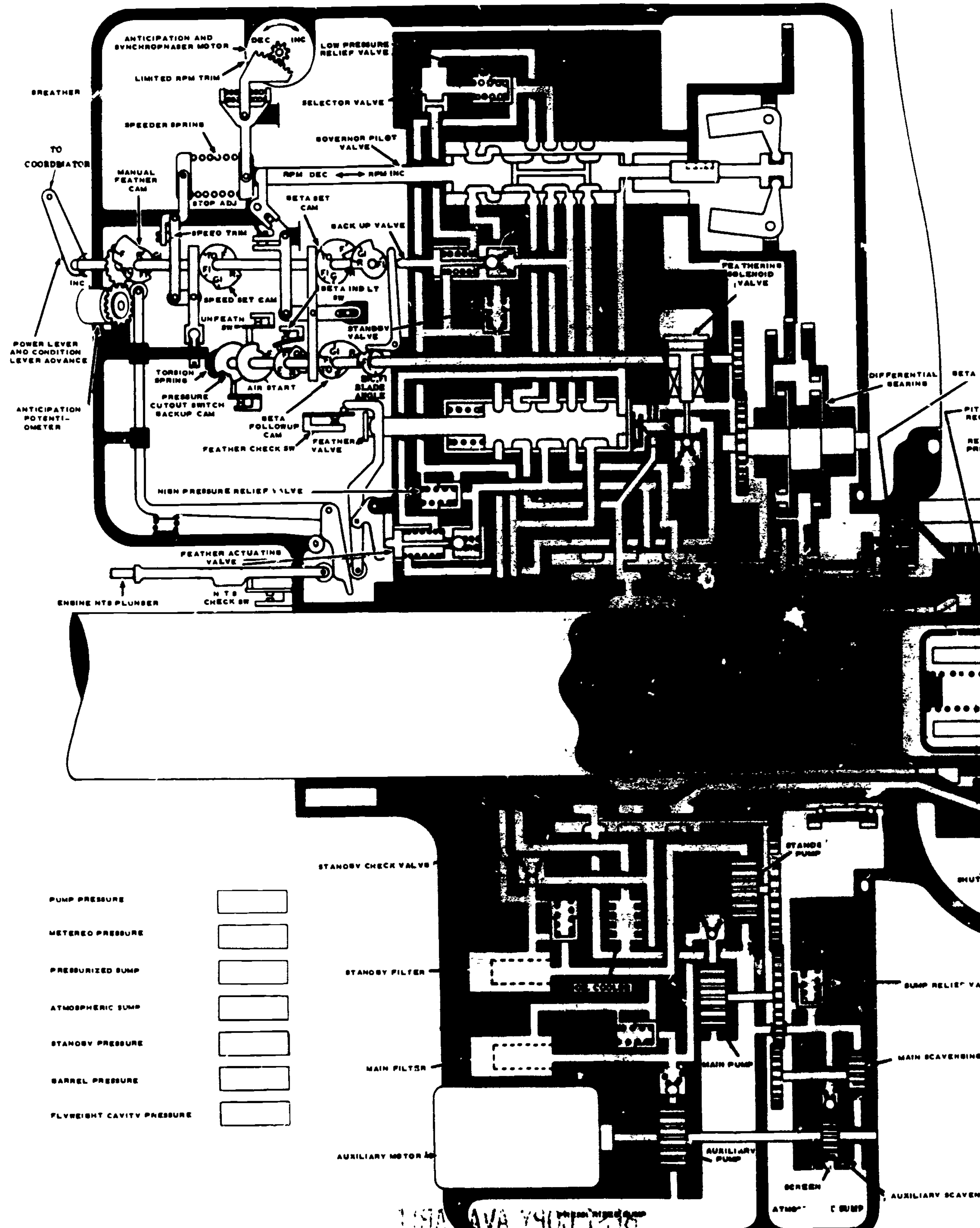


Figure 1. Onspeed.



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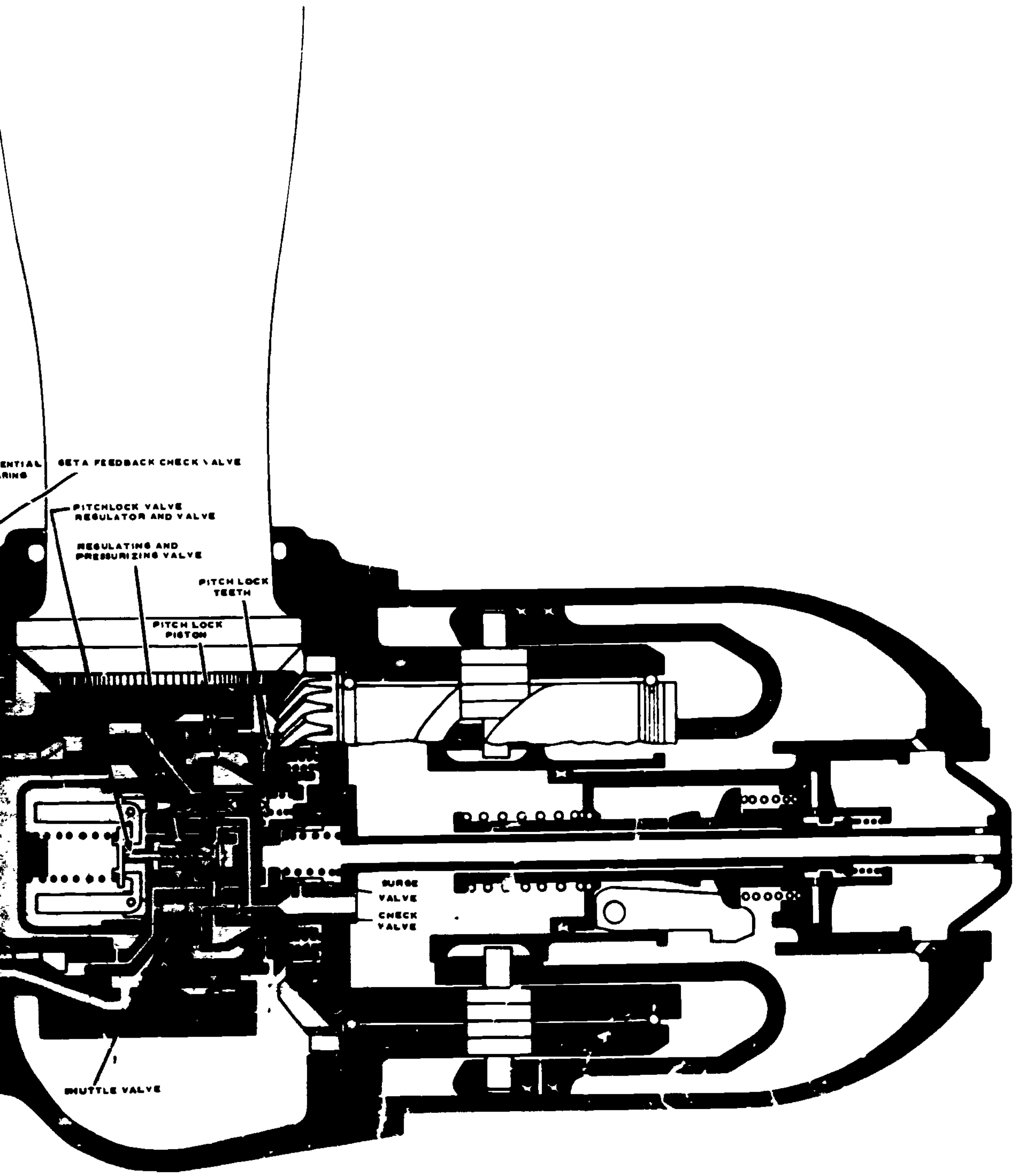
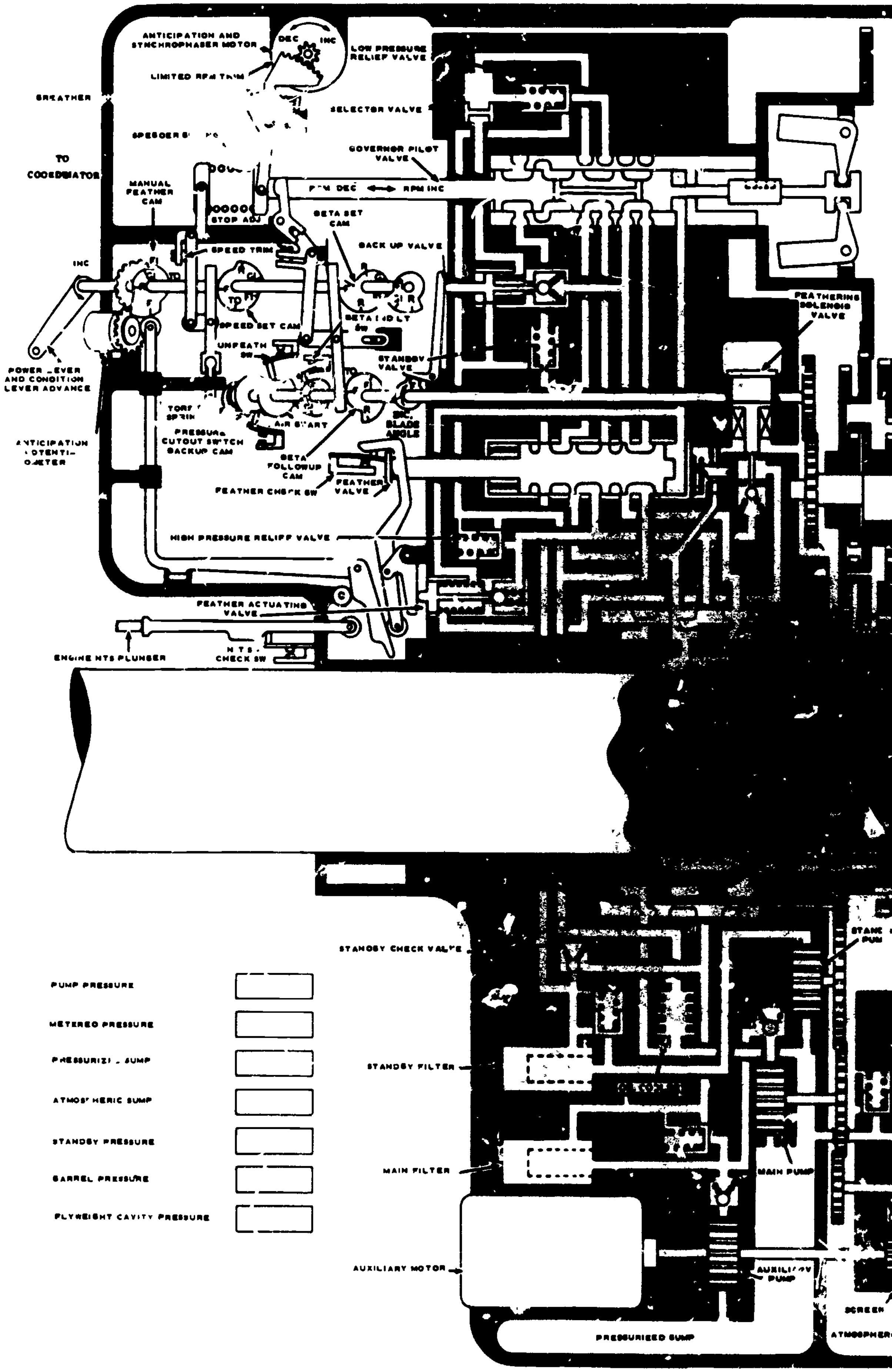


Figure 2. Underspeed.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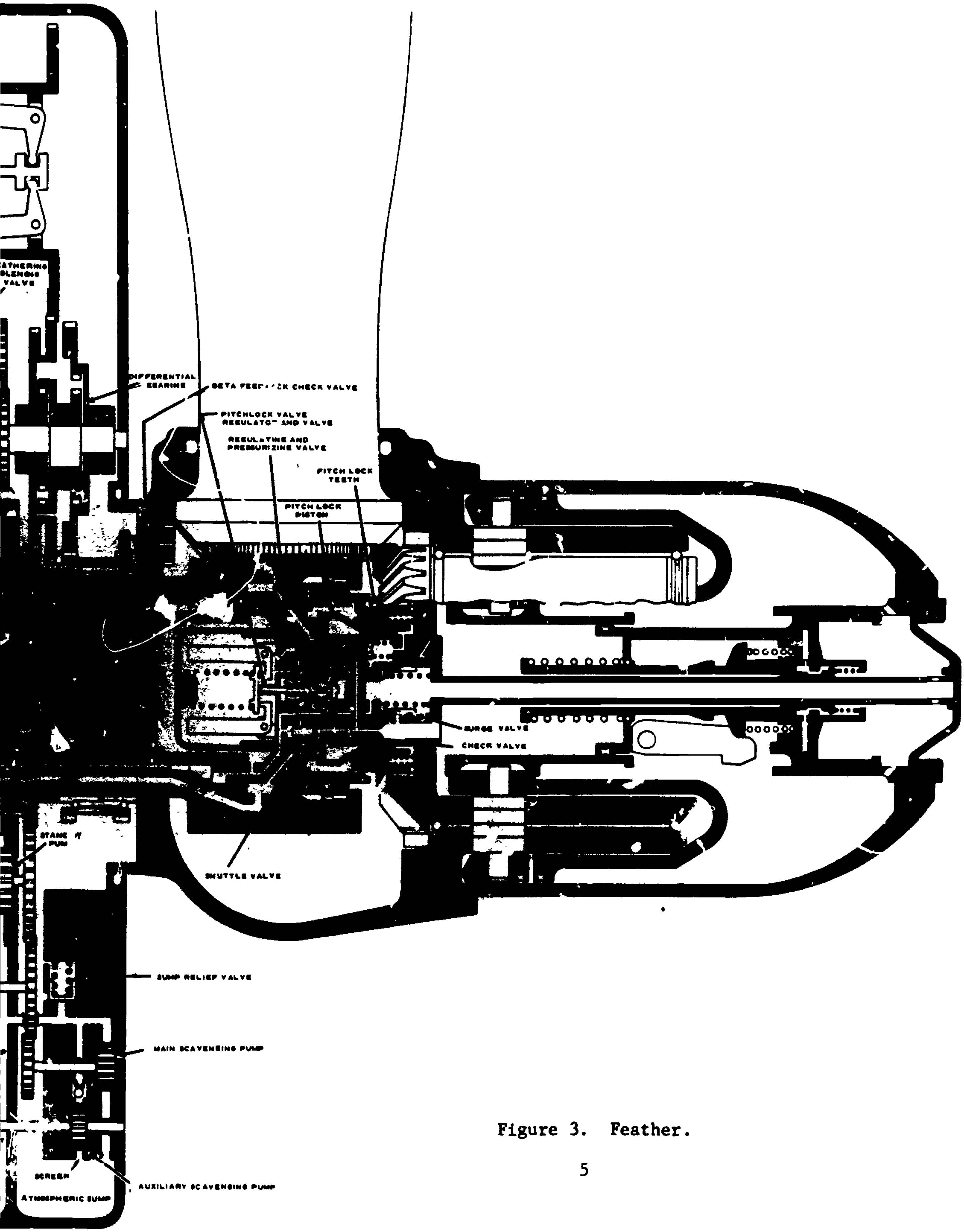
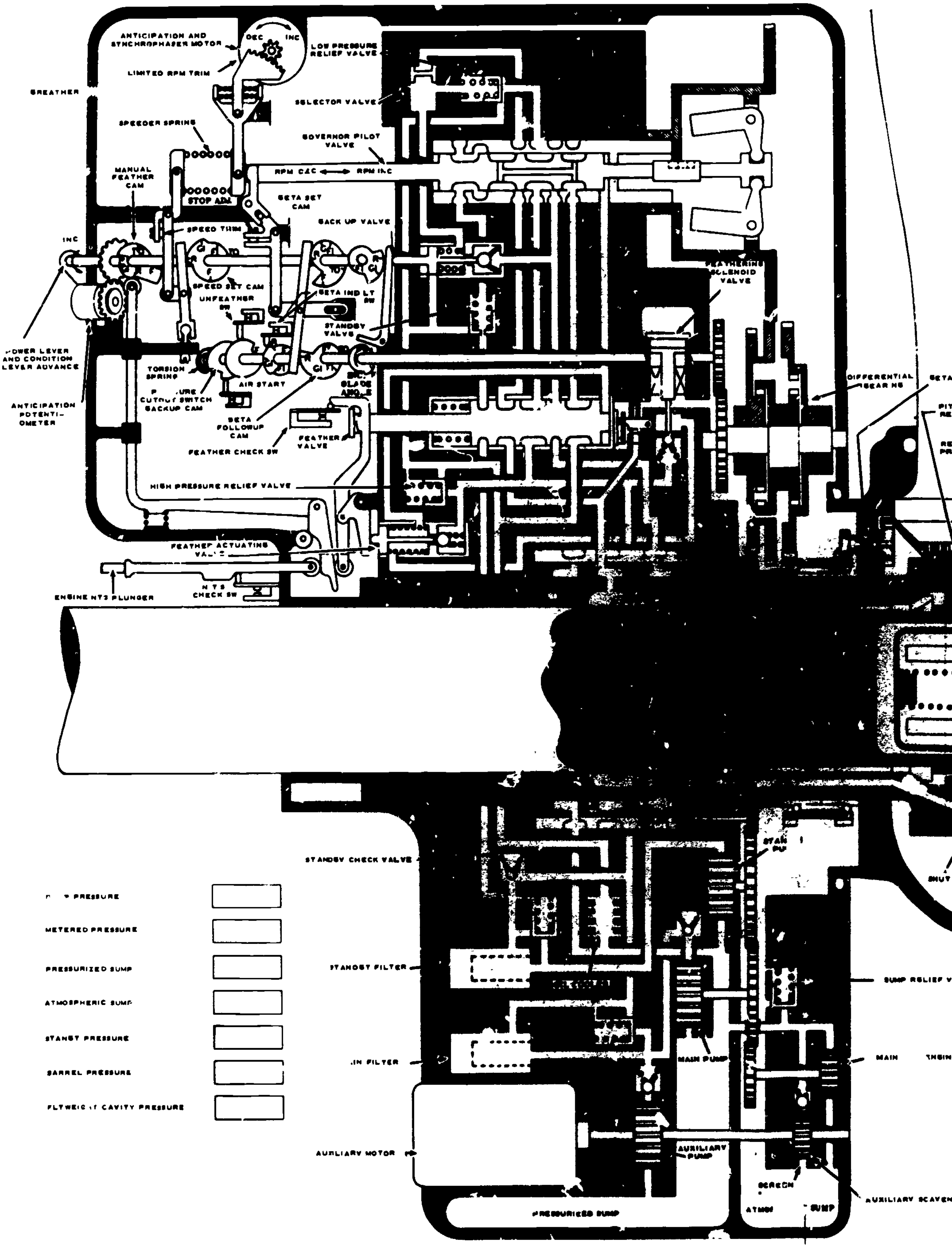


Figure 3. Feather.



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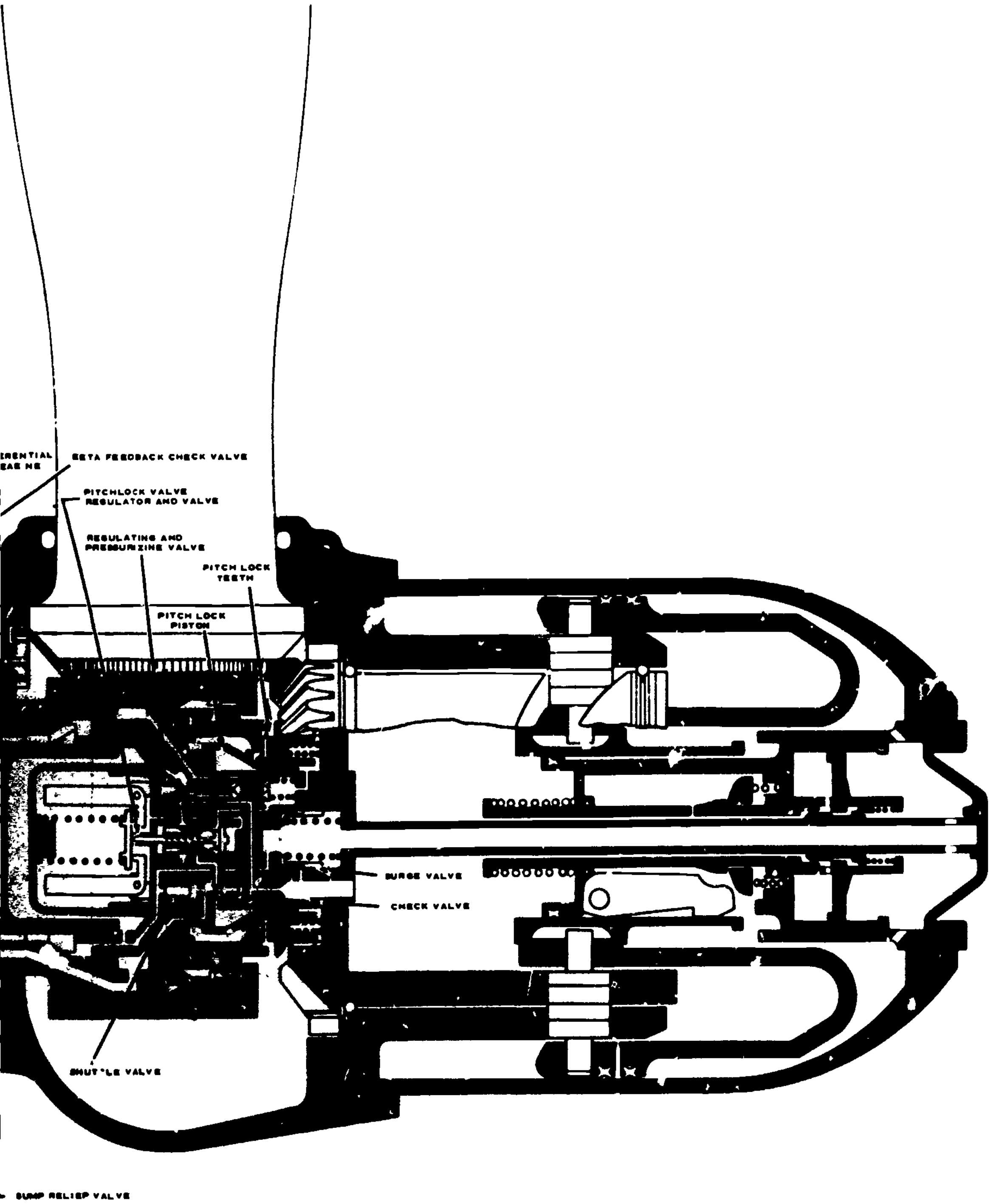

Figure 4 Reverse.

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-SG-301
5 October 1982

REMOVAL OF PROPELLER ASSEMBLY

OBJECTIVE

After completing this study guide and your classroom instruction, you will be able to identify facts about the removal of a 54H60 propeller assembly from a T-56 engine gearbox assembly, IAW 1C-130B-2-11.

INTRODUCTION

One of the most important tasks you can expect to perform on the flight line as a turboprop mechanic is propeller assembly removal. Some of the reasons for propeller removal are: Oil leaks, foreign object damage (FOD), time change item (expiration of operating hours).

Other items you must understand are the technical orders required to accomplish the job safely and completely. Also, how to document the work performed for record keeping.

INFORMATION

USING TECH ORDER INSTRUCTIONS AND SPECIAL TOOLS

The step-by-step procedure for removing the 54H60-91 propeller is shown in the TO 1C-130B-2-11. The descriptions, drawings and photographs explain the use of any and all special tools that are used to remove the heavy parts of the propeller assembly, such as the dome assembly and the hub and blade assembly.

REMOVAL OF THE AFTERBODY TOP HALF

Refer to figure 1 to determine the location of items to be removed. Also note that the removal sequence is in reverse of the index numbering.

The afterbody top half (32) is located in a place which makes it hard to take it from beneath the blade cuffs. The propeller is statically operated to the reverse blade angle to provide clearance for removal of the forward access panels. The blade angles are then positioned to ground idle for the afterbody top half removal, then to the FEATHER angle for removal and installation of the Hamilton 54H60 propeller.

Supersedes 3ABR42633-SG-302, 8 January 1980.

RGL: 10.1

OPR: 3350 TCHTG
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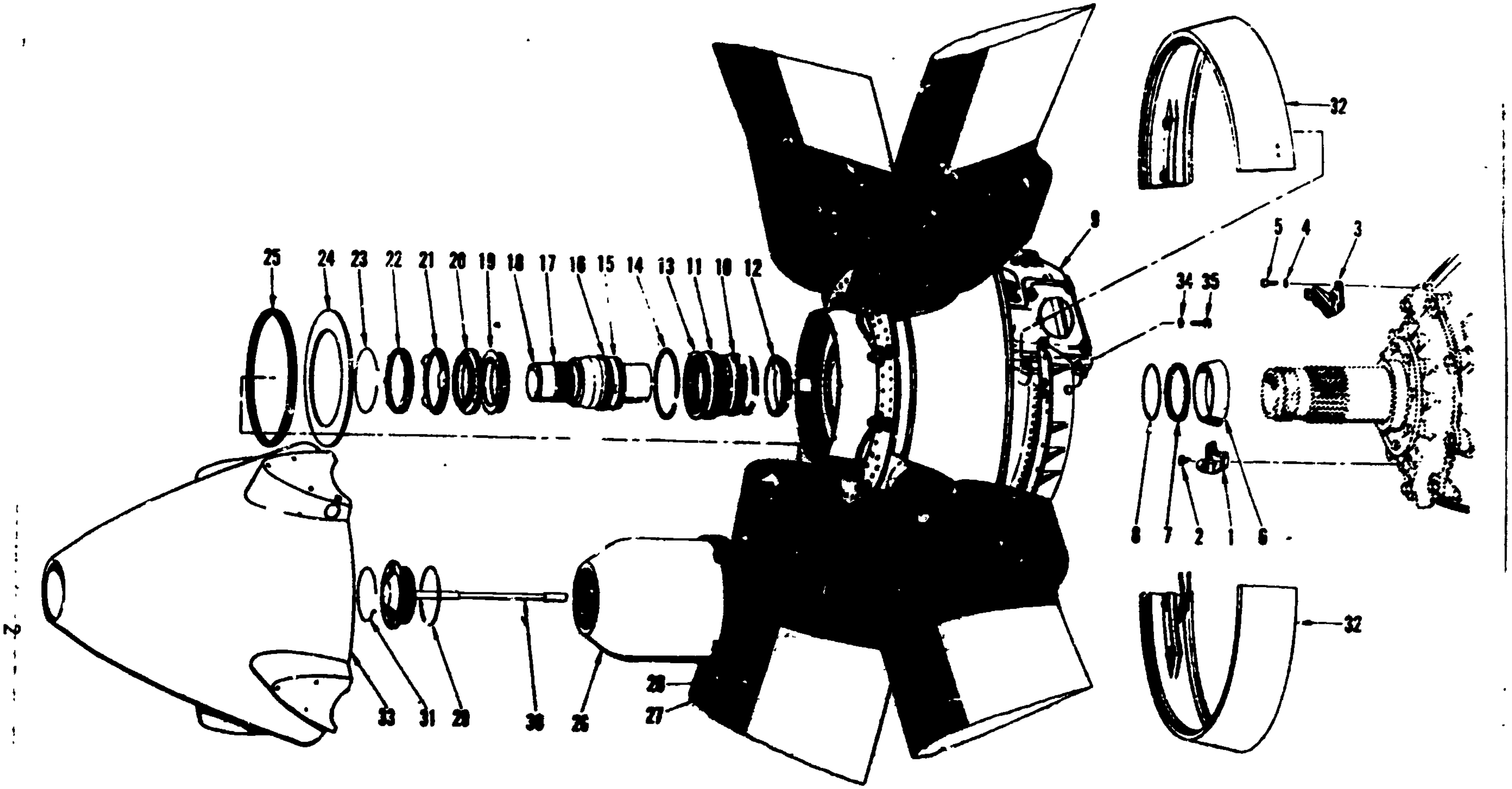
3350 TCHTG/TTGU-B - 200; DAV - 1



1 Control Drive Bracket
2 Bolt
3 Negative Torque Bracket Assembly
4 Flat Washer
5 Bolt
6 Rear Cone
7 Spacer
8 Packing
9 Control Assembly
10 Packing
11 Packing
12 Front Cone
13 Propeller Retaining Nut
14 Propeller Nut Retaining Ring
15 Packing
16 Packing
17 Packing
18 Pitch Lock Regulator Assy
19 Splined Spacer Ring
20 Ratchet Ring
21 Locking Control Cam
22 Externally Threaded Ring
23 Retaining Ring
24 Gear Preload Shim
25 Dome Barrel Seal
26 Dome Assembly
27 Lock Screw
28 Cotter Pin
29 Packing
30 Fluid Transfer Tube
31 Lock Wire
32 Spinner Afterbody
33 Front Spinner Assembly
34 Washer
35 Bolt

Figure 1. Propeller Group Installation.

REMOVAL OF THE ELECTRICAL AND MECHANICAL CONNECTORS

AN connector plugs located at the deicing brush block, auxiliary pump rotor, pump housing connector, valve housing, and feather solenoid must be unsafetied and removed. The ring type nut should be carefully backed off while jiggling the conduits. A universal coupling is disconnected from the input shaft by completely extracting the 1/4" x 28 bolt which fits in a groove in the splines of the input shaft.

REMOVAL OF THE FRONT SPINNER ASSEMBLY

Accessible through a hole in the camber side of the number one blade fairing in the spinner front section (figure 1, item #33) is an adjusting screw which is turned counterclockwise, thus contracting the spinner retention ring. Using a mechanical puller the front spinner is pulled straight off.

REMOVAL OF THE DOME ASSEMBLY

When preparing to remove the dome cap and dome (26), a container must be used to catch the hydraulic fluid. To remove the cap, the lockwire (31) is removed from the dome cap. The dome lifting handle takes the place of the cap and provides a place to put the hook of the dome lifter. It is important to use these tools when removing the dome because the dome weighs approximately 125 pounds. After unsafetying and loosening the dome retaining nut, it is slowly moved forward to avoid splashing of the hydraulic fluid. The dome must be drained and placed in a propeller dolly at this time.

REMOVAL OF THE PITCH LOCK GROUP

The pitch lock parts are retained by an externally threaded ring. The safety for it is a type of lockwire called retaining ring (23). After removing the externally threaded ring (22), the mechanical puller is screwed into the front of the pitch lock regulator. A few light taps with the slide handle of the puller will dislodge the pitch lock regulator along with the cam out ring (21), stationary ratche (20), and the externally splined spacer (19).

INSTALLATION OF THE PROPELLER NUT RETAINING RING

The propeller nut retaining ring, a special tool, must be installed in the propeller assembly to assure a smooth and consistent removal. The retaining ring should be installed in the propeller hub assembly in a groove just forward of the brass propeller retaining nu

REMOVAL OF THE HUB AND BLADE ASSEMBLY

The base plate is installed on the barrel shelf and retained to the barrel by a retaining ring. The base plate provides an attaching place for the sweeney power wrench and the propeller lift assembly.

After loosening of the propeller retaining nut (13) the propeller can be hoisted off the shaft. The spider to shaft seal (8), spacer (7), and rear cone (5) are then removed so that the shaft can be cleaned and inspected.

Remember that the weight of the propeller is nearly 1,000 pounds which makes handling it dangerous. Do not stand under the equipment while it is suspended on the hoist. The assembly can then be placed on a stand or propeller dolly. If it is left in a horizontal position, it will drain slowly, therefore, the control should be drained into a large drip pan placed under it.

SUMMARY

The removal of propellers can be a safe operation providing you stay alert, do not rush, and pay close attention to all safety precautions described in the maintenance manual. Failure to think before each step of the operation could be disastrous. Carefully check the condition of your equipment and tools before use.

The aircraft maintenance technical order gives the step-by-step instruction for propeller removal. Attention to those details will provide quality maintenance.

QUESTIONS

1. What is the recommended blade angle for removal of the afterbody top half?

2. Name the connector plugs which must be disconnected before removing the 54H60 propeller.

3. What is the direction the adjusting screw is turned when contracting the spinner retention ring.

4. What fits in the threads in the front of the dome when removing the dome disassembly?

5. Name the parts which must be removed along with the pitch lock regulator.

6. What fits in the groove just forward of the brass propeller retaining nut.

7. What is the purpose of the propeller nut retaining ring?

8. What is the purpose of the special tool called "base plate"?

9. What parts must be removed to allow cleaning and inspection of the propeller shaft?

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-SG-302
5 October 1982

REMOVAL OF THE CONTROL, DEICING CONTACT RING, AND THE REAR SPINNER

OBJECTIVE

After completing this study guide and your classroom instruction, you will be able to identify facts about the removal of the control assembly, deicing contact ring and the rear spinner assembly from a 54H60 propeller.

INTRODUCTION

After the propellar has been removed, the components mounted on the control assembly must be removed first to prevent damage to the parts.

INFORMATION

AFTERBODY BOTTOM HALF AND MOUNTING BRACKET REMOVAL

Two of the parts which stay with the propeller when it is removed from the aircraft are the afterbody bottom half and the afterbody mounting bracket. The afterbody bottom half is removed first and is done by removing the two electrical heater loads and the four mounting bolts. Strapped to the afterbody mounting bracket are the electrical leads from the brush block which are removed with the two terminal bolts. The ten cap screws holding the mounting bracket to the control are then removed and the bracket can then be removed with ease.

PROPELLER CONTROL REMOVAL

The propeller control is removed from the propeller barrel rear extension while the number one blade is set at the feather blade angle or just a bit higher. This will avoid snap back of the beta linkage.

The pin retaining ring is then removed from within the barrel extension bore by lifting the two pins out of the holes. The control puller tool is bolted to four studs on the aft end of the control where the rear lip seal is located. By turning the long threaded bolt of the mechanical puller clockwise, the control will slide off the barrel extension bore. Position a drip pan on the ground to catch spilled oil and be prepared to support the control when it separates from the barrel extension. DO NOT let the control drop on the puller as the propeller control weighs about 117 pounds.

Supersedes 3ABR42633-SG-303, 24 January 1980. RGL: 10.1
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 200; DAV - 1

REMOVAL OF DEICER CONTACT RING AND REAR SPINNER

The purpose of the deicer contact ring holder assembly is to send electrical power for the anti-icing and the deicing conditions from the brush block assembly which is mounted on the control, to the rotating propeller. On the front side of the deicer contact ring are four small brush blocks which send deicing power to the blade electrical contact rings which are wrapped around the shank of each blade.

To remove the holder assembly, detach the four rear spinner electrical connector straps from the terminals of the deicer contact ring holder. Remove the safety wire and the eight socket head cap screws, this will allow the removal of the holder assembly, the packing seat ring and its preformed packing. The purpose of the seat ring and i preformed packing is to prevent leakage between the rotating rear barrel half and the front of the stationary control assembly coverplate.

The rear deicing spinner is attached to the aft side of the hub mounting bulkhead assembly. By removing the eight self-locking nuts, spinner mounting washers, sleeve spacers, flat washers and dowel bolts, the rear spinner can be removed. The bolts, washers, spacers and nuts after being removed should be placed together to prevent the parts from becoming lost or causing foreign object damage (FOD). The propeller assembly is now ready for further disassembly as soon as it is placed on an assembly post mounted on an assembly bench.

SUMMARY

The components to be removed prior to propeller assembly overhaul are the afterbody bottom half and mounting bracket, the propeller control assembly, the deicer contact ring holder assembly and the rear deicer spinner assembly. Special care should be taken when removing these parts to avoid loss or damage.

QUESTIONS

1. Which parts of the propeller will remain until after removal from the aircraft?

2. The propeller control assembly is removed from what part of the propeller assembly?

3. Removing the control assembly while the blades are at feather angle protects which parts?

4. What is the purpose of the deicer contact ring holder assembly?

5. What parts of the holder assembly prevent leakage between the rotating rear barrel half and the front of the stationary control assembly coverplate?

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-SG-303
5 October 1982

INSTALLATION OF THE REAR SPINNER, DEICING CONTACT RING, AND THE CONTROL ASSEMBLY

OBJECTIVE

After completing this study guide and your classroom instruction, you will be able to identify facts about the installation of the rear spinner, deicing contact ring and the control assembly on a 54H60 propeller assembly.

INTRODUCTION

After the hub and blades have been assembled and tested, it is now ready for the external parts to be mounted in place. These parts are mounted just before the propeller assembly is installed on the aircraft.

INFORMATION

THE REAR SPINNER

In figure 1 is a detailed drawing and the nomenclature of the parts you will be installing when you mount the rear spinner to the hub mounting bulkhead on the hub and blade assembly.

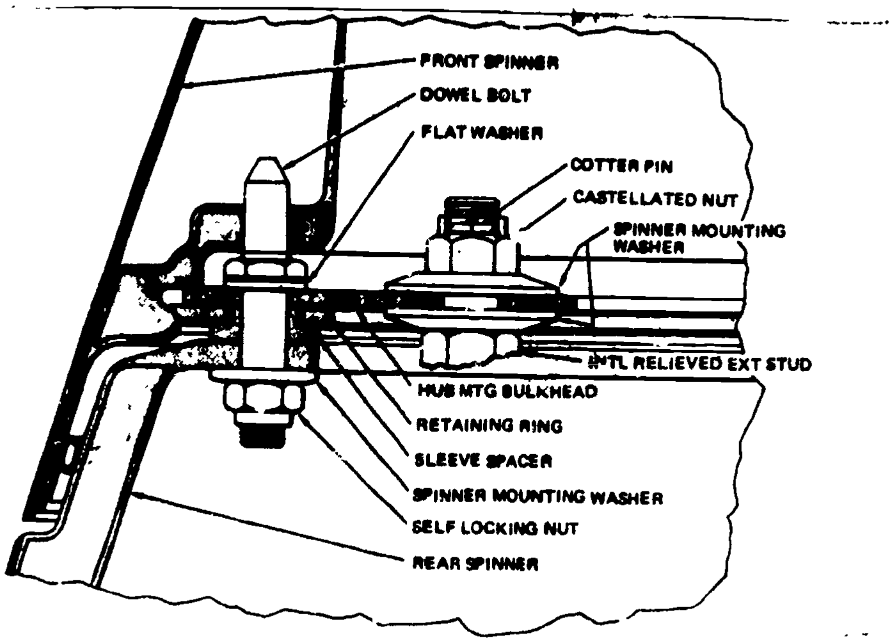


Figure 1.

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Refer to figure 1 to determine the installation sequence of the following items as they are mentioned.

After the hub mounting bulkhead has been attached and safetied to the barrel bolt extension studs, eight dowel bolts are used to attach the rear spinner to the propeller. The dowel bolts have bullet shaped ends that project into the holes in the front spinner.

A flat washer is mounted on each dowel bolt before it is slipped into the hole on the front side of the bulkhead, ensure that the bullet shaped end faces forward. Behind the bulkhead a sleeve spacer allows the dowel bolts to be torqued tightly without binding of the spinner retaining ring. Then the rear spinner is placed into position, making sure the No. 1 blade cutout section is aligned with the No. 1 blade. Install a spinner mounting washer and a self-locking nut on each dowel bolt and secure each one with the required amount of torque.

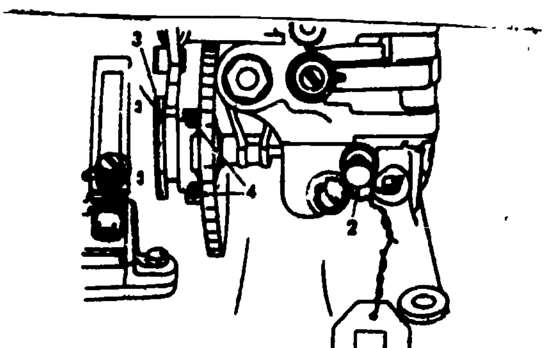
THE DEICING CONTACT RING

The contact ring assembly bolts up to the back of the rear barrel of the propeller. Eight socket head bolts are used for this purpose. The packing seat ring is held tightly in place under the deicer contact ring. The most important detail when tightening the contact ring is to assure alignment of the small cutout of the feedback shaft bushing. The TO calls this machined out area of the inner part of the packing seat ring a "relief." If the relief isn't lined up properly the feedback shaft bushing can be destroyed.

The four electrical connector straps must be connected by installing self-locking nuts and flat washers on the four terminal bolts. These terminals provide a path of current for spinner anti-icing and deicing.

THE CONTROL ASSEMBLY

The control assembly can be installed while the propeller is suspended on suitable hoisting equipment. No. 1 blade is turned to 92.5 degrees and held with the blade gear holding ring.



1. Propeller Valve Housing (Left Side)
2. Beta Shaft Alignment Pin
3. Back-Up Cam Scale
4. Beta Shaft Drive Screws

Figure 2. Beta Shaft Alignment.

The idler gear on the front of the pump housing must be turned to position the beta linkage. When the protractor on the backup valve cam reads 90° on the beta shaft, an alignment pin is inserted in the beta shaft to hold it at 90°. See figure 2.

Note: The reason for a 2° difference is to make up for gear backlash (slack).

The two beta shaft adjustment screws must be loosened to provide for movement of the gear train. The usual result of not loosening the beta shaft (lawnmower) screws is damage to the beta gear train or improper contact of gear teeth.

The inside diameter of the rotating sleeve in the control has four grooves for "O" ring packings. These packings provide separation of inboard and outboard oil pressure and prevent leakage of oil around the hub extension. After the "O" ring are installed in the grooves, they should be coated with petrolatum. Also, the hub extension is coated with petrolatum to provide lubrication while sliding the control in place.

The control puller tool is attached to the rear of the control by four of the studs that normally hold the rear seal assembly in place. When starting the control on the hub extension, extreme care is required to assure sliding the control straight to avoid binding. It may be necessary to back off and restart the control to prevent damage.

When the control is in place, the puller tool can be removed and the pin retaining ring installed. The pins are installed on the inside diameter of the hub extension and inserted in two holes. The purpose of the pins are to prevent the control from sliding off the shaft while handling the propeller.

AFTERBODY MOUNTING BRACKET AND BOTTOM HALF

After the control is on the propeller, the afterbody mounting bracket is installed. It is held in place by ten screws. All ten screws must be started before tightening. The two bottom screws are then tightened. If this is not done, the bracket may crack by having slack at the bottom. The anti-icing leads from the brush block are connected to the afterbody bracket.

The afterbody bottom half may be installed now, but it is perferable to leave it off until the propeller is installed on the shaft to avoid accumulating spilled oil in the lower parts.

SUMMARY

Preparation to install the 54H60 propeller includes mounting of the units which can't be installed after propeller installation.

The rear spinner must be on first followed by the deicer contact ring. Then the control is slid onto the hub extension after applying a lubricant coating to the seals and hub extension. After locking the control in place with the pin retaining ring, the afterbody bracket is installed.

QUESTIONS

1. How is the rear spinner attached to the propeller?

2. How is the hub mounting bulkhead attached to the prop?

3. What precaution should be taken before installing the nuts and washers on the rear spinner?

4. Which part will be damaged if proper alignment of the packing seat ring is neglected?

5. How is the deicer contact ring electrically connected to the spinner anti-icing and deicing heating elements?

6. What is the blade angle setting of Number 1 blade prior to installing the control?

7. What is the reading of the backup cam protractor prior to installing the control? Why?

8. What prevents leakage around the hub's extension of inboard and outboard oil pressure?

9. What is the purpose of the pin retaining ring?

Maintenance Training Branch
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INSTALLATION OF PROPELLER ASSEMBLY

OBJECTIVE

After completing this study guide and your classroom instruction, you will be able to identify facts about the installation of the 54H60 propeller assembly on the T-56 engine gearbox.

INTRODUCTION

One of the most important tasks you can expect to perform on the flight line as a turboprop mechanic is propeller installation. The C-130 propeller requires special care because of the pitch lock parts that must be installed prior to installing the dome.

INFORMATION

PREPARATION

Before installing the 54H60 propeller, several steps are necessary. The shaft must be cleaned, inspected and recoated with oil (hydraulic fluid). After insuring that the thrust nut is properly tight and safetied with a lock ring, install the rear cone and spacer with a new "O" ring seal. The cone is kept dry and free of oil to insure a tight fit when the propeller retaining nut torque is applied.

The drive bracket is checked for wear by temporarily placing it in between the tangs on the back of the propeller control and measuring that the clearance does not exceed .050 of an inch. The drive bracket must be installed at the six o'clock position on the nose section of the engine gearbox.

The NTS bracket assembly is attached to the nose section of the engine gearbox over the plunger at the ten o'clock position. Three screws hold the bracket in place.

The blade gear positioning tool must be removed to install the baseplate. Care must be taken not to turn #1 blade when alignment pins are installed in the valve housing. When the alignment pin is removed from the beta shaft, #1 blade can be turned, but not beyond minus 10° or plus 100° blade angle. The stops on the beta shaft would be broken in case of excessive travel.

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Installation on the Shaft

After all the preparation steps are completed, the propeller assembly is hoisted in place on the shaft. Then install the front cone. To install the prop retaining nut it should be hand started on the shaft to avoid cross threading. Torque is applied to the nut using the sweeney power wrench. To compute the actual torque, the data plate under the handle is used.

The pitc ..ck parts are installed after the retaining nut torque has been applied. The pitchlock regulator must have three external preformed packings in place in the proper grooves. The slide hammer type special tool is used to drive the pitchlock regulator in until a solid sound is heard. An externally splined spacer is fitted in place around the regulator to lock the prop retaining nut. The stationary ratchet is installed next with the small dowel pin aligned directly with the center line of number 2 blade. The barrel bore is marked with an etch mark to aid in alignment of the ratchet. The control cam (cam out ring) is positioned over the ratchet with the dowel hole aligned to the same etch mark. The pitch lock components are retained in the barrel bore by an externally threaded ring and safetied with a retaining ring. With the blades at feather angle the dome can now be installed.

The dome should be checked to insure the stop ring is properly indexed at 92.5° and placed in the feather position. The dome preload shims must be selected in accordance with the thickness etched on the barrel shelf. When installing the preload shims, place them under the serration in the front barrel half. If the location of the dome retaining nut lock screw was marked at removal, the dome retaining nut should be re-installed to line up at the same mark. If not marked, the dome must be installed without the "O" ring seal as directed by the technical order. After the dome is safetied, the dome lifting handle is unscrewed, the transfer tube and the dome cap is installed. The cap is safetied with a wire retaining ring. The holes should be marked before putting on the dome cap to allow seating of the lock wire because the holes are not visible with the cap in place.

Connecting Linkage and Electrical Plugs

The universal joint is connected to the input shaft and safetied with safety wire.

AN connectors must be attached to the deicing brush block, auxiliary motor, solenoid valve, valve housing main connector plug and the pump housing connector plug. It is important to remember that these type AN connectors should be put on hand tight, then safety wired with .020 inch safety wire.

Final steps such as servicing, adjusting the pulse generator and NTS bracket are discussed in Block III of this course. The remaining parts of the spinner and cowling access panels will complete the installation of the propeller.

SUMMARY

The removal and installation of the propeller assembly requires special care. The front of the engine should be properly prepared and necessary units installed before hoisting the prop in place. The retaining nut and pitchlock parts must have their seals in place and then carefully installed. The final steps include servicing, adjusting and installing spinner parts and cowling.

QUESTIONS

1. What parts require a coating of hydraulic fluid prior to installing the prop?

2. Where is the drive bracket mounted? NTS bracket?

3. What precaution must be observed after removing the blade gear positioning tool?

4. What unit acts as the propeller retaining nut lock?

5. Which parts are required to be aligned with #2 blade center line?

6. What procedures are used to insure that both blades and dome are at the same blade angle during propeller installation?

7. Which procedure is used to determine the location of the dome retaining nut safety screw if the location was not marked during disassembly?

8. What type of safety device prevents loss of the dome cap?

9. When installing the AN connector plugs, what size safety wire is used?

10. Name the mechanical linkage and the electrical connectors from the prop to the engine.

DISASSEMBLY AND INSPECTION OF HUB AND BLADE ASSEMBLY

OBJECTIVE

After completing this study guide and your classroom instruction, you will be able to identify facts about the disassembly and inspection of the hub and blade assembly.

INTRODUCTION

After the propeller has been removed, the disassembly of the hub and blades is necessary for either replacement of seals or preparation for shipment to the overhaul facility.

This study guide is designed to familiarize you with the parts to be disassembled.

INFORMATION

The hub and blade assembly consists of two major components. These are the barrel assembly and the blades and their associated parts. When disassembling the hub and blade assembly, there are certain steps which must be followed for safety and FOD prevention.

BARREL ASSEMBLY

The barrel assembly serves as a housing for the entire propeller and retains the blades in the assembly. See figure 1. The barrel is manufactured in two halves. These are machined and balanced as one unit and kept together throughout the service life of the propeller. The rear barrel half has an extension on it to mount the control assembly. Internal splines of the barrel will mate with the splines of the propeller shaft. Front and rear cones center the propeller on the shaft. Oil passages are provided in the front cone by machined out grooves. Barrel bolts hold the barrel halves together. Minor balance adjustment is made by attaching bolts, nuts, and washers on the hub bulkhead and seal assembly. Barrel half seals provide an oil seal between barrel halves. They protrude into the blade seal to prevent any leakage in this area. See figure 1, items 14 and 23.

BLADE ASSEMBLY

The major items that make up this assembly are the: blade; beveled thrust washer; split thrust washer; split roller thrust bearing; blade bushing; balance plug; balance washer or washers; and deicer heater. See figure 2. The blade is forged from a hard aluminum alloy. It is machined and handworked into its final shape. The beveled thrust washer is installed on the blade before the butt is formed. The centrifugal loads generated by the blades are transmitted from the butt through the

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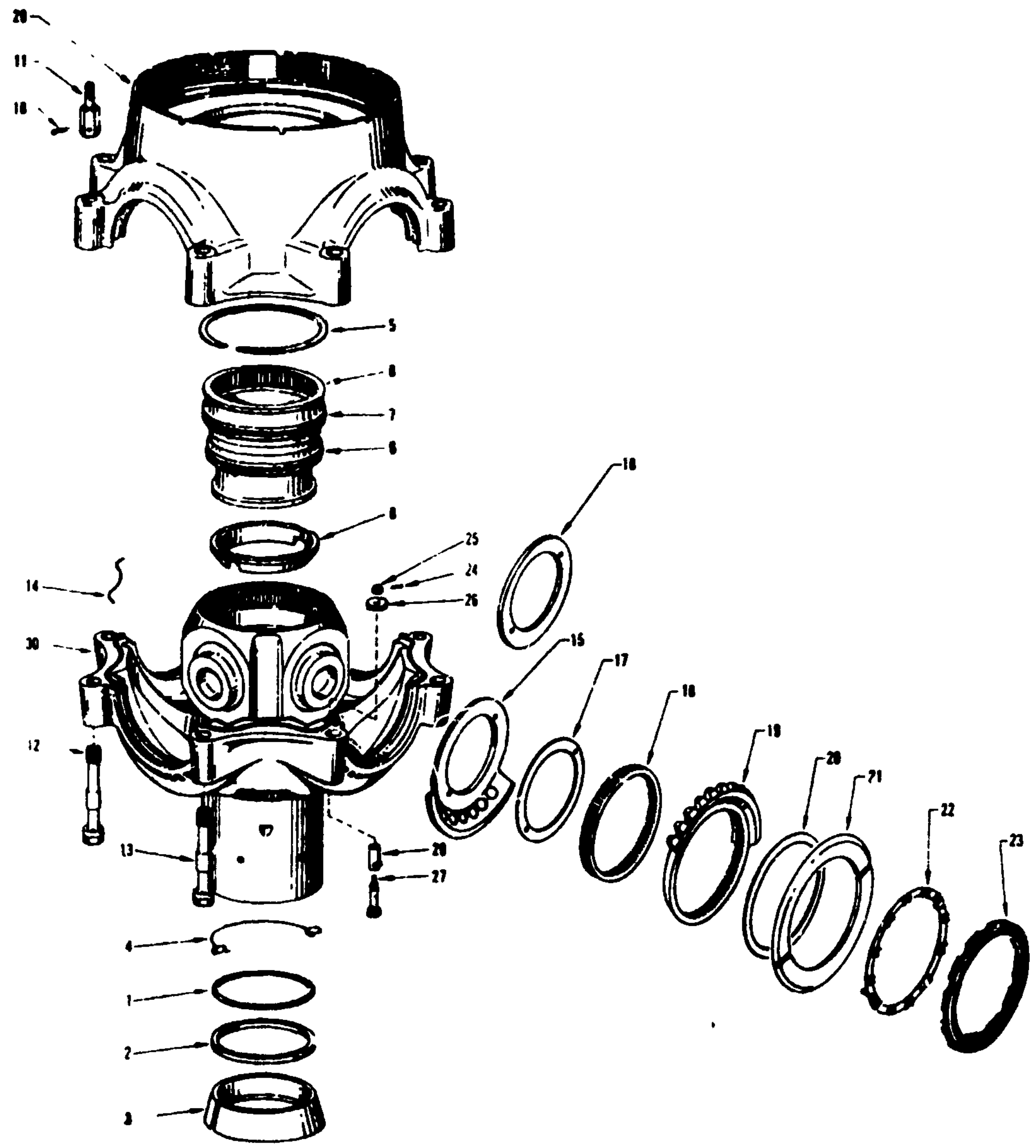
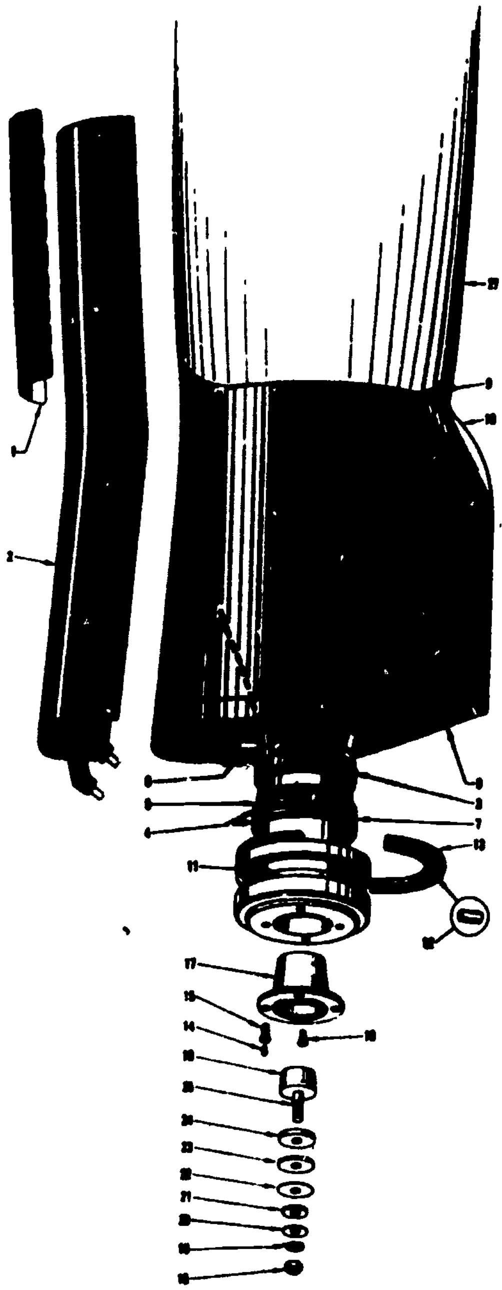


1. Preformed Packing
2. Packing Retainer
3. Rear Cone
4. Pin Retaining Ring
5. Retaining Ring
6. Preformed Packing
7. Preformed Packing
8. Prop Retaining Nut
9. Front Cone
10. Cotter Pin
11. Barrel Bolt Nut
12. Barrel Bolt
13. Barrel Bolt
14. Barrel Half Seal
15. Beta Gear Segment
16. Blade Shim Plate
17. Blade Barrel Shim
18. Micro Adjusting Ring
19. Blade Gear Segı
20. Gear Segment Shim
21. Thrust Washer
22. Packing Lock Ring
23. Preformed Packing
24. Cotter Pin
25. Hex Slotted Nut
26. Spur Gear
27. Beta Feedback Shaft
28. Feedback Gear Bushing
29. Front Barrel Half
30. Rear Barrel Half

Figure 1. Hub Assembly



1. Anti-Erosion Sheath
2. Blades Deicer Heater
3. Rubber Strip Seal
4. Electrical Contact Rings
5. Insulation Sheath
6. Special Purpose Cable Assembly
7. Electrical Contact Ring Holder
8. Rubber Fairing Boot
9. Coverstock
10. Formed Fairing
11. Friction Reduction Strip (Teflon)
12. Crowned Roller
13. Thrust Bearing Retainer
14. Shim Plate Drive Pin
15. Drive Pin
16. Flat Head Screw
17. Blade Bushing
18. Hex Head Nut
19. Lock Washer
20. Flat Washer
21. Plain Washer
22. Flat Lead Washer
23. Flat Lead Washer
24. Flat Lead Washer
25. Stud
26. Plug
27. Blade

Figure 2. Blade Assembly

beveled thrust washer, split roller thrust bearing and split thrust washer. A portion of the shank is hollow and bored to size. This is done to lighten the blade, to provide for major balance and make room for the blade bushing. The blade plug prevents oil from entering the hollow blade shank. The bushing is secured to the blade butt by two flathead screws and four drive pins. Two of the drive pins align the bushing to the blade. The other two are used to locate the blade shim. The flange of the bushing is splined to receive the micro adjusting ring.

The blade plug incorporates a stud onto which washers are installed to accomplish major balance. The fairing or cuff is designed to streamline the blade. It will also direct the flow of air into the engine. <u>The fairing is made of a plastic foam (lock foam) and covered with nylon reinforced rubber</u>. The inboard end of the fairing is sealed with a rubber boot. It is indented on the butt face to provide a recess for the deicer heater head straps. The micro adjusting ring that attaches to the bushing has both internal and external splines. The micro adjusting ring provides for small angle adjustment between the blade gear segment and the blade. The blade gear segment is held in place by its internal splines mating with the external splines on the micro adjusting ring. The blade gear segment meshes with the gears on the rotating cam in the dome assembly. The dome provides the force needed for changing blade angle. The shim and shim plate are used to obtain proper fit to the blades in the barrel assembly. A beta gear segment is used in place of the shim plate on the number one blade. It transmits blade angle position to the control assembly through the feedback gear. This gear is in the rear barrel assembly. The adjustments that will be required on the propeller are: the blade shims selection; gear segment shim selection; and indexing the gear segment and micro adjusting ring.

The propeller hub is the foundation for the propeller and retains the blades to the assembly. The aluminum blades will change pitch under the turning force created by the dome assembly. The low pitch stop lever assembly will stop blade angle travel at flight idle, but will allow travel into the beta range.

Anti-icing and deicing provisions are provided on the propeller blades and spinner. This will eliminate the possibility of icing conditions affecting the operation of the propeller.

QUESTIONS

1. Where is the propeller control mounted?

2. How does the front cone provide oil passages?

3. How is minor balance accomplished on the 54H60?

4. Why is the flange in the blade bushing splined?

5. What is the purpose of the micro adjusting ring?

6. Name two purposes of the blade plug.

7. What is the purpose of the beta gear segment?

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-SG-306
5 October 1982

ASSEMBLY OF THE HUB AND BLADE ASSEMBLY

OBJECTIVE

After completing this study guide and your classroom instruction, you will be able to identify facts relating to assembly of the hub and blade assembly.

INTRODUCTION

By taking extra care during assembly of the propeller, such as seating the seals properly, installing the parts correctly, etc., less trouble will be encountered later on during operation.

INFORMATION

When assembling the hub and blade assembly, each step listed in TO 3H1-18-2 must be followed in order to prevent damage to the propeller assembly. These procedures are to insure that safety and FOD procedures are followed during assembling of the hub and blade.

ASSEMBLY OF PROPELLER

Various components of the propeller are numbered to indicate their assembled location. It is imperative that these parts shall be installed in their correct positions in order to obtain proper fits and balance of the propeller; the blade butt, gear segment shim, micro adjusting ring, blade gear segment, blade barrel shim, blade shim plate, and each half of each split thrust washer. The front barrel half bolt holes are numbered and each barrel bolt is marked with the barrel bolt hole number. Each barrel half is marked with the blade position numbers.

During assembly of the propeller, the propeller blade angle shall be measured with the blade angle protractor and the blade checking template, unless otherwise specified. The blade angle shall be measured at the blade reference station which is the 42 inch station for this propeller. The reference station is marked on the blade face with a chordwise paint stripe. It also may be found by measuring from the propeller axis a distance of 42.875 inches (42 in. plus a hub allowance factor of 7/8 in.). All the blade angles referred to are the effective aerodynamic angles which are the angles that are actually measured plus or minus the correction angles. The correction angle is painted on the camber side of the blade and is also marked on the blade butt. The plus or minus sign show on the correction angle indicates that the correction angle shall be added to or subtracted from the blade angle acutally

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measured. Normally, however, the proper position of the micro adjusting ring and blade gear segment is marked when the propeller is new or overhauled. At that time, the blade angle correction factor is applied to the actual measurement at the feather position to arrive at the aerodynamic angle. Then, if necessary, the ring and segment are positioned to obtain an aerodynamic angle within specification. Etch marks across the blade bushing, micro adjusting ring and blade gear, provide the alignment during propeller build up.

During assembly of the propeller, all visible preformed packings and their mating surfaces shall be lubricated with hydraulic fluid, Military Specification MIL-H-6083 Type I. unless otherwise specified.

Caution: During assembly of the propeller, use care when turning the blades without the dome being installed to ensure that the blade gear segments do not contact each other or the barrel walls so as to cause damage.

INDEXING GEAR SEGMENT AND MICRO ADJUSTING RING

The micro adjusting ring is a vernier adjustment used to correct the variations in blade thrust. Variations of airfoil effecting thrust are caused by each blade being individually machined and hand worked during manufacture. The micro adjusting ring corrects this variation by raising or lowering the blade angle to get the desired thrust. See figure 1.

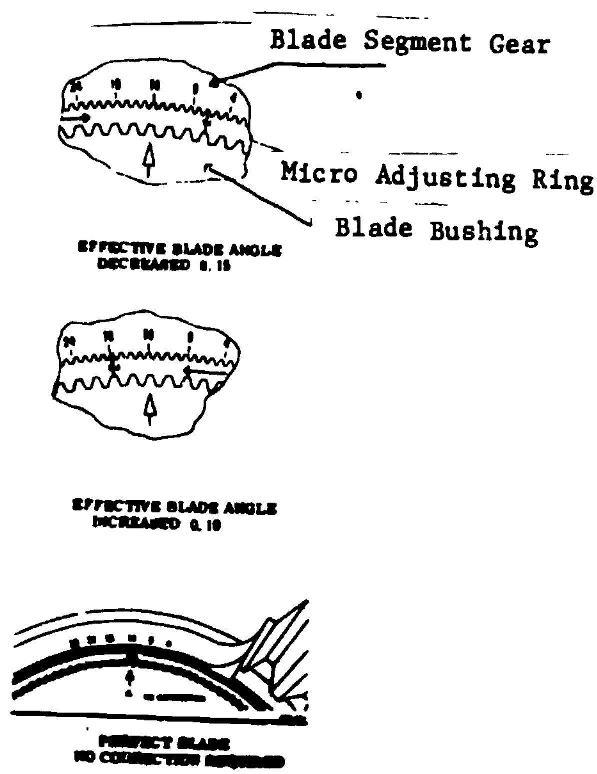

Figure 1. Indexing of Micro Adjusting Ring and Blade Gear Segment.

Other adjustments done on the propeller are the blade track, blade backlash, and the propeller balance.

Remember when assembling the propeller it is imperative that the parts are put in their correct positions in order to obtain proper fit and balance of the propeller.

All parts must be clean and free of contaminating particles and some of the parts are coated with hydraulic fluid or grease.

BLADE TRACK CHECK

Using four HS 6762 blade turning bars, unfeather the propeller by turning all blades simultaneously toward low pitch. Turn the blades to flat pitch so that the face of one blade, about 3-4 inches from the blade tip, is about parallel with the assembly bench. Establish a reference point on the bench which is directly beneath the blade centerline and 3-4 inches in from the blade tip. Rotate the propeller so that each blade in turn will be in the same position over the reference point and measure the distance from each blade centerline to the reference point. All blades of a propeller not installed on an aircraft shall track within 13/32 inches of each other.

BLADE BACKLASH CHECK - DOME INSTALLED

a. Using two HS 6762 blade turning bars, turn the blades to 45 degrees, measuring the blade angle as previously described.

b. Using a blade turning bar, check the backlash of each blade by first turning the blade in one direction and measuring the blade angle, and then turning the blade in the other direction and measuring the blade angle.

c. The difference between the two measurements of each blade shall not exceed 0.50 degrees. If the backlash is not as specified, check for the proper thickness of the gear preload shims and the proper assembly of the numbered parts which are installed on the blade shanks.

d. When the backlash is within limits, install the HS 7597 dome lifting handle in the dome cap threads. Loosen the dome retaining nut with the HS 7967 dome retaining nut wrench. Using a hoist, lift the dome off the propeller and set it down carefully to avoid shifting of the rotating cam. Remove the gear preload shims from the barrel shelf.

PROPELLER BALANCE CHECK

Horizontal Balancing

If the propeller has just been overhauled, the balancing bolts, washers, and nuts will be furnished with the propeller along with a WRNE Sketch No. 386 chart or equivalent. Use the chart to find the balancing bolts and nuts, and the right amount of washers per bolt, on the hub mounting bulkhead assembly. This assembly must now be used with this propeller.

QUESTIONS

1. What is the purpose of the blade micro adjusting ring?

2. Why is the micro adjusting ring etched?

3. What is meant by blade correction angle?

4. What component of the blade assembly is affected when the micro ring is moved one large tooth (.05°)?

5. Which parts have blade position numbers marked on them?

6. During assembly of the propeller what is used to make blade angle measurements?

7. What is used to coat preformed packings used in assembly of the propeller?

8. Where is the gear segment index #14 located when properly mounted? (See figure 1)

9. What may happen if the blades are carelessly turned while the dome is removed?

STUDY GUIDE/WORKBOOK

C3ABR42633-SW-307

Technical Training

Turboprop Propulsion Mechanic

PROPELLER OIL TEST

5 October 1982

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3350 Technical Training Group
Chanute Air Force Base, Illinois

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PROPELLER OIL TEST

OBJECTIVE

When you have completed this study guide/workbook and your classroom instruction, you will be able to explain facts and procedures for oil test of the propeller.

INTRODUCTION

When the propeller has been assembled after removal from the shipping crate or replacement of oil seals, it must be oil tested to determine that it operates properly with no internal or external oil leakage from the hub, blade, or dome assemblies.

INFORMATION

This lesson contains all the information you will need to know about the oil testing of the 54H60 propeller assembly in accordance with procedures contained in TO 3H1-18-2.

HYDRAULIC PROPELLER TESTER

The hydraulic propeller tester, GS 1221-M9 is used to perform operational, and external and internal leakage checks on the 54H60 propeller assembly. The tester simulates actual propeller operation as if the propeller assembly was installed on an aircraft engine. The tester has incorporated into the system a control panel consisting of an instrument panel, pressure control panel, and temperature control panel, an oil tank, electrical heaters, electrical driven motor and pump assembly, and three filters. It is mounted on four caster type wheels, which makes the tester portable.

The following is a [illegible] of the major parts on the instrument panel, temperature control [illegible] d pressure control panel. See figure 1 and figure 2 for the loc[illegible] these parts. It will be to your benefit to know the location of these parts, because you will be operating the tester in a later lesson.

Instrument Panel

1. TOGGLE SWITCH - Used to test the indicator light for proper operation.

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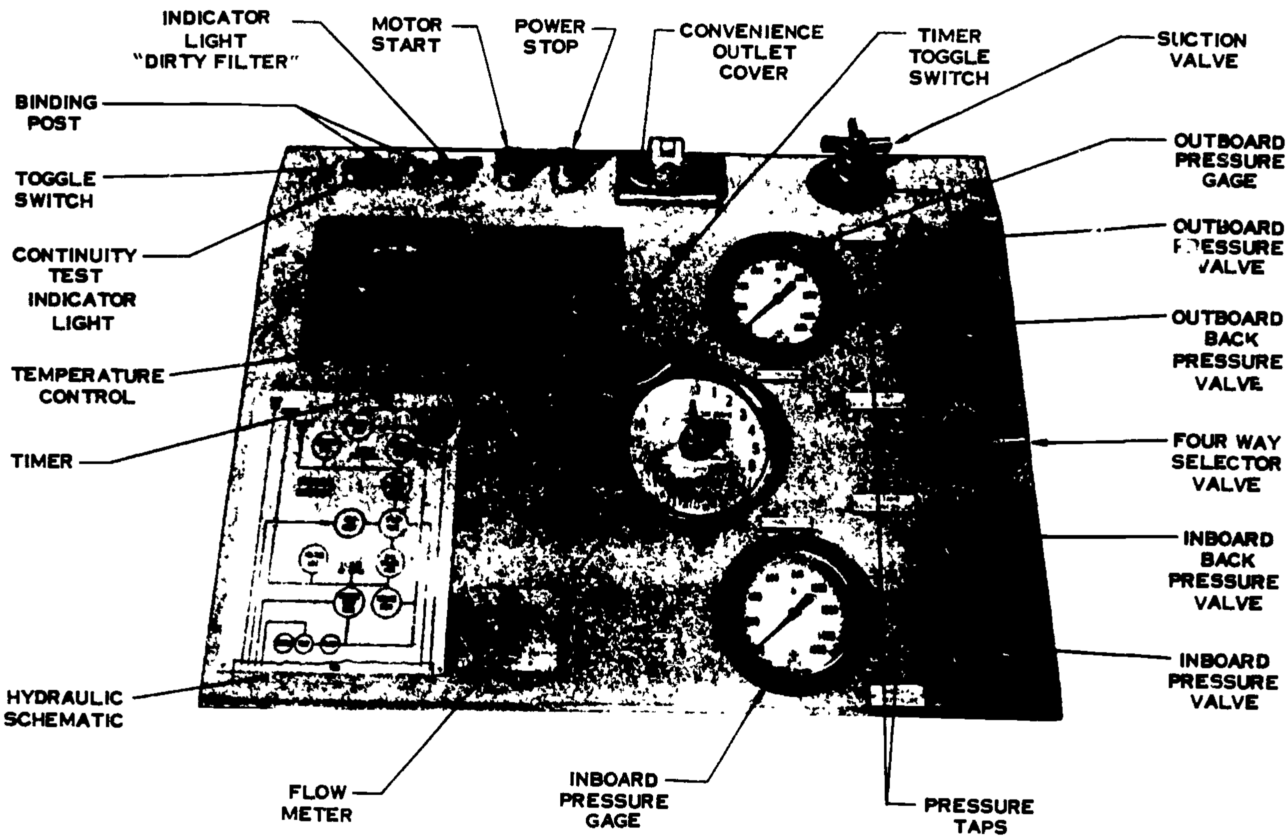

Figure 1. Hydraulic Propeller Tester Control Panel.

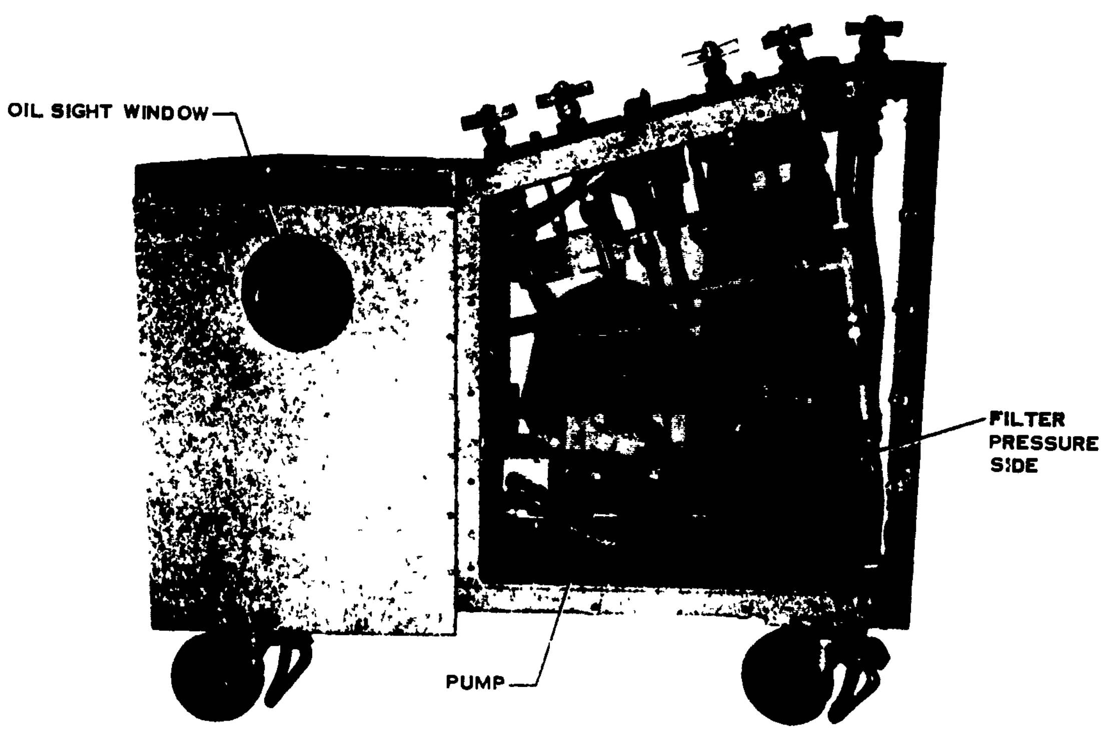

Figure 2. Pressure Side Filter Location.

2. INDICATOR LIGHT - Used as a warning indicator for a dirty filter on the pressure pump filter assembly.

3. MOTOR START - Turns the propeller tester motor on and off.

4. POWER STOP - Turns off electrical power to the hydraulic propeller tester.

5. TIMER - Used when checking for internal leakage and pressure checks.

6. CONVENIENCE POWER OUTLET - Used to provide 115 volts AC power for whatever requirement exists in the vicinity of the tester.

7. CONTINUITY TEST INDICATOR LIGHT - Used when troubleshooting electrical problems on the hydraulic propeller tester.

Temperature Control Panel

1. TEMPERATURE SELECTOR - Allows the operator to select the maximum oil temperature necessary to operate the propeller tester.

2. TEMPERATURE GAGE - Shows the operator the temperature of the oil during the test procedures.

Pressure Control Panel

1. OUTBOARD PRESSURE VALVE - Ports oil to the outboard side of the propeller dome assembly for blade movement.

2. OUTBOARD BACK PRESSURE VALVE - Ports hydraulic oil from the tank, through the flowmeter to the outboard side of the dome assembly, and is used to increase blade angle during oil test procedures.

3. INBOARD PRESSURE VALVE - Ports oil to the inboard side of the propeller dome assembly for blade movement.

4. INBOARD BACK PRESSURE VALVE - Ports hydraulic oil from the tank through the flowmeter to the board side of the dome assembly and is used to decrease blade angle.

5. FOUR WAY SELECTOR VALVE - Used to select inboard or outboard oil pressure, to be measured on the two pressure gages.

6. OUTBOARD PRESSURE GAGE - Measures the oil pressure in pounds per square inch for the outboard side of the dome assembly.

7. INBOARD PRESSURE GAGE - Measures the oil pressure in pounds per square inch for the inboard side of the dome.

8. FLOWMETER - Measures oil flow in fluid ounces for either the inboard or outboard oil during the oil test procedures.

9. PRESSURE TAPS - Are used to calibrate the outboard and inboard pressure gages during inspections or as required by the applicable technical order.

QUESTIONS

1. What does the indicator light on the control panel indicate when it is illuminated?

a. Dirty filter on the pressure pump filter

b. The timer is being used

c. Clean filter on the pressure pump filter

d. Temperature of the oil is at operating temperature

2. What is the purpose of the hydraulic propeller tester, GS 1221-M9?

a. To test a pitch lock assembly

b. To check electrical wiring on the propeller

c. To perform operational, external and internal leakage checks on 54H60 propellers

d. To perform operational checks on the engine

3. What part on the temperature control panel allows the hydraulic test machine operator to select the maximum oil temperature necessary to operate the propeller tester?

a. Temperature selector

b. Toggle switch

c. Temperature gage

d. Four way selector valve

4. Name the part on the pressure control panel that is used to port oil to the outboard side of the propeller dome assembly for blade movement?

a. Outboard back pressure valve

b. Inboard pressure valve

c. Four way selector valve

d. Outboard pressure valve

5. What measures oil flow in fluid ounces for either the inboard or outboard oil during the oil test procedures?

a. Outboard pressure gage

b. Flowmeter

c. Pressure taps

d. Timer

TESTER PREPARATION

With the completion of the assembly of the hub and blade assemblies, the propeller assembly is now ready for testing on the hydraulic propeller tester. Before testing the propeller on the hydraulic propeller tester, there several necessary steps that must be completed to prepare the tester for the operation procedures.

1. The following hydraulic oil must be used with the hydraulic propeller tester, Model GS 1221-M9. The types of oil are: MIL-H-6083, Type I; MIL-H-6083, Type II; or MIL-H-5606; with no substitutes allowed in accordance with TO 3H1-18-2. The capacity of the oil tank on the tester is approximately 39.5 gallons of hydraulic fluid.

2. There are three hydraulic lines that must be connected to the propeller test fixture, HSP-8961. Attach the inboard and outboard oil lines from the hydraulic propeller tester to the connectors located on the propeller oil test fixture, which is installed on the barrel extension. These are marked as LOW PITCH and HIGH PITCH, then attach the oil drain line from the tester to the bottom of the test post, HSP 2100. The oil test post is the assembly which the propeller assembly is mounted on during the oil test procedures.

3. There are two water lines on the hydraulic propeller tester, GS 1221-M9, that are used for cooling of the oil. When the oil temperature exceeds 170 degrees F, the tester will automatically allow the cold water to be ported to the oil tank through metal pipes to cool the oil during the test procedures.

The oil temperature is adjusted by turning the temperature selector knob until the indicator in the lower window is set at 140 degrees F. When the tester is turned on, the electric motor and oil pump will automatically heat the hydraulic oil to 140 degrees F, and then the tester will shut off the heaters, located in the oil tank, when the oil temperature reaches the preset temperature of 140 degrees F. The tester will automatically turn the heaters on again, if the oil temperature goes below the 140 degree setting. On the tester we will be using to test the 54H60 propeller assembly, the two water lines are not connected to the test machine. If the oil temperature goes above 170 degrees F, the tester will have to be shut off and allowed to cool until the oil temperature is below 170 degrees F.

4. Before the tester motor is started, the two pressure valves and the two back pressure valves must be opened by turning the valve handles in the counterclockwise direction. The suction valve must be closed. Do this by turning the valve handle in a clockwise direction. The four way selector valve must be turned in a downward position, towards the inboard pressure gage. After the valves are in the correct position, the tester motor can be started. This is completed by pushing the motor start button on the control panel. The tester must be allowed time to warm up the hydraulic oil in it before any pressure can be applied to the tester. The oil temperature must be at least 140 degrees F. After the oil has warmed up to 140 degrees F., close the outboard pressure valve. The outboard back pressure and the inboard pressure valves are left in the open position. The suction valve is left in the closed position. Slowly apply

decrease pitch oil pressure to fill the barrel and the inboard side of the dome assembly, by adjusting the inboard back pressure valve. After filling the barrel and the inboard side of the dome assembly, open the inboard back pressure valve first, and then the outboard pressure valve. Now, close the inboard pressure valve. The outboard pressure and the inboard back pressure valves are left in the open position. Then, slowly adjust the outboard back pressure valve to fill the outboard side of the dome assembly and to release the pitch lock ratchet ring that is attached to the bottom of the dome assembly. After the outboard side of the dome assembly has filled with hydraulic fluid, open the outboard back pressure valve, and open the inboard pressure valve to allow oil pressure to be released from the propeller assembly.

5. With the inboard and outboard sides of the dome assembly, and the barrel assembly filled with hydraulic fluid, cycle the propeller from feather to reverse blade angles by closing the outboard pressure valve, and slowly closing the inboard back pressure valve. Do not allow the propeller blades to stop when taking the blades to the reverse blade angle. So, keep the pressure at about 300 psi while using this procedure. When the propeller has reached the reverse blade angle and pressure starts to increase, open the inboard back pressure valve first, and then the outboard pressure valve. To cycle the propeller assembly back to feather blade angle, close the inboard pressure valve. Slowly close the outboard back pressure valve. Keep enough pressure applied to the propeller assembly to have smooth movement of the propeller blades. After the propeller assembly has reached the feather blade angle, which will be indicated by an increase in oil pressure, open the outboard back pressure valve first, and then the inboard pressure valve. Cycle the propeller assembly from feather to reverse blade angles at least eight times, using the above procedures, to purge air trapped in the propeller assembly. This will avoid erratic operation during the oil test procedures.

CAUTION: DO NOT STOP THE PROPELLER IN THE PITCH LOCK RANGE FROM 55 DEGREES TO 25 DEGREES OF BLADE ANGLE. IT MAY CAUSE THE PITCH LOCK RATCHET TEETH TO ENGAGE FULLY OR PARTIALLY CAUSING DAMAGE TO THE TEETH. IF THE PROPELLER ASSEMBLY DOES STOP IN THE ABOVE RANGE, THE PROPELLER ASSEMBLY MUST BE CYCLED BACK TO THE FEATHER BLADE ANGLE BEFORE THE PROPELLER BLADES ARE ALLOWED TO DECREASE TOWARDS THE REVERSE BLADE ANGLE. THEN THE CYCLE PROCEDURES CAN BE RESTARTED.

QUESTIONS

1. What type of oil is used in the hydraulic propeller tester, Model GS 1221-M9?

   a. MIL-H-6083 or MIL-H-5606

   b. MIL-H-8306 or MIL-H-6505

   c. MIL-G-2146

   d. MIL-L-23699B or MIL-L-21440

2. What is the temperature reading at which the test machine will automatically allow water to cool the hydraulic oil?

a. 140°F

b. 160°F

c. 170°F

d. 180°F

3. In what position is the suction valve set prior to starting tester operation?

a. Fully open

b. Partially opened

c. Partially closed

d. Fully closed

4. What is the name of the valve that is used to fill the barrel and inboard side of the dome?

a. Inboard pressure valve

b. Suction valve

c. Inboard back pressure valve

d. Outboard back pressure valve

5. Why is the propeller assembly cycled between feather and reverse at least eight times?

a. To fill the dome assembly

b. To purge air from the system

c. To empty the propeller of oil

d. To test the propeller blades

OIL TEST PROCEDURES

Now that we have completed the preliminary checks of the hydraulic oil test procedures, we can start the testing of the 54H60 propeller assembly for specific operational and leakage checks in accordance with TO 3H1-18-2.

Step One - External Leakage Test

With the barrel drain petcock, which is located on the oil test fixture, HSP 8961, in the closed position, cycle the propeller between feather blade angle HIGH PITCH and reverse blade angle LOW PITCH for at least eight (8) cycles and until the barrel assembly is at 150 psi, as read on the pressure gage of the HSP 8961 oil test fixture. If the barrel assembly pressure reaches 150 psi before the eight cycles are completed, open the barrel drain petcock until the total of eight (8) cycles are completed. There is no external leakage allowed during this check or while performing any of the hydraulic test procedures. If there is leakage from the barrel halves or blade seals, the propeller hub and blades will have to be disassembled and new seals installed, and then reassembled in accordance with TO 3H1-18-2. The oil test procedures will have to be started again at the beginning.

Step Two - Low Blade Angle Setting Check

Using the hydraulic propeller tester, move the blades from feather blade angle to the low pitch stop setting, by closing the outboard pressure valve and adjusting the inboard back pressure valve. Do not allow the inboard oil pressure to exceed 200 psi, as indicated on the inboard pressure gage. While maintaining this pressure and using blade turning bars, HS 6762, pull the blades into the mechanical low pitch stop, measure the low blade angle, using the blade angle protractor, P/N PE 105 and template, HS 7548. Low blade angles of all the blades shall be the same reading, within a total variation of 0.20 degree; and shall be within 0.50 degree of the 23.3 degree blade angle setting with the blade angle correction factors applied that are stencilled on the camber side of the blade fairing. If the specified blade angles are not within the limits, it will be necessary to adjust the low pitch stop assembly by either turning the low pitch stop assembly in or out of the piston sleeve of the dome assembly.

To make this adjustment, it will be necessary to take the propeller assembly to the feather blade angle, to move the low pitch stop levers away from the piston sleeve. To increase the low pitch stop blade angle, turn the low pitch stop assembly clockwise, and counterclockwise to decrease the low pitch stop assembly setting. This procedure can be completed by removing the dome cap from the dome assembly, removing the oil transfer tube assembly, and the low pitch stop retaining ring and snap ring. After completing the adjustment on the low pitch stop assembly, reinstall the low pitch stop retaining ring and snap ring, oil transfer tube assembly, and dome cap.

Step Three - Feather Pressure Test

To perform this test, slowly move the blades to the feather angle by closing the inboard pressure valve and adjusting the outboard back pressure valve. The pressure required to move the propeller assembly to the feather blade angle shall not exceed 350 psi as measured on the outboard pressure gage. Leave the inboard pressure valve and the outboard back pressure valve in the above position for further checks that are required in the feather position.

QUESTIONS

1. What is the purpose of the external leakage test?

   a. To check leakage on the barrel halves and blade seals

   b. To check leakage of the dome assembly

   c. To check leakage of the pitch lock and barrel halves

   d. To check leakage of the blades and dome assembly

2. How is the low pitch stop (LPS) adjusted during the low blade angle setting check, if the reading is 24.6 degrees?

a. By turning the LPS clockwise

b. By readjusting the blade microadjusting ring

c. By turning the LPS counterwise

d. No adjustment is required

3. What is the total variation of blade angle of all the blades at low blade angle?

a. 0.10 degree

b. 0.20 degree

c. .020 degree

d. 0.50 degree

4. What is the maximum pressure required to move the propeller assembly to the feather blade angle as measured on the outboard pressure gage?

a. 300 psi

b. 325 psi

c. 350 psi

d. 360 psi

5. What valves are used to move the propeller assembly to feather blade angle?

a. Inboard pressure and inboard back pressure

b. Outboard back pressure and inboard pressure

c. Outboard pressure and inboard back pressure

d. Outboard pressure and outboard back pressure

Step Four - Feather Blade Angle Setting Check

With the propeller in the feather position, apply 200 psi outboard oil pressure, measured on the outboard pressure gage. While maintaining this pressure, twist all the blades simultaneously towards the low pitch stop using the blade turning bars, HS 6762, to take up blade backlash. Slowly remove the torque simultaneously from the blade turning bars. Now, using the blade angle protractor, P/N PE 105 and the template, HS 7348, measure the feather blade angles of each blade. This measurement shall be the same reading within a total variation of 0.20 degree of the 92.5 degree feather angle setting with the blade angle correction factors applied. Record this reading for further use when checking the reverse blade angles.

Step Five - Internal Leakage in Feather Check

With the propeller assembly still in the feather position, apply outboard oil pressure until it is 600 psi greater than the inboard oil pressure as measured on the outboard pressure gage. The oil leakage from the outboard to inboard sides of the dome piston assembly shall be 15-45 fluid ounces per minute, which equals 1-3 pints of hydraulic oil in 64 seconds, as measured on the flowmeter. To take the reading accurately, you must use use the timer on the instrument panel.

With the propeller and tester still set as in the previous paragraph, the oil leakage from the outboard side of the piston to the barrel shall be collected in a graduated container from the barrel drain petcock of the oil test fixture, HSP 8961. This leakage from the petcock shall be 10-35 fluid ounces per minute. The combined fluid leakage of the two tests shall not exceed 75 fluid ounces per minute. Now, open the outboard back pressure valve, and the inboard pressure valve.

READ STEP SIX BEFORE ANSWERING THE FOLLOWING QUESTIONS

QUESTIONS

1. Why do you use blade turning bars, HS 6762, to twist the blades towards the low pitch stop?

   a. To maintain oil pressure

   b. To take up blade backlash

   c. To hold the blade from moving

   d. To release the feather locks

2. What is the maximum allowable internal oil leakage permitted during the internal leakage in feather check?

   a. 10 to 40 fluid ounces

   b. 10 to 45 fluid ounces

   c. 15 to 40 fluid ounces

   d. 15 to 45 fluid ounces

3. What is the maximum allowable oil leakage allowed from the outboard side of the dome to the barrel?

   a. 10-20 fluid ounces

   b. 10-30 fluid ounces

   c. 10-35 fluid ounces

   d. 10-40 fluid ounces

4. What valves are used to unfeather the propeller?

   a. Inboard pressure and outboard back pressure

   b. Outboard pressure and outboard back pressure

   c. Inboard back pressure and outboard back pressure

   d. Outboard pressure and inboard back pressure

5. What is the minimum oil pressure required to release the feather locks?

a. 160 psi

b. 170 psi

c. 180 psi

d. 190 psi

Step Six - Unfeather Pressure Test

With the propeller assembly still in the feather position, close the outboard pressure valve, and using the inboard back pressure valve, slowly apply inboard oil pressure until the propeller unfeathers. While applying the inboard oil pressure, and looking at the inboard pressure gage, slowly apply 180 psi of oil pressure to the propeller. The propeller shall release the feather locks at a minimum oil pressure of 180 psi. Leave the outboard pressure valve and the inboard back pressure valve in this position and do not apply any more pressure to the propeller.

Step Seven - Reverse Pressure Tests

With the hydraulic oil tester valves in the same position as in step six, apply enough inboard oil pressure to position the propeller blades at the low blade angle setting. Do not exceed 200 psi of inboard oil pressure during blade movement. After the propeller has stopped on the low pitch stop assembly, slowly increase the inboard oil pressure to 235 psi, as shown on the inboard pressure gage, and hold this pressure for one minute. The propeller shall not decrease blade angle to the reverse position. Slowly, apply more increase oil pressure. The propeller shall change blade angle at a pressure of 250 to 280 psi, as shown on the inboard pressure gage, and shall move to the full reverse blade angle. After the propeller has reached the reverse blade angle position, remove the inboard oil pressure by opening the inboard back pressure valve and the outboard pressure valve.

Apply oil pressure to the propeller to move the blades towards the low blade angle setting, this movement must be no more than one to 10 degrees below the low blade angle setting of 23.3 degrees of blade angle. To make this blade angle movement, close the inboard pressure valve, and adjust the outboard back pressure valve. After the desired blade angle movement has been completed, open the inboard pressure valve and the outboard back pressure valve. Close the outboard pressure valve and adjust the inboard back pressure valve to apply 85 psi of inboard oil pressure, read the amount of oil pressure on the inboard pressure gage. The result of this action is that the propeller blades should not move towards the reverse blade angle. Slowly apply more inboard oil pressure. The propeller blades shall move to the reverse position at a pressure of between 85 to 125 psi of oil pressure. After the blades have reached the reverse position, remove the outboard back pressure, and the inboard pressure by opening the two valves.

Step Eight - Reverse Blade Angle Setting

With the propeller blades in reverse, using the blade angle protractor, P/N PE 105, and the template, HS 7548, measure the blade angle at the reverse position and record the readings of all the blades. The reverse angle of each blade shall be equal to the feather angle of the blade minus the range of the feather stop ring. Use the feather angles previously recorded during the feather blade angle setting check (step four). Since the correction factors were previously applied to the feather blade angles, do not apply them to the reverse blade angles. Now using the stop ring range of 100 degrees to 102 degrees of blade angle, and the feather blade angle readings, subtract the feather blade angle from the stop ring range. The result will be the reverse blade angle limits.

EXAMPLE:

Stop Ring Range	-100.0 Degrees	-102.0 Degrees
Feather angle Recorded	+92.6 Degrees	+92.6 Degrees
Reverse Angle Limits	-7.4 Degrees	-9.4 Degrees

The reverse blade angle readings taken using the blade angle protractor and template previously in the above paragraph shall be within the reverse angle limits.

Step Nine - Internal Flow and Leakage Test in Reverse

With the propeller still in reverse, slowly apply inboard oil pressure until the pressure is 500 psi greater than outboard oil pressure and the surge valve has not opened. Use the inboard oil pressure gage. The oil leakage from the inboard to outboard side of the dome piston assembly shall be 15 to 45 fluid ounces per minute, which equals 1 to 3 pints of hydraulic fluid in 64 seconds as read on the flowmeter of the hydraulic oil test machine.

With the propeller still set up as in the previous paragraph, the oil leakage from the inboard side of the dome piston assembly to the barrel will be collected in a graduated container from the barrel drain petcock of the oil test fixture, HSP 8961. The combined oil leakage of the two above tests shall not exceed 75 fluid ounces per minute.

Slowly apply inboard oil pressure until it is no greater than 700 psi and the surge valve has opened as indicated by no further rise in the inboard oil pressure. The oil flow from the inboard to the outboard side of the dome piston assembly shall be a minimum of three quarts per minute as measured by the flowmeter on the instrument panel.

We have completed the oil test procedures for the 54H60 propeller assembly. Now, the propeller assembly must be removed from the oil test post, HSP 2100, and the hydraulic propeller tester disconnected. First, the propeller assembly must be placed in the feather position. Then the oil pressure must be removed from the propeller and the hydraulic propeller tester. After the propeller is in the feather position, and no oil pressure is applied to the propeller, we can remove the dome cap from the dome assembly. Then close the outboard pressure valve and the inboard pressure valve, and open the suction valve. This will pick up all excess oil in the propeller dome assembly and we will be able to further disassemble the propeller from the tester. You will be using the suction line as each assembly is removed from the oil test post, HSP 2100.

After the oil has been removed from the outboard side of the dome assembly, using the dome spanner wrench, HSP 648, remove the dome assembly from the hub and blade assembly. Using the suction line again, remove the excess oil in the dome shelf, which is part of the barrel assembly. After this has been completed, remove the pitch lock externally threaded ring. Using the pitch lock mechanical puller, HS 7580, and exercising caution not to damage the threads of the pitch lock cap, insert the puller into the pitch lock cap and remove the pitch lock assembly from the propeller retaining nut. Using the socket sleeve, SWE 86630, remove the propeller retaining nut, front cone, the associated parts from the propeller barrel assembly, and the oil test post, HSP 2100.

With the propeller still on the test post, recheck the torque on the barrel bolt extension studs and align the cotter pin holes on the barrel bolts and safety with the correct cotter pins.

Using the hoist, lift the propeller from the oil test post, HSP 2100, and remove the oil test fixture, HSP 8961, using the mechanical puller, HSP 1584, oil tester fixture puller. Then remove the preformed packing, phenolic spacer, and the rear cone from the oil test post. After the above procedures are completed, the propeller assembly is ready for minor balance and assembly of the hub mounted bulkhead assembly, rear spinner assembly, and deicer contact ring holder assembly. This concludes the operational and leakage tests for the 54H60 propeller assembly.

QUESTIONS

1. What is the maximum pressure allowed to release the low pitch stop levers?

a. 270 psi

b. 280 psi

c. 290 psi

d. 295 psi

2. Why do you <u>not</u> exceed 200 psi of inboard oil pressure when unfeathering the propeller?

a. To stop the propeller at the low pitch stop

b. To move the propeller to reverse

c. To release the low pitch stop levers

d. To check the pitch lock assembly

3. What is the maximum pressure allowed to move the propeller blades into reverse?

a. 85 psi

b. 95 psi

c. 115 psi

d. 125 psi

4. What is the range of the feather stop ring?

a. 100-102 degrees

b. 100-105 degrees

c. 100-110 degrees

d. 92-100 degrees

5. What is the maximum oil leakage allowed in reverse?

a. 10-45 fluid ounces

b. 15-45 fluid ounces

c. 10-50 fluid ounces

d. 15-50 fluid ounces

Maintenance Training Branch
Chanute AFB, Illinois

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27 January 1984

VALVE HOUSING MAINTENANCE

OBJECTIVE

After completing this study guide and your classroom instruction, you will be able to identify facts about the removal and replacement of the valve housing on the propeller.

INTRODUCTION

A propeller malfunction caused by an inoperative component on the turbocontrol valve housing will be corrected by replacing the complete valve housing.

INFORMATION

This study guide contains all the information that is necessary to remove and replace the valve housing assembly.

Valve housings can be interchanged from one control assembly to another.

Prior to removing the valve housing you will place the condition lever in the air start and the throttle in ground idle. This will operate the propeller to ground idle. Then the electrical connections will be disconnected from the control assembly.

Note: The electrical power must be turned off before removing the electrical connections to prevent burning out panels in the synchrophaser. The control linkage must now be disconnected from the alpha input shaft. The valve housing cover will be removed next. At this point you will check the protractor on the beta shaft indicator and note the reading. (See figure 1.) The replacement valve housing will be set at the same angle less 2° to provide for adjustment of beta shaft.

A rig pin must now be installed in the beta shaft (figure 2) to prevent the torsion spring from "snapping" the beta shaft and drive gear against the stop, when the valve housing is removed (figure 3). If the rig pin cannot be inserted, you must loosen the feather adjusting screws.

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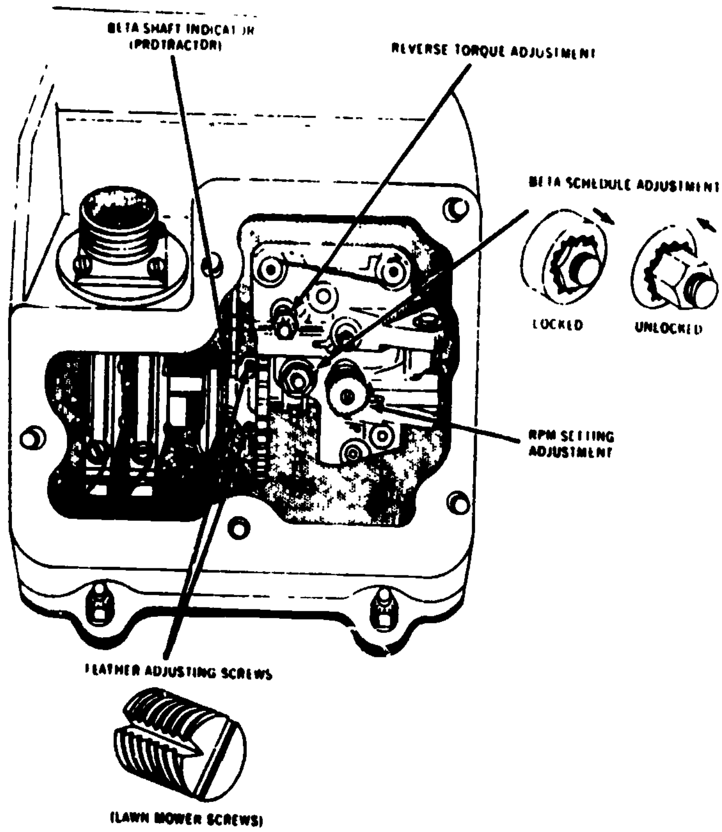

Figure 1. Valve Housing Assembly Adjustments.

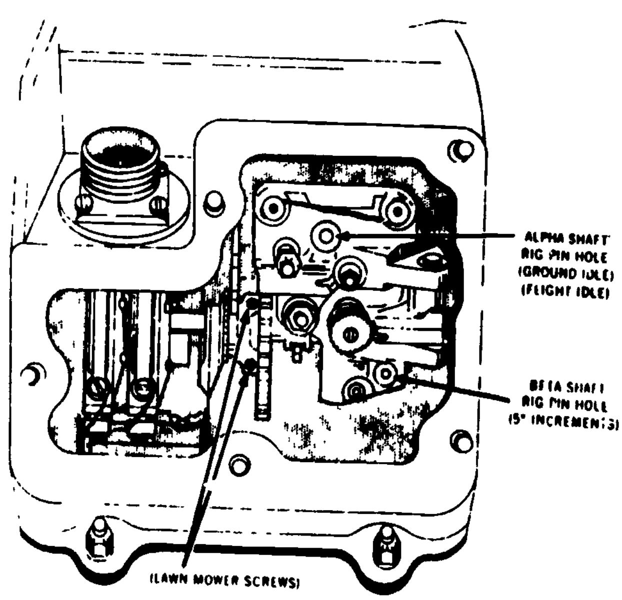

Figure 2. Beta Rig Pin Location.

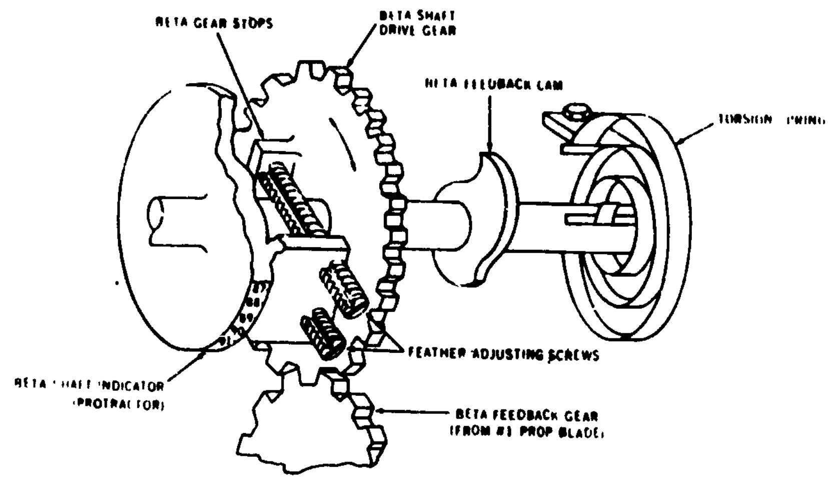

Figure 3. Beta Shaft.

This will allow the beta shaft to turn so the rig pin will fit. The blades should not be turned while this rig pin is installed. Severe damage to the valve housing will occur.

The nuts and washers that hold the valve housing on will now be removed and the valve housing and seal plate lifted off.

To remove the beta shaft rig pin, you should hold the beta drive gear, remove the rig pin and let the drive gear slowly rotate to the stop.

Before installing the replacement valve housing, a new seal plate should be installed on the pump housing. Then you should center the feather adjusting screws so feather angle can be adjusted later on.

Now the beta drive gear will be rotated until the protractor on beta shaft indicates near the same angle as was noted on the removed valve housing. The shaft will be locked in this position with the rig pin. The valve housing is ready to be installed. During installation, care should be taken to insure that the beta gear meshes properly with the inter-gearing. Tightening the valve housing down without proper mesh will result in damage to the valve housing. If the gears do not mesh you should loosen the feather adjusting screws, or "lawnmower" screws on the protractor about one turn each. This will allow movement of the beta gear enabling it to mesh with the intergearing.

The attaching washer and nuts would now be installed and evenly torqued according to the TO. Next the rig pin should be removed and the "lawnmower" screws adjusted to set the protractor to the angle noted during removal of the valve housing. The setting of the beta shaft is accomplished at ground idle, but the actual angle must be correct at feather.

To install the valve housing cover you must index the alpha input shaft in the cover to the alpha shaft on the valve housing. To do this you must lock the alpha shaft at the flight idle position with a rig pin. The rigging spacer that the rig pin fits into has two slots. To insure that you have the pin in the correct slot, you should try to rotate the alpha shaft. With the pin installed all the way in there shall be no free play of the alpha shaft.

The input lever on the valve housing cover should be positioned at flight idle. The cover should now be installed. If the split gears in the cover do not exactly mesh with the input gear on the alpha shaft, the input lever will be forced away from the flight idle position as the cover is installed. An adjustment to bring the input lever back to flight idle is made by repositioning the micro adjusting ring on the input shaft. Once the input lever is aligned the housing cover can be attached with the retaining nuts.

There must be no backlash between the split gears in the valve housing cover and the gear on the alpha shaft. To remove the backlash an adjustment is made with the screw on the split gears. This adjustment is made with the input lever placed at reverse. The electrical connections and control linkage should now be attached. A check will now be performed to insure that the beta cam is correctly set. The condition lever would be placed in the feather position. When the blade angle stops changing you should check the reading on the beta shaft indicator (protractor). It must read 92.5°.

The valve housing change is not completed until three more checks are performed. They are: Beta schedule, reverse stop (reverse torque) and mechanical governing. The adjusting screws are shown in figure 1.

SUMMARY

Changing a valve housing requires care and a good knowledge of the procedures to be followed. Improper handling and careless maintenance can easily damage the valve housing. After the valve housing has been installed, it must be adjusted to set the reverse torque, beta schedule, and mechanical governing rpm. Any time a valve housing or a turbocontrol has been changed, the NTS bracket clearances must be checked and adjusted. The procedures for performing all the rigging and adjustments after valve housing, installation can be found in TO 1C-130B-2-11.

QUESTIONS

1. What precaution should be taken during removal of the valve housing?

2. Why must electrical power be off before the electrical connectors are disconnected from the turbocontrol?

3. What is the first blade angle checked on the valve housing protractor following valve housing replacement?

4. What device is used to adjust backlash (gear lash) in the input shaft?

5. How is the blade angle reading of the beta shaft checked to see if it agrees with #1 blade angle?

6. What is the result of failing to remove the beta shaft rig pin?

7. What checks are required following valve housing change?

8. Which tech order gives complete valve housing replacement instructions?

9. Which clearances must be checked following valve housing change?

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STUDY GUIDE

C3ABR42633-SG-309

Technical Training

Turboprop Propulsion Mechanic

ADJUSTMENT OF PROPULSION ELECTRICAL SWITCHES

13 March 1984

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3350 Technical Training Group
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ADJUSTMENT OF PROPULSION ELECTRICAL SWITCHES

OBJECTIVE

When you have completed this study guide in accordance with TO 3H1-18-2, you will be able to name parts and identify facts about adjusting electrical switches.

INTRODUCTION

When it is determined that a propeller malfunction is caused by an inoperative switch in the propeller control assembly, the problem can be corrected by the adjustment of the proper switch or, if necessary, replacement.

INFORMATION

This lesson and TO 3H1-18-2, Section V (Valve Housing Parts Replacement), contains all the information you will need to be able to name parts and identify facts about adjusting electrical switches.

PROPELLER CONTROL SWITCHES

The propeller control assembly is a nonrotating assembly mounted on the rear extension of the propeller barrel. The control assembly consists of three major assemblies - the electrical contact brush assembly, the pump housing assembly. and the valve housing assembly. The control input lever, which is mechanically connected to the cockpit controls, positions various cams within the valve housing assembly to accomplish RPM control within the governing range and blade angle control in the beta range. Various cams, valves and switches are located in the valve housing assembly.

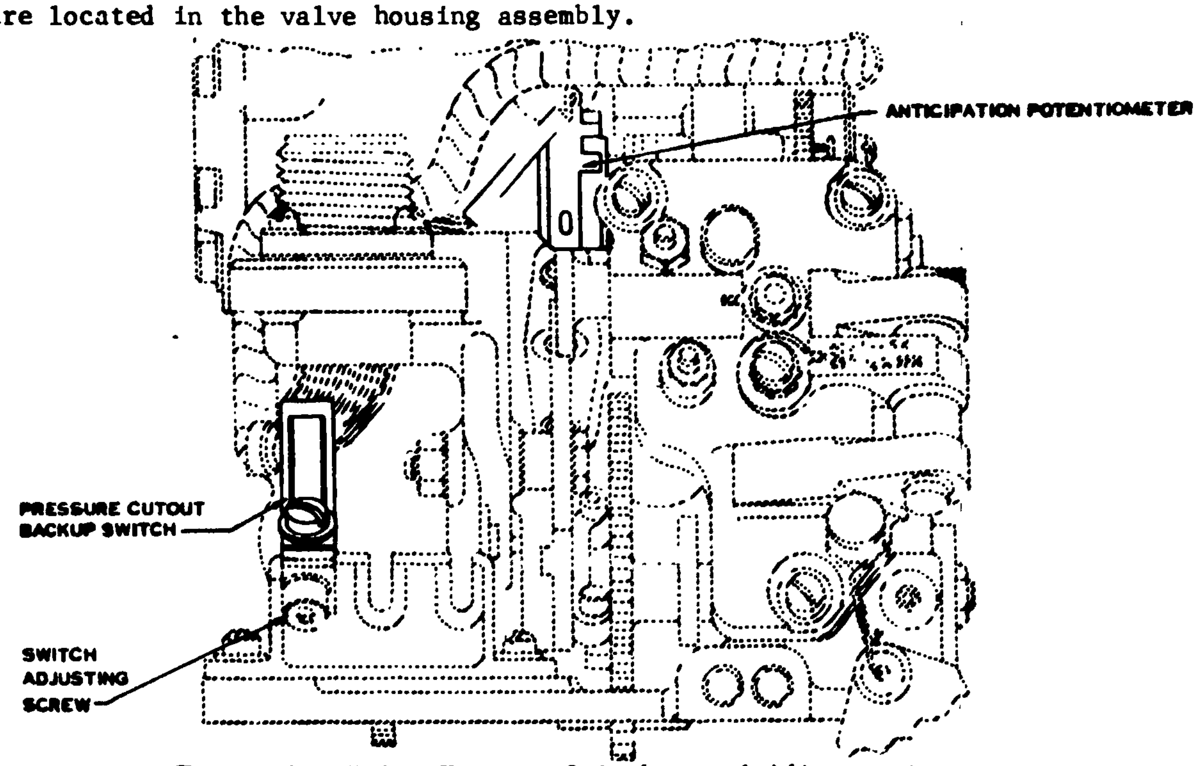

Figure 1. Valve Housing Switches and Adjustments.

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3350 TCHTG/TTGU-B - 300; DAV - 1

PRESSURE CUTOUT BACKUP SWITCH

The pressure cutout backup switch (figure 1), controlled by the pressure cutout backup cam on the beta shaft, opens within approximately 10° of feather, so that the pressure cutout switch can stop the auxiliary motor when the propeller is feathered. It will also prevent the pressure cutout switch in the pump housing assembly from stopping the auxiliary motor when blade angles are approximately 10° less than the feather blade angle due to pressure surges. See figure 2.

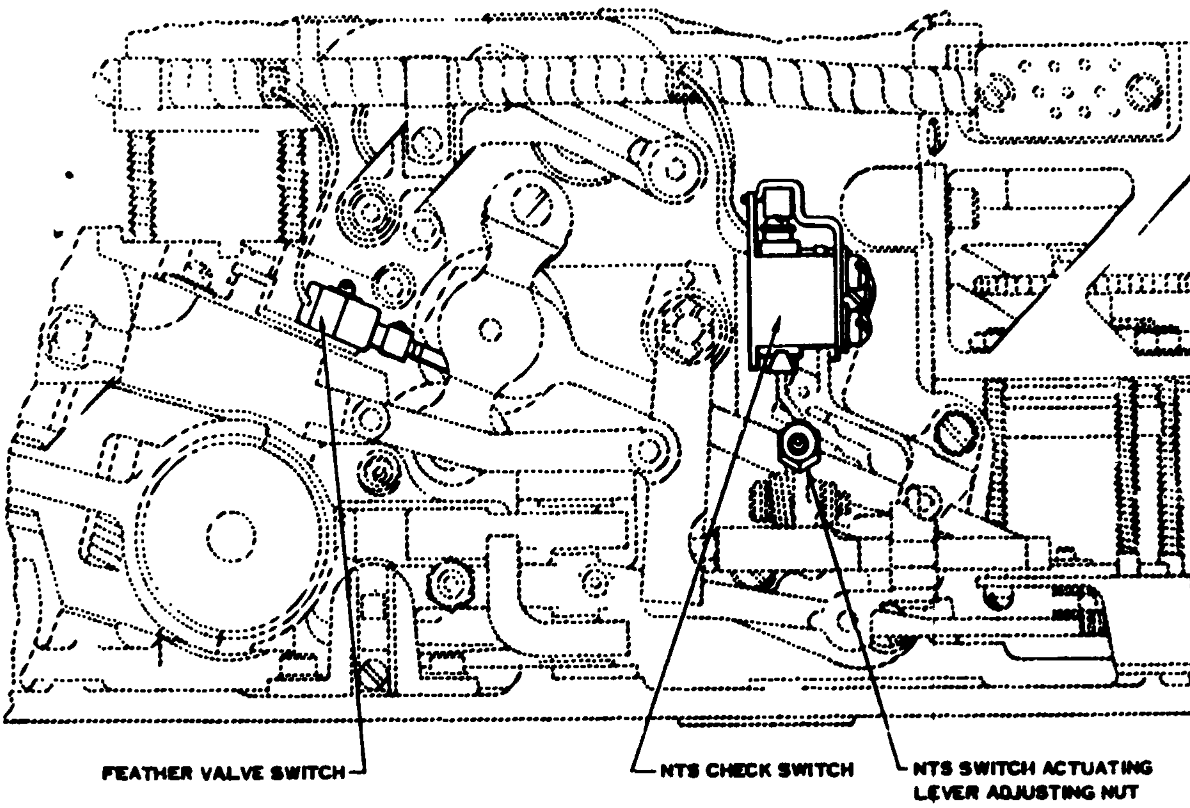
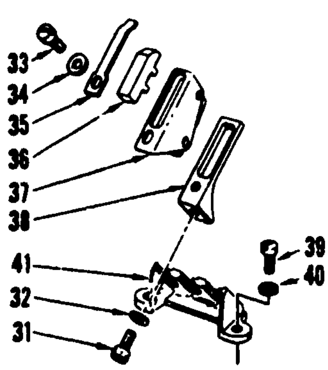


Figure 2. Valve Housing Switches and Adjustments.



31 Machine Bolt
32 Flat Washer
33 Machine Screw
34 Flat Washer
35 Insulator Retainer
36 Terminal Screw Insulator
37 Switch and Bracket Assembly
38 Switch Adjustment Bracket
39 Machine Screw
40 Flat Washer
41 Upper Switch Mounting Bracket

Figure 3. Pressure Cutout Backup Switch.

PRESSURE CUTOUT BACKUP SWITCH REPLACEMENT

I. REMOVAL

a. Remove the machine screw and flat washer that retain the insulator retainer, figure 3 #35. Remove the insulator retainer and the terminal screw insulator. Detach the two electrical leads from the terminal screws.

b. Remove the socket head cap screw and flat washer that retain the switch adjustment bracket, figure 3 #38. Remove the bracket and the switch.

II. INSTALLATION

a. Attach the replacement switch and the switch adjustment bracket to the switch mounting bracket with the flat washer and socket head cap screw. Tighten the screw snugly until the switch is adjusted.

b. Attach the purple lead from pin J of the cable assembly to the NC terminal of the switch. Attach the ground lead from the cable assembly to the COM terminal of the switch.

c. Install the terminal screw insulator, insulator retainer, and the flat washer and machine screw that retain the insulator. Tighten the screw snugly until the switch is adjusted.

d. Slightly loosen the screw that attaches the switch to the switch mounting bracket. Also loosen the switch mounting bracket adjusting screw. Adjust the switch to open when the blade angle is increased to 81-85 degrees as read on the back-up valve control cam. Overtravel of the switch lever after actuation of the switch is measured at the end of the switch lever and shall be maintained at 0.015 inch minimum. The switch lever shall not contact the switch housing at its point of maximum travel.

e. Tighten the switch mounting screws to a torque of 28.5 - 31.5 pound-inches. Tighten the bracket socket head cap screws to a torque of 34.25 - 36.75 pound-inches. Recheck the switch setting following tightening of the bracket and switch retaining screws.

QUESTIONS

Answer these questions on a separate sheet of paper.

1. Name the cam that is read for the pressure cutout backup switch adjustment.

2. How is the maximum travel of the switch lever determined?

3. After the switch is adjusted, at what blade angle should it open?

NEGATIVE TORQUE SIGNAL (NTS) SYSTEM

Negative torque is developed when the prop tries to drive the engine power section in lieu of the engine power section driving the prop. Negati torque can be caused by a quick drop-in speed or stopping of the power section, air gusts on the prop, a steep and quick fall in flight, or the wrong prop governing. When a negative torque condition exists on an engine, an uneven balance of force results.

An uneven balance of force can cause the aircraft to yaw, which is a dangerous state. It must be limited for safety of flight.

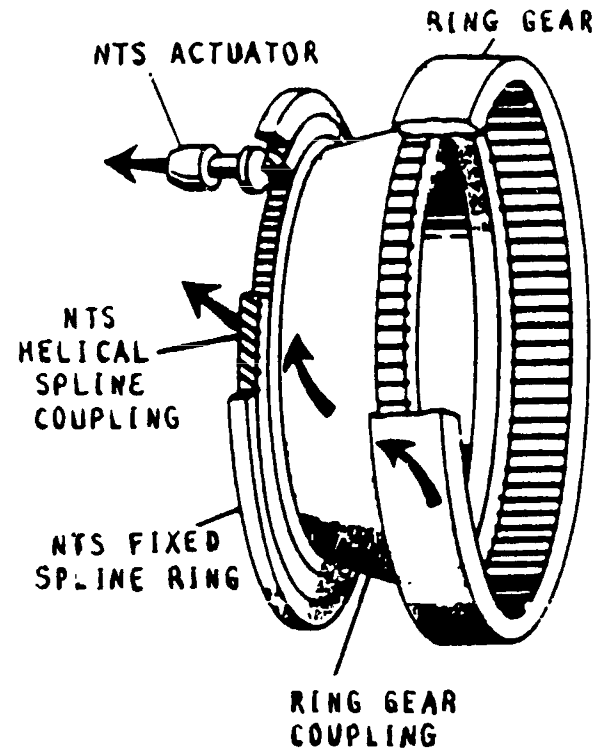


Figure 4. NTS Actuator.

When the engine has a negative torque condition, the rotational movement will cause the ring gear to move forward. This will overcome spring force and will cause the actuator rod to move forth. See figure 4.

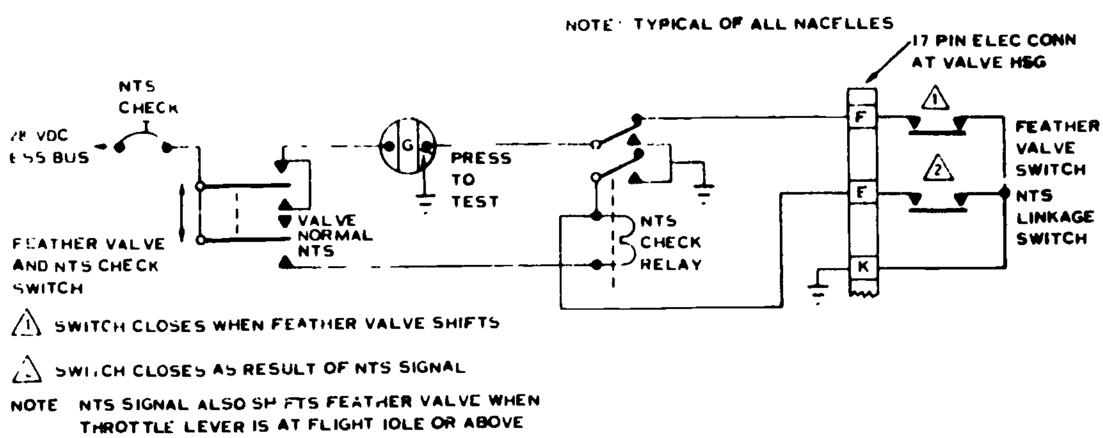
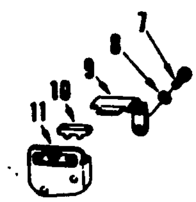


Figure 5. Feather Valve and NTS Check Schematic.

The actuator rod is mechanically linked to the prop. The mechanical linkage moves the prop control linkage to shift the feather valve for an increase in blade angle. This loads the propeller and eliminates the negative torque condition. As the negative torque condition is relieved, the actuator rod retracts. This moves the mechanical linkage from the propeller to its normal position. Thus any engine NTS signal will close the NTS linkage switch (figure 2) and provide a ground which will cause the NTS check relay to energize and close its contacts. Then, one contact of the relay provides a ground which causes the indicator light to illuminate in the flight station. The other contact of the relay provides a ground which makes the relay self-holding. Therefore, the relay remains energized and the indicator light remains illuminated after the NTS signal is removed. The above action resulting from an NTS signal occurs at any throttle lever position. See figure 5.



7 Machine Screw
8 Flat Washer
9 Insulator Retainer
10 Insulator
11 Mounting Switch and Plate

Figure 6. NTS Check Switch.

NTS CHECK SWITCH REPLACEMENT

I. REMOVAL

a. Remove the two machine screws and flat washers that retain the insulator retainer. Remove the insulator retainer and the terminal screw insulator, figure 6.

b. Detach the two electrical leads from the terminal screws and remove the NTS switch.

II. INSTALLATION

a. Attach the orange and green lead from pin E of the cable assembly to the NO terminal of the replacement NTS switch. Attach the ground lead to the COM terminal of the switch.

b. Install the terminal screw insulator, the insulator retainer, and the two flat washers and machine screws. Tighten the screws snugly until the switch is adjusted.

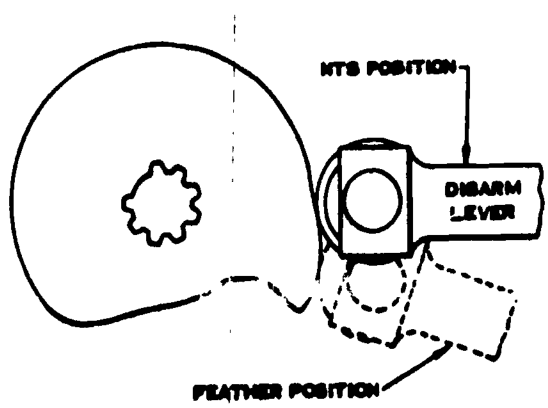


Figure 7. Disarm and Feather Cam Positions.

c. Move the input lever to rotate the disarm and feather cam to the position shown in figure 7 so that the roller is approximately half way up the rise portion of the cam. This is the approximate NTS positic .. Adjust the switch so that a continuity is obtained between pin E of the receptacle and ground. In addition to loosening the two NTS switch bracket screws and moving the switch to obtain actuation, the NTS switch actuating lever adjusting screw can be used to obtain proper switch actuation. After actuation of the switch, measure the overtravel at the end of the switch lever. Overtravel shall be maintained at 0.015 inch minimum.

d. Tighten the switch mounting screws to a torque of 14.25 to 15.75 pound-inches. Tighten the nut that locks the NTS switch actuating lever adjusting screw snugly.

ADJUSTMENT OF NTS CHECK SWITCH

The NTS check switch (figure 2) can be adjusted as follows in accordance with TO 3H1-18-2, Section V.

a. With alpha shaft anywhere in the idle position, lower the NTS switch by loosening the two mounting screws until the switch lever just touches the toe portion of the ramp on the upper switch actuating lever. Adjust actuating lever by turning screw in or out to obtain this initial position. Tighten lock screw. Then, set alpha shaft just beyond the takeoff position on the cam and adjust screw until switch actuates. Tighten lever adjusting lock screw.

b. Move alpha shaft into full feather position and check that clearance between NTS switch lever and switch housing is 0.008 inch minimum. If not, repeat step a, adjusting switch and switch actuating lever position to obtain this condition. Finally, check in the flight station to ensure NTS light switch actuates before feather light switch when advancing the alpha lever from takeoff to the full feather position.

c. When the conditions in steps a and b are satisfied, tighten all adjusting screws and lock screws and lockwire as required. Then, recheck step b to ensure lockwiring did not affect switch setting requirements.

QUESTIONS

1. What position of the cam should the NTS switch actuate?

2. What is the minimum clearance between the NTS switch lever and switch housing?

3. What is the torque of the NTS switch mounting screws?

THE FEATHER VALVE SWITCH

When the feather valve shifts (figure 2) as a result of feathering action, it closes the feather valve switch and thus provides a ground which causes the indicator light to illuminate in the flight station. Also, the feather valve can shift as a result of an engine NTS signal when the throttle lever is at flight idle or above. Thus, intermittent NTS signals will cause the indicator light to blink. See figure 5.

INSTALLATION OF THE FEATHER VALVE SWITCH

Prior to attaching feather valve switch to the valve housing, the switch lever shall be adjusted to obtain the maximum gap between the roller

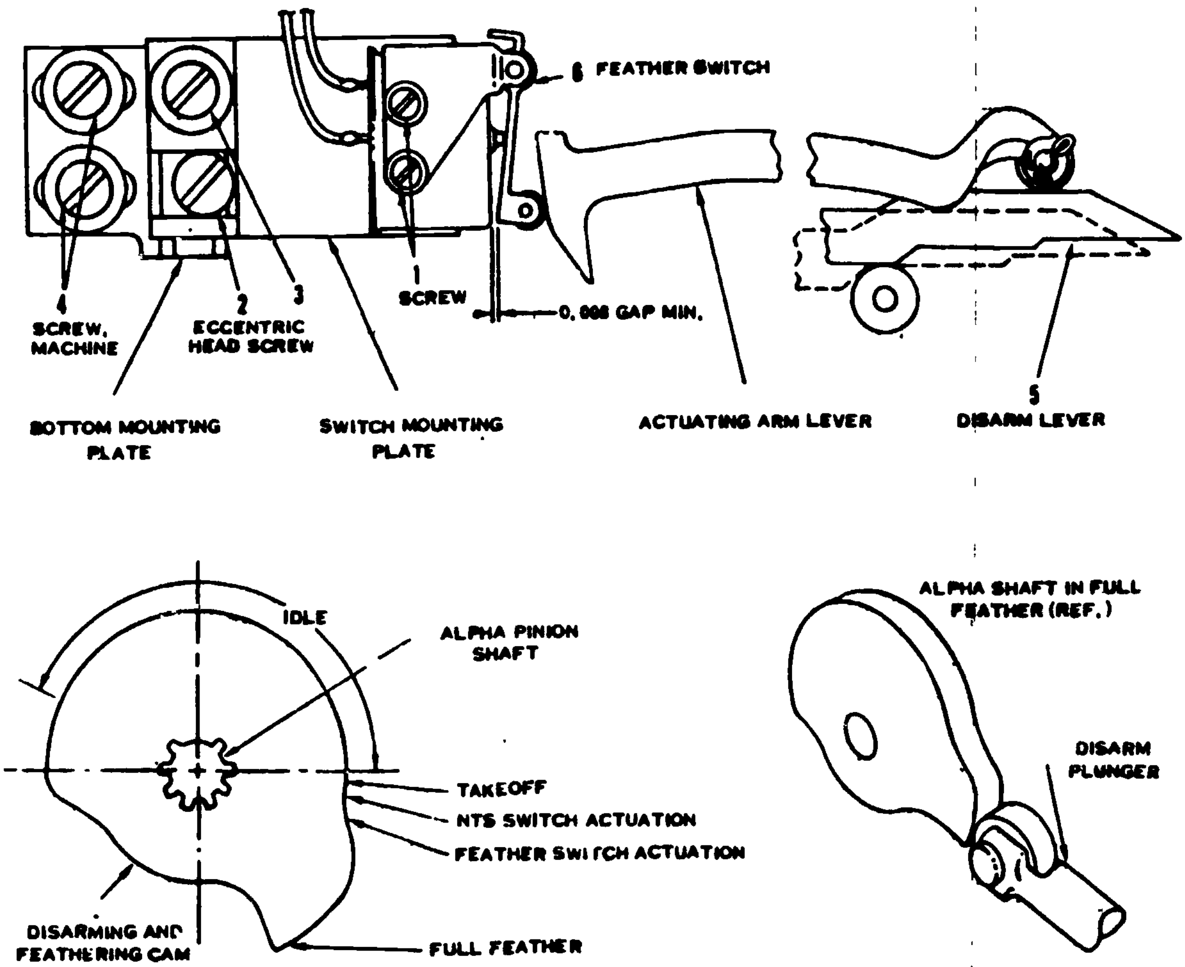


Figure 8. Adjustment of Feather Valve Switch (For Models With Feather Valve Switch Only).

end of the lever and the switch housing. This can be accomplished by loosening the two screws (#1, figure 8) which retain the switch and lever plate to the switch mounting plate and shifting the lever to obtain the maximum gap. Torque and lockwire the screws. Tighten the two screws to 5-7 pound-inches of torque. Loosen the three screws that retain the switch mounting plate and the bottom adjusting plate.

ADJUSTMENT OF THE FEATHER VALVE SWITCH

Note: Adjust the switch as follows only after the feather linkage has been adjusted.

The feather valve switch (figure 8) is adjusted in accordance with TO 3H1-18-2, Section V.

a. Adjust the top of the feather switch mounting plate by adjusting the eccentric screw (2) so that it is in the center of its travel relative to the bottom plate. Tighten the screw (3) that holds the plate together.

b. With the switch assembly installed on the valve housing and the alpha shaft in the full feather position (figure 8) move the assembly (by means of the bottom plate) toward the feather valve lever until the switch is just actuated. Then tighten the bottom plate holddown screws (4).

c. Reposition the alpha shaft to idle (figure 8) and then slowly advance s ıft so that it approachı ɜ the feather position as shown in figure 8. This position is located just before the roller goes over and rides on the constant radius portion of the cam at feather. Holding this position slightly loosen screw (3) and turn the eccentric screw (2) until the feather switch just actuates. Then retighten screw (3).

d. Move the alpha shaft into the full feather position (figure 8) and move the disarm lever (figure 8) through its full travel. Check to assure that the feather light switch lever to switch housing clearance is 0.008 inch minimum (figure 8). If not, adjust the top of the feather switch mounting plate by loosening screw (3) and turning eccentric screw (2) so that the screw moves inward. Tighten the screw (3) th t holds the plates together. Repeat steps b and c. The ı, recheck for proper earance. Repeat step d until all requirements are met.

QUESTIONS

1. What is the minimum clearance between the feather switch lever and switch housing?

2. When should the feather switch actuate on the alpha shaft?

3. What is used to adjust the top mounting plate of the feather switch?

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WB-401A
12 January 1983

COMBUSTION, TURBINE, REDUCTION GEARBOX AND TORQUEMETER ASSEMBLY CONSTRUCTIONAL FEATURES

OBJECTIVES

After completing this workbook you will be able to:

1. Identify facts about constructional features of the T56 engine combustion section.

2. Identify facts about the constructional features of the T56 engine turbine section.

3. Identify facts about the constructional features of the reduction gearbox.

4. Identify facts about the constructional features of the torquemeter assembly.

EQUIPMENT

	Basis of Issue
C3ABR42633-HO-400	1/student

PROCEDURE

Follow the directions given for each of the sections in this workbook.

COMBUSTION SECTION

INSTRUCTIONS

Complete the following statements by writing the correct word(s) in each blank space.

1. The engine has a ___ ________ _______________ type combustion section.

2. The _________ ____________ _______________ encloses the combustion liners and is the supporting structure between the

__________________ and _____________ ________________ casing.

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OPR: 3350 TCHTG
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3350 TCHTG/TTGU-B - 500; DAV - 1

Designed for ATC Course Use. Do Not Use on the Job.

3. Two __________ __________ __________ are mounted on the bottom of the outer combustion casing.

4. The burner drain valves are __________ __________ open.

5. The __________ __________ __________ __________ slips inside the inner combustion casing.

6. The inner combustion casing supports the combustion liners during __________.

7. __________ and __________ oil tubes are routed inside the inner combustion casing.

8. Two __________-__________ type seals prevent __________-__________ leakage at the slip joint.

9. The forward end of each combustion liner is supported by a __________ __________ and the aft end by the __________ __________ __________.

10. __________ tubes interconnect the six liners.

11. The __________, or mixing section of the combustion liner is at the __________ end.

12. Corrugated strips are welded around the liner and form __________ through which air enters.

13. The __________, or dilution, section controls the __________ pattern within the liner.

14. The __________ section forms the rear part of the combustion liner.

TURBINE SECTION

INSTRUCTIONS

Complete the following statements by writing the correct word(s) in each blank space.

1. The engine has a __________-__________ turbine assembly.

2. The turbine section is made of __________.

3. The turbine inlet casing houses the ____________ ____________ stator vanes and supports the turbine ____________ ____________.

4. The turbine inlet casing has mounts for the engine ____________ ________________ device.

5. The turbine vane casing supports the ____________ ____________ and ________________ stage stator vane assemblies.

6. ____________ ______________, one for each segment, fit into notches machined in a flange on the inside of the case.

7. On the inner rim of each segment are ______________ __________ which are positioned close to the turbine rotor __________ ___________.

8. The __________-___________ segments have overlapping lips which mate with the ________________-________________ segments.

9. The locating keys prevent ____________ of the third and fourth stage stator vane assemblies.

: The turbine rear bearing support supports the turbine rear beari , the turbi e ____________ ______________ ______________ and the inner ____________ ____________.

11. _________________ struts support the turbine rear bearing assembly.

12. The turbine rotor assembly consists of four ________________ ______________ and three ____________ ______________ held together by eight ___________ ______________ ______________.

13. A ____________ __________ ___ is used to position and hold the turbine rotor to the __________________.

14. The ______________ and ______________ stage turbine blades have a tip, which when all blades are installed forms a _______________.

15. The assembly of ______________ and ________________ hold the ________________ in place when the tie bolts (8) are installed.

16. The close tolerances between the __________ wheels and the __________ __________ of the stator vane assemblies form __________ seals which keep the combustion gas from leaking from one stage of the turbine into another stage.

TORQUEMETER ASSEMBLY AND COMPONENTS

INSTRUCTIONS

Complete the following statements by writing the correct word(s) in each blank space.

1. The torquemeter assembly connects the engine to the __________ __________ assembly and measures engines __________ (__________).

2. The safety coupling is mounted on the reduction gear assembly __________ __________ __________ __________.

3. A second shaft is fitted over the __________ shaft.

4. A __________, located at approximately mid point of the __________ assembly, is used to support and stabilize these shafts.

5. During assembly, the torque shaft is bolted to the __________ __________.

6. After the torquemeter housing has been bolted to the air inlet housing, the __________ __________ are installed.

7. The main parts of the safety coupling are the __________ __________, the __________ __________, the __________ __________ and __________ __________.

8. The intermediate member joins the inner and outer members by use of __________.

9. Four __________-__________ __________ hold the intermediate member to the inner member.

REDUCTION GEAR ASSEMBLY

INSTRUCTIONS

Complete the following statements by writing the correct word(s) in each blank e.

1. The ______________ stage of reduction is made by a __________ gear meshed to a larger gear called the ___________ _______________ gear.

2. The first stage reduction gears are located at the bearing __________________.

3. The ________________ gear is bolted to the ___________ ____________ gear.

4. The sun gear meshes with the _____________ ________________ gear.

5. The five plant gears the mesh with the sun gear also mesh with a __________-________________ ring gear.

6. The ____________ gear has more than _____________ times as many teeth as the ________________ gear.

7. The second stage reduction changes the speed by a ratio of _______________.

8. Only the ____________ actuator rod is used on the engine because the ___________ propeller control is located on ____________ for this installation.

9. The _______________ _________________ does not rotate in the reduction gear assembly.

10. The propeller brake is a ___________-_____________ type.

11. The starter shaft is machined so that its _________________ acts as a _______________ inside the brake outer member.

12. The brake ____________ and ________________ springs are saucer shaped.

13. The size and number of ___________________ on the gears determine the __________________ for each accessory.

14. The accessories driven by the reduction gear assembly are __________ ______________, ____________ ____________ ______________, ___________ _______________ and _____________ __________ _____.

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-SG-504
29 October 1982

ENGINE REMOVAL

OBJECTIVE

After completing this study guide and your classroom instruction, you will be able to identify facts relating to engine removal.

INTRODUCTION

For this part of the lesson, your class will remove an engine on the C-130 engine change trainer. Although this lesson will be limited to this type of aircraft, the job of engine removal is similar on most aircraft. Keep in mind, you must always use the specific organizational maintenance manual for the type, model, and series of aircraft you are going to work on.

INFORMATION

When doing work on the aircraft and engines, adequate planning should include the inspection of all the equipment, tools, materials, and the work area to be used during the job.

SAFETY

Aircraft Forms

Performing work on the C-130 aircraft, or any type aircraft, you must first review the aircraft AFTO Form 781 forms to make sure that the work you are going to do will not endanger the safety of the aircraft, yourself, or other people.

Aircraft Grounding

When you have checked the aircraft forms and before beginning the work, make sure that the aircraft is properly grounded. When you are working on the C-130 aircraft, two ground wires are required. One is located at the nose just aft of the nose radome, and one is at the single point refueling (SPR) panel, which is found on the right aft side of the aircraft just forward of the paratroop door.

Fire Extinguisher

Make sure that a fire extinguisher is placed near easy access of your work area. Check the extinguisher for serviceability and proper charge. Check the fire extinguisher operational steps with all members of the engine change team. Coordinate with other members so that they are aware of what action they are to take in case of an emergency. Remember, the safety of the aircraft and the lives of all the personnel depend on quick, coordinated response.

Supersedes 3ABR42633-SG-503, 13 May 1981. RGL: 9.25
OPR: 3350 TCHTG
DISTRIBUTION: X
3350 TCHTG/TTGU-B - 200; DAV - 1

Maintenance Stands

The most commonly used maintenance stands for C-130 engine removal and installation are the B-1 and B-5. All the stands used on the flight line are required to have at least two serviceable wheel locks. It is a good maintenance practice to lock all the available wheel locks before you go up a maintenance stand. You must check the equipment records, AFTO Form 244 (System/Equipment Status Record), and perform an operator's inspection to make sure it is serviceable prior to use. When raising the B-1 and B-5 stands, be careful not to extend them past the maximum height limitation. The maximum extension for a B-1 stand is when the lifting ram is at a 45° angle or the base of the platform is 10 feet from the ground. The maximum extension for a B-5 stand is when the base of the platform is 15 feet from the ground. When the stand is at the desired height, put in the safety lock. For the B-1 stand, use the ramlock, and on the B-5 stand use the two platform pins, one on each side just forward of the platform rollers. Do not remove the handrails unless it is necessary to do the job. Do not stand or sit on the handrails at any time. Use caution when on the stands, they can become slippery when wet. Wipe off all spilled hydraulic fluid and oil from the platform and ladder immediately. When lowering the stands, take out the safety locks and slowly release the hydraulic pressure so that the platform comes down in a slow, steady manner. If you lower the platform too fast, it could cause the hydraulic seals on the lifting ram to rupture. Use extreme caution when positioning the stands near the aircraft to prevent damage to the engine and the aircraft surfaces.

Support Equipment

Prior to using the support equipment, you must check the equipment records, AFTO Form 244, and perform an operator's inspection to determine the condition and serviceability of the unit. The most commonly used support equipment for the removal and installation of a T56 engine are the J1-B hoist, engine buildup and transportation truck, and the engine nacelle sling.

Handtools

All the handtools that are used for engine change can be found in the mechanic's toolkit. You must keep the tools in good condition, broken tools should be replaced as soon as possible and do not use them for any job. When selecting the tools, use the right tool for the job. Do not use a tool for a task other than what it was made for. (Example: Do not use a screwdriver for a punch or chisel.) To avoid injury, never place or carry handtools in your pockets. If safety wire must be removed, remember to cut the wire; do not try to break the wire. When cutting safety wire, hold the loose end of the wire or place your free hand over it to prevent eye injury.

Safety Precautions

Good planning and the observance of all the safety rules and the technical order "CAUTIONS" and "WARNINGS" can prevent damage to the equipment and injury to personnel.

PREPARATION FOR ENGINE REMOVAL AND INSTALLATION

The speed and ease with which you complete an engine installation or removal will depend on how well you prepare for the task prior to arriving at the job site.

Technical Data

The TOs that you will need for the installation and removal of a T56-A7 engine on a C-130 aircraft: 1C-130B-2-4, has the steps for the engine installation and removal; 1C-130B-10, has the information on the quick engine change (QEC) kit; 1C-130B-2-2, has the information for the grounding of the aircraft and servicing of the engine; and 1C-130A-6, which has the special inspection requirements.

Special Tools

The special tools that you will need are listed in the organizational maintenance technical order, aircraft -2. Check all special tools for their condition and serviceability prior to arrival at the job site.

Torque Wrenches

Since a variety of torque ranges are used for engine installation, your selection of torque wrenches should include a 1/4 inch drive, 3/8 inch drive, and a 1/2 inch drive. Do not use a torque wrench if it has been dropped or if it is overdue on its calibration date.

Caps and Plugs

All engine pneumatic lines, fluid lines, and electrical connectors must be covered as soon as they are disconnected, as well as the engine inlet and exhaust. You must take sufficient caps and plugs to the job site.

Waste Containers

When it is possible, use a rubber bucket to catch the fuel and oil from the disconnected lines. If it is necessary to use a metal bucket, the bucket <u>must</u> be grounded due to the hazard of static electricity. Try not to mix oil and fuel together. Use separate buckets. This is necessary because all fuel and oil waste can be sold by the Air Force to recycling agencies. Separate bowsers are used in the maintenance areas for the purpose of depositing fuel and oil waste to the recycling agencies.

FOD Containers

Some containers should be taken to the job site to place trash: cut safety wire, cotter pins, etc.

Rags

Rags should be available to wipe up spills.

Support Equipment

Preposition all the necessary support equipment at the job site.

T56 ENGINE REMOVAL AND DOCUMENTATION

T56-A7 engine removal steps are found in TO 1C-130B-2-4. No deviations are authorized from these steps.

Entries <u>must</u> be made in the aircraft forms (AFTO Form 781) to reflect that the engine has been removed. You must make entries in the aircraft forms for special inspections that are required prior to engine installation and Job Control must be told of these entries.

An AFTO Form 350 tag (Reparable Item Processing Tag) must be filled out and placed on the removed engine. When you are done with the engine removal, fill out an AFTO Form 349 (Maintenance Data Collection Record) and tell Job Control of your job status.

FOD PREVENTION

Foreign object damage is the main enemy of all aircraft jet engines. The prevention of damage to jet engines by FOD is everyone's job. Tool boxes must be inventoried prior to and after each job to make sure that all the tools are accounted for. Clean up your area when you are done with the job and put all waste materials in the appropriate dispensers.

QUESTIONS

1. What is the first thing to check before starting to remove the engine?

2. Where should the ground wires be located on the aircraft?

3. What is the form used to check the serviceability of support equipment?

4. When can the handrails be removed from the maintenance stands?

5. What is the best way to prevent damage to equipment and injury to personnel?

6. What TO will you need to find the steps on engine removal and installation?

7. When should a torque wrench not be used?

8. What type of container should you use to drain fuel?

9. Why should you <u>not</u> mix your waste oils and fuels together?

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WB-502
17 January 1983

SYNCHROPHASER OPERATION

OBJECTIVE

After completing this workbook and your assignment, you will be able to identify facts relating to synchrophaser arrangement and operation.

EQUIPMENT

	Basis of Issue
C3ABR42633-HO-500	1/student

DIRECTIONS

Locate information in the handout reading assignment and give the correct response for the blank spaces in the following questions.

1. All multi-engine, propeller-driven aircraft have beat noise which is produced by propellers rotating __________ ____________ or bv propellers rotating ____________ ________________ but with ______________________________.

2. The synchrophasing system has greatly reduced ______________ ______________.

3. Synchrophasing, in addition to keeping the propellers at ______________, maintains a ______________________ that yields minimum noise.

4. The synchrophaser is used in the ____________ range.

5. Either propeller __________ or ______________ may be used as master propellers.

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OPR: 3350 TCHTG
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3350 TCHTG/TTGU-B - 500; DAV - 1

Designed for ATC Course Use. Do Not Use on the Job.

6. The synchrophasing system consists of the following:

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

7. There are three sets of control switches:

a. ______________________________

b. ______________________________

c. ______________________________

8. The two positions of the prop governor control switches are ____________________ and ____________________.

9. The ________________ position of the prop governor control switches ____________________________ the synchrophasing system.

10. The prop resynchrophase switch selects either ___________ or __________________ and is used during __________________ and ______________________ procedures.

11. The fuel governin, check switches are used to reset the propeller governor to ____________ in the ________________ __________. This allows the engine speed to be _____________ to check the ________________ governor operation.

12. Below flight idle, the ________________ switch, opens the circuit that supplies the _____________________ for the speed _____________________.

13. During normal governing operation, the ________________ __________________ circuit stabilizes the propeller during __________________ movements. It functions only in the ____________________ range during ____________ governing or ______________________ mode of operation.

14. To add sy-.'hrophasing to the normal governing mode, the

________________ -______ switch is placed in ________________

or ________________ position.

15. The main components of the propeller synchrophaser system are:

a. ________________________________

b. ________________________________

c. ________________________________

d. ________________________________

16. Each pulse - generator unit consists of a ______________

mounted on the propeller ____________________ and a

________________ mounted on the ____________________

which rotates with the propeller. Each time the propeller makes a

complete ________________, the magnet passing the coil induces

a ________________ of voltage.

17. The synchrophaser power required by the system is:

a. ________________ AC

b. ________________ DC

18. The ____________________, located on the copilot's

side panel, is used to set the ________________ of each ________

propeller in relation to the ____________________ propeller.

19. A ________________ knob is located on the center

of the ____________________. The ________________

of the selected master propeller may be __________ or __________

about ________________ by rotating the knob.

20. The slave propellers can only follow the master a total of

____________ rpm.

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-WS-508
20 December 1982

ENGINE ADJUSTMENTS

OBJECTIVE

After completing this worksheet and your TO reading assignment, you will be able to identify facts relating to engine adjustments.

EQUIPMENT

	Basis of Issue
TO 1C-130B-2-4	1/student

PROCEDURE

Locate information in the TO reading assignment and give the correct response in the blank spaces for the following statements.

1. Adjust the temperature datum valve ____________ ____________ only when it is necessary to obtain the desired starting temperature of ____________ to ____________.

2. If fuel control is ____________ and starting temperatures are above ____________ adjust temperature datum ____________ ____________ to ____________ temperature.

3. When adjusting null orifice a ____________ temperature change will be obtained from each ____________ ____________ of adjustment.

4. High starting temperature may be caused by ____________ ____________ ____________ ____________, ____________ ____________ ____________ ____________ ____________, ____________ ____________ ____________ ____________, ____________ ____________ or ____________ ____________.

5. The worm shaft is located on the ____________ side of the ____________.

6. DO NOT remove the ____________ ____________ from the fuel control body under any circumstance.

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Designed for ATC Course Use Do Not Use on the Job.

7. Turn the worm shaft __________ to __________ the fuel governor cutout speed and __________ to decrease fuel governor cutout speed.

8. After final adjustment, __________ the __________ and __________ __________ with lockwire.

9. While the engine is operating with the throttle at __________ __________ and the __________ __________ __________ __________ button pushed in, engine speed should be __________ to __________ percent rpm as indicated on the __________ __________.

10. The worm screw is held in __________ with the __________ __________ by the cotter pin safety nut.

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-SG-5053
28 October 1982

ENGINE INSTALLATION

OBJECTIVE

After completing this study guide and your classroom instruction, you will be able to identify facts relating to engine installation.

INTRODUCTION

For this part of the lesson, your class will install a T-56 engine on the C-130 Engine Change Trainer. Keep in mind, you must always use the specific organizational maintenance manual for the type, model, and series of aircraft you are going to work on.

INFORMATION

T56 ENGINE INSTALLATION

Prior to beginning the installation, you must check the aircraft forms to make sure that all the special inspections have been done and documented. Visually inspect the engine to be installed and the aircraft engine bay area to make sure that there are no discrepancies, which would cause the engine to be removed.

Installation Procedures

The steps for the T-56-A7 engine installation can be found in TO 1C-130B-2-4. No deviations from these procedures are authorized.

Install the power package in reverse order of removal, except install the upper mounting bolts first and then the lower bolts. Both the lower and the upper mounting bolts will have to be magnafluxed prior to reuse. When using the 341663 torque wrench adapter to torque the lower mounting bolts use the right formula to find the torque to be set on the wrench

Documentation

Proper documentation of a completed job is as important as the task itself. Once the installation of the engine is done, you must clear the discrepancies concerning the engine removal in the aircraft forms. An engine that has just been installed will also require: an engine inlet, inspection prior to the next engine start, IAW TO 00-20-5: an engine runup to operationally check the engine systems, IAW TO 1C-130B-2-4; and some special inspections as shown in TO 1C-130A-6. These entries must be placed in the aircraft forms prior to leaving the job site. Fill out an AFTO Form 349 (Maintenance Data Collection Record) and tell Job Control of your job status.

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RGL: 10.1

FOD PREVENTION

Foreign object damage is the main enemy of all aircraft jet engines. The prevention of damage to jet engines by FOD is everyone's job. Tool boxes must be inventoried prior to and after each job to make sure that all the tools are accounted for. Clean up your area when you are done with the job and put all waste materials in the appropriate dispensers.

QUESTIONS

1. What is the main enemy of all aircraft jet engines?

2. Prior to beginning the engine installation, what must be checked?

3. Both lower and upper mount bolts will be ______________ prior to reuse.

4. What TO is used to find steps for T-56 Engine Installation?

SERVICE TEST
STUDY GUIDE
C3ABR42633-SG-504

Technical Training

Turboprop Propulsion Mechanic

ENGINE MECHANICAL CONTROL SYSTEM

4 November 1982

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air force Base, Illinois

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

RGL: 10.4

ENGINE MECHANICAL CONTROL SYSTEM

OBJECTIVE

After completing this study guide and given classroom instruction, you will be able to identify facts on the operation and arrangement of the engine mechanical control system.

INTRODUCTION

As a turboprop mechanic you will learn the importance of engine rigging procedures and be able to maintain an important part of the turboprop power plant that provides control of the engine and propeller. This control must be correctly rigged from the cockpit to the engine and to the propeller.

INFORMATION

This lesson has all the information you will need to know about the engine rigging in accordance with the steps that are found in TO 1C-130B-2-4.

THROTTLE CONTROL SYSTEM

Each of the throttle levers in the control quadrant is linked mechanically by cables, rods, and levers to a throttle shaft of the engine control coordinator on the corresponding engine, as shown in figure 1. A throttle output lever on the right side of the coordinator is linked by mechanical linkages to a throttle lever on the engine fuel control. A propeller output lever on the left side of the coordinator is linked to the coordinator throttle shaft, and is joined by linkages to the input shaft on the propeller. A movement of the throttle lever is transmitted through the linkages and the control coordinator, to cause a corresponding movement of both the fuel control throttle lever and the propeller input shaft. The forward and aft positions of the flight station throttle lever are TAKEOFF and MAXIMUM REVERSE, respectively, as shown in figure 2. When moved aft from the TAKEOFF position, the lever hits a gate at the FLIGHT IDLE position; it must be lifted over the gate to be moved into GROUND IDLE and MAXIMUM REVERSE. Pointers on the coordinator shaft and the fuel control throttle lever show their positions in degrees. The two should be within 1 degree of each other at all times. Each of the throttle positions and coordinator positions should read as follows:

Supersedes 3ABR42633-SG-504, 24 June 1981.
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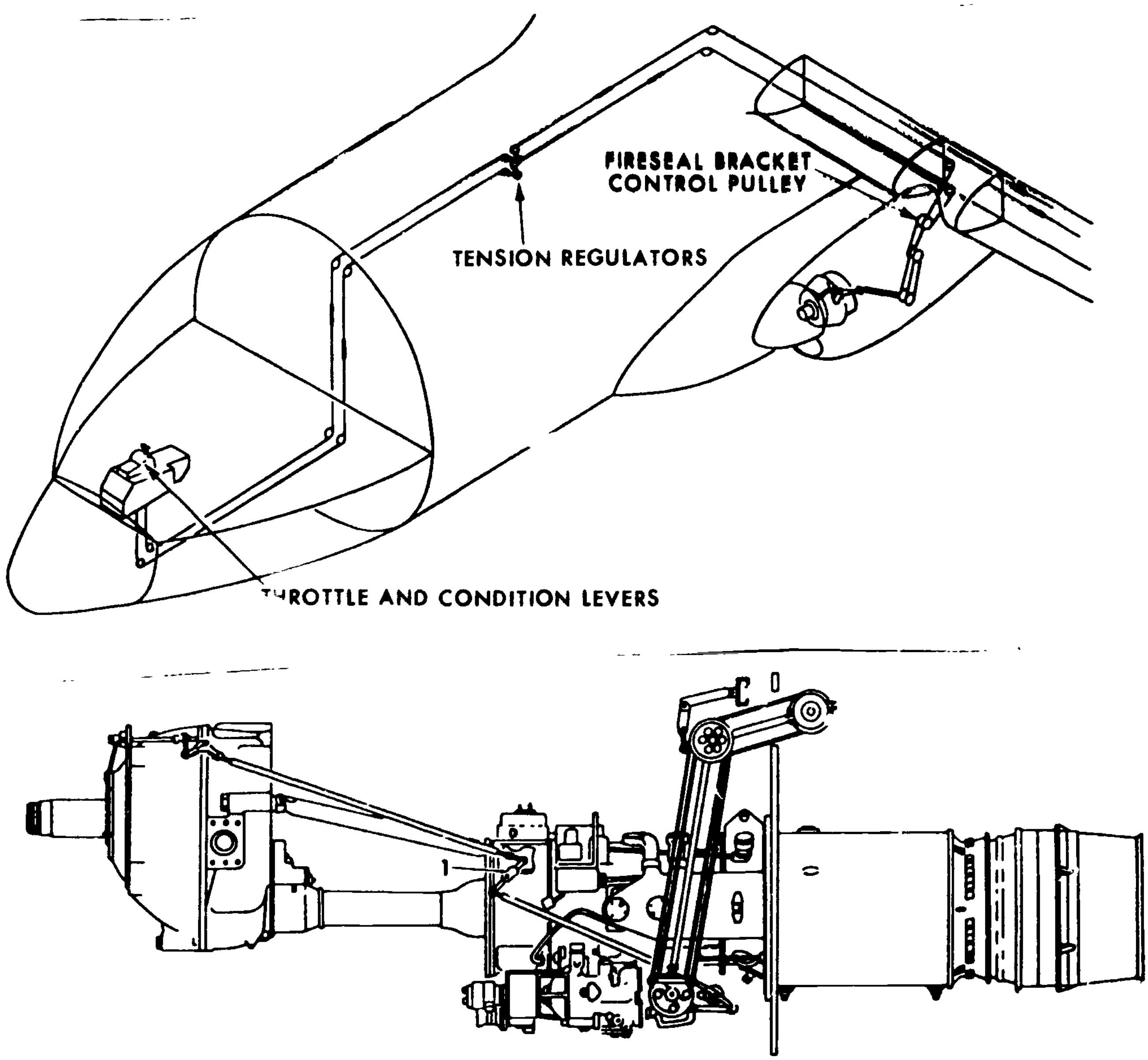

Figure 1. Aircraft and Engine Mechanical Controls.

THROTTLE POSITIONS	COORDINATOR POSITIONS
TAKEOFF	90 degrees
FLIGHT IDLE	34 degrees
GROUND IDLE	18 degrees
MAXIMUM REVERSE	0 degrees

When the throttle is below FLIGHT IDLE (34 degrees on the coordinator) in the taxi range, propeller pitch is controlled directly by the position of the throttle. In this way, the thrust and horsepower produced by the engine are controlled by positioning the throttle. Engine fuel flow in this range is controlled by the throttle position and by the governing action of the fuel control.

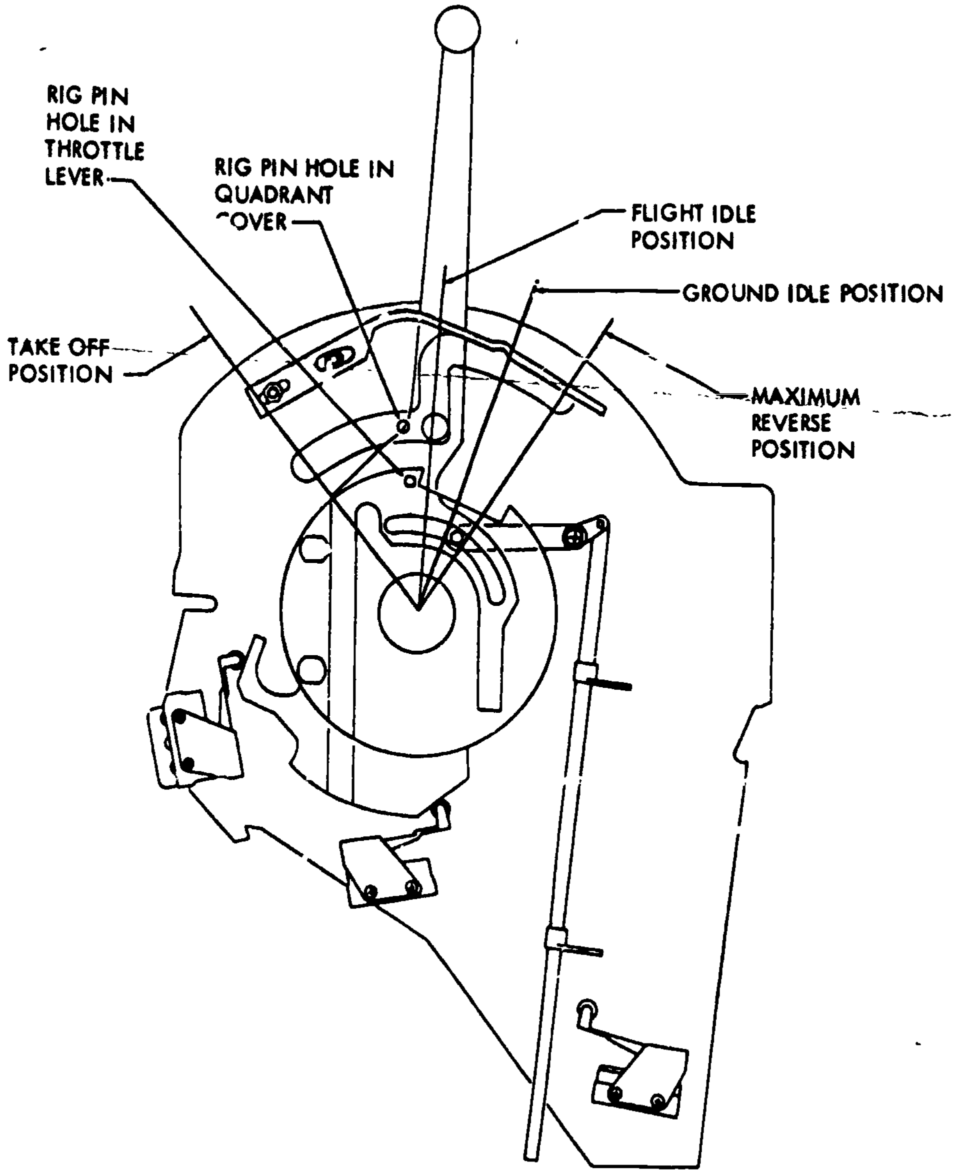

Figure 2. Control Quadrant Throttle Lever.

When the throttle setting is in the range of FLIGHT IDLE or TAKEOFF (34 and 90 degrees, respectively, read on the coordinator), the propeller pitch is controlled by the propeller governing system to hold a 100% engine speed. The low pitch stop is limited to 23.25 degrees for the 54H60-91 propellers on the C-130E airplanes. As a result, the engine speed will not be 100% rpm when the throttle is between 34 and 60 degrees (read on the coordinator) during ground operation because the engine will not put out enough power to keep 100% rpm at this blade angle. The power put out by the engine is controlled by the fuel control which sends fuel flow to the engine according to the throttle position. With the throttle set above 65 degrees, the electronic temperature datum control can control the engine power by altering the fuel flow as is needed to hold the turbine inlet temperature scheduled by a temperature selected potentiometer in the coordinator. The temperature selector potentiometer and the two micro-switches in the coordinator are controlled by the movement of the throttle.

QUESTIONS

1. What are the four throttle positions and their corresponding coordinator position readings?

2. How is thrust and horsepower produced by the engine controlled in the taxi range?

3. On the 54H60-91 propeller, what is the low pitch stop limited to above the flight idle range?

4. How is power produced by the engine controlled in the flight range?

ENGINE CONDITION CONTROL SYSTEM

Each of the condition levers in the control quadrant is linked mechanically by cables, rods, and levers to a feather shaft in the coordinator, as shown in figure 1. The feather shaft is in line with the coordinator throttle shaft and sticks out from the right side of the coordinator. These linkages that are connected from the engine condition lever give you a feathering system that is manual. When the condition lever is pulled aft to the FEATHER position, the linkage from the coordinator feather shaft to the fuel control cuts off the fuel shutoff valve. The feather shaft then engages the propeller output lever on the coordinator and turns it. The propeller output lever sends the motion through the propeller control linkages to move the input shaft on the propeller to the feather position. The throttle shaft in the coordinator is disengaged from the propeller output lever when the feather shaft engages the lever.

Each of the engine condition levers also operate four switches in the engine control quadrant. These are shown in figure 3. One of these is an air start switch which is turned on when the lever is held in the AIR START position. Actuation of the switch causes operation of a relay which puts power to the auxiliary pump motor of the propeller. Two feather switches are actuated at the same time that the lever is moved to FEATHER. One switch closes the propeller auxiliary pump motor and feather solenoid valve control circuits. The other closes a circuit to energize a fuel shutoff valve actuator in the engine fuel control and opens the engine start control circuit. A ground stop switch is actuated when the lever is moved to GROUND STOP. This switch completes a circuit to energize the fuel shutoff valve actuator in the fuel control.

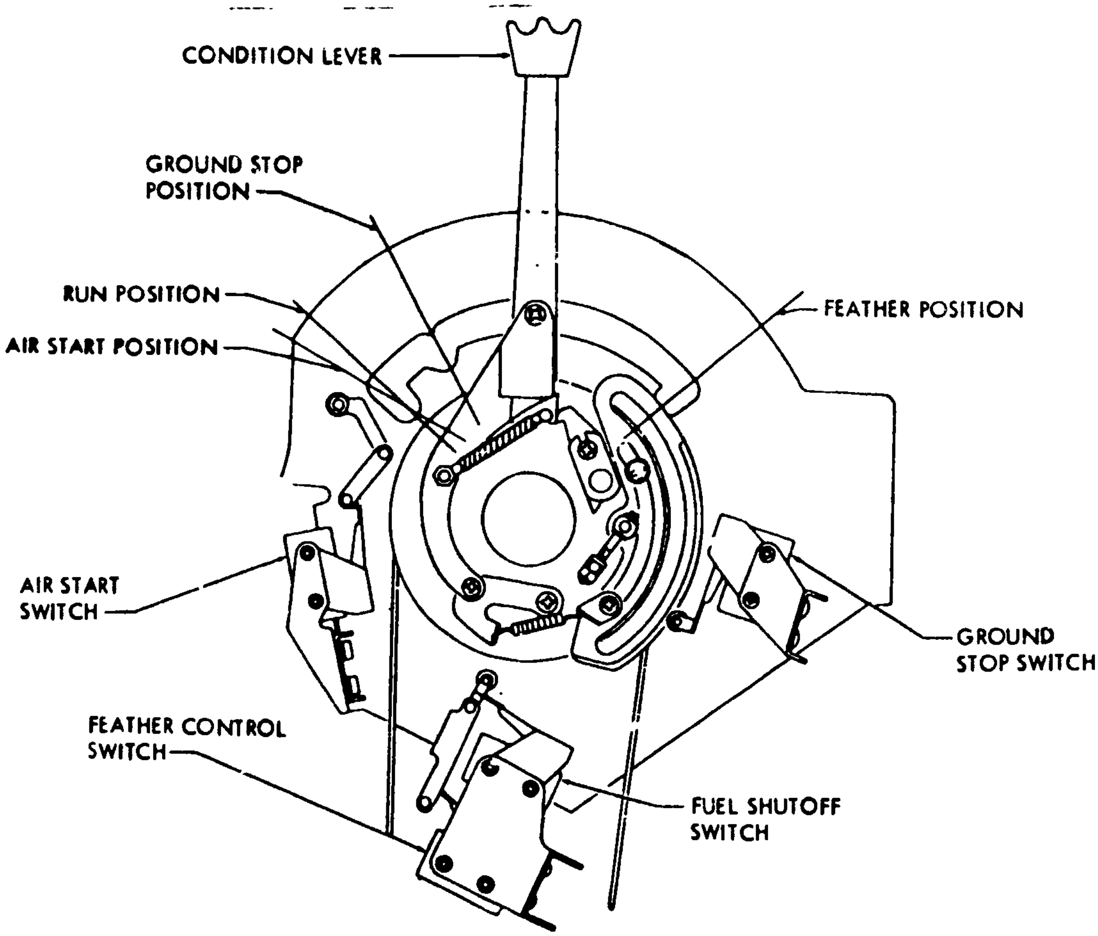

Figure 3. Control Quadrant Condition Lever.

QUESTIONS

1. What are the four positions of the engine condition lever in the cockpit?

2. What are the four switches operated by the condition lever?

SERVICE TEST
STUDY GUIDE

C3ABR42633-SG-505

Technical Training

Turboprop Propulsion Mechanic

PROPELLER RIGGING AND ADJUSTMENTS

8 November 1982

CHANUTE TECHNICAL TRAINING CENTER (ATC)
3350 Technical Training Group
Chanute Air Force Base, Illinois

Designed for ATC Course Use.
Do Not Use on the Job.

RGL: 9.1

ATC FORM 214 (JAN 76) OBSOLETES ATC FORMS 214, MAY 69, 522, NOV 63 AND 523, MAY 71. STANDARD COVERSHEET

SERVICE TEST

Maintenance Training Branch C3ABR42633-SG-507
Chanute AFB, Illinois

PROPELLER RIGGING AND ADJUSTMENTS

OBJECTIVE

After completing this study guide, classroom instruction, and with the aid of selected technical orders, you will identify facts on the rigging and adjusting the propeller control system.

INTRODUCTION

Rigging, to a propeller repairman is a term used to define the procedures of adjusting the control linkage from the fuel coordinator to the propeller turbocontrol. Rigging is necessary to insure that the propeller blade angle corresponds to the amount of fuel being fed to the engine. Rigging of the propeller linkage must be accomplished if any of the following items are replaced: propeller, a valve housing, a turbocontrol or an engine. Other adjustments to be made on the installation will be discussed in this study guide. They are NTS bracket clearance, pulse generator gap, and valve housing adjustments.

Rigging

To insure that the engine maintenance personnel have the engine properly rigged from the cockpit to the coordinator, you will check the coordinator pointer position for all throttle positions. With the throttle at takeoff the coordinator will read 90°. At flight idle the coordinator will read 34° and with the throttle at reverse the coordinator will read 0. (See figure 1, Detail A). The condition lever must be in the "run" position to place the coordinator as it will be during flight or with the engine running.

A system of cables and pulleys connect the throttle and condition lever to the fuel coordinator. Pushrods and bellcranks make up the linkage that connect the coordinator to the propeller turbocontrol. (See figure 1.) The pushrods can be shortened or lengthened to insure proper positioning of the input shaft (Alpha shaft) on the turbocontrol valve housing. The use of rig pins and rig pin holes in the linkage make it possible for the mechanic to adjust the linkage to correspond to the throttle position. (See figure 1, Detail B and C).

To rig the propeller you will first place the condition lever in "run." Then the throttle will be placed at the flight idle position. If the linkage is correctly adjusted, ou will be able to install rig pins in the linkage holes shown in figure 1, Detail B and C, in the indexing plate shown in figure 1, Detail C and in the alpha shaft inside the valve housing. If the rig pins cannot be installed in the linkage rig pin holes, the push rods will be adjusted to correctly align the holes. If the rig pin cannot be installed in the alpha shaft inside the valve housing, the micro adjusting ring on the alpha input shaft must be adjusted.

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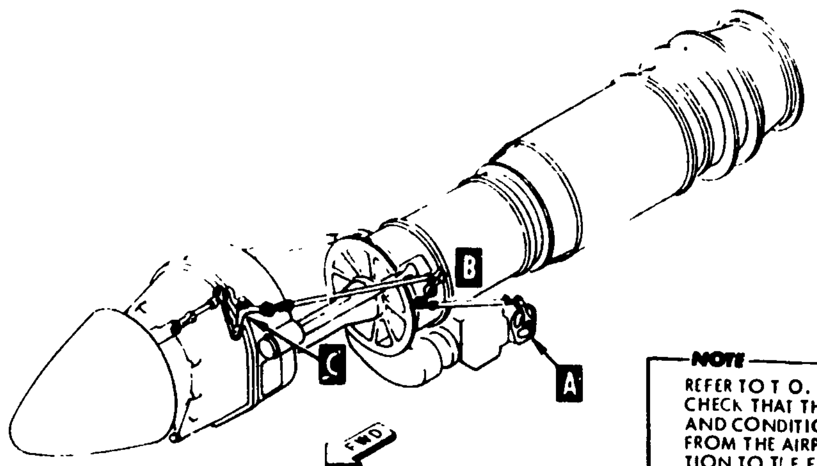
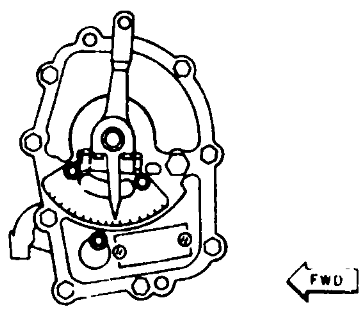


Propeller Control Linkage from Fuel Coordinator to Propeller Turbocontrol.

NOTE

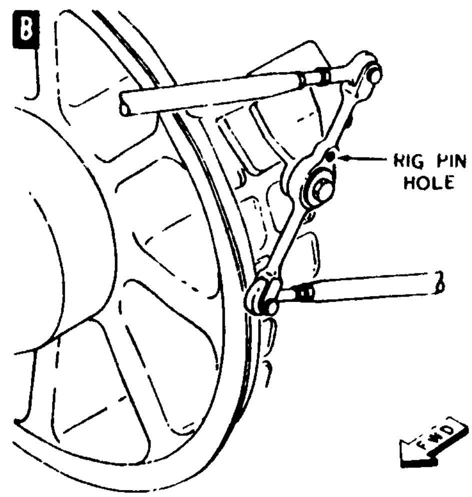
REFER TO T O. 1C-130B-2-4 AND CHECK THAT THE ENGINE THROTTLE AND CONDITION LEVER CONTROLS FROM THE AIRPLANE FLIGHT STATION TO THE ENGINE COORDINATOR ARE PROPERLY RIGGED.

A



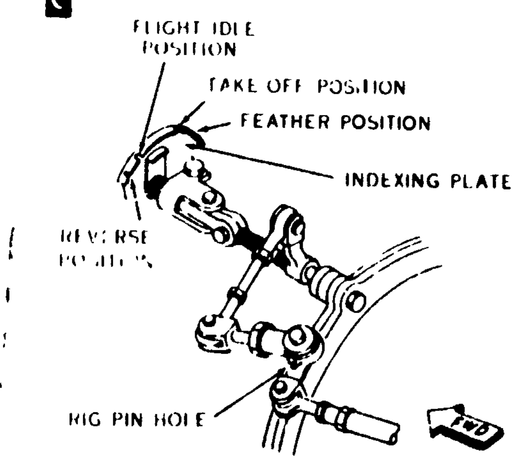
Fuel Coordinator at 34°
(Flight Idle)

B



Engine Bellcrank and Control Linkage (Pushrods)

C



Engine Nose Section to Valve Housing Linkage.

Figure 1. Propeller Control Linkage

When all rig pins can be installed at flight idle they will be removed and the throttle placed at takeoff. The input shaft should align with the indexing plate to allow rig pin installation. If it does not align, again, the pushrods must be adjusted. The same procedure will be performed for feather and reverse. The propeller linkage is correctly rigged when rig pins can be installed for the flight idle, takeoff and reverse positions of the throttle, and when the condition lever is placed in the feather position.

Valve Housing Change

A propeller malfunction caused by an inoperative component on the turbocontrol valve housing will be corrected by replacing the complete valve housing.

Valve housings can be interchanged from one control assembly to another.

Prior to removing the valve housing, you will place the condition lever in the air start and the throttle in ground idle. This will operate the propeller to ground idle. Then the electrical connections will be disconnected from the control assembly.

Note: The electrical power must be turned off before removing the electrical connections to prevent burning out panels in the synchrophaser. The control linkage must now be disconnected from the alpha input shaft. The valve housing cover will be removed next. At this point, you will check the protractor on the beta shaft and note the reading. (See figure 2.) The replacement valve housing will be set at the same angle.

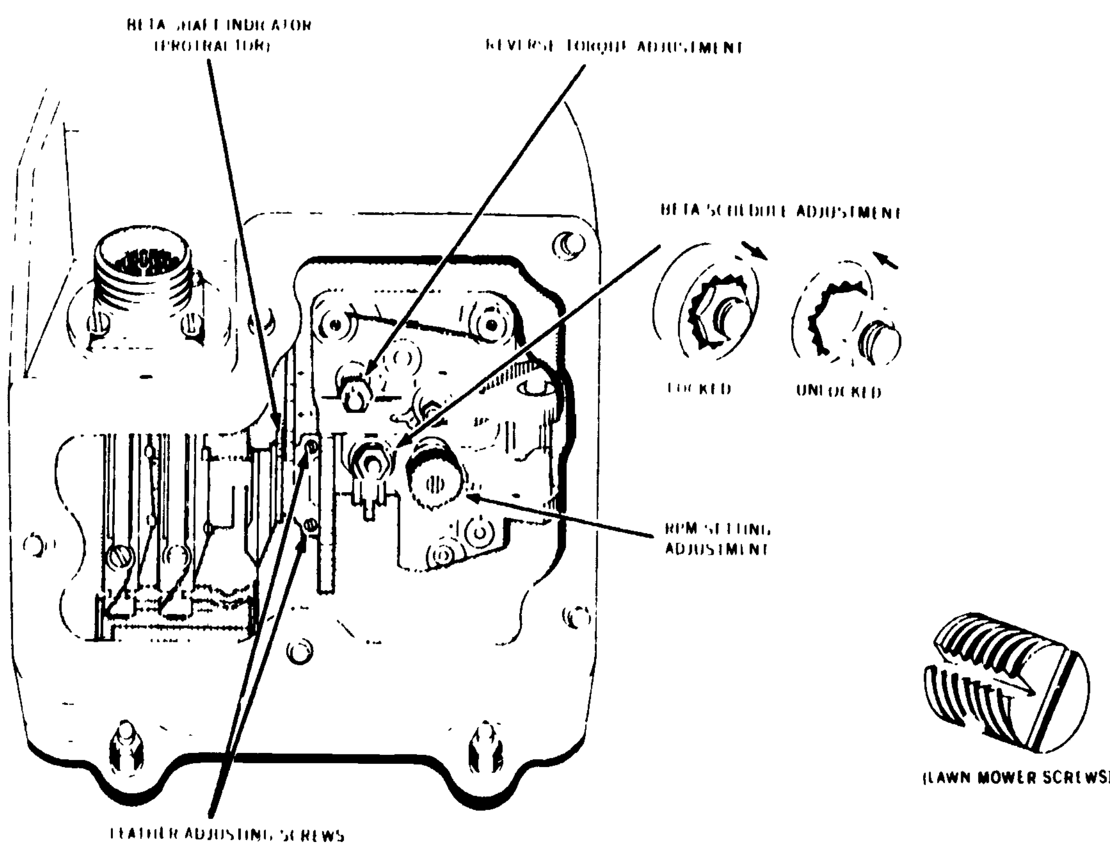


Figure 2. Valve Housing Assembly Adjustments

A rig pin must now be installed in the beta shaft (figure 3) to prevent the torison spring from "snapping" the beta shaft and drive gear against the stop, when the valve housing is removed (figure 4). If the rig pin cannot be inserted, you must loosen the feather adjusting screws. This will allow the beta shaft to turn so the rig pin will fit (figure 2). The blades should not be turned while this rig pin is installed. Severe damage to the valve housing will occur.

The nuts and washers that hold the valve housing on will now be removed and the valve housing and seal plate lifted off.

To remove the beta shaft rig pin, you should hold the beta drive gear, remove the rig pin and let the drive gear slowly rotate to the stop.

Before installing the replacement valve housing, a new seal plate should be installed on the pump housing. Then you should center the feather adjusting screws so feather angle can be adjusted later on.

Now the beta drive gear will be rotated until the protractor on beta shaft indicates the same angle as was noted on the removed valve housing. The shaft will be locked in this position with the rig pin. The valve housing is ready to be installed. During installation, care should be taken to insure that the beta gear meshes properly with the intergearing. Tightening the valve housing down without proper mesh will result in damage to the valve housing. If the gears do not mesh you should loosen the feather adjusting screws, or "lawnmower" screws on the protractor about one turn each. This will allow movement of the beta gear enabling it to mesh with the intergearing.

The attaching washer and nuts would now be installed and evenly torqued according to the TO. Next the rig pin should be removed and the "lawnmower" screws adjusted to set the protractor to the angle noted during removal of the valve housing.

To install the valve housing cover you must index the alpha input shaft in the cover to the alpha shaft on the valve housing. To do this you must lock the alpha shaft at the flight idle position with a rig pin (figure 3). The rigging spacer that the rig pin fits into has two slots. To insure that you have the pin in the correct slot, you should try to rotate the alpha shaft. With the pin installed all the way in there shall be no free play of the alpha shaft.

The input lever on the valve housing cover should be positioned at flight idle. The cover should now be installed. If the split gears in the cover do not exactly mesh with the input gear on the alpha shaft, the input lever will be forced away from the flight idle position as the cover is installed. An adjustment to bring the input lever back to flight idle is made by repositioning the micro adjusting ring on the input shaft. Once the input lever is aligned the housing cover can be attached with the retaining nuts.

There must be no backlash between the split gears in the valve housing cover and the gear on the alpha shaft. To remove the backlash an adjustment is made with the screw on the split gears. This adjustment is made with the input lever placed at reverse. The electrical connections and control linkage should now be attached. A check will now be performed to insure that the beta cam is correctly set. The condition lever would be placed in the feather position. When the blade angle stops changing you should check the reading on the beta shaft indicator (protractor). It must read 92.5°.

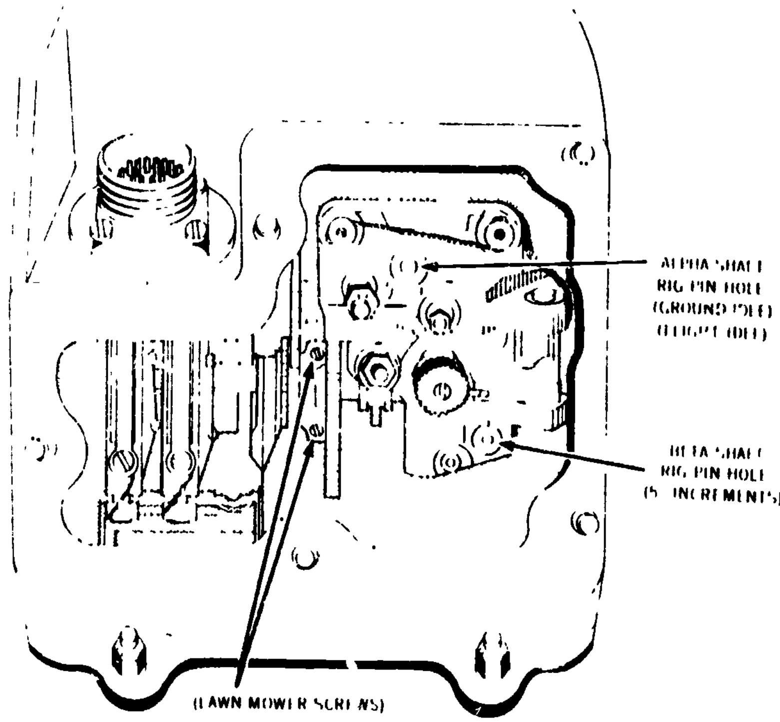


Figure 3. Beta Rig Pin Location

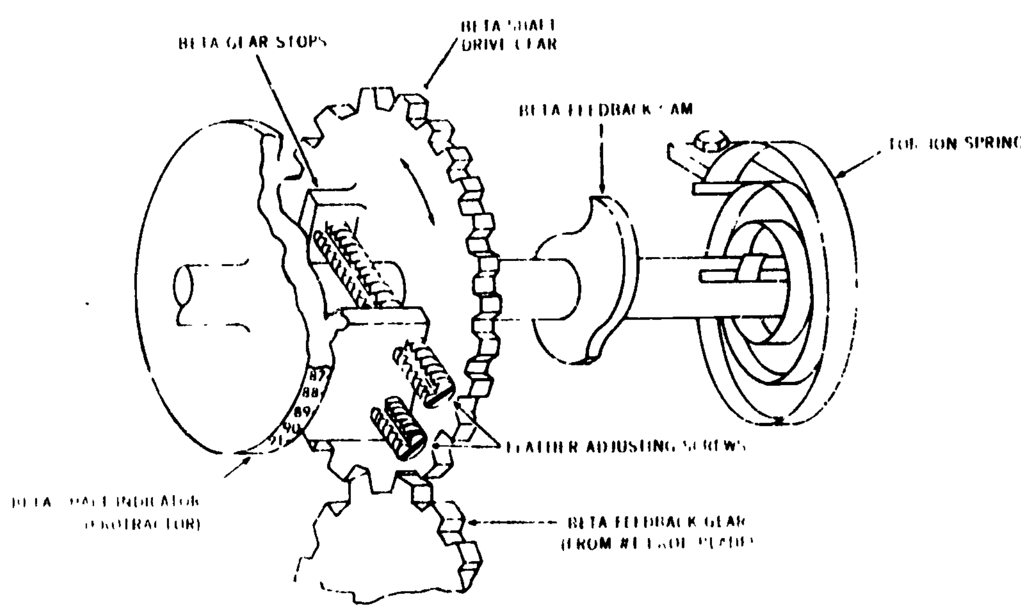


Figure 4. Beta Cam Adjustment

The valve housing change is not completed until three more checks are performed. They are: Beta schedule, reverse stop (reverse torque) and mechanical governing. The adjusting screws are shown in figure 2.

Beta Schedule Check

This check is made to insure that the information fed back from No. 1 blade will cancel the amount of blade angle change called for by throttle movement while operating in the ground range. To perform this check the throttle and condition lever should be positioned to operate the blades to maximum reverse. Then the propeller should be operated to ground idle. A ground idle rig pin should be installed in the input lever on the valve housing cover. The protractor on the beta shaft should read 4.0° to 5.5°. If the reading is not within these limits the beta adjusting nut must be adjusted. Turning the nut clockwise will increase blade angle. Each locking notch will change angle approximately 1/2 degree (see figure 5).

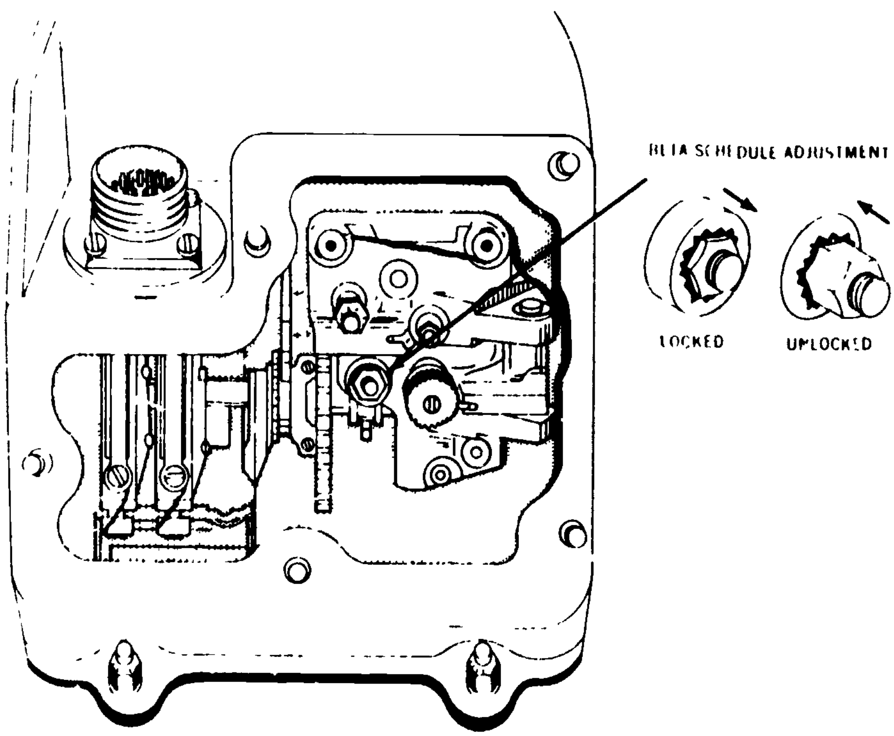


Figure 5. Beta Scheduling Adjustment

With the rig pin removed, the throttle and condition lever should be positioned to operate the propeller to reverse again. Then the propeller will be operated to flight idle. The flight idle rig pin should be installed in the input lever and a reading taken on the beta shaft protractor. The reading should not exceed 17.5°. This check is to insure that the blades do not go into the flight range with the throttle at flight idle.

Reverse Stop Check

This check is performed to insure that the hydraulic reverse stop will position the blades to -7° ± 1° reverse angle. To check the reverse stop the throttle and condition lever should be positioned to operate the blades to reverse. The beta shaft protractor should read -7° ± 1°. If the reading is incorrect an adjustment must be made using the reverse adjusting nut on the valve housing (see figure 6). Turning the nut clockwise will decrease reverse angle. Each flat of the nut will change angle approximately 1/2°. If adjustment is required, the throttle must be at ground idle to prevent damage to the control linkage. The reverse angle must be correct to develop the specified amount of engine torque while the propeller is operating in reverse.

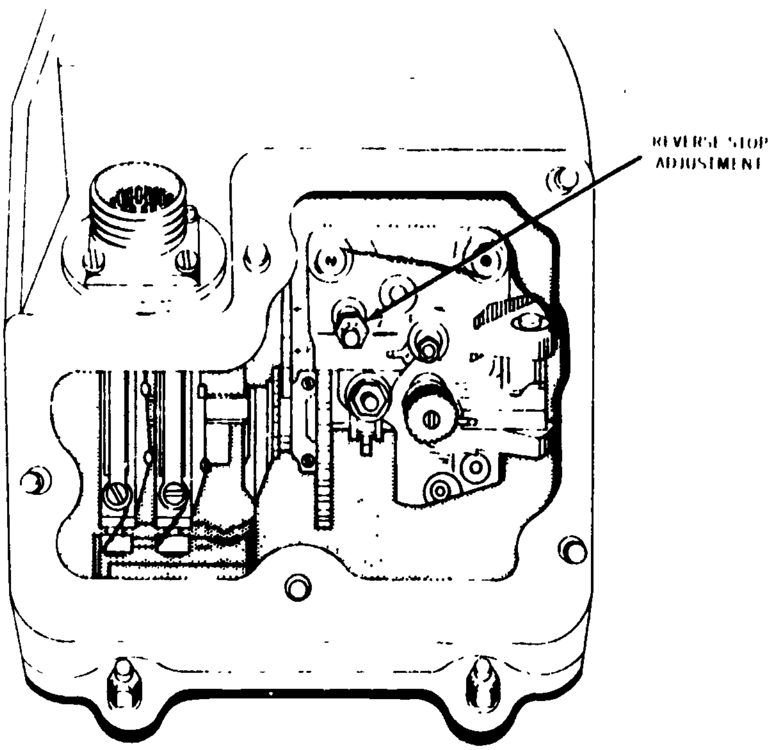


Figure 6. Reverse Stop Adjustment

Reverse torque will be checked later with the engines running.

Mechanical Governing Check

Mechanical governing is when the governor in the turbocontrol is controlling the blade angle to maintain 100% engine rpm. To perform the check a precision tachometer is connected to the system. The engines are running and the throttle is advanced to deveop at least [illegible]000 inch-pounds of torque. This is to insure that the governor is controlling the propeller and engine. The engine rpm on the test tachometer must read 100% + 1%. The engine tachometer must read within 1% of the test tachometer. If adjustment is required, the rpm adjustment screw on the valve housing can be turned clockwise or counterclockwise (see figure 7).

Turning the screw clockwise will increase rpm. Each click of the screw will change the rpm approximately 1/4 percent.

All the checks and adjustments discussed so far will be performed anytime a turbocontrol or valve housing has been changed. In addition, the NTS bracket clearance and pulse generator coil clearance must also be checked.

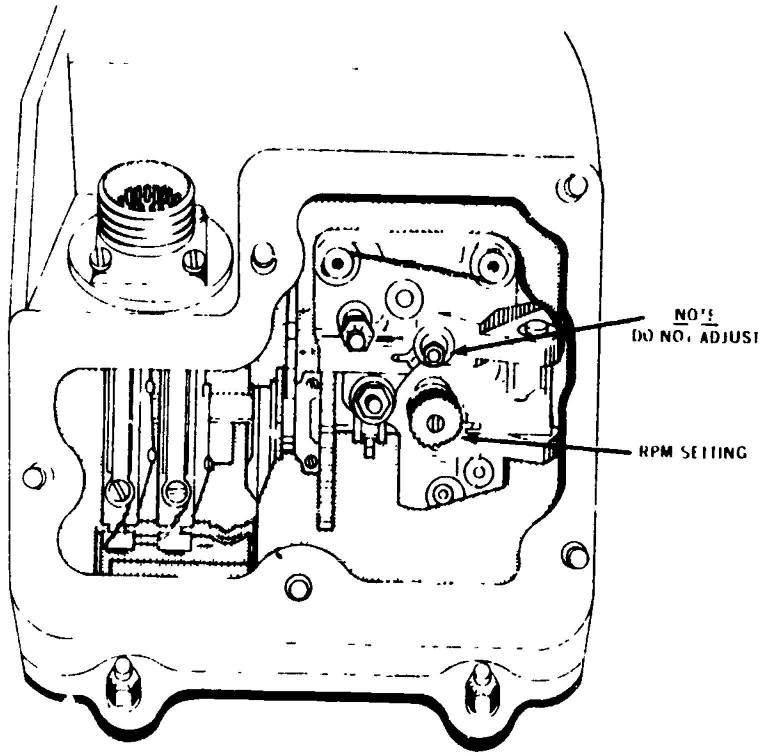


Figure 7. RPM Adjustment

NTS Bracket Clearance

Incorrect clearances at the NTS bracket could cause the negative torque system to be actuated at the wrong time, or possible not to be actuated at all. Two clearances must be checked, and if necessary, adjusted. One clearance is between the adjustment screw and the control lever on the inboard side of the turbocontrol. The other clearance is between the engine nose plunger and the NTS bracket. Both clearances must be between .011 to .020 inch. The check is made with a thickness gage and the adjustment is made by turning the adjusting screws (see figure 8).

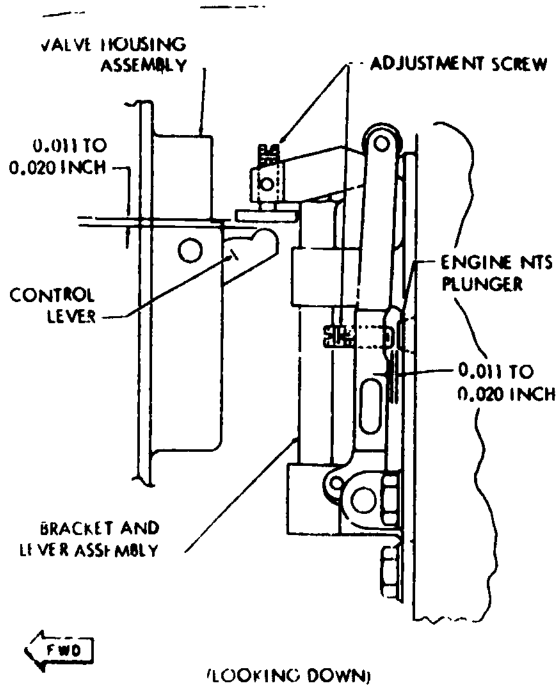


Figure 8. NTS Bracket Adjustment

While this check and adjustment is being made, the control assembly should be rotated clockwise and held against the drive bracket. This is the position the control will be at while the engine is running.

Pulse Generator Clearance

A check must be made at the pulse generator to insure that the magnet and the coil do not strike each other when the propeller is rotating, and also that the magnet and coil pass close enough to each other to produce the signal used by the synchrophaser. This check is made by rotating the propeller until the magnet on the de-icing contact ring holder is in line with the pulse generator coil. The clearance between the two can now be checked with a thickness gage. It must be .120 to .130 inch. If it needs adjusting, laminated shims should be added or removed under the magnet.

SUMMARY

Rigging the propeller control linkage is a very important part of the repairman's job. During beta operation, the propeller blade angle is controlled by the throttle position. Movement of the throttle actuates the fuel coordinator which in turn repositions the input lever on the turbocontrol. If the propeller is not properly rigged, an incorrect blade angle will be scheduled to the propeller for the various throttle positions.

Changing a valve housing requires care and a good knowledge of the procedures to be followed. Improper handling and careless maintenance can easily damage the valve housing. After the valve housing has been installed it must be adjusted to set the reverse torque, beta schedule, and mechanical governing rpm. Anytime a valve housing or a turbocontrol has been changed, the NTS bracket clearances must be checked and adjusted. The procedures for performing all the rigging and adjustments on the propeller installation can be found in TO 1C-130B-2-11.

QUESTIONS

1. Why must the propeller control linkage be rigged correctly?

2. How do you know when the control linkage is properly rigged?

3. With the alpha shaft pinned at flight idle, and the input shaft pinned at flight idle, the split gears in the valve housing cover will not mesh with the alpha shaft gear. Where would an adjustment be made to correct this?

4. What precaution should be taken during removal of the valve housing?

5. Why must electrical power be off before the electrical connectors are disconnected from the turbocontrol?

6. How is NTS clearance adjusted?

7. Mechanical governing check shows the rpm to be at 102%. What should be done to correct this?

8. Why is the reverse stop adjustment performed?

9. What adjustment would be performed if reverse torque was not within limits?

10. The propeller blades are at feather but the beta shaft indicator (protractor) indicates 91°. What would you adjust to correct this?

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-HO-505
4 November 1982

GROUND SUPPORT EQUIPMENT (J-1 HOIST and B-4 STAND)

OBJECTIVE

Using a J-1 hoist, handout and working in a team, operate hoisting equipment with no more than 2 procedural errors allowed.

Using a B-4 stand, handout and working in a team, operate maintenance stands with no more than 2 procedural errors allowed.

PROCEDURE

1. Perform a pre-operation inspection of the hoist and power source.

a. J-1 hoist

(1) Check AFTO Form 244, System/Equipment Status Record.

(2) Inspect hoisting cable for frays and/or kinks.

(3) Inspect welds for cracks.

(4) Inspect all nuts and bolts for security.

b. Power source

(1) Check AFTO Form 244, System/Equipment Status Record.

(2) Inspect power cables for signs of overheating and/or broken or frayed wires.

(3) Inspect electrical receptacles for loose and/or frayed insulation.

2. J-1 hoist operation.

a. Attach power source to hoist.

b. Attach power source to wall outlet.

c. Turn on power at wall, power source and hoist.

d. Operate hoist cable down and attach it to T-Sling.

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e. Operate hoist cable up until T-Sling will clear power package.

f. Roll hoist into position and lower T-Sling until it can be attached to the power package.

g. Raise cable until T-Sling will clear power package.

h. Remove hoist from in front of power package and lower T-Sling.

i. Disconnect cable from T-Sling and secure cable.

j. Turn off power at hoist, power source, and wall outlet.

k. Roll up power source cables and store hoist and power source in proper areas.

3. Perform a pre-operation inspection on the B-4 Stand.

a. B-4 Stand

(1) Check AFTO Form 244 System/Equipment Status Record.

(2) Inspect fluid lines for leaks.

(3) Insure all safety rails are in place and secure.

4. B-4 stand operation.

a. Secure wheel brakes.

b. Raise stand to desired height.

c. Lock platform by placing lockpins and lowering stand.

d. Raise stand and remove lockpins.

e. Lower stand.

Maintenance Training Branch
Chanute AFB, Illinois

C3ABR42633-SG-508
28 December 1982

ENGINE BLOCK TESTING

OBJECTIVES

After completing this study guide, you will be able to identify facts about block testing an engine.

INTRODUCTION

This study guide will give you information about test cell safety practices, engine block testing, purpose and procedures, and engine operation while installed in a test cell.

INFORMATION

SAFETY

The Air Force places great emphasis on the practice of safety. It is very difficult to list all of the possible hazards that exist in and around the jet engine test cell. Many safety precautions for test cell operation are those that you will use every day and require only common sense. There are three areas that need to be discussed.

The first area is the air intake of a jet engine. The air intake can develop enough suction to pull a person up to it or into it. The suction near the intake can pull in hats, glasses, loose clothing, and rags from pockets. Make sure these articles are secure or remove them entirely before you do any work aouund the engine.

The next area of danger is the jet engine exhaust. A jet engine exhaust creates a very high temperature, a high air velocity, and a very high concentration of toxic gases.

The last area is the rotating propeller. While operating an engine in a test cell, the engine can be run with or without a propeller installed. With a propeller installed, extreme care should be taken while working around the rotating propeller. The propeller creates a suction which could pull a person into the rotating blades.

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PURPOSE AND PROCEDURES

After any major in-shop maintenance an engine needs to be tested before it is installed on an aircraft. The reason for the test is to make sure the engine operates properly in all ranges. You will check the engine for all necessary plumbing, proper mounting of all the accessories, and to see if it measures up to set standards against TO charts.

The test cell for a T-56 engine is operated by qualified turboprop mechanics. If a discrepancy is found on an engine during test cell operation, it will be corrected by the mechanics assigned to the test cell, if minor in nature. If it is a major discrepancy, in-shop personnel will be responsible for any necessary maintenance.

OPERATION

A T-56 engine can be run in a test cell with or without the propeller installed. If operating without a propeller, you should take precaution when moving the throttle to avoid an overspeed condition. An engine should never be run more than 30 minutes without a propeller installed.

If a false start occurs, you should drain the raw fuel by purging the engine. Motor with the condition lever in the ground stop position, the power lever in the ground idle position, and the start switch depressed until the engine reaches starting speed before attempting another start. A normal start with raw fuel present may result in excessive turbine inlet temperature.

If a continual flame or steady stream of black smoke or fuel vapors are observed emitting from the exhaust nozzle on initial fire-up, the engine should be immediately shut down and an investigation made.

If the test cell is located outside, the weather can have a bearing on the test results. First, if the temperature is below freezing for an extended period of time, the engine should be checked to make sure it is not ice locked. If an engine is found to be ice locked, it should have hot air blown through it for 10 to 15 minutes. Second, if the wind speed exceeds 25 knots, the test results will not be valid.

QUESTIONS

1. What are the three danger areas around an operating turboprop engine test cell?

2. What types of articles can be pulled into a jet engine intake?

3. What three dangerous conditions are created by a jet engine exhaust?

4. When will an engine need to be tested before aircraft installation?

5. Who is responsible for correcting a minor discrepancy found during test cell operation?

6. How long can an engine be run without a propeller installed?

7. When motoring an engine after a false start, what positions must the throttle and condition levers be in?

8. Why would you blow hot air through an engine?

SCHEDULED INSPECTIONS

OBJECTIVES

After completing this study guide and your classroom instruction, you will be able to perform inspections.

INTRODUCTION

Do you perform an inspection on your car often or before you take a long trip? If you are a smart driver, you do. The Air Force inspects the aircraft before a mission, after a mission, and after a number of flying hours or calendar days. You may be able to afford for your car to break down on the road, but the pilot can't afford for his aircraft to break down.

INFORMATION

All work that is done on engines and propellers must be done by the technical orders (TOs). You are going to learn all about these TOs in this lesson. These TOs are the aircraft -6 (Inspection Requirements), aircraft -10 (Engine Buildup Instructions), Engine Maintenance Instructions, and aircraft -2 (Organizational Maintenance Instructions). We are going to discuss each of these TOs in detail.

INSPECTION REQUIREMENT TECHNICAL ORDERS

The aircraft -6, Inspection Requirement Technical Order, lists what items are to be inspected what the minimum inspection requirements are, and when the items are to be inspected. This technical order has the requirements for all of the inspections to be done at different times on the whole aircraft and its systems. Some examples of the inspections that are done include the preflight, thruflight, basic postflight, home station check, minor and major inspections.

Inspection Workcards

The information that is in the aircraft -6 TO is given to you in a smaller, more usable size on inspection cards. The inspection requirements that are in the aircraft -6 are found in the aircraft -6 WC (workcards) in a more logical working order. Workcards give you a checklist to be used in doing the inspection to make sure no item is overlooked

Inspection Wordcard Sections

TO 1C-130A-6WC-15, Minor and Major Inspection Workcards, is broken down into three parts:

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1. The introduction, which tells the overall arrangement and purpose of the technical order.

2. Inspection work areas, which shows the area of the aircraft where the work is to be done.

3. Workcard section, which shows the work assignments. This includes the card number, work area, type of mechanic, mechanic number, card time and information about the inspection.

The inspection workcards have only the information for one or two related inspections. Other sets of workcards are used to do some other inspections such as:

1. TO 1C-130A-6WC-12, Workcards--Preflight Inspection

2. TO 1C-130A-6WC-14, Workcards--Home Station Check

ORGANIZATIONAL MAINTENANCE INSTRUCTION TECHNICAL ORDERS

More technical orders must be used for removal and installation rules, wear and damage limits, torque values, special tools, and trouble-shooting procedures.

Some of the parts that are listed in the aircraft -6 WC TO must be removed from the equipment that is to be inspected. The aircraft -2 TO lists these removal instructions along with other needed information about the job. You can also get information from the aircraft -10 and the engine maintenance manual.

Information in these TOs may be found by using the table of contents at the front of the manual or the alphabetical index in the back of the manual. This is shown in the introductory part of the manuals.

INSPECTION PROCEDURES

Each inspection done on an aircraft or engine can be broken down into two steps, the look phase and the fix phase.

Look Phase

At this step of the inspection, the inspection workcard items are inspected, or looked at. Any major defects found are recorded on the AFTO Form 349. No repair actions are taken at this time. If any minor defects are found, that is, broken safety wire, loose bolts, missing cotter keys, etc., they are fixed at this time and no entry is made on the AFTO Form 349. There is a common maintenance practice of inspecting the three most serious trouble areas of the engine first. These areas are the intake and the exhaust for FOD and oil and fuel filters and strainers for contamination of any type.

Fix Phase

This step of the inspection starts when all of the workcard items have been inspected. At this step, all of the major defects entered on the AFTO Forms 349 during the look phase are taken care of by repair or replacement.

SUMMARY

Now you can see that a turboprop mechanic must use more than one technical order to complete the inspection. The aircraft -6 WC (Inspection Workcards) must be used with the aircraft -2 (Organizational Maintenance Instructions), -10 and/or engine or propeller maintenance manual, to properly complete any inspection.

QUESTIONS

1. What technical orders should you use when completing any inspections?

2. What three items of information can be found in the aircraft -6 technical order?

3. What technical orders tell you how to inspect?

4. What technical order lists what and when to inspect?

5. At which part of the phase inspection is a broken safety wire repaired?

6. Each type of inspection is broken into what two steps?

7. Give a brief description of these two steps of an inspection.